## CLASS 123, INTERNAL-COMBUSTION ENGINES

### SECTION I - CLASS DEFINITION

This class contains inventions relating to prime movers or engines in which a combustible material is burned within an inc losed space or chamber and the heat energy thus developed converted into work by permitting the resulting products of combustion to act upon and through mechanical powers, the engine in question including suitable mechanism whereby the functions above enumerated are continually and automatically carried out, and such engine being designed to communicate power to some machine or device exterior to itself.

The space or combustion chamber above referred to is ordinarily the interior of the working cylinder of the engine, the products of combustion acting immediately upon a reciprocating, rotating, or oscillating piston moving within the same chamber in which combustion takes place or in an extension thereof. Some types of internal-combustion engines, however, besides fulfilling the conditions above mentioned, have a transfer valve operated by and in unison therewith located between the combustion chamber and the elements upon and through which the products of combustion act to thereby control the flow of said products, in which case the above mentioned transfer valve is operated to establish communication between the combustion chamber and the working cylinder at the instant of ignition or prior thereto, so that the piston is driven by burning products of combustion.

The working fluid is ordinarily such as results from combustion alone; but in some of the engines in this class a small quantity of water is supplied to the engine, generally by injecting it directly into the interior of the combustion-chamber during or after the combustion of the combustible material; but in all engines using water the amount used is comparatively small, so that the resulting steam is necessarily in a superheated condition.

This class also includes separate parts of engines coming within the above definition and also subordinate elements designed for use with such engines, and incapable of use in the manner contemplated with other devices or in other relations.

From the above it will be seen that devices go into this class because of a function performed by a given element or combination of elements rather than because of any particular structure of such elements, and therefore, given structural features forming a machine adapted for use as an internal-combustion engine, may be found in any other classes having machines of like general structure. Thus probably any given structure adapted for use as an internal-combustion engine could generally with slight modification be used as steam or other heat engine, and often as an air, gas, or water pump, a hydraulic motor, a meter, etc. This would not ordinarily be the case with the subordinate or auxiliary devices included in this class, as from what appears above such subordinate elements as the class contains are adapted for use in the manner contemplated only with or forming a part of an internal-combustion engine.

It therefore follows that a search for a given general mechanical structure adapted for use as an internal-combustion engine will generally need to be continued in the classes above indicated.

Further fields of search for the various subordinate elements designed for and adapted to be used only with internal-combustion engines, and therefore included in this class, are indicated in the definitions hereinafter appearing of those various subclasses.

### SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

A compilation of all types of motors will be found in the Notes to the class definition of Class 60.

The following examples of terminology have been considered to be a nominal inclusion of an internal combustion engine and if so claimed would not preclude classification in Class 417:

(a) a cam driven pump; (b) a “crank (shaft)” driven pump; (c) a “gear” driven pump; (d) a “chain” driven pump; (e) a “belt” driven pump; (f) a “fluid” driven pump; (g) an “electrically” driven pump; (h) a pump and an “outlet” “tube” and “injector”.

The following pump control parameters are separately appropriate for Class 417. Control by both of these parameters is appropriate for Class 123;

(a) engine speed control; (b) manifold vacuum.

The following examples have been considered to be significant inclusion of an engine and if so claimed would cause classification in Class 123 if otherwise appropriate.

(a) timing of the pump relative to the engine; (b) engine temperature control of the pump.

(1) Note. When the pump-engine combination is claimed broadly, it is properly classified in Class 123. When the output of the pump is not delivered to the engine, classification is proper in Class 417.

## SECTION III - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

48, Gas: Heating and Illuminating, subclass 198.8 for a method of making a fuel gas from methane using an internal combustion engine.

60, Power Plants, subclasses 39.6+, for engines of the external-combustion type.

92, Expansible Chamber Devices, appropriate subclasses. Class 123 takes an expansible chamber device or element thereof which is limited for use in an internal combustion engine. However, since Class 123, has not been cleared, many expansible chamber devices which are not limited for use in an internal combustion engine will be found in Class 123, without any stated line or perceptible distinction with the subject matter found in Class 92.

440, Marine Propulsion, subclass 45, for devices utilizing an explosive jet to propel a vessel through the water.

417, Pumps, appropriate subclasses for pumps, per se, which may be disclosed as internal-combustion engine accessories and particularly subclass 34 for an internal-combustion engine driving a pump and having means for controlling the engine in response to a condition of the pump or pump fluid, subclasses 73+ for pumps in which one fluid is pumped by the ignition of another in direct contact therewith; subclass 364, for pumps driven by an internal-combustion engine; and subclass 380, for fluid motor driven pumps in which the motive fluid for the fluid motor is generated by an internal-combustion engine. Internal-combustion engine driven pumps are classified in Class 417 even though the pump may be solely disclosed as a mere accessory of or ancillary to the operation of the engine (e.g., cooling fluid pump, fuel pump, etc.). However, this class (123) takes those internal-combustion engine driven accessory pumps when the claims reflect a fluid connection between the pump and the engine, provided there is no additional pump fluid inlet or outlet claimed for supplying or exhausting fluid for use external of the engine.

477, Interrelated Power Delivery Controls, Including Engine Control, for interrelated controls between an engine and a transmission, clutch, or brake.

588, Hazardous or Toxic Waste Destruction or Containment, subclasses 313 through 320 wherein the waste is destroyed by burning it in an internal - combustion engine. Also, see cross-reference art collection, subclass 900, for apparatus used to treat hazardous or toxic waste.

## SUBCLASSES

**1** Internal combustion engines not coming within the terms of the definition of some one of the following internal-combustion engine subclasses. This subclass contains patents relating to cycles or modes of operation not hereinafter provided for or in which the cycle or mode of operation is not definitely determined by the structure disclosed and will not ordinarily contain patents relating to definite mechanical structure.

(1) Note. Given mechanical structures not provided for in structural subclasses, but operating upon a definite and determined cycle of operation provided for in this classification, are classified in miscellaneous functional or cycle subclasses, such as 65, and subclasses indented thereunder, and 311+, and indented subclasses, etc.

(2) Note. The use of unconventional fuels as found in this subclass are commonly hazardous and toxic waste and their chemical destruction or containment is found in Class 588, Hazardous or Toxic Waste Destruction or Containment.

**2** Combinations not coming within the terms of the following subclasses of combined devices in which an internal-combustion engine, is disclosed and claimed in combination with some other device not in itself classifiable in some appropriate subclass of internal-combustion engines and which combined device itself is

not treated as a unitary machine in the general system of Office classification and as such classified in some appropriate class.

SEE OR SEARCH CLASS:

290, Prime-Mover Dynamo Plants, for the combination of internal combustion engines and dynamoelectric machines.

368, Horology: Time Measuring Systems or Devices, subclass 5 for an horological device acted upon by an internal combustion engine.

**3** Combinations of an internal-combustion engine together with means for generating and supplying a combustible mixture thereto, the engine and generating apparatus being ordinarily capable of separation, but disclosed and claimed in combination, and the elements collectively forming a complete plant for developing and applying power. In the power plants occurring herein the various elements constituting the generating portion of the plant are of ordinary or commercial form and if presented by themselves would be classified in other classes or subclasses. Patents covering the engine and generating device together are classified in the class of internal-combustion engines, because all the elements of the plant are so correlated as to develop and apply power by means including an internal combustion engine.

(1) Note. The devices occurring in this subclass differ from many of the engines in subclasses of oil engines in that in an oil-engine the source of power is always a liquid hydrocarbon and the elements concerned with the vaporization of the oil and those constituting the engine are so designed with reference to each other as to form a single unitary machine incapable of being separated into its component sets of elements without defeating the operation of the engine as a whole in the manner contemplated.

**18** Internal-combustion engines irrespective of cycle or mode of operation, comprising a stationary inclosing casing, sections of which perpendicular to its axis are bounded by circular arcs concentric to said axis, and a movable member or piston therein moving in contact with the inner walls of the said casing, said piston partaking of an oscillating or swinging motion about the axis of the casing and, together with the walls thereof, inclosing a space or chamber within which the burned gases act expansively to impel the piston.

SEE OR SEARCH CLASS:

91, Motors: Expansible Chamber Type, subclasses 223 and 339+ for cyclically operable expansible chamber motors of the oscillating piston type.

**19** Internal-combustion engines in which a body of liquid is interposed between the burned gases and the working piston or equivalent element, whereby power is communicated to the main driving-shaft of the engine, the said liquid preventing the burned gases within the combustion-chamber and working cylinder from coming into direct contact with the working piston or equivalent element.

**21** Internal-combustion engines having a cylinder and a working piston-reciprocating therein, but irrespective of other structural features, in which means are provided whereby the mode of operation of the engine may be determined and the engine caused to operate upon either a two-stroke or a four-stroke cycle.

**22** Engines including in their structure elements normally found only in hot-air engines and other elements normally found only in internal-combustion engines and having steps in their cycle of operation peculiar to both such types of engines. This subclass includes engines including elements selected from both the above-mentioned types and convertible either at will or automatically, as by a suitable governing device, so as to operate either as hot-air or as internal-combustion engines, and engines operating upon a predetermined cycle, including working strokes, upon which the piston is impelled alternately by gases heated within the working cylinder by combustion, as in internal-combustion engines, and by gases heated within the working cylinder by contact with the inner surface of said working cylinder and the clearance-space.

SEE OR SEARCH THIS CLASS, SUBCLASS:

61, and 68.

**23** Internal-combustion engines in which a solid nonexplosive fuel or combustible is introduced into and burned within the working cylinder of an internal-combustion engine or into a combustion-chamber in permanently open communication therewith and the energy of the resulting gases converted into work by permitting them to expand and act upon a piston moving in the said cylinder. The solid fuel may be introduced into the working cylinder upon each successive cycle of operation of the engine and in quantities sufficient only to supply the energy required for the successive working strokes of the engine, or it may be introduced at comparatively long intervals of time and in quantities sufficient to furnish energy for several working strokes, in which case air only is supplied upon the successive cycles of operation to consume portions of the charge of fuel already within the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

24, and 445+, for feeding mechanism available generally for the purpose of supplying solid fuel to engines of the type occurring in this subclass.

SEE OR SEARCH CLASS:

60, Power Plants, subclass 39.461, for combustion motors other than internal-combustion engines operable on solid nonexplosive fuel.

**24** Internal-combustion engines in which a charge of gun powder or other explosive substances is supplied to and exploded within the cylinder of the engine or combustion-chamber in communication therewith and the energy of the resulting gases converted into work by permitting them to act upon a moving part of the engine. This subclass is intended to include all engines using an explosive substance as above, irrespective of other structural features, cycle, or mode of operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

23, and 445+, for feeding mechanism available, generally for the purpose of supplying the explosive substance to engines of the type occurring in this subclass.

SEE OR SEARCH CLASS:

60, Power Plants, subclasses 632+, for one shot explosion actuated expansible chamber type motors, and subclass 39.47 for combustion products generators combined with motors, other than internal-combustion engines, which operate on solid fuel containing an oxidizer.

**25** Internal-combustion engines having a cylinder and a working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which the combustible mixture supplied to and burned within the working cylinder contains a quantity of aqueous vapor or in which water in any form is supplied to the working cylinder after a charge has been ignited therein. The water may be supplied to the air and hydrocarbon before the charge is ignited in which case the combustible charge is made up of air, hydrocarbon, and aqueous vapor, or a combustible mixture of air and hydrocarbon may be ignited in the working cylinder, the water being supplied to the expanding gases therein during the working stroke. In cases where water in the form of steam is supplied to the combustible mixture, as above, the steam is frequently generated by means of heat ordinarily lost in the operation of the engine, as by the heat of the exhaust-gases, or the cooling-jacket may be utilized as a steam-generator to supply water to the combustible charge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

41.22, for similar devices designed primarily to reduce the pressure of the cooling system and thus reduce the boiling point of the liquid coolant.

SEE OR SEARCH CLASS:

60, Power Plants, subclass 39.54 where combustion products are used as a motive fluid having addition of steam or water within a prime mover, subclass 712 for an engine operated selectively or simultaneously by internal combustion of fuel and by expansion of motive fluid or subclass 775 for a process of introducing water or steam.

**26** Internal-combustion engines in which a combustible mixture is ignited in the working cylinder at the beginning of the working stroke, as in the ordinary operation of internal-combustion engine, after which and at some time before the end of the working stroke an additional quantity of compressed air or equivalent non-combustible gas is supplied to the working cylinder and mingles with the burned gases therein, the piston being impelled through the remaining portion of its working stroke by the combined action of the burned gases and the air supplied thereto.

**27** Internal-combustion engines in which air or equivalent noncombustible gas is supplied to the working cylinder and compressed therein by a distinct compression-stroke of the working piston to such a degree that the temperature of the gas rises to such a point that a combustible supplied thereto will be ignited by the highly-compressed noncombustible gas upon coming into contact therewith, after which and after the beginning of the working stroke a combustible upon being supplied to the body of the compressed noncombustible gas ignited as it comes into contact therewith and burns at constant pressure or perhaps constant temperature. The cycle upon which the engines occurring in this subclass operate, is sometimes designated by text-writers as the "Diesel" cycle.

(1) Note. For engines in which gas is burned at constant pressure, see this class, subclasses 61 and 68.

SEE OR SEARCH THIS CLASS, SUBCLASS:
495+, for with Fuel Pump.

SEE OR SEARCH CLASS:
239, Fluid Sprinkling, Spraying, and Diffusing, appropriate subclasses, especially subclasses 86, 87, 88+, 95, 96, and 533.2+ for nozzles disclosed for injecting fuel into combustion chambers of internal combustion engines.

**Oil-Engines:**
The "oil-engine" subclasses contain internal-combustion engines, having a cylinder and a working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, which are designed to be operated by a liquid hydrocarbon and in which the means concerned with the supply and vaporization of the oil so closely associated with the elements constituting the engine that a true combination would appear to exist between the two sets of elements. A given mechanism including an engine and means for supplying oil thereto to be burned therein is not classified as an oil-engine merely because it is designed to use oil as a source of power if the means whereby the oil or vapor is supplied to the engine is capable of separation therefrom and of use with other engines without affecting the operation of either the engine or the oil-supplying devices. A given structure will be classified in these subclasses only in cases where mechanical separation of the elements concerned with the supply or vaporization of the oil from the elements constituting the engine is impossible without defeating the operation of the device as a whole in the manner contemplated by the inventor, and a simple pipe or equivalent connection through which the exhaust-gases from the engine are conducted to the oil-supplying or vaporizing device to heat the same is not considered as bringing the two sets of elements into such intimate association as to make the whole mechanism a single device and as such classifiable as an oil-engine. From these considerations it therefore ordinarily follows that patents disclosing both an engine and a device for supplying it with oil or vapor therefrom and which do not come within the terms of the above definition, and are therefore not classifiable in oil-engine subclasses, are classified and cross-referenced according to the separate groups of elements entering into and forming the complete device, the oil-supplying or vaporizing device ordinarily going into appropriate subclasses of Charge-forming devices and the engine into appropriate subclasses in this class, according to its form, mode or operation, of other distinguishing features.

**37** Internal-combustion engines having a cylinder and working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which two or more separate and distinct charges of combustible mixture are burned and act in succession upon the working piston during each working stroke

thereof, each charge after the first upon ignition entering the cylinder and mingling with and tending to increase the pressure of the burned gases already therein.

**38** Internal-combustion engines of the reciprocating type wherein the working piston is permanently connected with the main driving-shaft of the engine in which a combustible mixture is burned within the working cylinder thereof and the resulting gases cooled and condensed, thereby producing a more or less perfect vacuum within the said working cylinder, whereupon atmospheric pressure acts upon the said working piston to move it through a working stroke. The pressure of the atmosphere may be the only force acting upon the working piston, or the engine may be so designed that the combustible gases upon being ignited generate pressure which also acts upon the said working piston.

**39** Internal-combustion engines of the reciprocating type, but irrespective of other structural features, in which the combustible mixture is ignited in the working cylinder at or substantially at atmospheric pressure. The combustible mixture ordinarily begins to enter the working cylinder at the beginning of the working stroke in which case it is ignited at atmospheric pressure, as above, after a definite portion of the working stroke has been performed and the whole charge supplied, the engine thus working upon a two-stroke cycle without compression. The charge may, however, be drawn into the working cylinder by a distinct charging stroke, such stroke being followed by a stroke corresponding with the compression-stroke in four cycle engines during which the exhaust-valve is held open and the charge then ignited under atmospheric pressure at the beginning of the third or working stroke, in which case the engine works upon a four-stroke cycle without compression.

(1) Note. Engines in this subclass working on the two stroke cycle without compression, as above, differ from the majority of the engines occurring in subclass 68, and engines working upon a similar cycle occurring in subclass 61, only in the degree of pressure under which the charge exists before the ignition thereof.

SEE OR SEARCH THIS CLASS, SUBCLASS:
38,

**41** Internal-combustion engines having a cylinder and a working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which means are provided for causing the engine to run in either direction at the will of the operator and subordinate mechanism for accomplishing the same result, but not disclosed in connection with all the elements necessary to form a complete and operative engine.

(1) Note. In this connection it should be observed that engines working upon a two-stroke cycle are frequently capable of operating in either direction without addition to or change in the elements necessary to the operation thereof, and this especially true of the engines in subclasses 71, 73 and 74.

**41.01** Such miscellaneous devices for cooling the working cylinder, piston, piston-rod, or other element of an internal-combustion engine as do not come within the terms of the definition of some one of the following subclasses of internal-combustion engines, cooling, and accessary devices designed for and used with cooling systems for internal-combustion engines and not classified in some appropriate cooling subclass.

(1) Note. The expressions “primary coolant” and “secondary coolant”, found in the definitions of the indented subclasses, refer, respectively to a fluid employed to cool an engine surface by direct contact therewith and to a fluid employed to cool such contacting fluid. For example, the liquid which flows through a radiator for an internal-combustion engine is the primary coolant, whereas the air passing through the radiator to cool the liquid coolant is a secondary coolant.

(2) Note. Class 165 will receive the combination of an internal-combustion engine and radiator when the internal-combustion engine is included by name only.

(3) Note. For structures including shutters for controlling the air flow, which devices do not include significant internal-combustion engine structure, search Classes 49, 180, 236, and 454.

SEE OR SEARCH CLASS:

60, Power Plants, subclass 39.83 for cooling of parts of an engine of the internal combustion type; subclasses 597+ for a fluid motor driven by the waste heat of an internal combustion engine; subclasses 320+ for an internal combustion engine having a cooled exhaust or in which the exhaust is used as a heat source and subclass 714 for plural motors with a common cooling means.

165, Heat Exchange, subclasses 41+ for a heat exchanger installed on a vehicle, and subclasses 51+ for a heat exchanger installed on an engine.

180, Motor Vehicles, subclasses 68.4 and 68.6 for motor vehicle combinations including radiator mountings; and subclasses 68.1+ for hoods and such combinations including shutters. See (3) Note.

236, Automatic Temperature and Humidity Regulation, subclasses 34+ for automatic radiator cooling. See (3) Note.

237, Heating Systems, subclasses 70+, for heating system radiators, per se.

244, Aeronautics and Astronautics, subclass 53, for aircraft engine cowling or enclosure devices; see (3) Note to subclass 53 in Class 244 for the line; and subclass 57, for radiators combined with aircraft structure.

417, Pumps, subclass 372, for an interrelated or common cooling means for a pump and drive motor therefor.

418, Rotary Expansible Chamber Devices, subclasses 83+, for such devices provided with heat exchange means.

454, Ventilation, subclasses 3+ for ventilating cowls and subclasses 284+ for registers. See (3) Note.

**41.02** This subclass is indented under subclass 41.01. Devices with means to sense some condition, which means causes operation of a control device for stopping, varying, or starting the flow of either the primary or secondary coolant.

(1) Note. Control of replenishment from a reserve supply, which may be condensate, is included.

(2) Note. The inclusion of significant engine structure or specific engine operation is the characteristic which distinguishes this type of device from those found in Class 236.

SEE OR SEARCH CLASS:

126, Stoves and Furnaces, subclass 351.1 for a fluid fuel burner other than a top-accessible liquid heating vessel and a condition responsive feature.

137, Fluid Handling, subclasses 457 and 468 for valves controlled by change in the line temperature.

236, Automatic Temperature and Humidity Regulation, subclasses 34+, for automatic coolant flow control. See (2) Note.

**41.03** This subclass is indented under subclass 41.02. Cooling systems wherein the control of the coolant flow is directly or indirectly controlled by a device which floats on the surface of the coolant.

SEE OR SEARCH CLASS:

236, Automatic Temperature and Humidity Regulation, subclass 52, for float control combined with thermal sensing means.

**41.04** This subclass is indented under subclass 41.02. Cooling systems wherein the primary or secondary coolant is air or gas and the device for stopping, varying, or starting the flow of the air or gas is a shutter, valve, damper, adjustable cowl, etc.

SEE OR SEARCH CLASS:

49, Movable or Removable Closures, appropriate subclasses, particularly subclasses 74.1+ for louvers interconnected for concurrent movement.

160, Flexible or Portable Closure, Partition, or Panel, appropriate subclass, for curtains, shades or screens, for radiator protectors.

236, Automatic Temperature and Humidity Regulation, subclass 35.2, for automatic shutter control.
454, Ventilation, subclasses 3+ for ventilating cowls and subclasses 284+ for registers.

**41.05** This subclass is indented under subclass 41.04. Devices in which the shutters are controlled by a temperature responsive device and also include an engine responsive device, e.g., an intake or exhaust manifold pressure responsive device or an oil pressure responsive device.

(1) Note. The engine responsive device usually acts to automatically close the shutters upon stopping the engine and cooperates with the thermostat to control the shutters in response to engine temperature while the engine is in operation.

**41.06** This subclass is indented under subclass 41.04. Devices wherein an operator of the servomotor (fluid, electric, etc.) type is interposed between the condition sensing means and the shutter, valve, damper, adjustable cowl, etc.

SEE OR SEARCH CLASS:
236, Automatic Temperature and Humidity Regulation, subclass 35.3, for heat responsive control of shutters including a servo-motor within the control linkage.

**41.07** This subclass is indented under subclass 41.04. Devices in which the control of the engine carburetor throttle valve also controls a shutter or shutters.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.13, for nonautomatic interrelated throttle and coolant flow control.

**41.08** This subclass is indented under subclass 41.02. Cooling systems wherein the primary or secondary coolant is a fluid and the device for stopping, varying or starting the flow of liquid is a valve.

**41.09** This subclass is indented under subclass 41.08. Cooling systems wherein the responsive valve interrupts the flow of fluid coolant from the engine block to a coolant source as in the case of a primary coolant, or from a radiator or heat exchanger to a coolant source in case of a secondary coolant, and directs the coolant to a bypass omitting the coolant source.

(1) Note. The coolant source may be either an exchanger or an external supply, as an intake from the sea.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.25, for systems in which a liquid coolant bypasses a vapor condenser.
41.29, for bypasses for pump, radiator, etc., not automatically controlled.

SEE OR SEARCH CLASS:
236, Automatic Temperature and Humidity Regulation, subclass 34.5, for radiator bypass valves controlled by heat responsive means.
440, Marine Propulsion, subclass 88, for combinations involving boat modification. Inclusion of hull by name only is not sufficient to place a patent in Class 440.

**41.1** This subclass is indented under subclass 41.09. Cooling systems wherein the coolant source is a radiator or condenser.

**41.11** This subclass is indented under subclass 41.02. Devices wherein the primary or secondary coolant is air and the device for stopping, varying or starting the flow of air is an impeller or fan which is controlled by an automatic device.

SEE OR SEARCH CLASS:
236, Automatic Temperature and Humidity Regulation, subclasses 35+, for automatic air impellers which are used to cool radiators.
416, Fluid Reaction Surfaces (i.e., Impellers), subclasses 31+ for an impeller, per se, controlled by an automatic device.

**41.12** This subclass is indented under subclass 41.11. Devices in which the automatic control device is actuated in response to temperature.

**41.13** This subclass is indented under subclass 41.01. Cooling systems for controlling the flow of primary or secondary coolant flow conjointly with the engine throttle.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.07, for automatic shutter and throttle control.

**41.14** This subclass is indented under subclass 41.01. Cooling systems including (1) devices or arrangements for draining the entire cooling system or any part thereof, usually to prevent freezing, or (2) devices for storing heat to be returned to the system when the engine is stopped to prevent freezing.

(1) Note. The draining devices usually include a heat insulated tank into which the coolant is drained and stored.

(2) Note. Mere internal passages in a cooling system which are not closed in normal operation of the system are not considered draining devices, even though indented to allow complete emptying of the block or other port.

(3) Note. Heat storing devices must include something in addition to mere bulk of coolant or stopping of circulation.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclasses 59+ for drain valves operated in response to a sensing of freeze conditions; subclass 107 for drains responsive to flow stoppage; and subclasses 301+ for hydrants combined with means to prevent freezing.
417, Pumps, subclass 434, for means for draining a pump or pump portion.

**41.15** This subclass is indented under subclass 41.01. Cooling systems having means for indicating the condition or amount of coolant in the cooling system or any part thereof and devices responsive to the condition or amount of cooling fluid for preventing injury to the engine being cooled.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.5, for tank, radiator, or jacket constructions which permit rupture of easily replaced parts in case of excessive pressure or which have compressible means or air pockets or resilient walls to prevent damage to the system.

**41.16** This subclass is indented under subclass 41.01. Cylinders, pistons, or valves with chambers containing a confined coolant therein which may be either a liquid, solid or gas.

(1) Note. If there is also an external flow circuit, there is no communication between the two.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 176 for a piston provided with an enclosed insulating space therein.

**41.17** This subclass is indented under subclass 41.01. Cooling systems in which the coolant, after cooling the engine or engine parts, discharges into the engine cylinder combustion space or valve passages or is merely exposed to the interior of said cylinder or valve passages.

SEE OR SEARCH THIS CLASS, SUBCLASS:
25, for water injected into the cylinder during the working stroke, which water may be derived from the cooling system.
543, for admission of heated air to the cylinder.

SEE OR SEARCH CLASS:
60, Power Plants, subclass 310 for a motor-exhaust combination in which the exhaust system includes liquid contact structure and subclasses 317+ for a system in which external fluid is mingled with exhaust gas.

**41.18** This subclass is indented under subclass 41.01. Cooling systems which are capable of operating in more than one way or of changing from the use of one coolant to another, as air, vapor, liquid, and having means for changing the system to adapt it to the coolant or mode of opera-

tion selected, or having means for substituting tanks for radiators or making other equivalent changes.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.2, for vapor systems which are converted to liquid systems or vice versa merely by adding more liquid or according to the heat developed, without change or adjustment of the physical structure.

**41.19** This subclass is indented under subclass 41.01. Cooling systems including a vaporized liquid other than water which is liquefied and then allowed to expand into gas, thus removing heat directly from the engine parts or from the engine coolant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.2, for aqueous vapor systems, especially subclass 41.25, for systems in which all the circulating coolant is vaporized.

SEE OR SEARCH CLASS:
62, Refrigeration, for refrigerating systems, per se.

**41.2** This subclass is indented under subclass 41.01. Cooling systems in which (1) vaporization is intended to occur, as evidenced by the creation of vapor in the jacket, the provision of vapor space therein or by a circulating system requiring vapor for its operation; (2) a closed system is provided which is claimed to be operated at pressures other than atmospheric; (3) there is manipulation to change the normal boiling point of the coolant in a part of the system as by providing a vacuum or pressurizing; or (4) a condenser is interposed in the system other than and/or in addition to the normal passage of the liquid coolant through a heat exchanging radiator, as (a) the radiator is vented through a condenser, or into the circulating fluid, (b) the radiator is modified to mix or recirculate vapors, or (c) the outlet from the water jacket enters the radiator at the bottom.

(1) Note. Vapor type operation may occur only in the starting and warming up period of motor operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.19, for refrigerating type coolers which involve vaporizing a nonaqueous primary coolant.

**41.21** This subclass is indented under subclass 41.2. Cooling systems in which there is condensation of vapor in parts of the system external to the block or cylinder jacket and ultimate or immediate return of the condensate to the system.

(1) Note. Condensation of vapor may be induced by passing the vapor through a heat exchanger, either with or without accompanying liquid, or by introducing it into a body of liquid either in a tank or in the circulating system.

(2) Note. Circulation involves return of at least a portion of the condensate to the block or cylinder jacket, either directly or after a period of storage. The path is usually circuitous, but may be a surge in and out through the same line.

(3) Note. Condensation of vapor in a heat exchanger opening widely and directly into the block water cavity or cylinder jacket is considered circulation, but a mere tank at the top of the water space or jacket is not so considered.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.51, 41.53, 41.54, and 41.55, for reserve supply tanks and for radiators combined with cooling systems.

**41.22** This subclass is indented under subclass 41.21. Cooling systems in which a connection to the combustion intake or carburetor reduces pressure in the system or a portion of it, usually to promote circulation or reduce the boiling point of the coolant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
25, for systems in which vapor from the cooling system is drawn into the combustion chamber to effect combustion.
41.17, for systems in which coolant escapes directly into the combustion chamber

or valve passages or is exposed thereto.

**41.23** This subclass is indented under subclass 41.21. Cooling systems in which the vapor emitted from the block or jacket or a portion of it, or the condensate resulting therefrom, is added to or separated into a fluid circuit which does not include the block or jacket, i.e., a secondary cooling circuit.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.55, for cooling a primary liquid coolant by a secondary liquid coolant.

**41.24** This subclass is indented under subclass 41.21. Cooling systems in which vapor and/or water flows from the top of the block or cylinder jacket to the bottom of the radiator.

(1) Note. This usually results in the water returning to the block or cylinder without circulating through the heat exchanger, which is an upflow condenser.

**41.25** This subclass is indented under subclass 41.21. Cooling systems in which vapor and water flow from the block or cylinder jacket through the same or adjacent outlets and the water is separated from the vapor and returned to the block or cylinder without passing through the condenser for the vapor.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.24, for similar systems in which the vapor and water flow from the top of the block or jacket to the bottom of the radiator.

**41.26** This subclass is indented under subclass 41.21. Cooling systems in which only vapor is emitted from the block or cylinder jacket.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.19, for similar systems in which the vapor is nonaqueous.

**41.27** This subclass is indented under subclass 41.21. Cooling systems provided with an overflow vent from the radiator-condenser which leads to a means for condensing vapors escaping from the system through the overflow.

(1) Note. The overflow tube may lead to a heat exchanger, a tank or reservoir or to a part of the system in which liquid is circulating.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.54, for cooling system vents.

**41.28** This subclass is indented under subclass 41.01. Cooling systems having (1) conduits for furnishing each of a plurality of cylinders with an individual supply of coolant the distribution system branching either externally or internally of the jacket, or (2) passages within the jacket having capacities varying from cylinder to cylinder to produce equal cooling effects on all cylinders.

(1) Note. Circulation through the head or body of the cylinder block or jacket with apertures individual to each cylinder for transfer of fluid between the head and body is not included under (1) above, but is included under (2) if the apertures vary in size.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.72+, for multiple cylinders having coolant circulating jackets or block passages where individual head chambers are supplied from the body or lower chambers through passages of uniform size. See (1) Note.

**41.29** This subclass is indented under subclass 41.01. Cooling systems in which a liquid coolant is circulated through plural paths which have at least some portion in common and which are diverse in character.

(1) Note. Typical examples of art are (1) bypass circuits, whether for pump, radiator or jacket; (2) primary and secondary liquid coolant circuits having a common portion in which the fluids mingle; and (3) separate circuits connecting either the pump or radiator to both the top and bottom of the block or jacket.

(2) Note. Mere circulation from one part of a cylinder block or jacket to another is not included, even though the connection is external.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.09+, for automatically controlled bypass for coolant.
41.2+, especially subclass 41.25, for plural path coolant circulators where vapor forming or condensing or structure especially adapted thereto is claimed.
41.28, for plural circuits to plural cylinders which are either interior manifolds or externally divergent or which vary the flow to different cylinders.
41.72+, for plural circuits which are developed internally of cylinder blocks or jackets and are mere duplicates.

**41.3** This subclass is indented under subclass 41.01. Cooling systems wherein air is admitted to coolant water for cooling the water and/or for circulating the water around the cooling system.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.2+, for vapor systems.
41.44, and 41.45, for other circulating systems involving a gas other than air, such as exhaust gases.
41.48, for positively circulated gaseous secondary coolant.

**41.31** This subclass is indented under subclass 41.01. Cooling systems with means for cooling such additional elements as spark plugs, exhaust manifolds, plural manifolds for both intake and exhaust, bearings, guides, transmissions, etc., or means for cooling substances such as exhaust gases, etc., together with the cooling of (1) the cylinder, (2) piston or (3) valves, or any combination thereof.

(1) Note. Where the claims include exhaust manifold cooling with no detailed engine cooling, the patent belongs in Class 60, Power Plants, subclass 321, unless the exhaust gases are diverted to the engine, in which case the patent belongs in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:
434+, and especially subclasses 543+, for inlet manifold cooling or heating.

**41.32** This subclass is indented under subclass 41.31. Cooling systems in which the additional part that is cooled is a spark plug.

SEE OR SEARCH THIS CLASS, SUBCLASS:
169, for spark plug cooling, per se.

**41.33** This subclass is indented under subclass 41.31. Cooling systems in which the additional substance cooled is a lubricant.

(1) Note. The passage of air through the crankcase is considered cooling lubricant in crankcase.

(2) Note. Devices wherein the air is circulated through the crankcase by the pumping action of the piston are also included.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.86, for crankcase ventilation, per se.
196, for lubricant cooling, per se, where the lubricating system includes significant internal combustion engine structure.

**41.34** This subclass is indented under subclass 41.01. Cooling means in which various movable elements of the engine have their inside surfaces, which are not exposed to combustion, cooperating surfaces, or direct atmosphere, cooled.

(1) Note. Movable elements in this subclass and in indented subclasses comprise pistons, cylinders, valves, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.16, for pistons and valves having a coolant sealed therein.
41.56+, for air cooled pistons which do not have a definite fluid receiving compartment.

41.76+, for valve seats and valve stem guide cooling by fluid circulating in a jacket.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 173 for a piston having an enclosed insulating space therein; subclass 186 for a piston having a ported chamber therein for circulating a heat exchange fluid; subclass 239 for a piston provided with heat radiating rib means.

**41.35** This subclass is indented under subclass 41.34. Cooling means wherein the element cooled is a piston.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 173 for a piston having an enclosed insulating space therein; subclass 186 for a piston having a ported chamber therein for circulating heat exchange fluid; subclass 239 for a piston provided with heat radiating rib means.

**41.36** This subclass is indented under subclass 41.35. Cooling means in which the piston has attached thereto a conduit, or the piston is shaped to include a conduit, which conduit slides in or on a stationary or fixed conduit for delivering coolant to or from said piston interior.

**41.37** This subclass is indented under subclass 41.35. Cooling means wherein the piston rod is hollow or has passages therein for conducting coolant to and/or from the piston.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 109+ for a piston having a hollow piston rod.

**41.38** This subclass is indented under subclass 41.37. Cooling means wherein the hollow piston rod is pivotally or otherwise nonrigidly connected with the piston to permit said rod to swing.

**41.39** This subclass is indented under subclass 41.35. Cooling means wherein the piston has openings in its side wall or cylindrical surface which usually communicate with openings in the cylinder for the passage of a coolant to or from the interior or side of the piston.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.78, for cylinder jackets adapted to be traversed by sidewall type cylinder valves.

**41.4** This subclass is indented under subclass 41.34. Cooling means wherein the movable element cooled is a rotary valve.

**41.41** This subclass is indented under subclass 41.34. Cooling means wherein the movable element cooled is a poppet type valve.

**41.42** This subclass is indented under subclass 41.01. Cooling systems employing liquid coolants other than water or water which has been treated to prevent freezing, corroding, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.16, for nonaqueous coolants sealed in cylinder valves or pistons.
41.19, for nonaqueous coolants which are vaporized and condensed in a refrigerating cycle.
142.5, for systems in which water is heated by external energy.

SEE OR SEARCH CLASS:
252, Compositions, subclasses 71+, for heat exchange compositions having low freezing point or high boiling point, and 387+, for anti-corrosion agents.

**41.43** This subclass is indented under subclass 41.01. Cooling systems employing at least one tank or radiator which is capable of linear or angular motion.

SEE OR SEARCH CLASS:
165, Heat Exchange, subclasses 86+ for a movably mounted heat exchanger not limited to use on an internal combustion engine.
244, Aeronautics and Astronautics, subclass 57 for radiators which may be movably mounted on aircraft.

**41.44** This subclass is indented under subclass 41.01. Cooling systems having positively acting means for circulating a liquid coolant within the engine block, through the block to the head, or through the block and head to a radiator.

**41.45** This subclass is indented under subclass 41.44. Cooling systems wherein the circulating means comprise a jet or aspirating device.

(1) Note. The jet may be liquid or gas operated.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.2+, particularly 41.23, for vapor type cooling systems having a jet type condenser.

**41.46** This subclass is indented under subclass 41.44. Cooling systems where the device for circulating the liquid is a pump which is operated in conjunction with an air cooling fan.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.49, for air cooling fans for liquid heat exchangers.

**41.47** This subclass is indented under subclass 41.44. Cooling systems wherein the liquid coolant circulating means is driven from the engine shaft.

(1) Note. The pump may be mounted on the engine shaft or may be on a separate shaft connected by some transmission to the engine drive shaft.

**41.48** This subclass is indented under subclass 41.01. Cooling systems including devices which guide, force, or direct air over surfaces which enclose a liquid coolant or which separate the air and liquid coolant.

**41.49** This subclass is indented under subclass 41.48. Cooling systems wherein the device which forces the air is of the fan type.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.46, for air cooling fans operated in conjunction with a liquid pump.
41.48, for driving impellers as means for forcing the air.
41.65+, for fans which cause air to flow over air cooled engines.

**41.5** This subclass is indented under subclass 41.01. Cooling systems having a normally rigid body, as a tank, radiator or jacket wall, constructed of yieldable material or provided with a replaceable portion weaker than the normal wall, or having a compressible or yieldable body within a tank, radiator or jacket, to prevent breakage of permanent rigid parts, particularly when the coolant freezes.

**41.51** This subclass is indented under subclass 41.01. Cooling systems in which two or more heat dissipators and/or tanks are included in a single circulating system so that the coolant passes through them successively.

**41.52** This subclass is indented under subclass 41.01. Cooling systems including a radiator or heat exchange for liquid coolants mounted on or integral with the engine or engine cylinder.

(1) Note. See (2) Note under subclass 41.01.

**41.53** This subclass is indented under subclass 41.52. Cooling systems wherein the heat exchanger or radiator is in the form of a tank shaped like a hopper and forming an extension of the block or cylinder jacket. The hopper or tank is coextensive with the cylinder exchange portion of the system or opens widely into it, and there is no other means for dissipating heat.

**41.54** This subclass is indented under subclass 41.01. Cooling systems having means for venting air or vapor to the atmosphere.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.27, for overflow type vents delivering fluid into a tank or condenser.

**41.55** This subclass is indented under subclass 41.01. Cooling systems including matter other than heat exchange jackets or casings for the combustion chambers, valves, pistons or their immediate associated parts or the heat exchange elements of the same as fins or air passages.

(1) Note. Included are miscellaneous heat dissipators for liquid coolants including those involving a secondary liquid coolant, automatic devices not concerned with coolant, flow, combinations with external power and/or heat using devices, i.e., auxiliary power plants, filters, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:
2, for internal combustion engines in which the heat energy imparted to the cooling medium is utilized for generating steam for general purposes.
41.02+, for automatic coolant flow control.
41.13, for interrelated coolant flow and throttle control.
41.15, for combined indicator and safety devices.
41.31, for cooling of parts in addition to cooling of cylinders, valves and pistons.
41.44+, for combined flow causing means.

SEE OR SEARCH CLASS:
126, Stoves and Furnaces, subclasses 204+, for devices in which the heat energy imparted to the cooling medium is utilized for warming purposes.

**41.56** This subclass is indented under subclass 41.01. Cooling means wherein the primary coolant is air or other gaseous fluid.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.19, for nonaqueous vapor coolant.
41.2+, for aqueous vapor coolants.

**41.57** This subclass is indented under subclass 41.56. Cooling means wherein a part of the engine is cooled by a liquid, i.e., there is a primary liquid coolant as well as a primary air coolant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.3, for mixed air and water coolant.

**41.58** This subclass is indented under subclass 41.56. Cooling means comprising means forming an air duct or passage for conducting cooling air to or against the engine including devices for controlling the flow of air through the duct or passages.

(1) Note. These devices for the most part include shutters mounted in or on cowling.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.04+, for automatic control of shutters.
41.7, for cowlings surrounding the engine cylinders.

SEE OR SEARCH CLASS:
49, Movable or Removable Closures, appropriate subclasses, particularly subclasses 74.1+ for louvers interconnected for concurrent movement.
180, Motor Vehicles, subclass 69.2, for hoods having adjustable shutters combined therewith.
236, Automatic Temperature and Humidity Regulation, subclass 35.2, for automatic shutter control.
454, Ventilation, subclasses 3+ for ventilating cowls and subclasses 284+ for registers.

**41.59** This subclass is indented under subclass 41.58. Subject matter wherein the flow of air through the duct of passage is controlled by adjustable means at the discharge end of the duct or passage.

**41.6** This subclass is indented under subclass 41.56. Devices for cooling a multiple cylinder engine which include vanes, baffles, conduits or the like, for dividing the flow of air into separate streams and directing said streams to different cylinders or portions of the cylinders of the engine.

**41.61** This subclass is indented under subclass 41.6. Subject matter wherein the stream dividing means comprise deflecting baffles positioned adjacent to or attached to the cylinders of the engine for directing air to or about each cylinder.

**41.62** This subclass is indented under subclass 41.6. Subject matter in which the stream dividing means comprises an air duct or passage having

discharge ports or conduits for directing the air flow to or against different parts of the engine.

**41.63** This subclass is indented under subclass 41.56. Subject matter which includes devices for impelling cooling air over the engine.

(1) Note. The impelling means includes fans, pumps, or like devices but excludes cowlings, ducts, or the like which merely direct the flow of air over the engine due to the movement of the vehicle.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.48, for means to force or direct air over a surface of a liquid coolant.

**41.64** This subclass is indented under subclass 41.63. Cooling means wherein the air impelling device is a jet pump or the like.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.45, for jet pumps for impelling liquid coolants.

**41.65** This subclass is indented under subclass 41.63. Subject matter in which the air impelling device is a fan.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.49, for fans used to cause air to flow over radiators and/or water cooled engines.

**41.66** This subclass is indented under subclass 41.65. Devices in which the air impeller is a suction fan for withdrawing air from the engine housing.

**41.67** This subclass is indented under subclass 41.56. Devices comprising a jacket, casing or conduit supported by or enclosing an individual cylinder for directing the flow of air thereover.

(1) Note. Various shaped baffles which cause the air flow to be deflected over the cylinder heads are included in this subclass.

(2) Note. Devices in which the heat dissipating fins cooperate with the jacket or casing to form channels to conduct the cooling air over the cylinder are in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.62, for conduits surrounding the cylinders.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 144 for a cylinder for an expansible chamber device encompassed by a heat exchange modifying space or jacket.

**41.68** This subclass is indented under subclass 41.67. Devices in which baffle means or cylinder fins are formed to impart a spiral flow to the air within the jacket, casing or conduit as it passes over the cylinder.

**41.69** This subclass is indented under subclass 41.56. Subject matter which includes cylinders and/or cylinder heads constructed with various shaped fins to increase the cooling area of the cylinder walls.

SEE OR SEARCH CLASS:
165, Heat Exchange, subclass 51 for heat exchange means installed on an engine; subclasses 181+ for a tubular structure with discrete heat transfer means; and subclass 185 for a heat transmitter, per se.

**41.7** This subclass is indented under subclass 41.56. Devices which comprise air ducts or passages which surround the engine to conduct or direct a stream of cooling air to or against the engine.

(1) Note. These devices are usually cowling and may include structure for supporting the air duct or cowling on the engine.

SEE OR SEARCH CLASS:
180, Motor Vehicles, subclasses 68.1+ for similar structure combined with significant vehicle features.
244, Aeronautics and Astronautics, subclass 53, for like structures. See (3) Note under definition of Class 244, subclass 53.

**41.71** This subclass is indented under subclass 41.01. Cylinder, piston or jacket construction in which a plurality of materials, usually of different thermal capacity, are combined in a single element.

(1) Note. A liner or cover permanently attached is considered a combined single element.

**41.72** This subclass is indented under subclass 41.01. Structures comprising an engine part which is immediately connected with the combustion process, as a cylinder wall or head or valve seat jacketed, channeled or constructed to form a passage for a confined coolant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.34+, for coolant introduction into moving parts.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 83+, for such devices provided with heat exchange means.

**41.73** This subclass is indented under subclass 41.72. Structures in which all or a portion of the coolant is confined in a channel within or adjacent jacket or coolant housing to a point immediately adjacent the part to be cooled, where it is released into the larger space with sufficient force to form a current, jet or spray directed toward said port.

**41.74** This subclass is indented under subclass 41.72. Structures including a plurality of cylinders within the same jacket or cooled by the same system.

SEE OR SEARCH THIS CLASS, SUBCLASS:
52+, for multiple cylinder engines.

**41.75** This subclass is indented under subclass 41.72. Subject matter in which the cooling head is formed with an internal concave portion with which the jacket is coextensive.

(1) Note. This concave portion usually constitutes the combustion space.

**41.76** This subclass is indented under subclass 41.72. Structures in which the cooling chamber is especially adapted to cool the valve areas, i.e., passages, seats and valve stem guides.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.16, for valves and cylinder ports having coolant sealed therein.
41.34, for means for cooling the moving parts of this area internally.
41.4, for internal cooling of valves combined with external cooling of valve seats or guides.
41.85, for cooling of valve seats or guides, per se.

**41.77** This subclass is indented under subclass 41.76. Cooling means in which the valve seats or guides support a poppet-type valve.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.41, for internal cooling of poppet type valves.

**41.78** This subclass is indented under subclass 41.76. Cooling means in which the valve passages, etc., are located in the side walls of the cylinders.

**41.79** This subclass is indented under subclass 41.72. Cooling structures in which the jacket or cylinder walls are constructed with channels or in such a way as to form channels, or baffles, fins, ribs or grooves are provided inside the coolant chamber, either to guide the coolant in particular paths or directions, or to increase the area of the wall exposed to the coolant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.67+, for air cooled cylinders having cooling passages or baffles.

**41.8** This subclass is indented under subclass 41.79. Structures in which the path formed for the coolant is spiral, or forms an ascending or descending path extending around the cylinder.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.68, for air cooled cylinders having spiral passages or conduits.

**41.81** This subclass is indented under subclass 41.72. Structures in which a member forming the external wall or walls of a coolant containing chamber are secured to the cylinder or cylinder block proper, so that they are carried thereby and have no other support or mounting means.

**41.82** This subclass is indented under subclass 41.72. Structures involving the cylinder head cooling means.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.76+, for similar constructions involving coolant chambers for valve seats or stem guides.

**41.83** This subclass is indented under subclass 41.72. Structures in which the cylinder or cylinder liner is detachably supported within the assembly in such a way as to form one wall of the coolant chamber.

**41.84** This subclass is indented under subclass 41.83. Structures in which the cylinder or liner has a flange by which it is engaged with or supported in the assembly.

**41.85** This subclass is indented under subclass 41.01. Structures in which the cooling means is especially adapted to cool the valve areas, i.e., passages, seats or valve stem guides.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.76+, for cooling of valve areas combined with cooling of the cylinder or cylinder head.

**41.86** This subclass is indented under the class definition. Engines wherein air is forced through the crankcase by some manner other than the mere pumping effect of the engine pistons for ventilating or removing fumes from the crankcase.

(1) Note. Air may be forced through the crankcase by the forward motion of the vehicle or by the fan due to the formation of a venture or aspirating nozzle on the crankcase.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.31+, for crankcase cooling or oil cooling by confined coolants and for crankcase ventilation combined with cylinder, piston or valve cooling.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 78+ for a means to purify a fluid to or from a portion of an expansible chamber device, subclass 80 for a force exerting means to move fluid from a nonworking chamber of an expansible chamber device, and subclass 82 for a means to control the flow of fluid from a nonworking chamber of an expansible chamber device.

**42** Internal-combustion engines having a cylinder and working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which the working cylinder partakes of an oscillatory motion about a fixed axis as the piston reciprocates therein.

SEE OR SEARCH CLASS:
91, Motors: Expansible Chamber Type, subclasses 176 and 210+ for expansible chamber motors of the oscillating cylinder type.
92, Expansible Chamber Devices, subclasses 118+ for an expansible chamber device having an oscillating cylinder.

**43** Internal-combustion engines having a cylinder and working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which the working cylinder partakes of a continuous rotary motion about a fixed axis as the working piston reciprocates therein and engines including a plurality of working cylinders each coming within the terms of this definition, the engine in question not coming within the terms of the definition of the subclass following this.

SEE OR SEARCH CLASS:

91, Motors: Expansible Chamber Type, subclasses 176, 197 and 472+, for expansible chamber motors of the rotating cylinder type.

92, Expansible Chamber Devices, subclasses 54+ for an expansible chamber device having a rotating cylinder.

**44** Internal-combustion engines differing from those occurring in the preceding subclass in that axial lines of the rotating cylinders lie in a plane perpendicular to the crank-shaft of the engine and are also radial thereto, the cylinders or cylinder when one only is disclosed being immovable relatively to the member by which they are carried and with which they rotate.

SEE OR SEARCH CLASS:

91, Motors: Expansible Chamber Type, subclasses 491+, for expansible chamber type motors having three or more radial rotating cylinders.

92, Expansible Chamber Devices, subclasses 58+ for an expansible chamber device provided with a plurality of radially disposed rotating cylinders.

**45** Internal-combustion engines having a cylinder and a working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which the working piston rotates or oscillates upon its longitudinal axis and that of the working cylinder as it reciprocates therein and in so doing opens and closes in proper order the various ports necessary to supply combustible mixture to and to permit the exhaust of the burned gases from the engine, the periphery of the piston or an extension thereof forming a closure for the supply and exhaust ports when they are required to be closed.

**46** Internal-combustion engines having a cylinder and one or more reciprocating pistons therein, one at least of which pistons is movable freely and independently of the main shaft of the engine on the stroke of such piston immediately following the ignition of the charge, during which stroke the energy of the burned gases is stored and thereafter transferred to the main shaft of the engine. Ordinarily the freely-movable piston is the only piston employed in engines in this subclass. The energy is ordinarily stored by forcing the piston against the pressure of the atmosphere; and the stored energy is ordinarily transferred to the main shaft by securing the piston thereto by means of a suitable clutch provided with suitable converting mechanism upon its return stroke.

SEE OR SEARCH CLASS:

60, Power Plants, subclass 595 for an internal combustion type free piston device supplying motive fluid to a motor and subclass 596 for an internal combustion type of free piston device with a pressure fluid type starting structure.

**47** Internal-combustion engines having a cylinder and working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, the said working piston being provided with a passage leading into the working cylinder and controlled by a valve depending upon the engine for its operation, said valve being concerned either with the supply of the successive combustible charges to the working cylinder or with the exhaust of the burned gases therefrom.

SEE OR SEARCH CLASS:

91, Motors: Expansible Chamber Type, subclasses 222+ for cyclically operable, expansible chamber motors having a valved piston.

**48** Internal-combustion engines having a cylinder and a working piston reciprocating therein, but irrespective of other structural features, cycle, or mode of operation, in which means are provided whereby the volume of the clearance-space or combustion-chamber may be varied or adjusted either manually or automatically as by a suitable governing device, to thereby insure a proper degree of compression of the combustible charge before ignition thereof.

SEE OR SEARCH THIS CLASS, SUBCLASS:

311+, for internal-combustion engines in which the volume of the clearance-space is varied in unison with the exhaust-stroke, such action being a definite step in each cycle of operation of the engine.

**50** Internal-combustion engines comprising a cylinder and a piston therein, the cylinder being capable or reciprocatory movement in a straight line relatively to the piston and the piston being either immovable or adapted for simultaneous movement in a direction opposite to the movement of the said movable cylinder whereby the gases resulting from the combustion of a combustible mixture within the cylinder as they expand act upon the movable cylinder and transmit power therethrough to the main driving-shaft of the engine or act upon the movable cylinder and the piston, when it also is movable, to transmit power through both said elements.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 117+ for an expansible chamber device having a moving cylinder.

**51** Internal-combustion engines comprising two working pistons moving simultaneously in the opposite directions in a single cylindrical structure composed of two working cylinders arranged tandem with a combustion-chamber between and in permanently open communication with both said cylinders or two working pistons moving in like manner in two similarly-arranged cylinders whose axial lines when extended are parallel and adjacent and which communicate with a single combustion chamber, as above, whereby the gases resulting from the combustion of a combustible mixture within the combustion-chamber as they expand act with equal pressure upon both pistons and transmit substantially equal amounts of power through each piston to the main driving shaft of the engine, and internal-combustion engines comprising two or more such units as are above defined.

SEE OR SEARCH CLASS:
91, Motors: Expansible Chamber Type, subclasses 170+ and 508+ for multi-piston or cylinder type expansible chamber motors.
92, Expansible Chamber Devices, subclasses 61+ for an expansible chamber device having relatively movable working members.

**52.1 MULTIPLE CYLINDER:**
This subclass is indented under the class definition. Internal-combustion engine having two or more separate and distinct cylinders and a single piston reciprocating in each cylinder to transmit force to a load.

(1) Note. The following terms are defined as used in this subclass and indented subclasses.

(2) Note. A “stroke” consists of a movement of the piston away from the cylinder head or a movement toward the cylinder head.

(3) Note. An internal-combustion engine may be defined by the number of strokes between ignition, the most common types are as follows:

(a)A “four-stroke” engine is one which operates as follows, starting with the piston near “top-dead-center”: (1) The piston moves away from the head, for the “power” stroke, as the ignited fuel expands as gases, to go to “bottom-dead-center”. (2) The piston moves toward the head for the “exhaust” stroke in which the combustion gases are expelled. (3) The piston again moves away from the head for the “intake” stroke in which air is drawn into the cylinder. (4) The piston moves toward the head for the “compression” stroke, at the conclusion of which ignition will occur and the cycles start over.

Note that a “four-stroke” engine makes two complete revolutions for each power stroke.

(b)A “two-stroke” engine is one which operates as follows, starting with the piston near “top-dead-center”: (1) The piston moves away from the head for the power stroke, with exhaust beginning at the bottom of the stroke. (2) The piston moves toward the head as exhaust completes, with the charge simultaneously being transferred to the cylinder, the latter part of the stroke serving to compress the charge, at the conclusion of this

stroke ignition will occur and the cycles start over.

Note that a "two-stroke" engine makes one complete revolution for each power stroke.

SEE OR SEARCH CLASS:

91, Motors: Expansible Chamber Type, subclasses 170+ and 508+ for a multi-piston or cylinder type, noninternal combustion, expansible chamber motor.

92, Expansible Chamber Devices, subclasses 146+ for plural unitarily mounted cylinders or a frame therefor for an expansible chamber device (that is not an engine).

GLOSSARY

CHARGE:

a quantity of "working fluid" intended to be ignited for a working stroke of the "piston".

COMBUSTION CHAMBER:

that volume of a "cylinder" enclosed by the "head" and the "piston" when the piston is closest to the head.

CONNECTING ROD:

The most common link for transmitting power from a "piston" to a "crankshaft".

CRANKSHAFT:

The most common type of "output shaft", which is journaled to turn about a fixed axis and including an offset portion for receiving energy from the piston.

CYLINDER:

a member having an internally facing surface of a shape generated by a straight line rotating a fixed distance about an axis.

HEAD:

the portion of a cylinder which closes off one end thereof.

**52.2 Simultaneous compression, distinct pistons, restricted communication to a single combustion chamber:**

This subclass is indented under subclass 52.1. Multiple cylinder engine including at least two cylinders each of which is connected to a single combustion chamber by a passage which is constricted to limit free flow of gasses between at least one of the cylinders and the combustion chamber and including means to coordinate movement of the pistons so as to compress the charge in the single combustion chamber.

(1) Note. One piston of the "at least two" cylinders may move somewhat in advance of the other. There may be provision to prevent a fresh combustible mixture separate from the residual products of combustion from the previous charge, as by leading the supply-conduit into one working cylinder, while the exhaust-conduit leads from another.

SEE OR SEARCH THIS CLASS, SUBCLASS:

51, for an engine including multiple pistons that utilize a single combustion chamber without restriction of flow of combustion gases there between. The engine of that subclass may include two oppositely moving pistons in a single cylinder.

**52.3 Four-stroke cycle:**

This subclass is indented under subclass 52.2. Multiple cylinder engine wherein the pistons in the working cylinders operate on a four-stroke cycle.

**52.4 Multiple crankshafts:**

This subclass is indented under subclass 52.3. Multiple cylinder engine including two output shafts, the first having at least one crank thereon which is drivingly connected to a first piston so as to convert the reciprocating motion of the piston into rotary motion of the first output shaft, and the second output shaft having at least one crank thereon which is drivingly connected to a second piston so as to convert the reciprocating motion of that piston into rotary motion of the second output shaft.

**52.5 Two-stroke cycle:**
This subclass is indented under subclass 52.2. Multiple cylinder engine wherein the pistons in the working cylinders operate on a two-stroke cycle.

**52.6 Multiple crankshafts:**
This subclass is indented under subclass 52.5. Multiple cylinder engine including two output shafts, the first having at least one crank thereon which is drivingly connected to a first piston so as to convert the reciprocating motion of the piston into rotary motion of the first output shaft, and the second output shaft having at least one crank thereon which is drivingly connected to a second piston so as to convert the reciprocating motion of that piston into rotary motion of the second output shaft.

**53.1 Cylinder offset from crankshaft axis:**
This subclass is indented under subclass 52.1. Multiple cylinder engine including a crankshaft that turns about an axis extending generally perpendicularly to a plane passing through the axis of at least one cylinder the piston of which is drivingly connected thereto, wherein the cylinder axis, if extended, would not intersect the crankshaft axis.

**53.2 Multiple crankshafts:**
This subclass is indented under subclass 53.1. Multiple cylinder engine including two output shafts, the first having at least one crank thereon which is drivingly connected to a first piston so as to convert the reciprocating motion of the piston into rotary motion of the first output shaft, and the second output shaft having at least one crank thereon which is drivingly connected to a second piston so as to convert the reciprocating motion of that piston into rotary motion of the second output shaft.

**53.3 Cylinders opposite:**
This subclass is indented under subclass 53.1. Multiple cylinder engine wherein the axes of a first and a second cylinder are spaced from each other by 180° about the crankshaft.

**53.4 Two-stroke cycle:**
This subclass is indented under subclass 53.3. Multiple cylinder engine wherein the pistons in the working cylinders operate on a two-stroke cycle.

**53.5 Crankshaft between parallel cylinders:**
This subclass is indented under subclass 53.1. Multiple cylinder engine wherein the axes of two cylinders are parallel and the axis of the crankshaft extends between the parallel axes.

**53.6 Cylinders having opposing heads:**
This subclass is indented under subclass 52.1. Multiple cylinder engine wherein a first and a second cylinder having axes collinear and have the combustion chamber ends of the cylinders facing one another along their axes.

**54.1 Cylinders radiating:**
This subclass is indented under subclass 52.1. Multiple cylinder engine including a rotary output shaft that turns about an axis intersected by and extending generally perpendicular to the axes of the first and second cylinders, the pistons of which are drivingly connected to the output shaft, wherein the cylinder axes are not parallel to each other.

(1) Note. The axes of the first and second cylinders may intersect the rotational axis of the crankshaft at the same or at different points along the axis of the crankshaft.

(2) Note. When viewed as a cross-section normal to the crankshaft axis, the first and second cylinder axes intersect at the point defining the crankshaft axis.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 148 for a plurality of radially disposed cylinders for an expansible chamber device that is not an internal combustion engine.

**54.2 Star:**
This subclass is indented under subclass 54.1. Multiple cylinder engine wherein at least three cylinders are equally spaced about the centrally disposed rotary output shaft.

**54.3 Cam on rotary output shaft:**
This subclass is indented under subclass 54.2. Multiple cylinder engine wherein the rotary output shaft includes a disk or a drum with an irregularly shaped surface which is engaged by a follower linkage drivingly connected to the

pistons to convert the reciprocating motion of the pistons into rotary motion of the output shaft.

**54.4 "V" type:**
This subclass is indented under subclass 54.1. Multiple cylinder engine wherein first and second radially extending banks of cylinders are spaced apart by an angle of less than 180°.

**54.5 Odd number of cylinders:**
This subclass is indented under subclass 54.4. Multiple cylinder engine wherein the total number of cylinders is not evenly divisible by two.

**54.6 Six cylinder:**
This subclass is indented under subclass 54.4. Multiple cylinder engine including six or more cylinders.

**54.7 Eight cylinder:**
This subclass is indented under subclass 54.6. Multiple cylinder including eight or more cylinders.

**54.8 More than eight cylinder:**
This subclass is indented under subclass 54.7. Multiple cylinder engine wherein the total number of cylinders is an even number greater than eight.

**55.1 Semi-radial:**
This subclass is indented under subclass 54.1. Multiple cylinder engine including at least three cylinders radially disposed and unequally spaced about the centrally disposed, rotary output shaft.

**55.2 Cylinders opposite:**
This subclass is indented under subclass 54.1. Multiple cylinder engine wherein the first and second cylinder axes are spaced from each other 180° about the crankshaft axis.

**55.3 Cam on rotary output shaft:**
This subclass is indented under subclass 55.2. Multiple cylinder engine wherein the rotary output shaft includes a disk or a drum with an irregularly shaped surface which is engaged by a follower linkage drivingly connected to the pistons to convert the reciprocating motion of the pistons into rotary motion of the output shaft.

**55.4 Four-stroke cycle:**
This subclass is indented under subclass 55.2. Multiple cylinder engine wherein the pistons in the cylinders operate on a four-stroke cycle.

**55.5 Cylinders opposite and aligned:**
This subclass is indented under subclass 55.4. Multiple cylinder engine wherein the axes of a first and a second cylinder are spaced from each other by 180° about the crankshaft and wherein the first and second cylinder axes are collinear.

**55.6 Two-stroke cycle:**
This subclass is indented under subclass 55.2. Multiple cylinder engine wherein the pistons in the working cylinders operate on a two-stroke cycle.

**55.7 Cylinders opposite and aligned:**
This subclass is indented under subclass 55.6. Multiple cylinder engine wherein the axes of a first and a second cylinder are spaced from each other by 180° about the crankshaft and wherein the first and second cylinder axes are collinear.

**56.1 Having rotary output shaft parallel to cylinders:**
This subclass is indented under subclass 52.1. Multiple cylinder engine including an elongated rotary output shaft intended to turn about its axis, in which the cylinder axes are parallel with the rotary output shaft axis.

(1) Note. In the engine of this subclass, the cylinder axes are usually at equal radial distances from the axis of the main shaft and are arranged around said shaft at equal angular intervals.

**56.2 Cam on rotary output shaft:**
This subclass is indented under subclass 56.1. Multiple cylinder engine wherein the rotary output shaft includes a disk or a drum with an irregularly shaped surface which is engaged by a follower linkage drivingly connected to the pistons to convert the reciprocating motion of the pistons into rotary motion of the output shaft.

**56.3 Swash plate type:**
This subclass is indented under subclass 56.2. Multiple cylinder engine wherein the cam comprises: (a) a disk-shaped plate rigidly connected on an incline to the output shaft, the pistons engage the periphery of the disk-shaped plate with a follower linkage thereby converting reciprocating motion of the pistons to rotary motion of the output shaft; or (b) a disk-shaped plate journaled to an incline to the output shaft such that the plate wobbles without rotating about the output shaft, the pistons are linked to the periphery of the disk-shaped plate by swivel joints so that the reciprocating movement of the pistons produces a wobbling motion of the disk-shaped plate turning the inclined crank producing rotation motion of the output shaft.

**56.4 Single bank of cylinders:**
This subclass is indented under subclass 56.3. Multiple cylinder engine wherein the cylinders are oriented in the same direction and are configured in one group equally spaced from and encircling the output shaft.

**56.5 Motion converting means between two banks of cylinders:**
This subclass is indented under subclass 56.3. Multiple cylinder engine wherein the cylinders are separated into two groups, one on either side of the swash plate, each group is oriented in one direction and encircles the output shaft at equal spacing.

**56.6 Multiple swash plate drive:**
This subclass is indented under subclass 56.3. Multiple cylinder engine wherein the rotary output shaft includes at least two disk-shaped plates inclined to the axis of the output shaft and at least one piston is linked to the periphery of each of the disk-shaped plates such that the reciprocating motion of the pistons is converted into rotary motion of the output shaft.

**56.7 Single bank of cylinders:**
This subclass is indented under subclass 56.2. Multiple cylinder engine wherein the cylinders are oriented in the same direction and are configured in one group equally spaced from and encircling the output shaft.

**56.8 Motion converting means between two banks of cylinders:**
This subclass is indented under subclass 56.2. Multiple cylinder engine wherein the cylinders are separated into two groups, one on either side of the swash plate, each group is oriented in one direction and encircles the output shaft at equal spacing.

**56.9 Multiple cam drives:**
This subclass is indented under subclass 56.2. Multiple cylinder engine wherein the rotary output shaft includes at least two contoured disks or drums and at least one piston linked by a follower arrangement to the contoured surface of the cam, so that reciprocating motion of the pistons is converted into rotary motion of the output shaft.

**57.1 Shaft rotates through piston:**
This subclass is indented under subclass 56.1. Multiple cylinder engine wherein the rotary output shaft extends through and is rotatable in a longitudinal bore in the piston.

**58.1 Cylinders in-line:**
This subclass is indented under subclass 52.1. Multiple cylinder engine including a crankshaft that turns about an axis in the same plane with the axis of first and second cylinders, the pistons of which are drivingly connected to the crankshaft.

**58.2 Locked pistons:**
This subclass is indented under subclass 58.1. Multiple cylinder engine wherein the pistons of the first and second cylinders are immovably secured to each other.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 150 and 151+ for coaxially disposed cylinders for an expansible chamber device.

**58.3 Two-stroke cycle:**
This subclass is indented under subclass 58.2. Multiple cylinder engine wherein the pistons in the working cylinders operate on a two-stroke cycle.

**58.4 Lengthwise charging:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including means for charging the working cylinders, whereby the charging travels generally along the length of the working cylinders.

**58.5 Step piston:**
This subclass is indented under subclass 58.4. Multiple cylinder engine including at least one piston configured with at least two different cross sections along the piston's length, the configured piston is received in a cylinder with at least two different diameter bores.

**58.6 Step piston:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including at least one piston configured with at least two different cross sections along the piston's length, the configured piston is received in a cylinder with at least two different diameter bores.

**58.7 Cylinder supercharged by pressure pulse of released exhaust gases:**
This subclass is indented under subclass 58.1. Multiple cylinder engine wherein prior to opening of a first cylinder's exhaust port, the high pressure exhaust gases of the first cylinder are released to push additional charge into a second cylinder which has already inlet charged at atmospheric pressure.

**58.8 Exhaust to next cylinder ready to fire:**
This subclass is indented under subclass 58.1. Multiple cylinder engine wherein exhaust from a first cylinder is released into a second cylinder to combust the residual fuel in the exhaust.

**58.9 Oscillating or reciprocating, nonpoppet valve:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including a valve mechanism which moves to-and-fro excluding poppet valves.

(1) Note. A poppet valve consists of a valve member including a rodlike portion (i.e., stem) connected to the center of a disk-shaped portion, said valve member is resiliently biased into sealing engagement with the rim of a hole (i.e., the seat)

**59.1 Rotary valve:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including a rotating valve mechanism.

**59.2 Tapered:**
This subclass is indented under subclass 59.1. Multiple cylinder engine wherein the outer surface of revolution of the rotary valve includes at least one conical segment, the conical segment is received in a conical bore thereby sealing the conical portion of the rotary valve.

**59.3 Sleeve valve:**
This subclass is indented under subclass 59.1. Multiple cylinder engine wherein the rotary valve consists of a hollow, thin walled surface of revolution lining or in surrounding relationship to at least a portion of a working cylinder.

**59.4 Disc valve:**
This subclass is indented under subclass 59.1. Multiple cylinder engine wherein the rotary valve has one or more thin, circular member(s) with at least one flat surface perpendicular to the axis of rotation.

**59.5 Plural carburetors:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including at least two devices for mixing air and fuel external to the combustion chamber.

**59.6 Multiple crankshafts:**
This subclass is indented under subclass 58.1. Multiple cylinder engine including at least two output shafts, each including one or more cranks, wherein the pistons are at the working cylinder and are drivingly connected to the cranks, thereby converting the reciprocating motion of the pistons into rotary motion of the output shaft.

**59.7 Two-stroke cycle:**
This subclass is indented under subclass 58.1. Multiple cylinder engine wherein the pistons in the working cylinders operate on a two-stroke cycle.

**60.1 Locked annular piston:**
This subclass is indented under subclass 52.1. Multiple cylinder engine including a first piston of circular cross section and including a

second piston that is hollow and concentric about the first piston, wherein the two pistons are secured to each other so that they move together.

**61** Internal-combustion engines working on a two-stroke cycle and in which successive burned charges act upon opposite sides of a single piston reciprocating in a single cylinder, whereby the working piston is impelled alternately in each direction. Includes two-cycle engines operating upon recompression and also two-cycle engines operating upon pump-compression cycles, both of which terms are more fully explained hereinafter. The working cylinder in the engines in this subclass is of simple cylindrical form, and the supply-pump for the combustible mixture is wholly separate and distinct from the working cylinder and is not considered in this definition.

**62** Internal-combustion engines working on a two stroke cycle and in which successive combustible charges after ignition thereof act so as to impel the working piston alternately in each direction, the elements of the engine and of the pump for supplying the combustible mixture thereto being all contained within a single cylinder structure and so intimately associated as to make mechanical separation of the two sets of elements impossible without defeating the operation of the engine as a whole.

SEE OR SEARCH THIS CLASS, SUBCLASS:
66, for combined pump and motor cylinder.

**63** Internal-combustion engines working on the four-stroke cycle, hereinafter defined, in which successive burned charges act alternately upon opposite sides of a single reciprocating piston moving in a single cylinder.

**64** This subclass is indented under subclass 75. Internal-combustion engines of the reciprocating type working upon a modified four-stroke cycle with recompression in the working cylinder, as defined in the definition of ... , below, and in which air unmixed with combustible is drawn into and expelled from the working cylinder one or more times upon distinct suction and expelling strokes of the working piston after the end of the exhaust-stroke and before the beginning of the suction-stroke of the normal four-stroke cycle, whereby a more complete removal of the burned gases, from the working cylinder and combustion-chamber is secured.

**65** Internal-combustion engines having a single single-acting working cylinder and a single working piston reciprocating therein and having suitable means for supplying a combustible mixture thereto, such engines working on the two-stroke cycle and not coming within the definitions of the following subclasses of two-cycle engines. Internal-combustion engines are said to work upon the two-stroke cycle when a combustible mixture under pressure materially greater than atmospheric pressure is burned and the resulting products of combustion allowed to expand within the working cylinder upon every second stroke of the working piston of the engine. The means for supplying the combustible mixture to the engine ordinarily includes a pump operated by and in unison therewith, which pump and engine are generally inseparable without destroying the identity of the device as a whole. In the engines occurring in two-cycle subclasses a combustible mixture is supplied to the working cylinder and burned therein under pressure upon each second stroke of the working piston, and such mixture after having been supplied to the working cylinder at a pressure not necessarily greater than is sufficient to insure its flow there into may be recompressed therein by the working piston or by the working and pump pistons acting together before ignition and the beginning of the working stroke, which is the more ordinary mode of operation, or the mixture may be supplied to the working cylinder after the beginning of the working stroke and at the maximum pressure under which it exists before ignition, in which case it is not recompressed in the working cylinder before ignition, but is ignited either at constant pressure as it enters or at constant volume after the whole charge has been supplied. Two-cycle engines coming within the latter of the above cases are classified as two-cycle pump-compression engines. The combustible mixture is ordinarily supplied to the working cylinder by a pump, and in the first of the above cases, while the charge may be compressed to a considerable degree by the supply-pump, such charge enters the working cylinder only against the pressure of the atmo-

sphere and after having entered must exist therein at or substantially at atmospheric pressure, and the initial compression of the charge upon which the efficiency of an internal-combustion engine so largely depends is produced wholly by recompression of the charge in the working cylinder while in the second case such initial pressure is produced wholly by the supply-pump which compresses the charge directly to the maximum pressure at which it exists before ignition.

SEE OR SEARCH THIS CLASS, SUBCLASS:

61, for double-acting two-cycle engines having a separate and distinct supply pump.

62, for double-acting two-cycle engines in which the engine and supply pump elements are contained within a single cylinder structure.

**66** Two-cycle internal-combustion engines in which separate and distinct working and pumping pistons operate in a single cylinder a portion of which together with the working piston, forms a motor, while another portion of such cylinder, together with the pumping-piston forms a pump for supplying a fresh charge to the working cylinder. The supply-pump is operated by and in unison with the engine, and as the supply-pump and motor elements of the engine are all contained in a single cylinder the two sets of elements are necessarily inseparable without wholly defeating the operation of the engine in the manner contemplated.

SEE OR SEARCH THIS CLASS, SUBCLASS:

62, for combined pump and motor cylinder.

**67** Two-cycle internal-combustion engines in which the air pumped by a single supply-pump operated by and in unison with the engine is separated or divided into two separate and distinct streams, one of which passes to the working cylinder unchanged, while the other receives a supply of hydrocarbon on its way to the working cylinder. The stream to which no hydrocarbon is supplied ordinarily acts to more or less thoroughly expel the burned gases from the working cylinder prior to the formation of a new charge therein, and the two streams frequently reunite as they enter the working cylinder or shortly before entry thereinto.

**68** This subclass is indented under subclass 39. Two-cycle internal-combustion engines in which the combustible mixture, or both the constituents thereof, is supplied to the working cylinder under pressure materially greater than atmospheric pressure, such supply beginning at the beginning of the working stroke and continuing for a determinate portion thereof, the combustible mixture being ignited either at constant pressure as it enters the cylinder or at constant volume after the whole charge has been supplied thereto, in either case without recompression in the working cylinder. The combustible mixture or the constituents thereof may be supplied directly to the working cylinder without preliminary storage or may be supplied to suitable reservoirs interposed between the compressing means and the working cylinder and within which a considerable volume of combustible mixture, or its constituents, is stored. Engines in this subclass in which ignition takes place after the whole charge has been supplied to the working cylinder differ from those in ... which work upon a two-stroke cycle, only in the degree of compression to which the charge is subjected before ignition, and as some of the engines in the subclass above mentioned are provided with a supply-pump for forcing air through a charge-forming device to the cylinder of the engine the combustible mixture thus produced is necessarily supplied to such engines under some pressure. However, where the structure and operation of the device as a whole clearly indicate that the pressure under which the charge is supplied is so slight as to be sufficient only to insure its flow into the working cylinder the engine is classified in subclass 39. In engines working on the two-cycle pump-compression cycle the whole charge properly mixed to form a combustible mixture may be compressed by a single pump or the air and combustible may be compressed by separate pumps to be mixed on their way to the working cylinder or after such constituents have entered thereinto.

SEE OR SEARCH THIS CLASS, SUBCLASS:

61, for double-acting engines working on the two-stroke pump-compression cycle.

495+, and 590+, for oil-engines operating upon a cycle similar to that defined by this definition.

**69** Two-cycle recompression internal-combustion engines in which air and combustible in the gaseous form are supplied to the working cylinder or combustion-chamber by separate and distinct pumps, each operated by and in unison with the engine, one at least of the constituents being recompressed within the working cylinder before the ignition of the combustible mixture. The air is ordinarily supplied to the working cylinder of the engine before the gas, and such air is frequently designed to more or less completely scavenge the working cylinder. In such cases a part of the air thus supplied remains in the cylinder to form with the gas subsequently supplied thereto the next following charge. The air and gas may, however, enter the working cylinder simultaneously. The air and gas are ordinarily intermixed within the working cylinder before the completion of the compression stroke, so that the complete charge is recompressed in the working cylinder before the ignition thereof and the beginning of the working stroke; but this subclass also includes engines in which one only of the constituents of the charge is recompressed in the working cylinder, in which case the other is supplied thereto under pressure during the working stroke.

SEE OR SEARCH THIS CLASS, SUBCLASS:

61, and 68, for other internal-combustion engines having separate pumps for air and gas.

590+, for oil-engines having one pump for supplying air to the working cylinder thereof and another for supplying oil and air, the oil being frequently atomized by the air, but not vaporized prior to its entry into the working cylinder.

**70** Two-cycle recompression internal-combustion engines in which the working cylinder and the pump for supplying a combustible mixture thereto are located adjacent each other, axial lines through the pump and motor cylinders being parallel and perpendicular to the axis of the main shaft of the engine and both lying in a plane passing through the axis of the main shaft. In engines in this subclass the supply-pump is inseparable from the engine and may draw both air and hydrocarbon into the cylinder thereof upon the suction-stroke, so that the pump operated upon the whole charge to be supplied to the working cylinder, or the supply-pump may draw in and discharge air only, in which case the combustible constituent of the charge is supplied to the air during its passage to the working cylinder.

SEE OR SEARCH THIS CLASS, SUBCLASS:

68, for pump compression.

**71** Two-cycle recompression internal-combustion engines in which the axes of the working and pump cylinders form a single straight line which, if extended, would intersect the main shaft of the engine at right angles, the cylinders abutting and the working piston being prolonged and extended into the pump-cylinder and enlarged therein to form the pumping-piston, thereby forming an annular pumping-chamber which surrounds the extension of the working piston. From the above it follows that the working and pump pistons form a single rigid structure. In engines in this subclass compression of the charge prior to the ignition thereof is effected by the joint action of the pump and motor pistons. The arrangement above defined may be reversed, in which case the cylinder above described as the working cylinder becomes the cylinder of the supply-pump and the annular pumping-chamber becomes the working chamber.

(1) Note. The supply-pump is inseparable from the engine and ordinarily operated upon the whole charge, as in engines in subclass 70.

**72** Two-cycle recompression internal-combustion engines in which the working piston and the pump for supplying a combustible mixture thereto are arranged at an angle to each other, axial lines through the pump and motor cylinders being perpendicular to the main shaft of the engine and lying in planes inclined to each other, which pass through the said main shaft. The axes of the pump and working cylinder also ordinarily lie in a single plane perpendicular to the main shaft of the engine.

(1) Note. The supply-pump is inseparable from the engine and ordinarily operated upon the whole charge, as in engines in subclass 70.

**73** Two-cycle recompression internal-combustion engines having a cylinder closed at one end and an air-tight casing inclosing the connecting-rod and crank and forming a closed crank-case in open communication with the other end of the cylinder and a piston reciprocating in the said cylinder, such piston performing at the same time the functions of both a working piston and a piston for the pump which supplies a fresh charge to the engine, one end of the cylinder and the corresponding end of the piston constituting the working cylinder and piston, while the other or rear end of the piston and the corresponding end of the cylinder, together with a closed crank-case form a pump for introducing a new charge into the working end of the cylinder. In engines in this subclass the supply or exhaust ports, or both, are generally formed in the cylinder-wall and are then controlled by the piston as it reciprocates, the piston forming a closure for such ports when it is required that they be kept closed.

**74** Two-cycle recompression internal-combustion engines having a cylinder closed at both ends and a piston reciprocating therein, such piston performing at the same time the functions of both a working piston and a piston for the pump which supplies a fresh charge to the engine, one end of the cylinder and the corresponding end of the piston constituting the working cylinder and piston, while the other or rear end of the piston and the corresponding end of the cylinder form a pump for introducing a new charge into the working end of the cylinder. In engines in this subclass the supply or exhaust ports, or both, are generally formed in the cylinder-wall and are then controlled by the piston as it reciprocates, the piston forming a closure for such ports when it is required that they be kept closed.

**76** Four-cycle internal combustion engines in which a volume of air unmixed with combustible is caused to pass through the working cylinder of the engine or the combustion-chamber thereof at any time between the end of the working stroke and the beginning of the next following charging stroke, whereby to secure a more complete removal of the burned gases of the previous charge from the cylinder and combustion-chamber, so that the successive charges will be unmixed with residual burned gases from a previous charge. The scavenging action may take place before or after or be simultaneous with the regular exhaust stroke of the engine. In the engines in this subclass a complete charge comprising all the ingredients necessary to form a combustible mixture enters the cylinder upon distinct charging stroke, the air supplied for the purpose of scavenging, not being necessary to form or complete the following charge.

(1) Note. Engines frequently described as scavenging engines and in which a volume of air is caused to pass through the working cylinder and combustion-chamber for the same purpose as in this subclass, but in which a portion of such air is necessary to complete the following charge, are classified in this class, subclass 69. In subclass 76, the engine begins its suction-stroke with air in the clearance space only, while in engines in subclass 69, the engine begins it compression-stroke with a considerable volume of air in the cylinder thereof, to which a combustible is supplied to complete the charge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

64, and 69, for six-cycle two-cycle Separate Air and Gas Pumps.

**77** Four-cycle internal-combustion engines in which a four-stroke cycle is carried out during a single revolution of the main shaft of the engine. For the purposes of this definition of continuous movement of the working piston in one direction is considered as two strokes and the sequence of the strokes is varied from that present in engines working on the ordinary four-stroke cycle, the working stroke being followed by the charging stroke as the piston moves in one direction and the exhaust and compression strokes taking place in the order named as the piston moves in the reverse direction.

(1) Note. For engines working on this cycle, but having two or more working cylinders, see this class, subclass 53.

(2) Note. For other engines in which the four strokes comprising a single cycle occur during a single revolution of the main shaft of the engine, see this class, subclass 78.

**78** Four-cycle internal-combustion engines provided with means whereby the clearance-space is varied in unison with the movement of the working piston, being as far as practicable eliminated at the end of the exhaust-stroke and greatest at the end of the compression-stroke, whereby to secure a more complete removal of the residual burned gases from the cylinder and combustion-chamber of the engine. The clearance-space is ordinarily varied by causing the strokes of the working piston to vary in length, and the four strokes required for a complete cycle are frequently performed during a single revolution of the main shaft of the engine.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclass 84 for an expansible chamber device having a resilient means interposed between the working member and a relatively movable power transmission element.

**79** Four-cycle internal-combustion engines in which the combustible charge enters the working cylinder and after ignition and expansion the burned gases are exhausted therefrom through a single passage controlled by a single positively-operated poppet or equivalent valve, said common passage being provided with means for directing the flow of the combustible charge from a supply-conduit to the common conduit and for directing the flow of the exhaust-gases from such common conduit into the exhaust-conduit leading from the engine. The directing means ordinarily comprise a valve or valves operated either positively or by the suction and pressure alternately existing in the common conduit, and such means are protected from the pressure of the gases within the cylinder by the single valve.

**80** Four-cycle internal-combustion engines provided with a rotating valve for directly controlling the supply of combustible mixture to the working cylinder or the exhaust of burned gases therefrom and means operated by the engine for rotating the said valve to secure the continuous and automatic operation of the engine. The rotating valve in the engines in this subclass ordinarily control both the supply to and the exhaust from the engine and frequently also a passage used in connection with a flame or incandescent igniting device, and the valve is so designed with reference to the particular engine with which it is used or with reference to other elements of the engine as to be incapable of convenient separation therefrom or of use with other engines.

(1) Note. For rotating valves capable of general use with internal-combustion engines, the structure of the engine or of elements thereof other than the valve not being involved, see this class, subclass 190.

SEE OR SEARCH THIS CLASS, SUBCLASS:
144, and 151, for flame and combined Sparker and Valve.

**81** Four-cycle internal-combustion engines provided with an oscillating valve for directly controlling the supply of combustible mixture to the working cylinder or the exhaust of burned gases therefrom and means operated by the engine for oscillating the said valve to secure the continuous and automatic operation of the engine. The oscillating valve ordinarily controls both the supply to and the exhaust from the engine and frequently also a passage used in connection with a flame or incandescent igniting device, and the valve is so designed with reference to the particular engine with which it is used or with reference to other elements of the engine as to be incapable of convenient separation therefrom or of use with other engines.

(1) Note. For oscillating valves capable of general use with internal-combustion engines, the structure of the engine or of elements thereof other than the valve not

being involved, see this class, subclass 190.

SEE OR SEARCH THIS CLASS, SUBCLASS:
144, for flame.

**82** Four-cycle internal-combustion engines having a rotating shaft driven from the crank-shaft thereof and extending parallel to the axis of the working cylinder and ordinarily along the side of the engine, said shaft being provided with means, generally in the form of cams, for operating in the proper order one or more of the valves, the igniting device or other element necessary for the continuous automatic operation of the engine, and mechanism including a rotating shaft located as above set forth and designed to operate the valves or other elements of the engine, but not shown in connection with all the elements necessary to form a complete and operative engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
57, for cylinders tandem.

**83** Four-cycle internal-combustion engines having a rotating shaft driven from the crank-shaft thereof and extending transverse to the axis of the working cylinder and clear across the engine, said shaft being provided with means, generally in the form of cams, for operating in the proper order one or more of the valves, the igniting device, or other element necessary for the continuous automatic operation of the engine, and mechanism including a rotating shaft located as above set forth and designed to operate the valves or other elements of the engine, but not shown in connection with all the elements necessary to form a complete and operative engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
84, for engines coming within the terms of this definition, except that the transverse shaft does not extend clear across the engine, the axis of such shaft lying in a plane passing through the axis of the working cylinder.

**84** Four-cycle internal-combustion engines having the supply and exhaust valves thereof located adjacent and in a single valve-chamber, the axes of such valves being parallel with the axial line of the working cylinder and both valves being positively operated, and reciprocating rods extending longitudinally of the engine and operated by and in unison therewith for operating such valves in the proper order to secure the continuous automatic operation of the engine, and similar arrangements of valves and operating means therefor but not shown in connection with all the elements necessary to form a complete and operative engine.

**85** Four-cycle internal-combustion engines having the supply and exhaust valves thereof arranged in alinement and in a single valve-chamber, the common axis of such valves being parallel with the axial line of the working cylinder, and a reciprocating rod or rods extending longitudinally of the engine and operated by and in unison therewith for operating one or both such valves in the proper order to secure the continuous automatic operation of the engine, and similar arrangements of valves and operating means therefor, but not shown in connection with all the elements necessary to form a complete and operative engine.

**86** Four-cycle internal-combustion engines having the supply and exhaust valves thereof located in separate valve-chambers upon opposite sides of the working cylinder, the axes of such valves being parallel with the axial line of the working cylinder and lying in a plane passing therethrough and through the axis of the crank-shaft, and a reciprocating rod or rods extending longitudinally of the engine and operated by and in unison therewith for operating one or both of such valves in the proper order to secure the continuous automatic operation of the engine, and similar arrangements of valves and operating means therefor, but not shown in connection with all the elements necessary to form a complete and operative engine.

**87** Four-cycle internal-combustion engines having the supply or exhaust valve thereof, or both, located in the cylinder head and disposed longitudinally to the working cylinder, the movement of such valve or valves being along a line parallel with the axial line of the working cylinder, a lever disposed transverse to the working cylinder and a reciprocating operating member operated by and in unison with the

engine for operating such valve or valves in the proper order to secure continuous operation thereof, and similar arrangements of valves and operating means therefor, but not shown in connection with all the elements necessary to form a complete and operative engine.

**88** Four-cycle internal-combustion engines having the supply or exhaust valve thereof, or both, disposed transverse to the working cylinder, the axis of such valve or valves lying in a plane perpendicular to the axial line of the working cylinder, and a lever extending longitudinally of the engine and operated by and in unison therewith for operating the valve or valves aforesaid in the proper order to secure the continuous automatic operation thereof, and similar arrangements of valves and operating means therefor, but not shown in connection with all the elements necessary to form a complete and operative engine.

**89** Four-cycle internal-combustion engines having the supply or exhaust valve thereof, or both, disposed transverse to the working cylinder, the axis of such valve or valves lying in a plane perpendicular to the axial line of the working cylinder, and a bell-crank lever operated by and in unison with the engine for operating such valve or valves in the proper order to secure the continuous automatic operation thereof, and similar arrangements of valves and operating means therefor, but not shown in connection with all the elements necessary to form a complete and operative engine.

**90.1** This subclass is indented under the class definition. Subject matter relating to mechanism intermediate the crank-shaft and the poppet-type intake or exhaust valve of an internal combustion engine for operating at least one such valve.

(1) Note. If the mechanism operates a reciprocating valve of a type other than a poppet valve, a body of art of such mechanism--as well as the valve that it operates--has evolved in subclass 188.

(2) Note. The majority of the valve operating devices of this subclass are disclosed in connection with four-stroke-cycle engines; however, the devices occurring herein are not dependent upon the mode of operation of the engine, and are ordinarily capable of operating a poppet-type valve of an engine functioning upon a cycle of some other number of strokes. Valve operating mechanism especially designed for use with an engine of a particular form or mode of operation will be found in the subclasses pertaining to that engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

41, for valve operating mechanism rendering the engine reversible.

64, for valve operating mechanism peculiar to a six-cycle engine.

65+, for valve operating mechanism peculiar to a two-cycle engine.

152, for valve operating mechanism combined with sparker operating mechanism.

179+, (particularly subclass 182), for valve operating mechanism related to facilitating engine starting.

188, for valve operating mechanism peculiar to reciprocating valves not of the poppet-type; see (1) Note above.

311+, (particularly subclasses 79 through 89), for valve operating mechanism peculiar to a four-cycle engine.

319+, for valve operating mechanism peculiar to the regulation of engine speed.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, appropriate subclasses for the actuation of valves of more general utility.

**90.11** This subclass is indented under subclass 90.1. Device wherein electrical energy provides the source of power for at least one direction of movement of the valve.

**90.12** This subclass is indented under subclass 90.1. Device wherein a liquid under pressure provides an essential link in the valve operating mechanism for at least one direction of movement of the valve.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, subclasses 12+, for a valve of more general utility which is opened or closed by fluid pressure.

**90.13** This subclass is indented under subclass 90.12. Device wherein the liquid under pressure is cyclically delivered through a manifold by an engine-driven distributor.

**90.14** This subclass is indented under subclass 90.1. Device wherein positive or negative pressure of a gas provides the source of power for at least one direction of movement of the valve.

SEE OR SEARCH THIS CLASS, SUBCLASS:
90.32, for a pneumatically-controlled interruption in the drive train of a valve that is not pneumatically actuated.

SEE OR SEARCH CLASS:
251, Valves and Valve Actuation, subclasses 12+, for a valve of more general utility which is opened or closed by fluid pressure.

**90.15** This subclass is indented under subclass 90.1. Device wherein means provided to vary the time, extent of duration of valve opening relative to the operating cycle of the engine.

(1) Note. In the art herein the timing is varied to maximize engine efficiency, whereas in that of subclasses 319+ it is varied for the purpose of speed regulation or braking.

SEE OR SEARCH CLASS:
464, Rotary Shafts, Gudgeons, Housings, and Flexible Couplings for Rotary Shafts, subclasses 1+ for a speed responsive device for adjusting the relative rotational position of coupled members.

**90.16** This subclass is indented under subclass 90.15. Device wherein the means is located between a cam and the valve actuated thereby and serves to modify the operational relationship of the one to the other.

**90.17** This subclass is indented under subclass 90.15. Device wherein the means varies the structure or the axial disposition of a camshaft or its cam.

**90.18** This subclass is indented under subclass 90.17. Device wherein the means provides for displacing the camshaft in the direction of its longitudinal axis, thereby bringing a different cam contour into play.

**90.19** This subclass is indented under subclass 90.1. Device wherein means is provided to compensate for structural deformation in an element of the operating mechanism occurring as a result of a change in the ambient temperature of the element.

**90.2** This subclass is indented under subclass 90.1. Device wherein means in the form of a groove, or its equivalent, in the outer surface of a revolving drum is provided to displace the cam follower both axially and radially of the camshaft.

(1) Note. The groove is usually in the form of two, intersecting loops, of different effective elevations, and the effect of the axial displacement of the follower from one loop to the other is to impart a valve-actuating movement to it upon every other revolution of the camshaft.

(2) Note. In a device of this nature, the crankshaft frequently serves as the camshaft.

**90.21** This subclass is indented under subclass 90.1. Device wherein means is provided, usually in the form of lobes perpendicular to the principal surface of a rotating disc, to displace a cam follower in a direction parallel to the longitudinal axis of the camshaft.

**90.22** This subclass is indented under subclass 90.1. Device wherein one actuating element (cam) operates one or more other elements (followers, rods, rockers, etc.), in the valve trains of two or more valves of a cylinder.

SEE OR SEARCH THIS CLASS, SUBCLASS:
90.4, for plural valves operated by a single train having a forked or branched rocker.

**90.23** This subclass is indented under subclass 90.22. Device wherein the two or more valves control the intake and the exhaust passages of the cylinder.

**90.24** This subclass is indented under subclass 90.1. Device wherein means is provided to mechanically drive the valve in its closing (i.e., seating) direction of travel.

(1) Note. While correctly identified as Desmodromic actuation, this aspect of valve operation frequently is termed "positive closing" (as contrasted with "spring return").

**90.25** This subclass is indented under subclass 90.24. Device wherein the driving means is the rocker that opens the valve.

**90.26** This subclass is indented under subclass 90.24. Device wherein the driving means is a follower that is joined to the cam in such fashion as to partake of the total range of movement of the cam.

(1) Note. By virtue of their marked similarity, eccentric-actuated unitary followers are included herein.

**90.27** This subclass is indented under subclass 90.1. Device wherein the shaft carrying the actuating element (cam) of the operating mechanism is located in proximity to, and generally somewhat above, the valve-containing head of an engine cylinder.

SEE OR SEARCH THIS CLASS, SUBCLASS:
193, for structural features of an engine cylinder.

**90.28** This subclass is indented under subclass 90.1. Device wherein means is provided for movement of the valve in addition to that of opening and closing.

(1) Note. Ordinarily this movement is in the form of rotation of the valve about the principal axis of its stem for such purposes as random seating surface engagement, seat cleaning, etc.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclasses 330+, for nonvalving motion in a valve of more general utility.
251, Valves and Valve Actuation, subclass 56, for a pressure actuated valve of more general utility having plural motions of the valve, and subclasses 215+, for a mechanical movement actuated valve of more general utility having plural motions of the valve.

**90.29** This subclass is indented under subclass 90.28. Device wherein means is provided within the operating mechanism to convert the oscillation imparted to the valve by the compression and decompression of its return spring into unidirectional movement (i.e., rotation).

SEE OR SEARCH THIS CLASS, SUBCLASS:
90.28+, for devices generally similar to those of this subclass but involving (e.g., by attachment thereto) an element external to the operating mechanism.

**90.3** This subclass is indented under subclass 90.28. Device wherein means is provided within the operating mechanism to rotate the valve.

(1) Note. A device of this subclass is often referred to as a positive rotator, and usually comprises a self-contained, insertable unit.

**90.31** This subclass is indented under subclass 90.1. Device wherein means is provided to drive a member (normally a rotating shaft) carrying the actuating element (cam) of the operation mechanism.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, appropriate subclasses for a specific power transfer means.

**90.32** This subclass is indented under subclass 90.1. Device wherein means is provided in an element (e.g., push rod, tappet, etc.), between the cam and the valve rendering that element ineffective--and interrupting the valve actuation--during alternate revolutions of the crankshaft.

SEE OR SEARCH THIS CLASS, SUBCLASS:
90.31, for a cam that is driven in such fashion as to produce alternate interruption of actuation.

**90.33** This subclass is indented under subclass 90.1. Device wherein means is provided for supplying, or controlling a supply of, lubricant to one or more elements of the operating mechanism.

SEE OR SEARCH THIS CLASS, SUBCLASS:
196, for lubricating means in general for internal combustion engines.

SEE OR SEARCH CLASS:
184, Lubrication, subclass 6, for lubricating systems for machines, particularly the bearing parts thereof, where no special combination exists between the system and the machine.
251, Valves and Valve Actuation, subclass 355, for lubricating a valve of more general utility.

**90.34** This subclass is indented under subclass 90.33. Device wherein a lubricant supply means directs lubricant under pressure to the camshaft and its cams.

**90.35** This subclass is indented under subclass 90.33. Device wherein a lubricant supply means directs lubricant under pressure through a tappet to another element of the operating mechanism.

**90.36** This subclass is indented under subclass 90.33. Device wherein a lubricant supply means directs lubricant under pressure through a rocker fulcrum (sometimes a tubular rocker support shaft) to another element of the operating mechanism.

**90.37** This subclass is indented under subclass 90.33. Device wherein a lubricant control means is provided to restrict, confine or direct a supply of lubricant for the operating mechanism.

(1) Note. Included herein are valve stem seals or shields which are movable with the operating mechanism.

SEE OR SEARCH THIS CLASS, SUBCLASS:
188.6, for a valve stem seal or shield fixed to the engine (e.g., fixed to the valve stem guide, etc.).

SEE OR SEARCH CLASS:
277, Seal for a Joint or Juncture, for a generic sealing means or process, subclasses 500+ for a dynamic, circumferential contact seal for other than a piston, especially subclass 502 for a valve stem seal for an internal combustion engine.

**90.38** This subclass is indented under subclass 90.33. Device wherein means is provided to enclose a portion of the operating mechanism which is subject to unrestrained lubricant flow.

(1) Note. Ordinarily the means is detachable, and frequently is serves as an access opening cover.

**90.39** This subclass is indented under subclass 90.1. Device comprising a pivoted element, usually directly engaging a valve stem, which transmits the motion developed in the operating mechanism to the valve.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclasses 519+ and 559, for linkage system elements in the form of a lever and a rocker arm, respectively.

**90.4** This subclass is indented under subclass 90.39. Device wherein the rocker element includes means to transmit motion to more than one valve.

**90.41** This subclass is indented under subclass 90.39. Device wherein the pivot means provided for the rocker element is separate form and independent of the pivot means provided for any like, pivoted element.

**90.42** This subclass is indented under subclass 90.41. Device wherein means is provided to restrict the pivotal movement of a rocker element to a plane defined by the pivot and by the stem of the valve which the rocker element engages.

**90.43** This subclass is indented under subclass 90.41. Device wherein means is provided in the region of the pivot to vary the relationship of the rocker element to other elements of the operating mechanism in order to create, modify or eliminate clearance (lash) in the mechanism.

(1) Note. In most instances the lash adjusting means of a device of this subclass is of the self-operating kind; i.e., it functions on its own initiative in response to the presence of an incorrect amount of lash.

**90.44** This subclass is indented under subclass 90.39. Device wherein the rocker element is in direct contact with the actuating element (cam) of the operating mechanism.

**90.45** This subclass is indented under subclass 90.39. Device wherein the rocker element is provided (other than at its pivot) with means to create, modify or eliminate clearance (lash) in the operating mechanism.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclass 522, for a linkage system element in the form of an adjustable lever.

**90.46** This subclass is indented under subclass 90.45. Device wherein the lash adjusting means is of the reciprocating hydraulic chamber type.

**90.47** This subclass is indented under subclass 90.39. Device wherein means is provided to afford a degree of resilience to the transmitting of motion by the rocker element.

(1) Note. In keeping any clearance or slack taken up (although not eliminated), the resilient means also serves to reduce the noise of operation.

**90.48** This subclass is indented under subclass 90.1. Device comprising an element which is in direct contact with the actuating element (cam) and which transmits (ordinarily by reciprocatory movement) the motion of that element to other components of the operating mechanism.

(1) Note. Occasionally a tappet is more descriptively referred to as a cam follower.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclass 569 for a mechanism element in the form of a cam follower.

**90.49** This subclass is indented under subclass 90.48. Device wherein the tappet element includes a nonmetallic insert or yieldable clearance take-up means to soften and/or reduce the noise of its transmitting of motion.

**90.5** This subclass is indented under subclass 90.48. Device wherein means provided to restrict the movement of the tappet element to the reciprocatory one intended to be imparted to it by the actuating element (cam).

(1) Note. This provision is most likely to be found where the tappet includes a roller for engagement by the cam.

**90.51** This subclass is indented under subclass 90.48. Device wherein the composition of material or the surface treatment or the process of manufacture, or more than one of them, of a tappet element is of primary concern.

SEE OR SEARCH CLASS:
29, Metal Working, subclass 888.43, for a process of making a tappet.
428, Stock Material or Miscellaneous Articles, subclasses 544+ for stock materials, e.g., of indefinite length, which are all metal or have adjacent metal components.

**90.52** This subclass is indented under subclass 90.48. Device wherein the tappet element is provided with means to create, modify or eliminate clearance (lash) in the operating mechanism.

**90.53** This subclass is indented under subclass 90.52. Device wherein the adjusting means of the tappet element functions on its own initiative in response to the presence of an incorrect amount of clearance (lash) in the operating mechanism.

**90.54** This subclass is indented under subclass 90.53. Device wherein the self-operating adjusting means is of the mechanical screw type.

**90.55** This subclass is indented under subclass 90.53. Device wherein the self-operating adjusting means is of the reciprocating hydraulic chamber type.

(1) Note. Requisite to a device of this nature is the presence, within the tappet element, of a reservoir, a pressure (or power) chamber, and a check valve to isolate the chamber from the reservoir.

**90.56** This subclass is indented under subclass 90.55. Device wherein the reciprocating hydraulic adjusting means has its pressure chamber located above (gravity-wise) its reservoir.

**90.57** This subclass is indented under subclass 90.55. Device wherein the reciprocating hydraulic adjusting means has a fluid vent from its pressure chamber.

(1) Note. This characteristic is in contrast with the provision of such an outlet from the reservoir, which is relatively common.

(2) Note. The presence of an anti-pump-up provision may be indicated where the medium vented is a liquid; the venting of a gas, on the other hand, indicates merely a provision to maintain the hydraulic fluid in a noncompressible (liquid) state.

**90.58** This subclass is indented under subclass 90.55. Device wherein the reciprocating hydraulic adjusting means is precharged with fluid and usually sealed; consequently, it does not require a continuous, external fluid supply (e.g., the lubricating system of an engine).

**90.59** This subclass is indented under subclass 90.55. Device wherein the reciprocating hydraulic adjusting means is modified in such fashion as to maintain the reservoir sufficiently charged that the check valve will be kept submerged while the means reciprocates in a generally horizontal plane.

**90.6** This subclass is indented under subclass 90.1. Device comprising a noncircular or eccentrically disposed surface formed on a rotating element, which constitutes the initial actuating means of the operating mechanism.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclass 567, for a mechanism element in the form of a cam.

**90.61** This subclass is indented under subclass 90.1. Device comprising an elongated, reciprocating element located between a tappet and a rocker or valve and serving to transmit the motion of the tappet thereto.

(1) Note. An element of the kind contemplated here may include means whereby its length can be changed manually in order to create, modify or eliminate clearance (lash) in the operating mechanism. In some types of mechanism (e.g., cam-engaged rocker), the element is not utilized.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclasses 579+, for a mechanism element in the form of a rod.

**90.62** This subclass is indented under subclass 90.61. Device wherein the rod element includes a length-changing means which functions on its own initiative in response to the presence of an incorrect amount of clearance (lash) in the operating mechanism.

**90.63** This subclass is indented under subclass 90.62. Device wherein the self-adjusting means of the rod element is of the reciprocating hydraulic chamber type.

**90.64** This subclass is indented under subclass 90.61. Device wherein the rod element is subjected to tension while performing its operational function.

(1) Note. This characteristic is in contrast with the arrangement found with most rod elements, which are of the “push” type and therefore function in compression. In a few instances the pull-type rod

directly engages the valve, thereby eliminating the rocker element.

**90.65** This subclass is indented under subclass 90.1. Device comprising a resilient element which is utilized to bias a valve toward its normal (usually closed) position.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, subclass 337, for a valve spring and for means for associating a spring with a valve where the valve is of more general utility.

267, Spring Devices, appropriate subclasses for a spring device of more general utility.

**90.66** This subclass is indented under subclass 90.65. Device wherein means is provided to dampen or otherwise regulate the rate at which the spring element imparts to the valve the potential energy that it received through the operation of the valve mechanism.

**90.67** This subclass is indented under subclass 90.65. Device wherein means is provided for receiving the fixed end portion of a spring element and/or for retaining the other end portion thereof in engagement with a valve or its operating mechanism.

SEE OR SEARCH THIS CLASS, SUBCLASS:

90.28+, for a spring seat or a retainer comprising a portion of a device having to do with nonvalving motion of a valve.

**142.5** This subclass is indented under the class definition. Devices not provided for in any of the preceding subclasses or in other classes including (1) the combination of an internal-combustion engine with means for supplying external energy to heat the engine, or (2) the combination of an internal combustion engine and means supplying external energy to heat some part or adjunct of the engine such as a radiator, or (3) internal-combustion engines having means using heat from one part to heat another part by exchanging heat between the parts.

SEE OR SEARCH THIS CLASS, SUBCLASS:

41.01+, for internal combustion engine cooling systems and devices and see notes thereto. Such systems and devices including means to heat the radiator and/or other parts of the cooling system are classified in this subclass (142.5).

179, for starting devices there provided for combined with heating means where some starting feature other than heating is claimed.

196, for internal combustion engine lubricators there provided for combined with means for heating and/or cooling the lubricant or lubricator only, including such devices using the engine cooling fluid for lubricant or lubricator heating and/or cooling.

543+, for charge-forming devices there provided for combined with heating means.

SEE OR SEARCH CLASS:

122, Liquid Heaters and Vaporizers, particularly subclass 23 and see notes thereto for field of search for fluid fuel heaters not in combination with an internal-combustion engine.

126, Stoves and Furnaces, subclass 19.5 for a combustion engine heated cooking stove, oven, or vessel; subclasses 93-97 for a heating stove that burns liquid fuel that may have a detachable hood that is placeable over an internal-combustion engine; and subclasses 271.1-271.3 for a surface heater that may use heat from the exhaust or cooling fluid of an engine.

165, Heat Exchange, subclasses 51+ for an engine installed heat exchanger that does not include significant internal-combustion engine structure.

184, Lubrication, subclasses 6 and 104.1+, for lubricators combined with heating means there provided for.

237, Heating Systems, subclasses 2, 5, 12.3, and 12.4+ for vehicle heating systems using rejected heat of internal combustion engines.

290, Prime-Mover Dynamo Plants, particularly subclass 2, for prime mover dynamo systems producing heat, and subclass 38, for prime mover dynamo systems having an electric motor for starting the prime mover.

392, Electric Resistance Heating Devices, subclasses 311+ for electric heaters for heating fluids not limited to an internal-combustion engine combination.

432, Heating, subclasses 227 through 232 for a heat generator with an associated work support or heat delivery structure.

**143** Miscellaneous devices not coming within the terms of the definitions of the following subclasses of igniters for igniting the successive combustible charges supplied to and burned within an internal-combustion engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

184, for devices for igniting the charge within the working cylinder at starting and designed for temporary use at such times.

SEE OR SEARCH CLASS:

313, Electric Lamp and Discharge Devices, subclasses 118+ for spark plugs of the jump spark type.

361, Electricity: Electrical Systems and Devices, subclasses 247+ for electric igniters and igniter systems.

**144** Igniting devices for internal-combustion engines comprising a burner located without the working cylinder and means for igniting the combustible charge in the working cylinder from the flame of the burner either by causing the flame itself to come into direct contact with the combustible charge within the working cylinder or by causing the flame to ignite an auxiliary volume of combustible gas, which burning gas is then moved into direct contact with the combustible charge within the working cylinder. Also contains patents in which a flame-igniting device as above defined is disclosed and claimed in combination with the supply or exhaust valve of the engine or with a valve controlling both the supply and exhaust ports. Flame-igniting devices capable of use only with internal-combustion engines operating upon noncompression cycles are when disclosed or claimed in patents claiming also a complete noncompression engine, considered as a part of such an engine and are not cross-referenced into this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

39, noncompression.

**145** Igniting devices for internal-combustion engines comprising an igniting member maintained at a temperature sufficient to ignite the combustible mixture when it comes into contact therewith and heating means for maintaining such igniting member at a high temperature, generally at incandescence, whereby the combustible charge will be ignited upon coming into contact with the igniting member.

(1) Note. The igniting member may extend without the working cylinder or combustion-chamber of the engine, in which case it is generally maintained at a high temperature by means of an external heating-burner or the said igniting member may be located wholly within the working cylinder or combustion-chamber, in which case it is ordinarily maintained in a heated condition by the burning gases within the engine. The heating means for the igniting devices ordinarily forms no part of the igniting device itself; but such burners as are especially designed for and adapted to be used with an incandescent igniting device and are disclosed in connection with such a device are classified in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

250+, and indented subclasses, and 146, for other patents relating to devices located within the working cylinder or combustion-chamber of an internal combustion engine and designed to or which in fact would both vaporize oil supplied to the engine and ignite the resulting combustible mixture.

**146** Incandescent igniting devices differing from those in the preceding subclass in that a valve operated by and in unison with the engine is provided for controlling the flow of the combustible charge to the igniting elements, whereby the time at which ignition of the charge takes place may be determined.

**146.5** Devices for igniting the successive combustible charges supplied to and burned within an internal-combustion engine, comprising electrodes extending into the space occupied by the charge to be ignited and electrical means for producing a spark or a series of sparks between the said electrodes, whereby the charge is ignited and subordinate and auxiliary devices designed and especially adapted for use with igniting devices of the type set forth above and incapable of use in the manner contemplated in other relations.

SEE OR SEARCH CLASS:

200, Electricity: Circuit Makers and Breakers, subclass 19.01, and indented subclasses, for intermittent circuit-closers which include distributors for internal-combustion engine ignition.

315, Electric Lamp and Discharge Devices: Systems, appropriate subclasses, for electrical, systems for supplying electric energy to electric space discharge devices of the arc or spark type. Merely claiming the spark or arc system as an ignition system will not exclude the system from class 315, provided that the claims are not otherwise limited by claimed subject matter to use with an internal-combustion engine. Such systems which include a periodic switch driven by the engine for timing the spark with reference to the engine cycle are in this subclass (146.5) or the indented subclasses of this class (123). Merely calling the discharge device a “spark plug” will not exclude the patent from Class 315. Note especially subclass 209 and indented subclasses of class 315, which provide for systems having a periodic switch in the supply circuit of the discharge device, and subclass 211, where the system includes a plurality of discharge devices and a distributor switch for distributing the energy to the discharge devices in sequence.

**147** Miscellaneous sparking devices for internal-combustion engines in which a current of electricity of low electromotive force is employed, thus necessitating the use therewith of electrodes normally out of contact with each other and which must be brought into contact and separated to produce a spark, as in the following make-and-break subclasses of electrical igniting devices, and subordinate and auxiliary devices designed for use with and to form a part of such an igniting device and incapable of use in the manner contemplated, in other relations, the device in question in either case not coming within the terms of the definition of some one of the following sparker subclasses.

SEE OR SEARCH CLASS:

361, Electricity: Electrical Systems and Devices, subclasses 247+ for electric igniting devices.

**149** Mechanism whereby a dynamo-electric machine is operated by an engine and is adapted to furnish a current of electricity for the purpose of igniting the successive, combustible charges supplied thereto and patents disclosing and claiming a dynamo in combination with igniting mechanism, which, considered by itself, would be classifiable in some one of the following igniter subclasses, the connection between the two being other than by means of mere conducting-wires, and patents disclosing and claiming dynamo-electric machines having features of construction or peculiarities in mode of operation particularly adapting them for use with internal-combustion engines for the purposes of igniting the successive combustible charges supplied thereto and rendering their use in other relations or with other devices impossible, or at least unlikely. Dynamo coming within the last of the above cases are generally so intimately associated with or built into the elements constituting the engine with which they are used as to be incapable of separation therefrom and of operation or existence as separate mechanism.

(1) Note. Dynamo-electric machines complete in themselves having no element in common with an internal-combustion

engine and capable when put in operation of furnishing a current of electricity available for any purpose to which the current produced by the said dynamo is suitable are classified in suitable subclasses of Class 310, Electrical Generator or Motor Structure, according to the type of device in question, and neither a positive statement in the specification to the effect that the device in question is intended to be used to furnish current for the igniting device of an internal-combustion engine nor the fact that a claim positively includes an internal-combustion engine or its igniting device in general terms will be sufficient to cause a patent for such a dynamo to be classified as an igniting device for internal combustion engines.

(2) Note. Mechanism interposed between an internal combustion engine and a dynamo driven thereby and designed to furnish current for the igniting device of such engine, the purposes of said mechanism being to maintain a constant speed of the dynamo irrespective of variations in speed of the engine, are not classified in this subclass. For such devices see Class 188, Brakes, subclasses 180+; Class 192, Clutches and Power-Stop Control, subclasses 103, 104 and 105 and Class 310, Electrical Generator or Motor Structure, subclasses 75+.

SEE OR SEARCH THIS CLASS, SUBCLASS:

147, and 594+, for low tension and high tension ignition systems.

SEE OR SEARCH CLASS:

290, Prime-Mover Dynamo Plants, for pertinent subclass(es) as determined by schedule review.

**150** Manually operated means used in connections with sparking devices for determining the time in the cycle of operation of the engine at which the charge will be ignited, in combination with means for acting upon the exhaust-valve of the engine to regulate the said valve, said last-mentioned means ordinarily operating either to cause the exhaust-valve to be opened upon the compression-stroke of the engine to thereby facilitate the starting thereof or to maintain the exhaust-valve in a partially or wholly open position thereby acting as a manually controlled speed-regulator.

**151** Devices comprising a valve for controlling the supply of combustible mixture to the working cylinder or combustion-chamber of an internal-combustion engine or the exhaust of burned gases therefrom, or both the supply and exhaust, together with a sparking device one or both the electrodes of which is carried by and moves with the said valve.

**152** Valve-operating mechanism and sparker-operating mechanism in combination and either with or without speed-controlling mechanism. In such of the devices occurring in this subclass as include speed-controlling mechanism the speed-regulator is frequently of the charge-omitting type, and the combined valve and sparker operating mechanism then takes the form of means operating to interrupt the operation of the igniting device of the engine while the supply of combustible charges thereto is suspended. The valve acted upon may be the supply, exhaust, fuel, or other valve upon which the operation of the engine depends, and the sparking device is always of the make-and-break type, hereinafter defined.

(1) Note. This subclass does not include devices in which the only connection between the valve-operating mechanism and the igniting device is that the valve-operating mechanism controls a circuit-closing device, whereby a circuit included in the sparking device is controlled. Such devices are classified in subclass 146.5, in this class.

**153** Sparking devices comprising relatively fixed and movable electrodes normally out of contact with each other and mechanically-operated means adapted to move the movable electrode into contact with the fixed electrode shortly before and to separate the electrodes when the combustible charge is to be ignited, whereby an electric circuit in which the electrodes are included is alternately made and broken and a spark produced, and subordinate and auxiliary devices designed and especially adapted for use with sparking devices of the type above set forth and incapable of use in the manner con-

templated in other relations, the device in question in either case not coming within the definition of some one of the following make-and-break subclasses. The make-and-break subclasses include sparking devices in which the time during which the electrodes are in contact with each other is much greater than the time during which they are separated, the normal condition of electrodes which must be brought into contact and then separated to produce a spark being considered as out of contact with each other.

**154** Sparking devices differing from those defined in the preceding definition in that the operating means for the movable electrode includes an electromagnet.

SEE OR SEARCH CLASS:
361, Electricity: Electrical Systems and Devices, subclasses 247+ for electric ignitors and ignitor systems.

**155** Sparking devices differing from those defined in the second preceding definition in that the means whereby the movable electrode is actuated and is dependent for its operation upon a gas under pressure.

**156** Make-and-break sparking devices in which the movable electrode partakes of a reciprocating motion of translation, the relatively fixed electrode being either rigid or yieldable.

**157** Make-and-break sparking devices in which the movable electrode is carried by a rock-shaft and the electrodes separated by a reverse movement of the movable electrode, the relatively fixed electrode being rigid and unyielding the operating means to the movable electrode including a hammer element adapted to separate the electrodes by delivering a blow to the movable electrode, whereby a more sudden separation of the electrodes is secured and a more effective spark produced.

(1) Note. For other sparking devices in which the means for separating the electrodes include an element designed to deliver a blow to the movable electrode, but which do not have the structural features enumerated in this definition, see the preceding subclass.

**158** Make-and-break sparking devices in which the movable electrode is carried by a rock-shaft and the electrodes separated by a reverse movement of the movable electrode, the relatively fixed electrode being rigid and unyielding.

**159** Make-and-break sparking devices in which the movable electrode is carried by a rock-shaft and the electrodes separated by a reverse movement of the movable electrode, the relatively fixed electrode being yieldable, so as to move slightly after contact of the electrodes and during the slight further movement of the movable electrode.

**160** Make-and-break sparking devices in which the movable electrode is carried by the rock-shaft and the electrodes separated by a farther movement of the movable electrode in the same direction.

**161** Make-and-break sparking devices in which the movable electrode is carried by the rotating shaft driven continuously or intermittently in one direction.

**162** Sparking devices comprising an electric circuit including relatively fixed and movable electrodes, the movable electrode being adapted to make and break the circuit, as in the preceding make-and-break subclasses, and the operation thereof depending immediately upon the piston of the engine with which the device is used. In the devices in this subclass the movable electrode is either carried by the working piston or is located in the clearance space of the engine, and said electrode when not carried by the piston is generally operated directly by the piston or by a projection thereon as it comes into contact with the movable electrode near the end of the compression-stroke.

**163** The form of construction of the stationary electrode designed for use with and to form a part of a sparking device including relatively fixed and movable electrodes, as in the preceding make-and-break subclasses, such stationary electrodes being ordinarily capable of use with and as forming a part of any sparking device which includes fixed and movable electrodes.

(1) Note. It is intended that patents classifiable in other make-and-break subclasses, but which disclose specific stationary-electrode structure shall appear in this subclass as cross-references. Inasmuch, however, as all make-and-break sparking devices necessarily include a stationary electrode, a search involving stationary-electrode structures may sometimes extend to all make-and-break subclasses.

**164** Inventions relating to manually-operated means used in connection with make-and-break sparking devices for determining the time in the cycle of operation of the engine at which the electrodes shall be separated and the combustible charge ignited. Includes manually-operated devices for temporarily delaying the ignition of the combustible charge when the engine is to be started for the purpose of preventing a reversal of rotation of the engine at such times.

(1) Note. Patents disclosing devices designed for use with and to form a part of a high-tension electric igniting system for internal-combustion engines and including an electric circuit having suitable means therein for making and breaking such circuit and also means for adjusting the circuit making and breaking mechanism to vary the time at which the ignition of the charge takes place do not appear in this subclass as cross-references. For such devices see this class, subclass 146.5, and indented subclasses, and Class 200, Electricity: Circuit Makers and Breakers, subclasses 19.05, 19.11, 19.19, and 19.21+.

(2) Note. For devices for regulating the speed of an internal-combustion engine by automatically varying the time at which the charge therein is ignited, see this class, subclasses 406+.

(3) Note. For devices for determining the time at which the ignition of the charge shall take place in combination with means designed to act upon and regulate the exhaust-valve of the engine, generally for the purpose of facilitating the starting thereof, see subclass 150 in this class.

(4) Note. Patents classifiable in other make-and-break subclasses but which discloses specific spark adjusting or timing mechanism, appear in this subclass as cross-references. Inasmuch, however, as make-and-break sparking devices ordinarily include means for varying the adjustment thereof, so that the charge will be ignited at the proper time, a search involving an adjusting or timing mechanism may extend to all make-and-break subclasses.

**169** Combinations of a jump spark ignitor with internal combustion engine structure or an internal engine and spark plug accessory which is especially designed for use with an internal combustion engine.

(1) Note. This subclass relates, for example, to the combination of a spark plug and a cylinder head; the combination of a plug and cylinder space in which the interior of the skirt has a special claimed relationship to the cylinder volume; the combination of a spark plug with an adaptor of the screw coupling type (which, for example, permits a small plug to be inserted in a large hole or which acts to extend the shell skirt to provide a chamber for the spark), etc. Also included are accessories designed to fit onto the engine and also provided with means to hold the spark plug which are not of general utility.

SEE OR SEARCH CLASS:

313, Electric Lamp and Discharge Devices, provides for the structure of spark plugs, per se. See especially subclasses 11.5 and 118+ and the subclasses mentioned in the Notes thereto for the subclasses to be searched for spark plugs. Note also the classes listed under "SEARCH CLASS" in Class 313, subclass 118 for other classes which provide for parts of spark plugs and accessories used with spark plugs.

315, Electric Lamp and Discharge Devices: Systems, subclass 32 and indented subclasses, for electric space discharge devices of the spark plug type and other electric space discharge devices which have combined therewith an electric circuit element, such as a resistance inductance, or condenser, the discharge device and the circuit element being structurally united so as to form a unitary device.

**179.1 STARTING DEVICE:**
This subclass is indented under the class definition. Apparatus, for starting an internal combustion engine from a condition of rest or for facilitating the starting of such an engine (i.e., starter) or accessory device designed to facilitate the starting of such an engine and incapable of use in the manner contemplated in other relations.

SEE OR SEARCH THIS CLASS, SUBCLASS:
142.5, for internal combustion engine combined with heating means where no starting features are claimed.

SEE OR SEARCH CLASS:
60, Power Plants, subclasses 632+, for one shot explosion actuated expansible chamber-type motor.
91, Motors: Expansible Chamber Type, subclass 53 for expansible motor of the engine rotating or starting type.
290, Prime-Mover Dynamo Plants, subclasses 10+, 22+, 30, 31+, 36+, 38, 46, 47, and 48 for an electric starting motor and for an electric generator used as a starting motor.

**179.11 Manual pump device or squeeze bulb:**
This subclass is indented under subclass 179.9. Apparatus wherein the primer is a hand-operated fluid transfer means.

**179.12 Condition responsive:**
This subclass is indented under subclass 179.9. Apparatus wherein the primer operates in response to a sensed parameter.

**179.13 Temperature:**
This subclass is indented under subclass 179.12. Apparatus wherein the sensed parameter to which the primer responds is temperature.

**179.14 Condition responsive:**
This subclass is indented under subclass 179.7. Apparatus wherein the means for supplying a mixture operates in response to a sensed parameter.

**179.15 Temperature:**
This subclass is indented under subclass 179.14. Apparatus wherein the sensed parameter to which the means for supplying a mixture responds is temperature.

**179.16 With fuel or intake air control:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter regulates hydrocarbon delivery or incoming air.

**179.17 Fuel injection pump:**
This subclass is indented under subclass 179.16. Apparatus wherein the hydrocarbon regulating means is a fluid transfer means which delivers hydrocarbon directly into a cylinder of the engine.

**179.18 Intake air control:**
This subclass is indented under subclass 179.16. Apparatus wherein a means regulates the flow of incoming air.

**179.19 Includes auxiliary internal combustion engine:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter is an additional or another engine.

**179.2 Remote control:**
This subclass is indented under subclass 179.1. Apparatus having a means separated from the engine which directs the operation of the starter (e.g., radioed instruction).

**179.21 With charge or cylinder heating:**
This subclass is indented under subclass 179.1. Apparatus wherein an accessory device increases the temperature of the hydrocarbon in a combustion chamber or cylinder which makes up a combustion chamber.

**179.22 Inertia type:**
This subclass is indented under subclass 179.1. Apparatus wherein the energy for the starter is obtained from a moving mass (e.g., flywheel).

**179.24 Either power or manual starting device:**
This subclass is indented under subclass 179.1. Apparatus having a starter which can be manipulated by hand or by an application of energy.

**179.25 Having specific mounting or drive connection for electric starter motor:**
This subclass is indented under subclass 179.1. Apparatus having detail to an electric motor support or to its linkage between the starter and the internal combustion engine.

**179.26 For nonoperator supporting wheeled platform:**
This subclass is indented under subclass 179.25. Apparatus wherein the internal combustion engine and starter are mounted on a distinct wheeled platform such as a mower which is not intended to support a human.

**179.27 For airplane:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter is especially adapted for use with an aircraft (e.g., toy airplane).

**179.28 With electric generating means:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter is equipped with a producer of electricity.

**179.29 Auxiliary magneto:**
This subclass is indented under subclass 179.1. Apparatus wherein the electric producer generates alternating current with small magnets.

**179.3 Condition responsive control of starting device:**
This subclass is indented under subclass 179.1. Apparatus having means to regulate operation of the starter in response to a sensed parameter.

**179.31 Having fluid-driven starting motor:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter includes a motor which is powered by pneumatic or hydraulic means.

**179.4 Including automatic engine stop:**
This subclass is indented under subclass 179.3. Apparatus wherein the regulation of the engine is a ceasing operation for the engine.

**179.5 Control of spark ignition during starting:**
This subclass is indented under subclass 179.1. Apparatus wherein a means is provided to regulate intermittent firing of the igniter when the engine is starting.

**179.6 Control of glow plug during starting:**
This subclass is indented under subclass 179.1. Apparatus wherein a means is provided to regulate a small heating element used to start ignition, when the engine is starting.

**179.7 Auxiliary fuel supply device:**
This subclass is indented under subclass 179.1. Apparatus wherein the accessory device comprises means for supplying a combustible mixture of air and hydrocarbon directly to the working cylinder of the engine, together with means for igniting the mixture within the working cylinder after the mixture is supplied to the cylinder, and the accessory devices being separate and distinct from the elements constituting the engine and not involved in its normal operation.

(1) Note. The accessory device for this and the indented subclasses include means for supplying an easily vaporized fluid to the engine when it is to be started, whereby the initial combustible charge is more easily formed, the engine being afterwords operated by a less volatile fluid, the means not coming within the terms of subclass 127 definition. The means for igniting the combustible mixture is frequently the regular igniting device of the engine or such device with suitable auxiliary appliances to adapt it to use in a starting device of the type occurring in the subclass. The essential features in the devices is that a combustible mixture is supplied directly to the interior of the working cylinder and ignited to start the engine by power generated within itself. Such mixture may be supplied at substantially atmospheric pressure or at a comparatively high pressure, and it may or may not be com-

pressed in the working cylinder by a movement of the working piston before ignition.

(2) Note. Inventions limited to a mechanism for igniting a combustible mixture as above where the engine is to be started are classified in this class, subclass 184.1, notwithstanding the fact that the starting devices occurring in this subclass are necessarily provided with some type of igniting device or the fact that the igniting device in question may be designed for use with a starting device of the type occurring in this subclass.

(3) Note. For internal combustion engines which are self-starting because of the cycle upon which they operate, a combustible mixture being supplied to the working cylinder under pressure, see this class, subclass 68.

**179.8 Starting fluid:**
This subclass is indented under subclass 179.7. Apparatus having a separate distinct liquid or gas, such as alcohol or acetylene, used to initiate ignition.

**179.9 Priming means:**
This subclass is indented under subclass 179.7. Apparatus ... having means to prepare the engine for ignition by adding an initial amount of priming fuel to a carburetor or cylinder.

**182.1 Compression relieving type:**
This subclass is indented under subclass 179.1. Apparatus wherein the accessory device comprises means for permitting a portion of the combustible charge in the working cylinder to escape during a part of the compression stroke of the engine, whereby the volume of the combustible charge compressed and ignited upon the initial strokes of the engine is reduced and the external work necessary to start the engine is lessened.

SEE OR SEARCH THIS CLASS, SUBCLASS:
150, for combined adjusting and exhaust regulating.

**183.1 Gunpowder type:**
This subclass is indented under subclass 179.1. Apparatus wherein the accessory device utilizes a charge of gunpowder or other explosive substance which is exploded and the resulting gases act upon the working piston of the engine.

SEE OR SEARCH CLASS:
60, Power Plants, subclasses 632+ for one shot explosion activated expansible chamber-type motors.

**184.1 With auxiliary igniters:**
This subclass is indented under subclass 179.1. Apparatus wherein the engine is started by introducing and burning a combustible mixture within the working cylinder, and the starting means includes either (1) a supplemental igniting device separate and distinct from the regular igniting device of the engine and designed for temporary use at starting or (2) a device independent of the engine for actuating the regular igniting device.

(1) Note. The combustible mixture may be supplied to the working cylinder by separate and distinct means as in subclasses 179.7+, or it may reach the cylinder by way of the regular supply passage and inlet valve of the engine in their ordinary manner.

(2) Note. This subclass does not include a device for delaying the ignition of the combustible mixture to facilitate the starting of the engine, but which device is not in itself capable of igniting the charge. For such device, if manually operated, see subclass 164, and if automatically operated, see subclasses 406+ in this class.

(3) Note. For electrical igniting devices provided with interchangeable sources of electricity, one for use at starting and the other in the normal operation of the engine, see this, class subclasses 147 and 594+.

SEE OR SEARCH THIS CLASS, SUBCLASS:
179.7+, for combustible mixture supplying means.

**184.21 INTAKE MANIFOLD:**
This subclass is indented under the class definition. Internal-combustion engine component including at least one passage in fluid communication with an inlet port of the engine through which working fluid (i.e., air, air and fuel mixture, etc.) is distributed to the engine.

(1) Note. A manifold that conveys intake gases to an engine and also conveys exhaust gases away from an engine is included herein. Preheating of intake gases may be done by the exhaust gases in such a manifold.

SEE OR SEARCH CLASS:
60, Power Plants, subclass 323 for an exhaust manifold, per se, or in combination with a power plant.

**184.22 Passage to crankcase:**
This subclass is indented under subclass 184.21. Intake manifold wherein the chamber enclosing the crankshaft is connected to the intake manifold to draw working fluid therethrough.

**184.23 For use with carburetor upstream of manifold:**
This subclass is indented under subclass 184.22. Intake manifold which communicates between the engine and a device for mixing air with fuel working fluid.

**184.24 Manifold having plenum:**
This subclass is indented under subclass 184.22. Intake manifold including a chamber in which the working fluid is contained at a pressure different from the pressure surrounding the chamber.

**184.25 Plural plenums:**
This subclass is indented under subclass 184.24. Intake manifold including more than one chamber in which the working fluid is contained.

**184.26 Interconnection between plenums:**
This subclass is indented under subclass 184.25. Intake manifold wherein the plenums communicate with one another so that working fluid may pass between the plenums.

**184.27 Multiple passage leading to inlet of one cylinder head:**
This subclass is indented under subclass 184.22. Intake manifold including more than one passage communicating with inlet ports at the end of a single cylinder in the closed end of a single cylinder so that working fluid is distributed therethrough.

**184.28 For engine having radiating cylinders:**
This subclass is indented under subclass 184.21. Intake manifold adapted to be used on an engine which includes a rotary output shaft that turns about an axis intersected by and extending perpendicular to the axes of first and second cylinders, the pistons of these cylinders are drivingly connected to the rotary output shaft, wherein the cylinder axes are separated at an angle with respect to one another.

**184.29 Star-type engine:**
This subclass is indented under subclass 184.28. Intake manifold wherein the engine includes at least three cylinders which are equally spaced about the centrally disposed rotary output shaft.

**184.31 For V-type engine:**
This subclass is indented under subclass 184.28. Intake manifold wherein the engine has first and second cylinders with axes spaced apart by an angle less than 180°.

**184.32 For use with carburetor upstream of manifold:**
This subclass is indented under subclass 184.31. Intake manifold which communicates between the engine and a device for mixing air with fuel working fluid.

**184.33 Inlet manifold heated by outlet manifold:**
This subclass is indented under subclass 184.32. Intake manifold wherein the engine also includes at least one exhaust passage intermingling with or in thermal communication with at least a portion of the intake manifold.

**184.34 Manifold having plenum:**
This subclass is indented under subclass 184.31. Intake manifold including a chamber in which the working fluid is contained at a pressure different from the pressure surrounding the chamber.

**184.35 Plural plenums:**
This subclass is indented under subclass 184.31. Intake manifold including more than one chamber in which the working fluid is contained.

**184.36 Interconnection between plenums:**
This subclass is indented under subclass 184.35. Intake manifold wherein the plenums communicate with one another so that working fluid may pass between the plenums.

**184.37 Multiple passage leading to inlet of one cylinder:**
This subclass is indented under subclass 184.31. Intake manifold including more than one passage communicating with inlet ports at the end of a single cylinder in the closed end of a single cylinder so that working fluid is distributed therethrough.

**184.38 For in-line engine:**
This subclass is indented under subclass 184.21. Intake manifold wherein the engine has first and second cylinders with axes coplanar with the axis of the rotary output axis.

**184.39 For use with carburetor upstream of manifold:**
This subclass is indented under subclass 184.38. Intake manifold which communicates between the engine and a device for mixing air with fuel working fluid.

**184.41 Intake manifold heated by outlet manifold:**
This subclass is indented under subclass 184.39. Intake manifold wherein the engine also includes at least one exhaust passage intermingling with or in thermal communication with at least a portion of the intake manifold.

**184.42 Manifold having plenum:**
This subclass is indented under subclass 184.38. Intake manifold including a chamber in which the working fluid is contained at a pressure different from the pressure surrounding the chamber.

**184.43 Plural plenums:**
This subclass is indented under subclass 184.42. Intake manifold including more than one chamber in which the working fluid is contained.

**184.44 Interconnection between plenums:**
This subclass is indented under subclass 184.43. Intake manifold wherein the plenums communicate with one another so that working fluid may pass between the plenums.

**184.45 Multiple passage leading to inlet of one cylinder:**
This subclass is indented under subclass 184.38. Intake manifold including more than one passage communicating with inlet ports at the end of a single cylinder in the closed end of a single cylinder so that working fluid is distributed therethrough.

**184.46 For use with carburetor upstream of manifold:**
This subclass is indented under subclass 184.21. Intake manifold which communicates between the engine and a device for mixing air with fuel working fluid.

**184.47 Manifold having plenum:**
This subclass is indented under subclass 184.21. Intake manifold including a chamber in which the working fluid is contained at a pressure different from the pressure surrounding the chamber.

**184.48 Plural plenums:**
This subclass is indented under subclass 184.47. Intake manifold including more than one chamber in which the working fluid is contained.

**184.49 Interconnection between plenums:**
This subclass is indented under subclass 184.48. Intake manifold wherein the plenums communicate with one another so that working fluid may pass between the plenums.

**184.51 Adjustable plenum:**
This subclass is indented under subclass 184.47. Intake manifold wherein the volume of the plenum chamber is variably controlled.

**184.52 Multiple passage leading to inlet of one cylinder:**
This subclass is indented under subclass 184.21. Intake manifold including more than one passage communicating with inlet ports at the end of a single cylinder in the closed end of a single cylinder so that working fluid is distributed therethrough.

**184.53 Manifold tuning, balancing, or pressure regulating means:**
This subclass is indented under subclass 184.21. Intake manifold including means to: (a) select the resonant frequency of the chamber for desired flow of the working fluid; (b) optimally vary the passage to one cylinder with respect to another; (c) control the pressure of the working fluid therein.

**184.54 With back flow prevention valve:**
This subclass is indented under subclass 184.53. Intake manifold including a one-way valve for restricting the flow of working material to one direction.

**184.55 Adjustable length passage:**
This subclass is indented under subclass 184.53. Intake manifold including a means for changing the length of the work fluids path to the engine.

**184.56 Adjustable cross section passage:**
This subclass is indented under subclass 184.53. Intake manifold including a means for reversibly blocking a portion of the flow path of the working fluid.

**184.57 Resonator chamber:**
This subclass is indented under subclass 184.53. Intake manifold including an enclosed portion that is tuned to convert the pressure pulses of the pistons sucking in air into resonating waves which facilitates more efficient charging of the cylinders.

**184.58 Return loop to inlet:**
This subclass is indented under subclass 184.53. Intake manifold including a recirculation passage which allows a portion of the working fluid to bypass the engine cylinder and return to the inlet of the manifold.

**184.59 Interconnection between passages:**
This subclass is indented under subclass 184.53. Intake manifold wherein the inlet passages communicate with one another allowing working fluid to pass there between.

**184.61 Manifold material or composition:**
This subclass is indented under subclass 184.21. Intake manifold wherein the material or composition of the manifold is specifically claimed.

**185.1 Mechanical:**
This subclass is indented under subclass 179.1. Apparatus wherein the starter includes mechanical means forming a connection between the mainshaft of the engine and starting force input operating member.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclass 6, and indented subclasses for engine starters, per se.

**185.11 Includes worm gear in linkage:**
This subclass is indented under subclass 185.1. Apparatus wherein the mechanical means connecting the operating member to the main shaft includes a threaded shaft and a wheel with teeth that mesh into the threads.

**185.12 Including crank-type handle:**
This subclass is indented under subclass 185.1. Apparatus wherein the operating member for the mechanical means consists of a hand operated lever or arm attached at a right angle to the engine or a linking shaft which it revolves.

**185.13 Means provided to prevent counter rotation of crank:**
This subclass is indented under subclass 185.12. Apparatus having a means to preclude the lever or arm from revolving in a direction opposite its normal direction of operation.

**185.14 Includes mechanical potential motor (e. g., spring motor):**
This subclass is indented under subclass 185.1. Apparatus wherein the starter includes a motor which is powered by means which stores mechanical energy.

**185.15 Operated by wheels of vehicle:**
This subclass is indented under subclass 185.14. Apparatus wherein the energy input source for the energy storing means is a wheel of a vehicle.

**185.2 Includes cable:**
This subclass is indented under subclass 185.1. Apparatus wherein the operating member or mechanical means includes an elongated flaccid member (e.g., cord, chain, etc.) which the operator uses to revolve the main shaft of the engine.

**185.3 Including recoil mechanism:**
This subclass is indented under subclass 185.2. Apparatus which also includes a grooved wheel around which the elongated flaccid member is turned and a resilient coil which draws the cord tight.

**185.4 Lever connected to the cable:**
This subclass is indented under subclass 185.3. Apparatus having a rigid rod pivoted on a fixed fulcrum attached to the elongated flaccid member which assists the operator in revolving the mainshaft of the engine.

**185.5 Includes lever or slide linkage:**
This subclass is indented under subclass 185.1. Apparatus wherein the mechanical means includes a rigid rod pivoted on a fixed fulcrum or a rod that glides along a guide and is used to revolve the main shaft of the engine.

**185.6 Lever or slide actuates a gear segment:**
This subclass is indented under subclass 185.5. Apparatus wherein the rod moves a toothed machine element to revolve the mainshaft of the engine.

**185.7 Manual type:**
This subclass is indented under subclass 179.27. Apparatus wherein starting means is hand-operated.

**185.8 Includes friction means in linkage:**
This subclass is indented under subclass 185.1. Apparatus wherein the mechanical means connecting the operating member to the main shaft includes means which transmits power to the main shaft solely by rubbing contact between two or more of its components.

**185.9 Includes coaxial cooperating threaded members in linkage:**
This subclass is indented under subclass 185.1. Apparatus wherein the mechanical means connecting the operating member to the main shaft includes means which transmits power to the main shaft when two helical or spiral ridged members rotate relative to each other about the same axis.

**188.1 VALVE:**
This subclass is indented under the class definition. Apparatus relating to either (1) the intake, exhaust, or fuel valve of an internal-combustion engine having a stationary opening (i.e., seat) and moving closure (i.e., head) or (2), a component thereof (e.g., a valve-seat), or (3), an adjunct accessory (e.g., supply conduit for valve) solely for use with the supply, exhaust or fuel valve of an internal combustion engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

41.16, for valve having coolant sealed therein.

41.34, for internal cooling of moving valve parts.

41.76+, for valve seats and guide with cooling means.

144+, for supply or exhaust valves or a single valve controlling both the supply and exhaust ports of the engine, in combination with a flame igniting device.

434+, for valves used in connection with charge-forming devices.

SEE OR SEARCH CLASS:

148, Metal Treatment, appropriate subclasses for valves claimed broadly by name only and defined significantly or broadly solely by their metal or alloy compositions and including a specific Class 148 treatment of the metal or alloy, or for products distinguished only by the internal structure or characteristics of the metals, metallic compositions or alloys comprising such structures.

251, Valves and Valve Actuation, particularly subclasses 251+ for cam actuated valves.

420, Alloys or Metallic Compositions, appropriate subclasses for valves claimed by name only and defined solely by their metal or alloy composition.

428, Stock Material or Miscellaneous Articles, subclasses 544+ for valve element or adjunct having only nominally claimed structure, that is, one insufficiently defined in its ultimate use form, comprised all of metal or having metal components.

**188.11 Wear feature:**
This subclass is indented under subclass 188.1. Apparatus wherein a feature or means is provided to compensate for changes or deterioration of a valve component or accessory caused by prolonged use.

**188.12 For spring:**
This subclass is indented under subclass 188.11. Apparatus wherein the component or accessory compensated is a resilient element.

**188.13 Including attaching means:**
This subclass is indented under subclass 188.12. Apparatus having means to hold spring in place.

**188.14 Valve head cooperates with manifold:**
This subclass is indented under subclass 188.1. Apparatus wherein the valve head has a specific form to engage an aperture of the manifold.

**188.15 Shepherd type:**
This subclass is indented under subclass 188.4. Apparatus having two valve heads one on top of the other with concentric valve stems.

**188.16 Pivoted:**
This subclass is indented under subclass 188.2. Apparatus wherein there is a hinge member between the stem and the valve head.

**188.17 Having actuation springs concentric with valve stem:**
This subclass is indented under subclass 188.1. Apparatus wherein a valve return spring encircles the valve stem and is centered around the same axis.

**188.2 Poppet:**
This subclass is indented under subclass 188.4. Apparatus wherein the valve head has a flat disk shape on the end of a vertically set stem.

**188.3 Material or structure:**
This subclass is indented under subclass 188.2. Apparatus having specific substance, or arrangement (e.g., ceramic) of the valve.

**188.4 Reciprocating valve:**
This subclass is indented under subclass 188.1. Apparatus wherein the valve head slides to and fro during an opening and closing operation.

**188.5 Sleeve:**
This subclass is indented under subclass 188.4. Apparatus wherein the valve head consists of a thin cylindrically shaped sheet having an inlet or outlet port.

**188.6 Packing:**
This subclass is indented under subclass 188.1. Apparatus having a sealing means located around a valve stem.

SEE OR SEARCH THIS CLASS, SUBCLASS:

90.37, for a poppet valve mechanism's lubrication system including a seal or shield that may include a valve stem seal or shield movable with the operating mechanism.

SEE OR SEARCH CLASS:

277, Seal for a Joint or Juncture, for a generic sealing means or process, subclass 502 for a valve stem seal for an internal combustion engine.

**188.7 Combustion improving accessory:**
This subclass is indented under subclass 188.1. Apparatus having adjuncts for the valve (e.g., vanes) for enhancing the combustion process.

**188.8 Valve seat relation:**
This subclass is indented under subclass 188.1. Apparatus having specific characteristics of a stationary opening with which the valve head cooperates.

**188.9 Guide, lubricant or coolant:**
This subclass is indented under subclass 188.1. Apparatus either (1) having means to direct the motion of a valve stem or (2) having a substance to reduce friction or (3) has a substance to dissipate heat.

**189** Conveniently disassembled valves and accessories thereof and ordinarily comprises means for attaching the supply or exhaust conduit to the engine in such a way as to be readily disconnected therefrom, thereby permitting the convenient inspection and generally the removal of the valve located at the end of the conduit in question.

SEE OR SEARCH CLASS:
417, Pumps, subclass 454, for expansible chamber type pumps having means to facilitate assembly or disassembly of a pump valve.

**190.1 Rotary:**
This subclass is indented under subclass 188.1. Apparatus having a valve that rotates, or revolves during opening and closing.

SEE OR SEARCH THIS CLASS, SUBCLASS:
80, for rotating valve, specific to a 4 cycle engine.

**190.11 In horizontal plane on the side of the cylinder:**
This subclass is indented under subclass 190.4. Apparatus wherein the rotary valve lies in a plane perpendicular to the cylinder axis and is located at the side of the cylinder.

**190.12 Sleeve:**
This subclass is indented under subclass 190.1. Apparatus wherein the rotary valve comprises a thin cylindrical sheet which rotates on an axis which is the same axis as the central axis of the cylinder.

**190.13 With lubrication means:**
This subclass is indented under subclass 190.12. Apparatus having a means to reduce the friction of the valve.

**190.14 Disc, cone, or sphere shaped:**
This subclass is indented under subclass 190.1. Apparatus wherein the rotating valve body is in the form of either (1) a thin flat rotor; (2) a surface generated by a straight line passing through a fixed point and moving along the intersection with a fixed curve; or (3) a three-dimensional surface all points of which are equidistant from a fixed point.

**190.15 Controls plural cylinders:**
This subclass is indented under subclass 190.14. Apparatus wherein the valve controls the intake, exhaust or fuel to more than one cylinder.

**190.16 Lubricant:**
This subclass is indented under subclass 190.1. Apparatus having means to reduce the friction of the rotary valve.

**190.17 Seal:**
This subclass is indented under subclass 190.1. Apparatus having means to prevent leaking of fluids around the rotary valve.

**190.2 Single function, (i.e., exhaust and intake by separate tube):**
This subclass is indented under subclass 190.1. Apparatus wherein the rotary valve moves between individual distinct ducts.

**190.3 For crankcase:**
This subclass is indented under subclass 190.1. Apparatus wherein fuel and combustion products enter or leave the crankcase through a rotary valve.

**190.4 Double function type:**
This subclass is indented under subclass 190.1. Apparatus wherein a single rotary valve handles both intake and exhaust gases for cylinder.

**190.5 For two or more cylinders:**
This subclass is indented under subclass 190.4. Apparatus wherein a single multi-passage rotary valve handles both intake and exhaust gases for multiple cylinders.

**190.6 Elongated rotary double-function valve:**
This subclass is indented under subclass 190.4. Apparatus wherein a cross section of the rotary valve perpendicular to its rotational axis is sig-

nificantly smaller than the dimension of the valve parallel to its rotational axis.

**190.7 Tapered:**
This subclass is indented under subclass 190.6. Apparatus wherein the cross section of the rotary valve becomes gradually narrower along the rotational axis.

**190.8 In horizontal plane above cylinder:**
This subclass is indented under subclass 190.4. Apparatus wherein the rotary valve lies in a plane which is perpendicular to the cylinder axis and located over the top of the cylinder.

**190.9 Tapered:**
This subclass is indented under subclass 190.8. Apparatus wherein the cross section of the rotary valve perpendicular to the rotational axis becomes gradually narrowed along the rotational axis.

**192.1 VIBRATION COMPENSATING DEVICE:**
This subclass is indented under the class definition. Apparatus having a stabilizing device adapted only for use with an internal combustion engine, which renders the force transmitted to the main driving shaft of the engine more uniform and minimizes or counteracts a shaking or oscillating motion caused by the reciprocation of engine parts.

SEE OR SEARCH CLASS:
29, Metal Working, subclass 6.01 for crankshaft making
73, Measuring and Testing, subclasses 66+ for testing instruments for determining imbalances including arrangements employing compensating countershafts.
74, Machine Element or Mechanism, subclass 36 for overcoming dead centers; subclass 573.1 for fluid balanced flywheels; subclass 574.1 for flywheel with electrical or magnetic damping; subclass 574.2 for damping using swinging masses, e.g., pendulum type for damping, etc.; subclass 574.3 damping by increasing frictional force; and subclass 574.4 damping by absorbing the vibration force (via rubber, elastomeric material, etc.).
92, Expansible Chamber Devices, subclass 7 for an expansible chamber device having an over center means to bias the working member in opposite directions over different portions of the stroke.
464, Rotary Shafts, Gudgeons, Housings, and Flexible Couplings for Rotary Shafts, subclass 180 for shafting having particular balancing or vibration dampening structure.

**192.2 Balancing arrangement:**
This subclass is indented under subclass 192.1. Apparatus wherein the stabilizing device comprises means to establish equilibrium using equal opposing forces.

**193.1 PARTICULAR PISTON AND ENCLOSING CYLINDER CONSTRUCTION:**
This subclass is indented under the class definition. Apparatus including a specific detail of either a piston (e.g., shape, material, construction) or a guiding chamber cooperating with and surrounding the piston, the piston or guiding chamber being adapted soley for use with an internal combustion engine or having a feature, construction, or peculiarity in mode of operation rendering its use in other relations or with other devices either impossible, or improbable.

SEE OR SEARCH THIS CLASS, SUBCLASS:
41.01+, for cylinder or piston cooling arrangement, especially subclass 41.16, for those having coolant sealed inside; subclass 41.34 for cooling of a piston and moving cylinder; and subclasses 41.67+ and 1.72+, for a jacketed or finned cylinder.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 169.1+ for cylinder details for an expansible chamber device, subclasses 172+ for a piston for an expansible chamber device.

**193.2 Cylinder detail:**
This subclass is indented under subclass 193.1. Apparatus having a specific detail of the chamber in which a piston moves.

**193.3 Having detail of connection to other cylinder structure:**
This subclass is indented under subclass 193.5. Apparatus having specific means which is utilized in fastening the structures to the upper end of the chamber.

**193.4 Having detail to guiding structure cooperating with cylinder:**
This subclass is indented under subclass 193.6. Apparatus wherein the piston has a specific surface or formation cooperating with the chamber.

**193.5 Cylinder head:**
This subclass is indented under subclass 193.1. Apparatus having structure which is utilized in an assembly which fits on the upper end of the combustion chamber and which may have provision for valves, spark plugs, etc.

**193.6 Piston:**
This subclass is indented under subclass 193.1. Apparatus having a structure, shape, material or construction which is utilized in a piston (i.e., a solid cylinder or disk fitting snugly in a cylinder and reciprocating).

**195** The form, construction, or other features of the casing, frame, or bed-plate which supports the various elements necessary to form a complete internal-combustion engine and maintains them in proper operative relation with one another and includes such constructions of the cylinder as relate to the means of attachments to the bed.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, subclasses 606+.
92, Expansible Chamber Devices, subclasses 146+ for a plurality of unitarily mounted cylinders or frame therefor for an expansible chamber device, subclass 161 for a support or frame for an expansible chamber device, and subclass 261 for a crankcase, per se, for a crank associated with an expansible chamber device.

**196** Lubricating means for internal-combustion engines, the device in question being designed and adapted for use only with such an engine and being dependent for its action upon peculiarities of operation present only in internal-combustion engines.

(1) Note. Lubricating means capable of use with engines generally, irrespective of the fluid by which they are operated, and capable of use with air, steam, internal-combustion, or other engines are classified in Class 184, Lubrication appropriate subclasses, notwithstanding they may be designed with reference to use with internal-combustion engines.

SEE OR SEARCH CLASS:
92, Expansible Chamber Devices, subclasses 153+ for lubricating means for an expansible chamber device.
210, Liquid Purification or Separation, subclasses 153+ for a structural installation of a separator, especially subclasses 167 and 171 wherein an internal-combustion engine may be broadly recited as the source of the material to be treated.

**197.1 TRANSMISSION MECHANISM FROM PISTON:**
This subclass is indented under the class definition. Apparatus having a mechanism intermediate the working piston and the main driving-shaft of the engine through which power is transmitted to the shaft.

(1) Note. A patent proper for this and the indented subclasses may have ordinary parts of the engine mentioned broadly in the claims, provided no specific construction of such parts is involved.

SEE OR SEARCH THIS CLASS, SUBCLASS:
46, and 78, for a transmission-mechanism involved in the cycle upon which the engine operates.

SEE OR SEARCH CLASS:
74, Machine Element or Mechanism, appropriate subclasses according to the character of the device in question.

**197.2 With particular piston:**
This subclass is indented under subclass 197.1. Apparatus provided with specific details to the working piston.

**197.3 Particular connecting rod:**
This subclass is indented under subclass 197.4. Apparatus wherein the transmitting mechanism includes specific details to the reciprocating rod.

**197.4 Crankshaft and connecting rod:**
This subclass is indented under subclass 197.1. Apparatus wherein the transmitting mechanism includes a reciprocating rod linking rotating parts and one of the rotating parts is a shaft that has a handle or arm attached at right angles.

**197.5 Including clutch:**
This subclass is indented under subclass 197.1. Apparatus wherein the transmitting mechanism includes a device to engage or disengage it from a drive shaft.

**198** Miscellaneous accessory device designed for use with internal-combustion engines not otherwise provided for in this classification.

(1) Note. For thermometers combined with internal-combustion engine structure wherein no more of said internal combustion engine is included than is necessary to locate the thermometer, see the Search Class notes below.

(2) Note. Cleaning apparatus and processes are for the most part provided for elsewhere. See the Search Class notes below.

SEE OR SEARCH CLASS:

15, Brushing, Scrubbing, and General Cleaning, for cleaning apparatus which involve at least one of the following means or operations: a gas blast or vacuum, brushing, beating, scraping, wiping, shotting, the use of a squeegee, with or without a detergent.

134, Cleaning and Liquid Contact With Solids, for processes of cleaning engines or parts thereof even though claimed in combination with steps of engine operation, when only such engine operation steps are claimed as are necessary for the cleaning operation claimed and also for apparatus for cleaning engines when a combination with the engine is not claimed.

148, Metal Treatment, for metal cleaning or pickling processes combined with other metal treating steps.

181, Acoustics, subclass 204 for acoustical machine type enclosures specifically adapted for internal-combustion engines.

252, Compositions, for detergent compositions and for cleaning processes limited to the mere use of a detergent even though the thing or surface cleaned be specified.

374, Thermal Measuring and Testing, subclass 144, and indented subclasses, for thermometers combined with internal-combustion engine structure wherein no more of said internal combustion engine is included than is necessary to locate the thermometer,

**200 ROTARY:**
This subclass is indented under the class definition. Apparatus having a cylinder structure enclosing a piston structure wherein the piston structure cooperates with the cylinder structure and one or more other elements to constitute an enclosed space for burning the combustible material wherein the piston structure and cylinder are capable of relative rotary movement.

(1) Note. A rotary expansible chamber device having only nominally claimed air or fuel supply, air or fuel modifying means or ignition means without recitation of any other combustion aspects such as stratification, charge forming, scavenging, compression, etc., is properly classified in Class 418.

(2) Note. Included in these subclasses are engines wherein a gas is transferred or moved from one variable volume to another. Transfer of gas after being acted upon by one surface of said piston to a point where said gas acts upon another surface of said piston is considered to be a transfer to a different volume.

(3) Note. The majority of the engines found within this and indented subclasses are of the type in which the cylinder structure is stationary and the piston structure rotates; however, also included are engines wherein the cylinder structure rotated and the piston structure remains stationary, such engines being treated as kinematically inverted.

(4) Note. The term "rotor" herein is synonymous with "piston structure"; the term "enclosed space" is synonymous with "working chamber". The term "rotation" herein includes "plantation". The term "partition structure" and "vane" are synonymous and refer to the generally long, thin platelike elements capable of reciprocation and designed to form working chambers within the engine by the separation of one volume of the piston-cylinder volume from others.

(5) Note. Further included in these subclasses, from Class 60 (old subclass 39.61) are rotary engines provided with a volume structure external to the enclosed space for burning and with means for intermittently communicating the enclosed space with the external volume structure such that the combustion may occur either within the enclosed space or the external volume structure.

SEE OR SEARCH THIS CLASS, SUBCLASS:

43+, for internal-combustion engines comprising a cylinder or cylinders having a continuous rotary movement, and pistons having reciprocating movement relative to the cylinder.

SEE OR SEARCH CLASS:

418, Rotary Expansible Chamber Devices, appropriate subclasses for devices with similar structure but without significant internal-combustion features. See Class Definition, section III, miscellaneous class notes of Class 418, and (1) Note above in this subclass for statements of the line between Class 123 and Class 418.

**201 Reversible:**

This subclass is indented under subclass 200. Apparatus provided with means to allow the burning material to act on the piston structure or elements to produce rotary motion in either direction.

(1) Note. An example of reversing arrangements not included within this subclass is reverse gearing to reverse the direction of rotation of the output while the direction of rotation of the engine remains unchanged. See Class 74, Machine Element or Mechanism, subclass 810.2.

**202 With means to control degree of compression:**

This subclass is indented under subclass 200. Apparatus provided with distinct means to vary the level of pressure of the air or combustible material prior to combustion.

(1) Note. The means of this subclass is distinct structure, such as a bypass valve, e.g., and excludes the cooperating elements which normally and inherently produce compression in a rotary engine.

SEE OR SEARCH CLASS:

417, Pumps, subclass 283 for a rotary expansion chamber device having a condition responsive bypass or relief valve.

418, Rotary Expansible Chamber Devices, subclass 159 for a rotary expansible chamber device provided with means adjacent to the fluid inlet or outlet for controllably modifying the flow of fluid.

**203 With combusted gas treatment or handling means:**

This subclass is indented under subclass 200. Apparatus provided with means for treating or handling the burning combustible material within the volume where the burning occurs during the expansion or exhaust phase of operating cycle.

(1) Note. The treatment or handling of the combusted material is in addition to the expansion occurring in the working

chamber and includes air injection, scavenging, etc.

SEE OR SEARCH CLASS:
60, Power Plants, subclasses 272+ for an engine in which combusted gases are treated or handled after exhausting from the working chamber.

**204 With compression volume means in uninterrupted communication with expansion volume means:**
This subclass is indented under subclass 200. Apparatus wherein the piston structure cooperates with one or more other elements or with another piston structure or with the cylinder structure such that an unobstructed passageway always exists between the volume in which the air or combustible material is compressed and the volume in which the combustible material is burned.

(1) Note. This subclass includes engines operating on the Brayton (constant pressure) cycle.

SEE OR SEARCH CLASS:
60, Power Plants, subclass 39.01 for non-positive displacement engines operating on the same cycle.

**205 With fuel injection means:**
This subclass is indented under subclass 200. Apparatus provided with means for introducing liquid combustible material under pressure into an air supply to form a combustible mixture.

SEE OR SEARCH THIS CLASS, SUBCLASS:
32+, for other types of internal-combustion engines provided with fuel injectors.

**206 And pump or control means:**
This subclass is indented under subclass 205. Apparatus further provided with distinct means to either increase the pressure of the fuel being injected or to modify the amount of the fuel being injected into the combustion space.

SEE OR SEARCH THIS CLASS, SUBCLASS:
139+, for a fuel injection pump, per se.

SEE OR SEARCH CLASS:
417, Pumps, appropriate subclasses for generic pump structure.

**207 Into intake port:**
This subclass is indented under subclass 205. Apparatus wherein the fuel injector is located so as to inject the fuel into the passageway leading to the working chamber of the engine.

**208 Into intake chamber:**
This subclass is indented under subclass 205. Apparatus wherein the fuel injector is located so as to inject the fuel directly into the working chamber during the air and fuel induction stroke of the operating cycle.

**209 Into prechamber:**
This subclass is indented under subclass 205. Apparatus wherein the fuel injector is mounted for feeding fuel into a cavity structure external to but communicating with the working chamber via a passageway.

**210 With ignition means:**
This subclass is indented under subclass 200. Apparatus provided with a source of heat energy for initiating the combustion reaction.

SEE OR SEARCH THIS CLASS, SUBCLASS:
143+, for ignition structure, per se.

**211 Plural:**
This subclass is indented under subclass 210. Apparatus provided with a plurality of ignition means.

**212 With plural compression volume means:**
This subclass is indented under subclass 200. Apparatus provided with a plurality of means to pressurize and deliver air or combustible material to the enclosed space.

(1) Note. The volume designated for compressing the air or combustible material inherent in the operating cycle of most rotary piston engines is included as one of the compression volume means for this subclass.

**213 In series:**
This subclass is indented under subclass 212. Apparatus wherein the plural compression volume means are arranged such that the pressurized air or combustible material is passed directly in line from one compression volume means to the next.

SEE OR SEARCH THIS CLASS, SUBCLASS:
119+, for other types of internal-combustion engines provided with serially arranged superchargers.

**214 With plural expansion volume means:**
This subclass is indented under subclass 200. Apparatus provided with a plurality of space means capable of enlargement to receive the combusted material from the combustion space such that the reception of the combusted material causes the space means to enlarge.

(1) Note. The volume designed for receiving the combusted material inherent in the operating cycle of most rotary piston engines is included as an expansion volume means for this subclass.

**215 In series:**
This subclass is indented under subclass 214. Apparatus wherein the plural expansion volume means are arranged such that the combusted material is passed directly in line from one expansion volume means to the next.

SEE OR SEARCH CLASS:
60, Power Plants, subclass 623 for a rotary motor driven by waste heat or exhaust energy.

**216 With charge treatment means:**
This subclass is indented under subclass 200. Apparatus provided with means to modify or prepare the combustible material prior to or during its delivery to the combustion space.

(1) Note. Charge treatment means includes, e.g., preparation means such as mixing means for the fuel and air, or for a plurality of substances to form a combustible mixture.

SEE OR SEARCH THIS CLASS, SUBCLASS:
434+, for charge forming devices, per se.

**217 Exhaust gas recirculation:**
This subclass is indented under subclass 216. Apparatus wherein the treatment means consists of structure returning a portion of the combusted material to the air or fuel being delivered to the combustion space.

**218 Rotor shape:**
This subclass is indented under subclass 216. Apparatus wherein the treatment means consists of a cavity structure integral to the piston structure for creating turbulence so as to mix the air and fuel during the compression phase of the operating cycle in preparation for combustion.

**219 Stratification:**
This subclass is indented under subclass 216. Apparatus wherein the treatment means consists of structure for feeding air or air/fuel mixtures having different air/fuel ratios into the working chamber.

**220 Preheating:**
This subclass is indented under subclass 216. Apparatus wherein the treatment means consists of structure for raising the temperature of the air or combustible material prior to delivery to the combustion space.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclass 86 for a rotary expansible chamber device provided with heat exchange means wherein the heating of the working fluid is an ancillary function to the cooling of the rotary device.

**221 With transfer means intermediate single compression volume means and single expansion volume means:**
This subclass is indented under subclass 200. Apparatus having a singular space means to pressurize the combustible material and a singular space means capable of enlargement to receive the combusted material and with means, located therebetween, to deliver the

pressurized combustible material to the receiving space means.

(1) Note. Combustion of the gas mixture may occur in the transfer passage means, in the expansion volume means, or in both.

(2) Note. This subclass and indented subclasses include engines having an unequal number of compression volumes and expansion volume, wherein each compression volume serves only a single expansion volume at any one time.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, and appropriate subclasses for similar rotary expansion chamber device.

**222 Isolated charge in movable transfer element:**
This subclass is indented under subclass 221. Apparatus provided with means to isolate and physically move a quantity of combustible material from a source to the space in which it may be burned, there being no volumetric change in the material as it is being moved.

**223 Reciprocating or oscillating compression volume means:**
This subclass is indented under subclass 221. Apparatus wherein the means to pressurize the combustible material has a member capable of moving alternately backward and forward thereby pressurizing the combustible material.

**224 Radially spaced from expansion volume means:**
This subclass is indented under subclass 223. Apparatus wherein the compression volume means is spaced from the combusted material receiving means on a line radiating from the center or approximate center of rotation of the combusted material receiving means.

**225 Abutment acts as compression means:**
This subclass is indented under subclass 224. Apparatus wherein the means to receive the combusted material is formed in part by a first portion of a partition structure mounted within the cylinder structure for oscillation or reciprocation relative thereto during rotation of the piston structure, wherein the first portion of the partition structure engages the periphery of the piston structure to form a seal therebetween, and further wherein a second portion of the partition structure acts as a means to compress the air or combustible material.

**226 Compression means disposed in rotor:**
This subclass is indented under subclass 224. Apparatus wherein the compression volume means is mounted on the rotary piston structure.

**227 Vane acts as compression means:**
This subclass is indented under subclass 226. Apparatus wherein the means to receive the combusted material is formed in part by a first portion of a partition structure mounted within the piston structure for oscillation or reciprocation relative thereto during rotation of the piston structure, wherein the first portion of the partition structure engages the inner periphery of the cylinder structure to form a seal therebetween, and further wherein a second portion of the partition structure acts as a means to compress the air or combustible material.

**228 Compression volume means circumferentially disposed relative to expansion volume means:**
This subclass is indented under subclass 221. Apparatus wherein the means to pressurize the combustible material is distally located from the means to receive the combusted material on a closed curvilinear boundary about the axis of rotation of the piston structure.

**229 Transfer means in rotor:**
This subclass is indented under subclass 228. Apparatus wherein at least a portion of the means to transfer the pressurized material is composed of the rotary piston structure.

**230 Compression volume is also expansion volume:**
This subclass is indented under subclass 228. Apparatus wherein the singular space means to pressurize the combustible material acts alternately as the singular space means to receive the combusted material, the combustible material being confined in the transfer means after compression and prior to expansion.

**231 Vane:**
This subclass is indented under subclass 228. Apparatus wherein the means to pressurize the combustible material and the means to receive the combusted material are formed in part by a partition structure mounted within the piston structure for oscillation or reciprocation relative thereto during the rotation of the piston structure wherein the partition structure engages the inner periphery of the cylinder structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 259+ for vane-type rotary chamber devices.

**232 Interengaging rotors:**
This subclass is indented under subclass 228. Apparatus wherein the means to pressurize the combustible material and the means to receive the combusted material are separated by a seal produced by the engagement of a rotatable element structure with the periphery of the piston structure.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 191+ for gear-type rotary chamber devices.

**233 Nonparallel axes:**
This subclass is indented under subclass 232. Apparatus wherein the piston structure and the partition structure are mounted for rotation about lines of center that are at an angle relative to each other.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclass 195 for a gear-type rotary chamber device having nonparallel axes.

**234 Compression volume means axially disposed relative to expansion volume means:**
This subclass is indented under subclass 221. Apparatus wherein the means to pressurize the combustible material is spaced from the means to receive the combusted material on the line of center of rotation of the piston structure.

**235 Transfer means in rotor:**
This subclass is indented under subclass 234. Apparatus wherein at least a portion of the means to transfer the pressurized material is disposed within the rotary piston structure.

**236 Vane:**
This subclass is indented under subclass 234. Apparatus wherein the means to pressurize the combustible material and the means to receive the combusted material are formed in part by a partition structure mounted within the piston structure for oscillation or reciprocation relative thereto during the rotation of the piston structure, wherein the partition structure engages the inner periphery of the cylinder structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 259+ for a vane-type rotary chamber device.

**237 Abutment:**
This subclass is indented under subclass 234. Apparatus wherein the means to receive the combusted material is formed in part by a first portion of a partition structure mounted within the cylinder structure for oscillation or reciprocation relative thereto during rotation of the piston structure, wherein the first portion of the partition structure engages the periphery of the piston structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 243+ for abutment-type rotary chamber devices.

**238 Interengaging rotors:**
This subclass is indented under subclass 234. Apparatus wherein the means to receive the combusted material is formed in part by a seal produced by the engagement of a rotatable element structure with the periphery of the piston structure.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 191+ for gear-type rotary chamber devices.

**239 Compression volume means radially disposed relative to expansion volume means:**
This subclass is indented under subclass 221. Apparatus wherein the means to pressurize the combustible material is spaced from the means to receive the combusted material on a line radiating from the center or approximate center of the combusted material receiving means.

**240 Concentric:**
This subclass is indented under subclass 239. Apparatus wherein the means to pressurize the combustible material and the means to receive the combusted material both are essentially toroidally, and further wherein one of the means encircles the other, with a common center, such that the air or combustible material is transferred from one toroidal shaped means to the other.

**241 With compression, combustion, and expansion in a single variable volume:**
This subclass is indented under subclass 200. Apparatus wherein the pressurization of the combustible material, the ignition of the combustible material, and the expansion of the combusted material all occur within the same enclosed space.

**242 Planetating rotor:**
This subclass is indented under subclass 241. Apparatus wherein the geometric center of the piston structure rotates about an axis noncoincident with said center.

(1) Note. The term "planetating" includes both the rotary motion of an object about an axis other than its own geometric axis with or without rotary motion about its own geometric axis.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 54+ for planetating working member rotary chamber devices.

**243 Vane:**
This subclass is indented under subclass 241. Apparatus wherein the enclosed space is formed at least in part by a partition structure mounted within the piston structure for oscillation or reciprocation relative thereto during the rotation of the piston structure, wherein the partition structure engages the inner periphery of the cylinder structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 259+ for vane-type rotary chamber devices.

**244 Abutment:**
This subclass is indented under subclass 241. Apparatus wherein the enclosed space is formed at least in part by a partition structure mounted within the cylinder structure for oscillation or reciprocation relative thereto during rotation of the piston structure, wherein the partition structure engages the periphery of the piston structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 243+ for abutment-type rotary chamber devices.

**245 Alternately approaching and receding elements:**
This subclass is indented under subclass 241. Apparatus wherein the enclosed space is formed by the simultaneous combined movement produced by the rotation of a plurality of elements or piston structures and the oscillation of two or more of the elements or piston structures.

SEE OR SEARCH THIS CLASS, SUBCLASS:
43+, for an internal-combustion engine wherein the piston reciprocates relative to a toroidal cylinder.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 33+ for alternating piston-type rotary chamber devices.

**246 Eccentric interengaging rotors:**
This subclass is indented under subclass 245. Apparatus wherein the peripheries of the elements or piston structures cooperate to form a seal therebetween thereby forming the enclosed space.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 191+ for gear-type rotary chamber devices.

**247 Only combustion and expansion of charge in engine:**
This subclass is indented under subclass 200. Apparatus wherein the piston structure, the cylinder structure, or the other elements cooperate to form an enclosed space in which only burning of the combustible mixture and the enlargement of the combusted material occurs, the compressed combustible material being supplied from an undefined source.

(1) Note. This subclass is limited to patents which do not claim the kinetic compressor or other source of the compressed air or fuel mixture. Patents claiming such a compressor or source have been classified in subclasses 221+.

**248 Abutment:**
This subclass is indented under subclass 247. Apparatus wherein the enclosed space is formed at least in part by a partition structure mounted within the cylinder structure for oscillation or reciprocation relative thereto during rotation of the piston structure, wherein the partition structure engages the periphery of the piston structure to form a seal therebetween.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 243+ for abutment-type rotary chamber devices.

**249 Interengaging rotors:**
This subclass is indented under subclass 247. Apparatus wherein the enclosed space is formed at least in part by a seal produced by the engagement of a rotatable element structure with the periphery of the piston structure.

SEE OR SEARCH CLASS:
418, Rotary Expansible Chamber Devices, subclasses 191+ for gear-type rotary chamber devices.

**250 ENGINE MEANS HAVING INTERNAL VAPORIZING IN PRECHAMBER WITH ALL COMBUSTION IN MAIN CHAMBER:**
This subclass is indented under the class definition. Subject matter having a main combustion chamber in which all combustion takes place and an auxiliary chamber (prechamber) that is used only to vaporize liquid fuel or thoroughly mix a fuel-air mixture before it is burned in the main combustion chamber.

**251 Whirling in prechamber:**
This subclass is indented under subclass 250. Subject matter in which means is provided to effect swirling of the fuel or fuel-air mixture in the prechamber to more thoroughly vaporize or mix the fuel.

**252 Vaporizing by a hot surface of prechamber:**
This subclass is indented under subclass 250. Subject matter in which the fuel in the prechamber is vaporized by heat stored in a surface (e.g., wall) of the prechamber.

(1) Note. The heat is usually obtained from combustion in the main chamber.

**253 PRECOMBUSTION AND MAIN COMBUSTION CHAMBERS IN SERIES:**
This subclass is indented under the class definition. Subject matter having at least two distinct physical volumes or chambers in which combustion occurs. The combustion is multistage and is initiated in a first chamber, known as a prechamber or auxiliary combustion chamber, and spreads into a final or "main" combustion chamber where combustion is complete and expansion occurs.

(1) Note. The prechamber must be a volume that is physically provided for and distinct from the main combustion space and must have at least intermittent fluid communication with the main chamber.

(2) Note. Multiple prechambers may be provided for, emptying serially into each other and then into the main chamber, or each emptying in parallel into the main chamber.

**254 Chamber temperature control means:**
This subclass is indented under subclass 253. Subject matter in which means is provided to adjust, maintain, heat, cool, or otherwise con-

trol the temperature of the main combustion chamber or prechamber.

(1) Note. The means may include particular positioning or construction of a chamber.

**255 Vaporizing in precombustion chamber:**
This subclass is indented under subclass 253. Subject matter in which means is provided in the prechamber to aid in the vaporization of fuel droplets to promote complete and smooth burning.

SEE OR SEARCH THIS CLASS, SUBCLASS:
254, for an engine in which the vaporization is aided by heating.

**256 Plural precombustion chambers:**
This subclass is indented under subclass 253. Subject matter in which more than one prechamber is provided.

(1) Note. They may empty separately into the main chamber, serially into each other then into the main chamber, or both.

**257 Two-cycle:**
This subclass is indented under subclass 253. Subject matter in which the engine operates on the two-stroke cycle principle.

(1) Note. An engine operating in the two-stroke cycle principle completes its operating cycle in one crankshaft revolution.

**258 Having timed valves to precombustion and main combustion chambers:**
This subclass is indented under subclass 253. Subject matter in which the main and prechamber each have at least one intake valve, with significance attributed to the relative valve timing.

**259 Having volumetric relation between precombustion and main combustion chambers:**
This subclass is indented under subclass 253. Subject matter in which a specific ration of the volumes of the main and prechamber is specified.

**260 With ignition means particularly positioned relative to precombustion and main combustion chambers:**
This subclass is indented under subclass 253. Subject matter in which significance is attributed to the location of the ignition means in relation to the pre and main chambers.

**261 With injection means particularly positioned relative to precombustion and main combustion chambers:**
This subclass is indented under subclass 253. Subject matter in which significance is attributed to the location of the injection means in relation to the pre and main chambers.

**262 Having fluid whirling means:**
This subclass is indented under subclass 253. Subject matter wherein means is provided to cause whirling of the fluid in the pre or main chamber or in the intake manifold adjacent a pre or main chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
280, for atomizer, deflector, or shield in prechamber.
290, for positioning of connecting passage to cause whirling.

**263 Whirling in precombustion chamber only:**
This subclass is indented under subclass 262. Subject matter wherein the means causes whirling of the fluid only in the prechamber.

**264 Precombustion chamber is carried by a valve:**
This subclass is indented under subclass 253. Subject matter in which the prechamber is attached to or formed as an integral part of an engine valve.

**265 Precombustion and main chambers form an "L" head:**
This subclass is indented under subclass 253. Subject matter in which the main and prechamber are so located relative to each other than their cross section is in the shape of an "L".

SEE OR SEARCH THIS CLASS, SUBCLASS:
658, for "L" shaped combustion chamber, per se.

**266 Precombustion chamber assembly inserted in spark plug hole:**
This subclass is indented under subclass 253. Subject matter in which the prechamber is attached to the engine by insertion into the hole provided for the spark plug.

(1) Note. This type of prechamber is usually used as a retrofit device on an engine not normally having a prechamber. The displaced spark plug is usually screwed into a hole provided for in the prechamber assembly.

(2) Note. Prechamber usually screws in.

SEE OR SEARCH THIS CLASS, SUBCLASS:
273, for other prechamber mounting means.

**267 Separate fuel or combustible mixture added to precombustion chamber:**
This subclass is indented under subclass 266. Subject matter in which fuel or air-fuel mixture is added to the prechamber in addition to the fuel or mixture obtained from the main chamber.

**268 Valveless precombustion chamber:**
This subclass is indented under subclass 253. Subject matter in which the prechamber contains no valving of any type.

**269 Piston shape complements precombustion chamber discharge:**
This subclass is indented under subclass 253. Subject matter in which an engine piston is shaped to conform to the shape or direction of the discharge from the prechamber outlet and allows free flow therefrom.

(1) Note. The piston may also be further shaped to direct the flow from the prechamber to a particular part of the main combustion chamber.

**270 Precombustion chamber liner or coating:**
This subclass is indented under subclass 253. Subject matter in which a surface of the prechamber is provided with a coating or liner.

SEE OR SEARCH THIS CLASS, SUBCLASS:
280, for deflector or shield.

**271 With liner mounting means:**
This subclass is indented under subclass 270. Subject matter in which means is disclosed to secure the coating or liner within the prechamber (glue, screw, friction fit, etc.).

**272 Including combustion catalyst liner or coating means:**
This subclass is indented under subclass 270. Subject matter in which the liner or coating contains a catalytic agent that aids or enhances the combustion in the prechamber.

(1) Note. The catalyst may even initiate combustion in the prechamber.

**273 Precombustion chamber mounting means:**
This subclass is indented under subclass 253. Subject matter wherein some specific structure or method is disclosed for fastening or removing the prechamber body.

SEE OR SEARCH THIS CLASS, SUBCLASS:
266, for a prechamber mounted in a spark plug hole.

**274 Having combustible mixture forming means:**
This subclass is indented under subclass 253. Subject matter wherein specific means is disclosed to provide an air-fuel mixture for the pre or main combustion chamber.

**275 By fuel injection into precombustion or main combustion chamber:**
This subclass is indented under subclass 274. Subject matter wherein fuel at a pressure greater than atmospheric is introduced into either the pre or main combustion chamber.

**276 Fuel injected into precombustion chamber formed in piston:**
This subclass is indented under subclass 275. Subject matter where fuel under pressure greater than atmospheric is introduced into a prechamber which is located in the engine piston.

**277 By fuel injection into precombustion chamber with carbureted main chamber:**
This subclass is indented under subclass 275. Subject matter wherein fuel is introduced under pressure greater than atmospheric into the prechamber and the main chamber is fed with an aspirated or carbureted mixture of air and fuel.

**278 By fuel injection into main chamber with carbureted precombustion chamber:**
This subclass is indented under subclass 275. Subject matter wherein the main chamber is charged with fuel at a pressure greater than atmospheric and where the prechamber is fed with an aspirated or carbureted mixture of air and fuel.

**279 Piston carried precombustion chamber:**
This subclass is indented under subclass 253. Subject matter wherein the prechamber is carried by and mounted on the engine piston.

(1) Note. The prechamber may be fueled from the combustion chamber, or through the piston, and/or cylinder wall.

**280 Atomizer, deflector, or shield in precombustion chamber:**
This subclass is indented under subclass 253. Subject matter wherein the prechamber or prechamber throat contains an atomizer, deflector, or shield mounted in the path of the fuel or air-fuel mixture.

SEE OR SEARCH THIS CLASS, SUBCLASS:
270+, for prechamber with a liner.

**281 Precombustion chamber shape is a figure of revolution:**
This subclass is indented under subclass 253. Subject matter wherein the three-dimensional shape of the precombustion chamber can be formed by rotating a single planar shape, formed from a combination of straight or curved lines, through 360° about an axis.

(1) Note. Connecting throats are not considered as part of the figure of revolution.

(2) Note. An example would be to rotate a semicircle about a straight line connecting its free ends (diameter) thus forming a sphere.

**282 Figure of revolution is multishaped to form a precombustion chamber:**
This subclass is indented under subclass 281. Subject matter wherein the three-dimensional shape of the prechamber can be formed by rotating a plurality of separated planar shapes through 360° about an axis.

(1) Note. The resulting separate volumes generally have an interconnecting passage.

**283 Cylindrical:**
This subclass is indented under subclass 281. Subject matter wherein the resulting 3-D shape is a cylinder.

**284 Spherical:**
This subclass is indented under subclass 281. Subject matter wherein the resulting 3-D shape is a sphere.

**285 Precombustion chamber having a specific shape:**
This subclass is indented under subclass 253. Subject matter wherein the prechamber has a shape disclosed as critical to the engine operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:
281+, for a prechamber having a shape that can be formed by a figure of revolution.

**286 Having specific connecting passage means between precombustion and main combustion chambers:**
This subclass is indented under subclass 253. Subject matter wherein significance is attributed to the design of the passage between the pre and main combustion chambers.

(1) Note. The design is usually disclosed as being critical to the combustion process.

**287 With ignition means in connecting passage:**
This subclass is indented under subclass 286. Subject matter wherein combustion initiating means is employed in the connecting passage.

**288 Having fuel, a combustible mixture, or air added in the connecting passage:**
This subclass is indented under subclass 286. Subject matter wherein either fuel, air, or a mixture of both is supplied in the connecting passage.

**289 Fluid flow through passage controlled by working piston:**
This subclass is indented under subclass 286. Subject matter wherein the flow or fluid in the connecting passage between the main and pre chamber is valved or otherwise controlled by some portion of or attachment to the engine working piston.

**290 With whirling:**
This subclass is indented under subclass 289. Subject matter wherein means is provided for swirling the fluid contained in the pre or main chamber, or the connecting passage.

**291 Multiple connecting passages:**
This subclass is indented under subclass 289. Subject matter wherein there are multiple connecting passages or divisions of a single passage between the pre and main chambers.

**292 With valve means or variable orifice means in the passage:**
This subclass is indented under subclass 286. Subject matter wherein the means is provided in the connection between the pre and main chambers to vary the flow path therebetween.

SEE OR SEARCH THIS CLASS, SUBCLASS:
289+, for piston-controlled connected passage.

**293 Having multiple passages:**
This subclass is indented under subclass 286. Subject matter wherein there are multiple connecting passages or divisions of a single passage between the pre and main chambers.

**294 COMBUSTION CHAMBER MEANS HAVING FUEL INJECTION ONLY:**
This subclass is indented under the class definition. Subject matter in which all fuel, liquid or gaseous, and unmixed with air, is supplied under pressure to the interior of the combustion or working chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
495+, for a fuel pump available for supplying fuel to form the combustible charge in an engine of the type in this subclass.
531+, for engines having air-fuel mixture injected into combustion chamber.

SEE OR SEARCH CLASS:
239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 533.2+ for injection nozzle structure, per se.
417, Pumps, subclass 364 for a fuel pump available for supplying fuel to form the combustion charge in an engine of the type in this subclass.

**295 Combustible mixture stratification means:**
This subclass is indented under subclass 294. Subject matter in which means is provided to deliberately create a nonhomogeneous mixture charge within the combustion chamber.

**296 Injector is an integral part of engine valve:**
This subclass is indented under subclass 294. Subject matter in which the fuel injector is mounted on, carried by, or otherwise an integral part of an engine intake or exhaust valve.

**297 Combination igniting means and injector:**
This subclass is indented under subclass 294. Subject matter wherein an engine spark plug or external ignition device and an engine fuel injection nozzle or valve are at least in part combined in one structural unit.

**298 Injection of fuel onto igniter, deflector, heater, or atomizer:**
This subclass is indented under subclass 294. Subject matter wherein the injected fuel spray pattern or some part of the pattern in the combustion chamber impacts on a heater, igniter, deflector, or atomizer.

**299 Using multiple injectors or injections:**
This subclass is indented under subclass 294. Subject matter wherein, a plurality of injectors or a plurality of distinct spray patterns from the same injector are employed in each engine cylinder.

(1) Note. This includes simultaneous or sequential injections.

**300 Alternating multiple injectors (e.g., series injection):**
This subclass is indented under subclass 299. Subject matter wherein multiple injectors make their injections, one following the other, with no overlap of their injection periods (e.g., series injection).

**301 Injected fuel spraying into whirling fluid:**
This subclass is indented under subclass 294. Subject matter wherein the injected fuel is sprayed into a whirling, swirling, or rotating fluid mass in the engine cylinder.

**302 Air entering combustion chamber through plural inlets:**
This subclass is indented under subclass 294. Subject matter wherein the combustion chamber has plural separate air or oxidant inlet ports.

**303 Having inlet uncovered by working piston:**
This subclass is indented under subclass 302. Subject matter wherein at least one of the inlet ports is valved by a part of the engine piston during some portion of its working stroke.

**304 Injecting diverse fuels or different states of same fuel:**
This subclass is indented under subclass 294. Subject matter wherein at least two different types of fuel or the same fuel in two or more different states (e.g., liquid and gas, are injected directly into a combustion chamber).

**305 Having a particular relationship between injection and ignition characteristics (e.g., nozzle location, spray pattern, timing relative to igniter location, timing):**
This subclass is indented under subclass 294. Subject matter in which significance is attributed to the relationship between the functional or structural characteristics of injection and ignition.

**306 MEANS TO WHIRL FLUID BEFORE, UPON, OR AFTER ENTRY INTO COMBUSTION CHAMBER:**
This subclass is indented under the class definition. Subject matter which employs a combustion chamber and some means either in the inlet or outlet of the combustion chamber or within the chamber itself to whirl the engine fluid so that some fluid whirling results in the combustion chamber itself.

SEE OR SEARCH THIS CLASS, SUBCLASS:
262+, and 290, for fluid whirling means with a prechamber.

**307 Structural projection on working piston causes whirling:**
This subclass is indented under subclass 306. Subject matter wherein the engine working piston includes some form of projection which induces whirling of the engine fluid in the combustion chamber.

(1) Note. This subclass does not include a piston projection which merely directs the fluid along some nonrotary path. Whirling is rotary motion and is generally about the cylinder axis.

**308 Having multiple oxidant inlet means:**
This subclass is indented under subclass 306. Subject matter wherein the combustion chamber has a plurality of separate air or oxidant inlet members.

**309 Specific spark plug location:**
This subclass is indented under subclass 306. Subject matter wherein significance is attributed to the specific location of the spark plug with respect to the whirling fluid.

**310 COMBUSTION CHAMBER HAVING MULTIPLE SPARK GAPS:**
This subclass is indented under the class definition. Subject matter which employs a plurality of spark plugs per engine combustion chamber or which employs a plurality of spark gaps per combustion chamber with the spark gaps extending beyond the diameter of spark plug hole.

SEE OR SEARCH THIS CLASS, SUBCLASS:
169+, for multiple gap spark plug.

SEE OR SEARCH CLASS:
313, Electrical Lamp and Discharge Devices, subclasses 123+ for multiple gap spark plug.

**311 FOUR-CYCLE:**
This subclass is indented under the class definition. Subject matter having a single-acting working cylinder and a single working piston reciprocating therein and in which compression takes place in the working cylinder before ignition, said engine working upon a cycle comprising four distinct strokes, namely, an expansion stroke following ignition of the charge, followed by exhaust, intake, and compression strokes.

(1) Note. This subclass and those indented hereunder are intended to include four-stroke cycle engines in which at least one of the cycles is varied or modified from the conventional four-stroke cycle engine. A nominally claimed four-stroke cycle is not sufficient for classification in this and indented subclasses, if there is significant disclosure for classification elsewhere in the class, unless there is a claim for a specific four-stroke engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
559+, for a super-charged four-cycle engine.

**312 Engine cylinder having a reciprocating sleeve valve:**
This subclass is indented under subclass 311. Subject matter in which the four-stroke engine utilizes a reciprocating sleeve to valve the intake or exhaust port. The sleeve is reciprocated in timed relationship with the movement of the piston in the cylinder.

(1) Note. The sleeve valve is usually cylindrical in shape.

**313 Having a junk ring seal:**
This subclass is indented under subclass 312. Subject matter in which a sealing ring is provided between the sleeve valve and cylinder head.

(1) Note. The ring is referred to as a junk ring, and is usually located between the head and the inside surface of the sleeve valve.

(2) Note. The junk ring is usually provided to prevent combustion residue from entering the space provided for sleeve valve and interfering with the operation of said valve.

**314 Having sleeve valve lubrication means:**
This subclass is indented under subclass 312. Subject matter including means to provide for lubrication of the sleeve valve.

**315 Multiple exhaust:**
This subclass is indented under subclass 311. Subject matter wherein said exhaust means comprises a plurality of exhaust apertures.

**316 Having subcharger associated with the cylinder:**
This subclass is indented under subclass 311. Subject matter wherein some part of the charge is bled from the cylinder upon compression, stored and then returned to the system upon a subsequent intake stroke.

**317 Crankcase compression of air or combustible mixture to be subsequently pumped into the working cylinder:**
This subclass is indented under subclass 311. Subject matter wherein the charge or any part of the charge is compressed at least partially in the chamber housing the engine crankshaft upon the downstroke of the engine working piston; the pressurized air or mixture is then pumped into the cylinder to insure complete filling.

**318 Rear compression of air or combustible mixture to be subsequently pumped into the working cylinder:**
This subclass is indented under subclass 311. Subject matter wherein the charge or some part of the charge is compressed by the engine

working piston on its downstroke in a volume other than that of the engine crankcase.

(1) Note. This volume is generally immediately adjacent the connecting rod side of the engine piston and is sealed at the passage of the connecting rod to the crankcase. The pressurized air or mixture is pumped into the cylinder to insure complete filling.

**319 ENGINE SPEED REGULATOR:**
This subclass is indented under the class definition. Subject matter in which the output shaft speed of an internal combustion engine is controlled (i.e., accelerate, decelerate, or maintain constant R.P.M.) by varying the power input thereto.

(1) Note. The primary purpose of a speed regulator is to regulate the shaft speed of the engine and includes feedback or non-feedback types. Since fuel injection pump governors almost always regulate the engine shaft speed by varying the amount of fuel injected, they have been included in the speed regulating subclasses. The primary purpose of the charge former is to form a combustible charge to be fed to the engine at any given operating condition. Charge former may utilize sensed engine parameters to adjust the quality of the mixture formed. The parameters may include engine speed, vacuum (load), air flow, etc.

SEE OR SEARCH CLASS:
48, Gas: Heating and Illuminating, subclasses 144+ and 180.1+.
60, Power Plants, where combustion products are used as a motive fluid subclass 773 for processes of having power output control or subclasses 793-39.3 for a power plant combined with a regulation of power output feature.
73, Measuring and Testing, subclasses 488+ for a speed-responsive device to general application.
137, Fluid Handling, subclasses 47+ for speed-responsive valve control.
180, Motor Vehicles, subclasses 170+ for vehicle speed-responsive regulators.
188, Brakes, subclasses 266+ for internal resistance brakes of the fluid type in which no significant internal combustion engine is claimed.
477, Interrelated Power Delivery Controls, Including Engine Control, for interrelated controls between an engine and a transmission, clutch, or brake.

**320 Responsive to deceleration mode (e.g., engine acting as a brake):**
This subclass is indented under subclass 319. Subject matter wherein the speed regulator senses high manifold vacuum, closed throttle, and rpm above idle and responds to cause or attempt to cause a further reduction in engine rpm.

(1) Note. In many instances, the speed regulator includes means to reduce pollutants in the exhaust gas causes by the deceleration condition.

**321 Valve timing altering means (e.g., axially sliding cam shift):**
This subclass is indented under subclass 320. Subject matter in which a device is provided to alter the instant at which opening or closing of an engine valve begins, to cause the engine to act as a brake.

**322 Electrical means adapted to alter valve timing:**
This subclass is indented under subclass 321. Subject matter having means to change the amount of time the intake or exhaust valve is open, each cycle wherein said means is electric.

**323 Exhaust throttling or blocking:**
This subclass is indented under subclass 320. Subject matter to throttle or block the exhaust as the engine acts as a brake.

SEE OR SEARCH CLASS:
188, Brakes, subclass 273 for a brake on an internal combustion engine acting by restricting the exhaust from said engine.

**324 Part of the air or combustible mixture to the engine cylinder omitted:**
This subclass is indented under subclass 320. Subject matter that includes means to omit a portion of the engine input air or charge, further decelerating the motor or clean the exhaust of the already decelerating motor.

**325 Deceleration responsive cutoff of fuel to engine (e.g., pollution control):**
This subclass is indented under subclass 320. Subject matter including means to stop fuel flow of the engine to decal the engine or clean up the emissions of the already decelerating engine.

**326 Rich resupply of fuel at end of deceleration:**
This subclass is indented under subclass 325. Subject matter to deliver a squirt of fuel to the engine to facilitate a burst of power for an impending acceleration.

**327 Auxiliary air fed to the engine:**
This subclass is indented under subclass 320. Subject matter wherein means are provided to supply additional air to the engine cylinder in response to a deceleration condition.

**328 Idle jet bypassed by a slight opening of the throttle:**
This subclass is indented under subclass 320. Subject matter in which the speed regulator includes means to open the throttle butterfly slightly when the engine is in a deceleration condition to prevent an excessive amount of fuel from being drawn from the idle jet.

**329 Having means to retard spark (e.g., ignition timing):**
This subclass is indented under subclass 320. Subject matter in which the speed regulator includes means to retard the spark firing instant so that the plug fires closer to or after top dead center.

**330 Engine speed reduction by overriching the combustible mixture (e.g., choking engine):**
This subclass is indented under subclass 319. Subject matter to regulate the engine speed by adding more fuel to the mix or otherwise providing less air per part of mix, thus producing a choking effect on the engine, resulting in engine speed reduction.

**331 By electric means:**
This subclass is indented under subclass 330. Subject matter wherein said engine speed regulating means is electrical or is an electrically actuated mechiready decelerating engine.

**332 Engine speed reduction by fuel cutoff:**
This subclass is indented under subclass 319. Subject matter to regulate the engine speed by stopping the fuel supply to the engine.

**333 By electric means:**
This subclass is indented under subclass 332. Subject matter including means to stop fuel flow to the engine wherein said means is electric or is an electrically actuated mechanical or fluidic means.

**334 Engine speed reduction by partial or complete omission of the ignition:**
This subclass is indented under subclass 319. Subject matter in which a means to regulate engine speed is operative to prevent ignition in at least one engine cylinder.

**335 By electric means:**
This subclass is indented under subclass 334. Subject matter in which a means to prevent ignition is electrically operated.

**336 Having plural throttle valve structure:**
This subclass is indented under subclass 319. Subject matter having more than one butterfly valve in the engine intake (e.g., carburetor).

**337 Specific throttle valve structure:**
This subclass is indented under subclass 319. Subject matter wherein the carburetor or engine intake has a unique butterfly configuration that is significant to its operation as a speed regulating device.

**338 Fuel injection pump bypass control:**
This subclass is indented under subclass 319. Subject matter having a fuel injection pump bypass governor so that fuel is diverted from the pumping chamber during the pump intake stroke, or part of the fuel delivered past the pump outlet valve is diverted from delivery to the associated engine.

(1) Note. The fuel diverted is usually conducted back to the supply tank or inlet of the pump.

**339.1 Idle speed control:**
This subclass is indented under subclass 319. Subject matter (a) wherein the output shaft has a varied minimum operating speed, and (b) comprising a manual input member and means for adjusting the minimum operating speed of the shaft while maintaining the manual input member (e.g., accelerator pedal, hand control) at a minimum position.

(1) Note. An engine idle speed control responsive to a signal indicative of an engine operating condition or indicative of an external load applied to the engine (e.g., power steering pump, lights, electric generator) is provided for here.

SEE OR SEARCH CLASS:
290, Prime-Mover Dynamo Plants, appropriate subclasses, especially subclasses 40+ for engine idle speed control responsive to a sensed parameter of an electric generator.
477, Interrelated Power Delivery Controls, Including Engine Control, appropriate subclasses, especially subclasses 34+ for an engine idle speed control responsive to a signal indicative of a transmission, clutch, or brake condition.

**339.11 By regulating spark ignition timing:**
This subclass is indented under subclass 339.1. Subject matter comprising a combustion chamber, a combustible mixture, a piston traveling in the chamber, a rotatable crankshaft, and means creating a short pulse or flow of electric current for causing the combustible mixture to burn in the combustion chamber wherein the minimum output shaft operating speed is adjusted by varying the point of piston travel or crankshaft rotation at which the short pulse or flow of electric current occurs.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.19+, for an internal combustion engine spark ignition timing control adjusted in response to sensed engine shaft output speed.

**339.12 And air-fuel ratio feedback controlled:**
This subclass is indented under subclass 339.1. Subject matter comprising a combustion chamber having a space therein, a combustible mixture containing an oxidant and a fuel, and wherein the minimum output shaft operating speed is adjusted and the relative proportion of oxidant and fuel in the combustible mixture which is fed to the combustion space or chamber is varied according to a sensed parameter indicative of the proportion of oxidant in the mixture.

(1) Note. The parameter sensed may be indicative of an amount of a component of the combustible mixture fed to the combustion chamber or an amount of a component of the exhaust gas.

SEE OR SEARCH THIS CLASS, SUBCLASS:
344, for a device for controlling the engine speed by varying the air-fuel ratio.
680, for a charge-forming device which is responsive to engine exhaust gas condition and idling condition.
704, for a charge-forming device which is responsive to a sensed air-fuel ratio prior to combustion.

**339.13 Manual adjustment:**
This subclass is indented under subclass 339.1. Subject matter wherein the means for adjusting the minimum output shaft operating speed of the internal combustion engine is adjusted by hand or through use of a hand-manipulated tool.

(1) Note. The manual adjustment may be combined with an electrically operated control device.

SEE OR SEARCH CLASS:
261, Gas and Liquid Contact Apparatus, appropriate subclasses for carburetor adjustments, per se.

**339.14 Electrically operated control means:**
This subclass is indented under subclass 339.1. Subject matter wherein the means for adjusting the minimum output shaft operating speed of

the internal combustion engine is powered by electrical energy.

SEE OR SEARCH THIS CLASS, SUBCLASS:

350+, for electrical sensing or regulating of engine speed with the engine being part of a closed loop condition responsive feedback system.

395+, for an open loop condition responsive speed regulator for an engine.

**339.15 With fail-safe, backup, or malfunction detecting means:**

This subclass is indented under subclass 339.14. Subject matter and wherein the electrically powered adjusting means includes an electrical circuit having a circuit element and wherein the electrically powered adjusting means (a) upon sensing failure in the circuit element shifts operation (1) into a substitute circuit, or (2) to a substitute mechanism to accomplish the same function, or (b) senses functioning of the circuit or circuit element outside of acceptable parameters.

SEE OR SEARCH THIS CLASS, SUBCLASS:

479, for a charge-forming device having an electrically actuated fuel injector and an actuator circuit including a fail-safe, backup, or failure indicator.

690, for an exhaust gas condition responsive charge-forming device including a fail-safe, backup or malfunction means.

SEE OR SEARCH CLASS:

340, Communications: Electrical, appropriate subclasses for an electrical alarm or indicating system.

361, Electricity: Electrical Systems and Devices, appropriate subclasses for an electrical fail-safe or backup system without significant internal combustion engine structure.

701, Data Processing, Navigation, and Relative Location, subclasses 99+ for control means for an internal-combustion engine including specific computer or data processing details.

**339.16 External load condition responsive:**

This subclass is indented under subclass 339.14. Subject matter wherein the electrically powered adjusting means is adjusted or modified in response to a signal from a transducer responsive to a parameter indicative of the resistance to rotation of the output shaft of the engine by a device driven by the engine.

SEE OR SEARCH CLASS:

180, Motor Vehicles, subclass 69.3 for a motor vehicle having means to increase the idle speed of an internal combustion engine to compensate for an accessory load.

**339.17 Air conditioner operating mode responsive (i.e., compressor on-off):**

This subclass is indented under subclass 339.16. Subject matter including (1) an apparatus (a) for lowering a temperature and humidity of an enclosed space, and (b) having a clutch compressor and (2) wherein the minimum engine output shaft operating speed is adjusted in response to a parameter indicative of the state of engagement (i.e., on or off) of the compressor clutch.

SEE OR SEARCH THIS CLASS, SUBCLASS:

41.19, for an internal combustion engine cooled by a refrigeration cycle.

SEE OR SEARCH CLASS:

62, Refrigeration, appropriate subclasses, especially subclasses 323.1+ for engine idle speed control in response to a specific air conditioner parameter (e.g., refrigerant pressure).

**339.18 Accessory load (e.g., lights, heater blower motor, radiator fan motor, generator) on engine electrical system responsive:**

This subclass is indented under subclass 339.16. Subject matter comprising an ancillary device that induces a resistance to rotation of the output shaft and wherein the electrically powered means for adjusting the minimum engine output shaft operating speed responds to a condition indicative of the resistance to rotation of the output shaft induced by the ancillary device.

(1) Note. An internal combustion engine idle speed control electric generator combination in which the electric generator is merely a nominal load driven by the internal combustion engine is found here.

SEE OR SEARCH CLASS:

290, Prime-Mover Dynamo Plants, subclasses 40+ for the combination of an internal combustion engine idle speed control and an electric generator in which is included (a) any detail of the generator, (b) any relationship between a generator part and an internal combustion engine, or (c) any control of the internal combustion engine in response to the electricity produced by the generator.

**339.19 By engine speed error feedback:**

This subclass is indented under subclass 339.14. Subject matter wherein the electrically powered adjusting means (a) measures an actual minimum engine output shaft operating speed, (b) compares the measured output shaft operating speed to a target minimum output shaft operating speed, and (c) adjusts the measured output shaft operating speed to achieve the target minimum output shaft operating speed.

SEE OR SEARCH THIS CLASS, SUBCLASS:

352+, for electrical sensing or regulating of engine speed with the engine being part of a closed loop condition responsive feedback system and an error signal producing circuit.

395+, for an open loop condition responsive speed regulator system for an engine.

**339.2 Dynamic state variable model:**

This subclass is indented under subclass 339.19. Subject matter wherein the electrically powered adjusting means (a) has a preprogrammed memory of stored values from a previous test phase (e.g., bench test), (b) compares actual engine condition values to the stored values, and (c) anticipates adjustments necessary to control the minimum output shaft operating speed.

SEE OR SEARCH THIS CLASS, SUBCLASS:

350+, for electrical sensing or regulating of engine speed with the engine being part of a closed loop condition responsive feedback system.

395+, for an open loop condition responsive speed regulator for an engine.

418+, for a spark ignition timing control responsive to engine output shaft operating speed.

480, for an electrically actuated fuel injector actuator circuit having a microprocessor.

SEE OR SEARCH CLASS:

701, Data Processing, Navigation, and Relative Location, subclasses 101+ for control means for an internal-combustion engine including specific computer or data processing details.

**339.21 And integral or derivative control:**

This subclass is indented under subclass 339.19. Subject matter and wherein the electrically powered adjusting means (a) receives a signal indicative of an engine operating parameter, and (b) either (1) determines on a continuous basis the total value of the parameter being measured as a function of time or (2) determines a rate of change of the parameter being measured as a function of time, and (c) uses the result to vary the minimum engine shaft operating speed.

**339.22 And temperature responsive:**

This subclass is indented under subclass 339.19. Subject matter and wherein the electrically powered adjusting means additionally adjusts the minimum engine shaft operating speed in response to changes in temperature (e.g., temperature of an engine component, engine fluid, or the ambient environment).

SEE OR SEARCH THIS CLASS, SUBCLASS:

362, for electrical sensing or regulating of engine speed of a cold engine with the engine being part of a closed loop condition responsive feedback system having an error signal producing circuit.

588, for a charge-forming device having the quantity of auxiliary air or oxygen added to the combustible mixture controlled by engine temperature.

**339.23 Controlling throttle bypass:**
This subclass is indented under subclass 339.19. Subject matter comprising a combustion mixture forming conduit having a means for varying its cross-sectional area and wherein (a) a fluid passage extends from a location upstream from the means for varying the cross-sectional area of the mixture forming conduit to a location downstream from the means for varying the cross-sectional area of the mixture forming conduit, and (b) a device controls the flow of fluid through the fluid passage to vary the minimum engine output shaft operating speed.

SEE OR SEARCH THIS CLASS, SUBCLASS:
585+, for a charge-forming device having a quantity of auxiliary air or oxygen added to the combustible mixture.

SEE OR SEARCH CLASS:
251, Valves and Valve Actuation, appropriate subclasses for specific details of a valve of general utility.

**339.24 Temperature responsive:**
This subclass is indented under subclass 339.14. Subject matter wherein the electrically powered adjusting means adjusts the minimum engine shaft operating speed in response to changes in temperature (e.g., temperature of an engine component, engine fluid, or the ambient environment).

SEE OR SEARCH THIS CLASS, SUBCLASS:
179.16+, for an engine starting device with fuel or intake air control.
588, for a charge-forming device having the quantity of auxiliary air or oxygen added to the combustible mixture controlled by engine temperature.

**339.25 Including rotary actuator:**
This subclass is indented under subclass 339.14. Subject matter wherein the electrically powered adjusting means includes a member which is turned about an axis by a source of electrical energy.

(1) Note. The member may turn about its axis less than 360 degrees and still be proper for this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:
361, for electrical sensing or regulating of engine speed with the engine being part of a closed loop condition responsive feedback system and an engine speed error producing circuit controlling an electric throttle operator.
399, for an open loop condition responsive engine speed regulator having an electrical device between the input and the speed regulator.
585+, for a charge-forming device having a quantity of auxiliary air or oxygen added to the combustible mixture.

SEE OR SEARCH CLASS:
251, Valves and Valve Actuation, appropriate subclasses for a valve of general utility and a valve actuator therefor, and especially subclasses 129.01+ for an electrically actuated valve.

**339.26 Stepping motor type:**
This subclass is indented under subclass 339.25. Subject matter comprising (a) a device which converts electrical energy into mechanical energy which tends to assume a predetermined angular position in response to being continuously energized, and indexes in discreet angular increments of essentially uniform magnitude as a function of electrical pulse inputs, and (b) wherein the member which is turned about its axis is driven by the device.

SEE OR SEARCH CLASS:
310, Electrical Generator or Motor Structure, appropriate subclasses, especially subclasses 49+ for a specific rotary step-by-step motor of general utility, per se.

**339.27 Including linear reciprocating solenoid control device:**
This subclass is indented under subclass 339.14. Subject matter wherein the electrically powered adjusting means comprises an actua-

tor which uses electrical energy to change the position of a movable element to regulate the minimum output shaft operating speed, the actuator having a coil and an armature, and the coil and armature being mounted for relative movement in a straight line back and forth along its axis when the coil is energized.

SEE OR SEARCH THIS CLASS, SUBCLASS:

339.25, for an idle speed control including a device having a rotary actuator.

585+, for a charge-forming device having a quantity of auxiliary air or oxygen added to the combustible mixture.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, especially subclasses 129.09+ for plural solenoid valve arrangements, and subclasses 129.15+ for solenoid valves, per se.

310, Electrical Generator or Motor Structure, subclasses 15+ for an electromagnetic reciprocating motor, of general utility, in which the elements move in a straight line.

335, Electricity: Magnetically Operated Switches, Magnets, and Electromagnets, subclasses 220+ for specific details of an electromagnet having an armature.

**339.28 Having valve controlled vacuum actuator:**
This subclass is indented under subclass 339.27. Subject matter wherein the electrically powered adjusting means controls the flow of a fluid through a passage connected to an expansible chamber of negative fluid pressure, and the negative fluid pressure in the chamber is used to actuate the movable element that varies the minimum output shaft operating speed.

**339.29 By overriding injection pump governor:**
This subclass is indented under subclass 339.1. Subject matter (a) comprising a fuel pressurizing and metering device, a mechanical fuel quantity regulator that varies the amount of fuel fed to the engine from the fuel pressurizing and metering device at all operating speeds, and (b) wherein the means for adjusting the minimum output shaft operating speed of the internal combustion engine modifies operation of the mechanical fuel quantity regulator when the engine is at the minimum output shaft operating speed.

SEE OR SEARCH THIS CLASS, SUBCLASS:

339.13, for an idle speed control having manual adjustment.

**342 Regulator changes length of accelerator linkage:**
This subclass is indented under subclass 319. Subject matter having means to change the length of the linkage connecting the engine throttle valve and the operating lever or pedal.

(1) Note. Changing the linkage length changes the amount that the throttle valve may be opened.

**343 Regulator accessory (e.g., cleaner, adjusting tool, etc.):**
This subclass is indented under subclass 319. Subject matter for use with an engine speed regulator not provided for elsewhere.

(1) Note. Including accessory safety device, cleaner, tool.

**344 Charge proportion varying (e.g., the fuel-air ratio is varied):**
This subclass is indented under subclass 319. Subject matter including means for regulating the speed of an engine by automatically varying the relative amount of air and fuel forming the combustible charge.

(1) Note. The volume of each successive charge remains constant and the pressure thereof being at or substantially at atmospheric pressure at the beginning of the compression stroke. The proportion of air and fuel may be varied by (a) controlling the flow of both air and fuel, (b) controlling the flow of one constituent, leaving the other uncontrolled, or (c) supplying variable and regulated quantities of an air-fuel mixture to the working cylinder along with an additional amount of fluid as is necessary to fill the cylinder at atmospheric pressure.

**345 By changing valve lift:**
This subclass is indented under subclass 319. Subject matter in which the speed regulator acts to alter the lift of a cyclically operated valve controlling the flow of the fuel-air mixture to or from the combustion chamber.

(1) Note. A device which shuts this value or which holds it to a constant lift less than full lift is also properly classified in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:
347, and 348, for a device which holds the valve at full open position.

**346 Intake valve lift altered:**
This subclass is indented under subclass 345. Subject matter in which the regulated valve is the mixture inlet valve.

**347 By changing valve timing:**
This subclass is indented under subclass 319. Subject matter in which the speed regulator acts to alter the timing of a cyclically operated valve controlling the flow of the fuel-air mixture to or from the combustion chamber.

(1) Note. Such a device which shuts the valve or which holds its lift to a constant valve less than full lift is classified in subclass 345. A device which holds the valve at full open is properly classified in this subclass.

**348 Intake valve timing altered:**
This subclass is indented under subclass 347. Subject matter in which the cyclically operated valve is the mixture inlet valve.

**349 Having condition responsive means with engine being part of a closed feedback system (e.g., cruise control):**
This subclass is indented under subclass 319. Subject matter in which the speed regulator (a) responds to an engine parameter and produces an initial speed control output to alter the present speed of the engine, (b) monitors the engine's response to this initial speed control output, and (c) if necessary, modifies the speed control output of the regulator.

SEE OR SEARCH CLASS:
180, Motor Vehicle, subclasses 170+ for a vehicle speed regulating system.

**350 Electrical sensing or regulating:**
This subclass is indented under subclass 349. Subject matter in which the parameter is electrically sensed or in which the regulating action is electrically effected.

SEE OR SEARCH CLASS:
180, Motor Vehicles, subclasses 170+ for an electrical vehicle speed regulator.
251, Valves and Valve Actuation, subclass 30.01 for electromagnetically actuated fluid pressure pilot valve, and subclasses 129.01+ for electrically operated valves.
290, Prime-Mover Dynamo Plants, subclasses 40+ for general purposes speed regulating systems for generators.

**351 Engine overspeed sensing with an indicator or alarm and speed regulation:**
This subclass is indented under subclass 350. Subject matter in which the engine speed is sensed and the speed regulated to decrease rpm when the engine speed is higher than a predetermined limiting speed, and combined with an overspeed alarm or indicator.

**352 Engine speed sensing having an error signal producing circuit:**
This subclass is indented under subclass 350. Subject matter in which the regulator employs a specific type or design of circuit to (a) compare the actual engine speed with a desired or preset speed, and (b) produce an output signal when the two speeds are unequal.

**353 Having variable duty cycle multivibrator (e.g., length of "time on" in each cycle):**
This subclass is indented under subclass 352. Subject matter in which the regulator employs an output of a variable duty cycle controlled oscillator to effect the speed regulation.

(1) Note. The oscillator or multivibrator operates at a constant frequency with regulation effected by varying the length or "on" time of the output control pulse.

**354 Having variable frequency multivibrator (e.g., number of "time ons" per unit of time):**
This subclass is indented under subclass 352. Subject matter in which the regulator includes a variable frequency oscillator or multivibrator having a constant length output pulse.

**355 Having phase difference detector:**
This subclass is indented under subclass 352. Subject matter in which the error signal producing circuit has means to compare an electrical signal representative of the desired engine speed with an electrical signal representative of the actual engine speed in order to determine if the two signals are coincident in time (in phase) with each other, thereby producing an error signal if the signals compared are found not to be coincident in time (out of phase).

**356 Circuit resonates (e.g., tuned) at governed speed:**
This subclass is indented under subclass 352. Subject matter in which the error signal producing circuit has means to compare the actual engine speed to the desired engine speed and contains means to tune the circuit so that the circuit resonates or oscillates, producing no error signal output when the speeds compared are the same.

**357 Electric fuel injection pump governor:**
This subclass is indented under subclass 352. Subject matter in which the output of the error signal producing circuit is used to control the engine speed by controlling the fuel delivery of a fuel injection pump.

**358 Max-min governor (i.e., no control in between):**
This subclass is indented under subclass 357. Subject matter in which the circuit output regulates the fuel injection pump output to maintain a minimum engine speed and prevent engine speed from exceeding a maximum value.

**359 Fail-safe feature (e.g., cuts off fuel pump):**
This subclass is indented under subclass 357. Subject matter in which safety means is provided to effect backup control when part of the electric regulator fails.

(1) Note. The said safety means may cut off the pump, reduce the pump output to effect engine idling, etc.

**360 Circuit controls a fluid throttle operator (e.g., vacuum):**
This subclass is indented under subclass 352. Subject matter in which the output of the circuit is used to control a throttle valve or speed adjusting mechanism that is fluid powered.

(1) Note. The fluid may be air (vacuum or pressurized), lubricating oil, fuel, etc.

**361 Circuit controls an electric throttle operator:**
This subclass is indented under subclass 352. Subject matter in which the output of the circuit is used to control a throttle valve or speed adjusting mechanism that is electrically powered.

**362 Cold engine control:**
This subclass is indented under subclass 350. Subject matter in which the regulator includes means to effect special control of engine speed during engine starting or warm-up conditions.

**363 Mechanical sensor or regulator:**
This subclass is indented under subclass 349. Subject matter in which the sensor or regulator is a mechanical device, e.g., lever, gear, cam.

**364 Fuel injection pump governor (e.g., diesel):**
This subclass is indented under subclass 363. Subject matter in which the engine employs a fuel injector regulator to control the speed of the engine by adjusting the amount of fuel fed to the engine by its fuel injection pump.

(1) Note. The regulator usually controls the position of a pump "rack" or control rod to regulate fuel quantity in response to at least engine speed, and may be responsive to other engine parameters as well.

SEE OR SEARCH THIS CLASS, SUBCLASS:
375, for fuel delivery rate controlled by fuel pressure.

**365 Governor override:**
This subclass is indented under subclass 364. Subject matter in which means is provided to prevent or modify normal action of the regulator.

(1) Note. The means may be provided for as an integral part of the speed regulator.

**366 Engine starting or warm-up control:**
This subclass is indented under subclass 365. Subject matter in which the means for modifying normal action of the injection pump governor is operative during starting or warm-up of the associated engine.

**367 Variable throttle or control rod stop:**
This subclass is indented under subclass 365. Subject matter in which the means for modifying normal action of the injection pump governor operates to limit the distance that the governor can move the control rod (rack) of the pump.

**369 Three-dimensional cam control:**
This subclass is indented under subclass 364. Subject matter in which the governor includes a rotary cam whose profile is such that axial movement of the cam is effective to alter the cam lift action (e.g., at one axial extreme the cam provides maximum lift to a valve while at the other extreme minimum lift is produced).

**370 Acceleration responsive:**
This subclass is indented under subclass 364. Subject matter in which the governor includes means for special adjustment of the pump output in response to a sudden demand for an increase in the power output of the engine (acceleration).

**371 Deceleration responsive:**
This subclass is indented under subclass 364. Subject matter in which the injector pump governor is responsive to (a) high manifold vacuum, (b) closed throttle, and (c) rpm above idle.

**372 Biased axial link (e.g., sliding rod with spring return):**
This subclass is indented under subclass 364. Subject matter in which the governor regulation is effected through a biased axially moving rod or link.

(1) Note. One end of the link is connected to the fuel pump rack, i.e., member which determines pump delivery, the other end of the link is acted upon by at least one engine parameter.

SEE OR SEARCH THIS CLASS, SUBCLASS:
373+, for axial link devices in which the parameter end of the link is acted on by a pivoted link.

**373 Pivoted link connected to pump rack:**
This subclass is indented under subclass 364. Subject matter in which the governor regulation is effected by a pivoted lever one end of which is connected to the fuel pump rack (member which controls pump delivery amount).

(1) Note. The lever is pivoted somewhere along its length at a fulcrum or pivot and the other end of the lever is acted upon by at least one engine parameter.

**374 Movable fulcrum (e.g., slot and pin):**
This subclass is indented under subclass 373. Subject matter in which the point at which the lever is pivoted (fulcrum point) is movable.

**375 Fuel injection pressure governor:**
This subclass is indented under subclass 363. Subject matter wherein speed regulation is effected by means that controls the fuel injection pressure.

**376 Throttle positioning:**
This subclass is indented under subclass 363. Subject matter in which the speed regulator is effected by means controlling the position of an engine intake throttle.

**377 Safety override of dangerous manual position:**
This subclass is indented under subclass 376. Subject matter wherein feedback means is provided to override a manually positioned throttle so as to prevent an unsafe or undesired engine operating condition.

**378 Fluidic sensor or regulator:**
This subclass is indented under subclass 349. Subject matter wherein the engine speed or other parameter sensed, the sensing action, the regulator, or the output control actuator is fluidic.

(1) Note. The term fluidic is intended to include pneumatic or hydraulic controls or a fluidic amplifier.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclasses 479+ for combustion engine induction-type valves which are responsive to changes in line condition.

**379 Fuel injection pump governor:**
This subclass is indented under subclass 378. Subject matter in which the fuel for the engine is provided to an engine cylinder or intake manifold by a fuel injection pump and in which the speed of the engine is regulated by varying the delivery amount of the pump.

(1) Note. The system must include a speed input to a speed regulator and must be fluidic. The system is generally used on diesel or a compression ignition engine but can include Otto or a spark ignition engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
390, for fuel delivery rate controlled by fuel pressure.

**380 Barometric sensor:**
This subclass is indented under subclass 379. Subject matter wherein atmospheric pressure is an input parameter to the injection pump governor.

**381 Fuel viscosity sensor (e.g., temperature sensing):**
This subclass is indented under subclass 379. Subject matter wherein the viscosity of the injected fuel is an input parameter to the injection pump governor.

(1) Note. This input may be fuel temperature.

**382 Manifold pressure sensor:**
This subclass is indented under subclass 379. Subject matter where the engine intake manifold pressure is a parameter input to the fuel injection pump governor.

(1) Note. This subclass includes sensing the pressure at a venturi in the intake manifold.

**383 Supercharger:**
This subclass is indented under subclass 382. Subject matter where a supercharger or other means of pressurizing the engine intake air is employed.

**384 Floating piston-type governor (e.g., Bessiere):**
This subclass is indented under subclass 379. Subject matter in which the injection pump governor includes a freely floating piston whose position within the pumping cylinder is determined by (a) the amount of fluid trapped between said floating piston and a second driving piston, and (b) the position of the driving piston, and in which the effective pumping stroke may be controlled by varying the amount of trapped fluid during part or all of the pumping cycle.

**385 Liquid fluid governor:**
This subclass is indented under subclass 379. Subject matter in which the sensor or regulating action of the governor is provided by means that makes use of a liquid fluid.

**386 Lubrication pressure sensor:**
This subclass is indented under subclass 385. Subject matter in which the governor control means is responsive to the pressure of the fluid used to lubricate the engine.

**387 Fuel pressure sensor:**
This subclass is indented under subclass 385. Subject matter in which the fluid is the fuel that is to be burned in the engine.

**388 Override for basic mechanical governor:**
This subclass is indented under subclass 385. Subject matter in which liquid fluid means acts to modify or prevent operation of a mechanical governor. This may occur during starting, cold engine operation, etc.

**389 Intake manifold vacuum responsive:**
This subclass is indented under subclass 378. Subject matter where the speed regulator utilizes engine intake manifold vacuum as in input.

**390 Fuel injection pressure governor:**
This subclass is indented under subclass 378. Subject matter wherein speed regulation is effected by means that controls the fuel injection pressure.

**391 Responsive to intake airflow:**
This subclass is indented under subclass 378. Subject matter in which engine speed is regulated in response to the output from a device sensing the flow of air being inducted into the engine air intake.

**392 Responsive to cooling fan airflow:**
This subclass is indented under subclass 378. Subject matter in which engine speed is regulated in response to the output from a device sensing the flow of air past or through the engine cooling means.

(1) Note. Including airflow through radiator of water-cooled engine.

**393 Responsive to exhaust gas:**
This subclass is indented under subclass 378. Subject matter wherein the fluid sensed is the engine exhaust gas.

**394 By combustion air or air-fuel mixture cut-off:**
This subclass is indented under subclass 349. Subject matter wherein the flow of the engine's intake air or air-fuel mixture is throttled or cut-off by a valve means in the engine intake (other than the engine throttle) acting in response to engine speed.

(1) Note. The valve means may itself sense the engine rpm by responding to airflow rate.

**395 Open loop condition responsive:**
This subclass is indented under subclass 319. Subject matter in which speed regulating means responds to (a) an engine parameter, or (b) an environmental condition to alter the present engine speed without regard to the resulting engine speed.

**396 Resistance or override acts on input connection to regulator:**
This subclass is indented under subclass 395. Subject matter in which condition responsive means are provided to alter or override the action of a speed control of the engine.

(1) Note. Included in this subclass are devices that act to override a closed-loop device but do not themselves have a feedback system.

**397 Shutdown safety device:**
This subclass is indented under subclass 396. Subject matter which acts to place the speed regulator at idle or full stop position when a condition indicating an unsafe or otherwise undesirable engine condition occurs.

**398 Throttle position lock:**
This subclass is indented under subclass 396. Subject matter that act in response to a sensed condition to lock the speed regulator at a particular throttle position.

**399 Having an electrical device between input and speed regulator:**
This subclass is indented under subclass 395. Subject matter in which there is some electrical device in the control path between the sensed engine condition and the actual engine speed regulator.

(1) Note. This includes any condition sensor, comparison circuitry, or output actuator. This subclass includes any system in which only a part of the control path is electrical.

**400 Mechanical connection between input and speed regulator:**
This subclass is indented under subclass 395. Subject matter in which the control path between the sensed engine condition and the actual engine speed regulator is mechanical.

**401 Fluidic device between input and regulator:**
This subclass is indented under subclass 395. Subject matter in which there is some fluidic device-hydraulic or pneumatic-in the control path between the sensed engine condition and the engine speed regulator.

(1) Note. This includes any condition sensor, comparison device, or output actuator. This subclass includes any system in which only a part of the control path is fluidic.

**402 Charge volume varying (e.g., total amount of mixture fed to engine is varied; relative amounts of air and fuel are fixed):**
This subclass is indented under subclass 319. Subject matter for regulating the speed of an internal combustion engine by varying the volume at constant pressure of successive charge of air-fuel mixture fed to the working cylinder.

(1) Note. The relative amount of air and fuel is fixed.

**403 Throttling (e.g., volume varying using throttle valve):**
This subclass is indented under subclass 402. Subject matter in which the flow of fuel, oxidant, or combustible mixture to the engine or mixing chamber is controlled by varying the cross-sectional area of the mixture conduit or of the conduits of the components of the mixture, thereby varying the volume of charge for induction into the engine cylinder.

**404 Suction operated supply valve lift regulating:**
This subclass is indented under subclass 402. Subject matter in which the volume of the charge of combustible mixture to the engine is varied by controlling the degree of opening or amount of lift of an intake valve whose operation is dependent on the suction created in the cylinder during the intake stroke.

**405 By engine operated valve:**
This subclass is indented under subclass 402. Subject matter in which said device includes an engine driven valve and acts either to open the valve to a variable degree during the entire engine intake stroke, or open the valve during variable portions of the intake stroke.

(1) Note. The regulator may include a valve to control the flow of mixture or valves to individually control the flow of the mixture constituents.

**406.11 SPARK IGNITION TIMING CONTROL:**
This subclass is indented under the class definition. Subject matter wherein (a) a short pulse or flow of electric current which arcs across a pair of electrodes in the combustion chamber is used to cause a mixture of combustible material and oxidant in the combustion chamber to burn (i.e., spark ignition), (b) the engine has a point of piston travel or crankshaft rotation during each combustion cycle at which the spark ignition occurs (i.e., spark ignition timing), and (c) the engine has a regulator means (i.e., control) to vary spark ignition timing in response to a change in either (1) an engine operating condition (e.g., temperature, load, etc.), (2) an ambient operating condition (e.g., ambient temperature, barometric pressure, etc.) or (3) the position of a manually operated control device.

SEE OR SEARCH THIS CLASS, SUBCLASS:

146.5, for a mechanical ignition distributor in combination with an internal combustion engine.

179.5, for control of spark ignition during starting which do not include timing control.

329, for an engine speed regulator control responsive to a deceleration mode including means to retard spark ignition timing.

339.11, for idle speed control of an internal combustion engine by regulating spark ignition timing.

594+, for spark ignition systems which do not include timing control.

SEE OR SEARCH CLASS:

200, Electricity: Circuit Makers and Breakers, subclasses 19.01+ for a periodic circuit maker and breaker and subclasses 80+ for a centrifugal circuit maker and breaker (e.g., an ignition distributor, rotor or breaker points).

324, Electricity: Measuring and Testing, subclasses 378+, for means for testing electrical ignition systems for internal combustion engines

464, Rotary Shafts, Gudgeons, Housing, and Flexible Couplings For Rotary Shafts, subclasses 1+ for a particular relationship between a rotary shaft of a component such as an ignition distributor and ignition points.

**406.12 Electronic control:**

This subclass is indented under subclass 406.11. Subject matter wherein the regulator means for varying spark ignition timing includes an electrical component which either (a) modifies an electrical input signal to the component, or (b) creates an electrical output signal from the component.

(1) Note. An electronic control to be proper for this and the indented subclasses must do more than merely complete a circuit (e.g., a switch), it must modify the electrical input signal being received or create an electrical output signal (e.g., amplification, signal generation, signal processing, signal control, etc.). Therefore, a transistor acting as a switch would be proper.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.67+, for ignition timing control actuated by engine vacuum.

406.75, for a centrifugal ignition timing mechanism.

SEE OR SEARCH CLASS:

701, Data Processing: Vehicles, Navigation, and Relative Location, subclasses 101+ for a data processing system associated with an internal-combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.13 With fail-safe, backup or malfunction detecting means:**

This subclass is indented under subclass 406.12. Subject matter wherein the regulating means to vary spark ignition timing includes electrical adjusting means that upon detecting failure in a circuit or circuit element (a) shifts operation (1) into a substitute circuit or (2) to a substitute mechanism to accomplish the same function, or (b) indicates functioning of the circuit or circuit element outside of acceptable parameters.

SEE OR SEARCH THIS CLASS, SUBCLASS:

519, for a fail-safe, backup or malfunction detecting circuit for an engine fuel system having a fuel vapor recovery and storage system having an absorbent canister.

568.15, for a fail-safe, backup, or malfunction detecting means for an exhaust gas recirculation (EGR) system.

630+, for a safety device for a high tension ignition system which do not include timing control.

690, for a fail-safe, backup or malfunction detecting means for an exhaust gas condition responsive combustion charge forming device.

SEE OR SEARCH CLASS:

324, Electricity: Measuring and Testing, subclasses 378+ for electrical measuring and testing of internal combustion engine ignition systems or device.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 107 for a digital or programmed data processing system associated with an internal combustion engine designed to detect an abnormality in operating conditions and carry out the appropriate sequence of instructions to stabilize the air/fuel ratio or fuel injection operation, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.14 Including spark failure responsive means (e.g., misfire):**
This subclass is indented under subclass 406.13. Subject matter wherein the regulating means to vary spark ignition timing includes means to detect the omission of the short pulse or flow of electric current which arcs across the pair of electrodes in the combustion chamber of the internal combustion engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
435, for a combustion charge forming device having means responsive to cylinder temperature or pressure.
436, for a combustion charge forming device having means responsive to an instantaneous change in engine speed (e.g., roughness).

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 35.01+ for explosive-detonation or knock measuring and testing, and subclasses 116+ for motor and engine testing.
324, Electricity: Measuring and Testing, subclass 399 for electrical measuring and testing of spark plug condition.

**406.15 Fuel sensor malfunction responsive:**
This subclass is indented under subclass 406.13. Subject matter wherein the regulating means is responsive to a signal indicative of a cessation of proper functioning (i.e., outside of normal operating parameters) of a transducer sensitive to a characteristic of that component of the combustible mixture which is consumed to produce energy (i.e., fuel).

SEE OR SEARCH THIS CLASS, SUBCLASS:
479, for malfunction detecting circuit for an engine fuel injection system having an electrically actuated fuel injector.

**406.16 Knock control malfunction responsive:**
This subclass is indented under subclass 406.13. Subject matter wherein the regulating means is responsive to a signal indicative of a cessation of proper functioning of a circuit means which is responsive to an unusually high force (i.e., outside of normal operating parameters) of a shock wave produced when the mixture of combustible material and oxidant in the combustion chamber is detonated.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.21, for an engine knock responsive spark ignition timing control having closed loop feedback control with separate control for each cylinder.
406.29+, for an engine knock responsive spark ignition timing electronic control.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 35.01+ for explosive-detonation or knock measuring and testing.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.17 Cylinder pressure sensor malfunction responsive:**
This subclass is indented under subclass 406.13. Subject matter wherein the regulating means is responsive to a signal indicative of a cessation of proper functioning of a transducer which responds to changes of pressure of fluid (e.g., combustible mixture, products of combustion, etc.) in the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.22, for an engine cylinder pressure responsive spark ignition timing electronic control having closed loop feedback control with separate control for each cylinder.
406.41+, for an engine cylinder pressure responsive spark ignition timing electronic control.

**406.18 Engine shaft rotational position sensor malfunction responsive (e.g., crank shaft, cam shaft):**
This subclass is indented under subclass 406.13. Subject matter wherein (a) the engine includes an elongated member located in the engine block or in the cylinder head which continuously turns in the same direction about its axis during engine operation and transmits torque or motion and (b) the regulating means is responsive to a signal indicative of a cessation of proper functioning of a transducer which responds to changes in rotational displacement of the elongated member.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.58+, for an engine shaft rotational position responsive spark ignition timing electronic control.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 116+ for motor and engine testing.

**406.19 Closed loop feedback control of spark timing:**
Subject matter under subclass **406.12** wherein the regulating means (a) measures an actual engine parameter, and produces an initial control output signal to alter spark ignition timing, (b) compares the measured parameter to a target value, and (c) if necessary, modifies the spark ignition timing to cause the measured parameter to achieve the target value.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclasses 101+ for a data processing system associated with an internal-combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.2 Separate control for each cylinder:**
Subject matter under subclass 406.19 wherein the regulating means varies the spark ignition timing for each combustion chamber individually.

**406.21 Knock responsive:**
This subclass is indented under subclass 406.2. Subject matter wherein the regulating means is responsive to a signal indicative of an unusually high force (i.e., outside of normal operating parameters) of a shock wave produced when the mixture of combustible material and oxidant in the combustion chamber is detonated.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.16, for a spark ignition timing electronic control responsive to engine knock control malfunction.
406.29+, for an engine knock responsive spark ignition timing electronic control without separate timing control for each cylinder.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 35.01+ for explosive-detonation or knock measuring and testing.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.22 Cylinder pressure responsive:**
Subject matter under subclass 406.2 wherein the regulating means is responsive to a signal indicative of the force per unit area of either (a)the combustible material or (b) the products of combustion in the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.17, for a spark ignition timing electronic control which is responsive to malfunction of an engine cylinder pressure sensor.
406.41+, for an engine cylinder pressure responsive spark ignition timing electronic control without separate timing control for each cylinder.

**406.23 Engine output (e.g., torque, speed, horsepower) or fuel consumption optimization:**
This subclass is indented under subclass 406.19. Subject matter wherein the regulating means responds to a signal indicative of either (a) the power or force produced by the internal combustion engine, or (b) the rate at which the combustible material is burned, and (c) continuously varies the spark ignition timing to obtain either (1) the best attainable power or force produced by the engine, or (2) the best rate, for a given set of conditions, at which the supply of the combustible material is used.

SEE OR SEARCH THIS CLASS, SUBCLASS:
436, for a charge forming device including means responsive to instantaneous change in engine speed.

**406.24 Including means responsive to the instantaneous change in engine speed (e.g., roughness, unstable combustion, etc.):**
Subject matter under subclass 406.19 wherein the regulating means is responsive to sudden variations in the rate of rotation of an engine output shaft.

(1) Note. The patents placed in this and the indented subclass must at least sense and respond to instantaneous changes in engine speed. Those patents which sense and respond to changes in the combustion chamber without sensing instantaneous changes in engine speed are classified in the subclasses below.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.2+, for an engine spark ignition timing control having a closed loop feedback control with separate control for each cylinder.
406.26+, for an engine spark timing control responsive to sensed changes within the combustion chamber.
436, for a charge forming device including means responsive to instantaneous change in engine speed.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.25 Acceleration or deceleration responsive:**
This subclass is indented under subclass 406.24. Subject matter wherein the regulating means is responsive to a sudden demand for an increase or decrease in the power or torque output of the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.5+, for an open loop spark ignition timing control responsive to an acceleration or deceleration engine condition.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 116+ for internal-combustion engine testing, per se.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 110 for a digital or programmed data processing system associated with an internal combustion engine, designed to include the regulation of the vehicle speed, acceleration, or deceleration, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.26 Combustion condition responsive:**
This subclass is indented under subclass 406.19. Subject matter wherein the regulating means senses a characteristic or parameter indicative of the state of burning of the combustible mixture (e.g., temperature, pressure, etc.) and uses such information to modify spark ignition timing.

SEE OR SEARCH THIS CLASS, SUBCLASS:

435, for a combustion charge forming device having means responsive to cylinder temperature or pressure.

**406.27 Combustion failure responsive (e.g., misfire):**

This subclass is indented under subclass 406.26. Subject matter wherein the regulating means to vary spark ignition timing includes means to detect a complete omission of the burning of the combustible mixture.

SEE OR SEARCH THIS CLASS, SUBCLASS:

436, for a charge forming device including means responsive to instantaneous change in engine speed.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 116+ for engine testing.

**406.28 Combustion condition sensed by optical sensor:**

This subclass is indented under subclass 406.26. Subject matter wherein the condition or parameter is detected by a transducer responsive to visible, infrared, or ultraviolet radiation within the combustion chamber.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 35.01+ for an optical sensor for detecting a combustion condition.

250, Radiant Energy, appropriate subclasses for an optical sensor, per se.

**406.29 Engine knock responsive:**

This subclass is indented under subclass 406.26. Subject matter wherein the regulating means is responsive to a signal indicative of an unusually high force (i.e., outside of normal operating parameters) of a shock wave produced when the combustible mixture of combustible material and oxidant in the combustion chamber is detonated.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.16, for a spark ignition timing electronic control responsive to knock control malfunction.

406.21, for a spark ignition timing electronic control having a closed loop feedback control of timing with a separate knock responsive control for each cylinder.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 35.01+ for explosive-detonation or knock measuring and testing.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.3 Fuel quality or composition signal responsive:**

This subclass is indented under subclass 406.29. Subject matter wherein the regulating means to vary spark ignition timing is additionally responsive to a signal indicative of either (a) how well the combustible material burns (e.g., octane rating, grade) or (b) the relative proportion of constituent chemicals in the combustible material.

SEE OR SEARCH CLASS:

73, Measuring and Testing, appropriate subclasses, especially subclasses 53.01+ for a fuel quality or composition sensing, per se.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 103 for digital or programmed data processing system associated with an internal combustion engine, designed to control the air/fuel ratio or the injection of fuel based on engine operating conditions or environmental conditions, where significant details of the mechanical construction of the

component or subsystem within a vehicle are not claimed.

**406.31 Alcohol concentration responsive:**
This subclass is indented under subclass 406.3. Subject matter wherein the regulating means to vary spark ignition timing is additionally responsive to a signal indicative of the relative proportion of a colorless, volatile, flammable liquid,, produced by yeast fermentation of carbohydrates or, synthetically, by hydration of ethylene (e.g., C2H5OH) (i.e., alcohol) per unit of volume of combustible material.

**406.32 Having a plurality of speed/load maps related to fuel quality or composition:**
Subject matter under subclass 406.3 wherein the regulating means to vary spark ignition timing includes (a) more than one digital memory table addressed by both the rate of rotation of the engine output shaft and the resistance to rotation of the engine output shaft and (b) wherein one of the tables is selected according to the signal indicative of either (1) how well the combustible material burns (e.g., octane rating, grade) or (2) the relative proportion of constituent chemicals in the combustible material (e.g., composition).

(1) Note. The engine load may be indicated by fuel injection quantity.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 115 for a digital or programmed data processing system associated with an internal combustion engine, includes specific structure to function either as data storage or as an information interconnecting device, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.33 With modifying or updating memory (i.e., learning):**
Subject matter under subclass 406.29 wherein the regulating means to vary spark ignition timing includes an information storage section for storing values of spark ignition timing adjustment, the values being stored at a plurality of memory locations, and wherein the stored values may be replaced by newly determined values to produce the desired spark ignition timing.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 106 the digital or programmed data processing system associated with an internal combustion engine, designed to indicate information or control the air/fuel ratio or fuel injection by the manipulation of a value of a predetermined function of antecedent and consequent operations corresponding to the operating conditions of the combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed

**406.34 Modification of knock signal by engine operating condition signal:**
This subclass is indented under subclass 406.29. Subject matter wherein the regulating means to vary spark ignition timing (a) generates a signal indicative of a measured actual engine operational parameter (e.g., engine speed, engine temperature), (b) produces an initial control output signal indicative of the unusually high force (i.e., outside of normal operating parameters) of the shock wave produced when the combustible mixture of combustible material and oxidant in the combustion chamber is detonated, and (c) changes or interrupts the initial control output signal in response to the signal indicative of the measured actual engine operational parameter.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.35 Engine operating condition is load or speed:**
This subclass is indented under subclass 406.34. Subject matter wherein the operational parameter is indicative of either (a) a resistance to rotation of an engine output shaft, or (b) the rate of rotation of (1) the engine output shaft, or (2) of a component driven by the engine output shaft.

(1) Note. The engine load may be indicated by an intake manifold pressure, throttle position, or intake airflow quantity signal.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 110 for a digital or programmed data processing system associated with an internal combustion engine, designed to include the regulation of the vehicle speed, acceleration, or deceleration, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.36 Acceleration or deceleration responsive:**
This subclass is indented under subclass 406.35. Subject matter wherein the regulating means is responsive to a sudden demand for either (a) an increase in the power or torque output of the engine or (b) a decrease in the power or torque output of the engine.

(1) Note. Acceleration or deceleration may be indicated by the rate of change of engine speed or load.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.5+, for an acceleration or deceleration responsive spark ignition timing electronic control which is not responsive to combustion condition.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 116+ for internal-combustion engine testing, per se.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 110 for a digital or programmed data processing system associated with an internal combustion engine, designed to include the regulation of the vehicle speed, acceleration, or deceleration, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.37 Having specific knock detecting means:**
This subclass is indented under subclass 406.29. Subject matter including a particular structural aspect of either (a) the transducer for sensing a characteristic of the force of the shock wave or (b) the complete path of an electric current, including the generating apparatus, intervening resistors, or capacitors for sensing a characteristic of the force of the shock wave.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 35.07+ for explosive-detonation or knock measuring and testing.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.38 Knock frequency distribution pattern responsive:**
This subclass is indented under subclass 406.37. Subject matter wherein an amplitude of the signal indicative of the unusually high force (i.e., outside of normal operating parameters) of the shock wave produced when the combustible mixture of combustible material and oxidant in the combustion chamber is detonated is measured, and the amplitude measurements of the signal are classified according to the number of occurrences per unit of time.

(1) Note. The pattern may be represented as a graph plotting frequency of knock signals against knock signal amplitude measurements.

**406.39 Knock signal counting:**
This subclass is indented under subclass 406.37. Subject matter wherein the regulating means totals the signals indicative of the unusually high force (i.e., outside of normal operating parameters) of the shock wave produced when the combustible mixture of combustible material and oxidant in the combustion chamber is detonated is measured over a predetermined interval.

(1) Note. The predetermined interval may be a period defined by a specific number of engine rotations, a particular portion of one engine rotation, or a predetermined time period.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 111 for a digital or programmed data processing system associated with an internal combustion engine, designed to control or sense vibration, roughness, or knocking condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.4 And specific system component mounting or location details:**
This subclass is indented under subclass 406.37. Subject matter including a particular structural aspect of a means for attaching to the engine either (a) a portion of the regulating means or (b) the transducer for sensing a characteristic of the force of the shock wave.

**406.41 Engine cylinder pressure responsive:**
This subclass is indented under subclass 406.26. Subject matter wherein the regulating means is responsive to a signal indicative of the force per unit area of either (a)the combustible material or (b) the products of combustion in the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.17, for a spark ignition timing electronic control responsive to malfunction of an engine cylinder pressure sensor.
406.22, for a spark ignition timing electronic control with closed loop feed back control for each engine cylinder separately, the control being responsive to engine cylinder pressure.
435, for an internal combustion engine charge forming device responsive to engine cylinder pressure.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclass 115 for a device for testing engine cylinder pressure as related to engine performance.

**406.42 Peak pressure responsive:**
Subject matter under subclass 406.41 wherein the regulating means is responsive to the point in a combustion event at which the force per unit area of either (a) the combustible material or (b) the products of combustion in the combustion chamber reaches the greatest magnitude.

**406.43 Responsive to derivative, integral or average of pressure:**
This subclass is indented under subclass 406.41. Subject matter wherein the regulating means for varying spark ignition timing (a) receives a signal indicative of the force per unit area of the fluid in the combustion chamber, and (b) either (1) determines a rate of change of the force per unit area as a function of time, (2) determines on a continuous basis the total value of the force per unit area being measured as a function of time, or (3) determines on a continuous basis the sum of the forces per unit area measured divided by the number of force per unit area measurements taken.

(1) Note.The signal indicative of the pressure within the combustion chamber may be treated to remove noise or distortion.

**406.44 Exhaust gas condition responsive control of spark timing:**
This subclass is indented under subclass 406.19. Subject matter wherein the regulating means to vary spark ignition timing is responsive to a signal indicative of characteristic or parameter of the products of combustion (e.g., composition, temperature, pressure, etc.) of the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

672+, for an internal combustion engine charge forming device responsive to exhaust gas condition.

SEE OR SEARCH CLASS:

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 108 for a digital or programmed data processing system associated with an internal combustion engine, designed to control the air/fuel ratio or fuel injection to change the exhaust gas system, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, subclass 109 for a digital or programmed data processing system associated with an internal combustion engine where exhaust gas circulation is controlled or modified in response to a sensed oxygen content in the exhaust gas, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.45 Including control of combustible mixture or a constituent thereof (e.g., air, fuel, exhaust gas):**

Subject matter under subclass **406.12** wherein the regulating means to vary spark ignition timing includes means to vary either (a) the (1) amount of or (2) timing of the supply of a component of the combustible mixture to the combustion chamber or (b) the relative proportion of the components of the combustible mixture supplied to the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:

434+, for a charge forming device for an internal combustion engine.

SEE OR SEARCH CLASS:

261, Gas and Liquid Contact Apparatus, appropriate subclasses for apparatus adapted to produce an intimate contact between gases and liquids, per se.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 103 for digital or programmed data processing system associated with an internal combustion engine, designed to control the air/fuel ratio or the injection of fuel based on engine operating conditions or environmental conditions, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.46 Acceleration or deceleration responsive:**

Subject matter under subclass **406.45** wherein the regulating means to vary spark ignition timing is responsive to a sudden demand for either (a) an increase in the power or torque output of the engine or (b) a decrease in the power or torque output of the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.25, for an internal combustion engine closed loop spark ignition timing electronic control responsive to engine speed roughness, and acceleration or deceleration.

406.36, for an internal combustion engine closed loop spark ignition timing electronic control responsive to engine knock, and acceleration or deceleration.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 116+ for internal-combustion engine testing, per se.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 110 for a digital or programmed data processing system associated with an internal combustion engine, designed to include the regulation of the vehicle speed, acceleration, or deceleration, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.47 With fuel injection control:**

This subclass is indented under subclass 406.45. Subject matter wherein the regulating means to vary spark ignition timing further

adjusts the spraying of liquid fuel into either (a) a passage in communication with an inlet port of the combustion chamber (i.e., an intake manifold) or (b) the combustion chamber of the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:

478+, for a charge forming device for an internal combustion engine having a an actuator circuit for an electrically actuated fuel injector.

SEE OR SEARCH CLASS:

239, Sprinkling, Spraying and Diffusing, subclasses 88+, 533.2+ and 584+ for particular fuel injector structure, per se for internal combustion engines.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 103 for digital or programmed data processing system associated with an internal combustion engine, designed to control the air/fuel ratio or the injection of fuel based on engine operating conditions or environmental conditions, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.48 With exhaust gas recirculation (EGR) control:**

This subclass is indented under subclass 406.45. Subject matter wherein the regulating means to vary spark ignition timing further varies either (a) the returning of the products of combustion exhausted from the engine combustion chamber (i.e., exhaust gas recirculation (EGR)) either (1) to a passage in communication with an inlet port of the combustion chamber (i.e., an intake manifold) or (2) directly to the combustion chamber for subsequent re-burning or (b) regulates the amount of the products of combustion which are retained in the combustion chamber for re-burning during a successive combustion event (i.e., internal exhaust gas recirculation).

SEE OR SEARCH THIS CLASS, SUBCLASS:

568.21+, an internal combustion engine charge forming device having exhaust gas used with the combustible mixture and electrical actuator control.

SEE OR SEARCH CLASS:

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 108 for a digital or programmed data processing system associated with an internal combustion engine, designed to control the air/fuel ratio or fuel injection to change the exhaust gas system, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.49 Barometric pressure responsive:**

Subject matter under subclass 406.12 wherein the regulating means to vary spark ignition timing is responsive to ambient atmospheric pressure.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.68, for a spark ignition timing control utilizing engine vacuum and responsive to barometric pressure.

**406.5 Acceleration or deceleration responsive:**

This subclass is indented under subclass 406.12. Subject matter wherein the regulating means to vary spark ignition timing is responsive to either (a)a sudden demand for an increase in the power or the torque output of the engine, or (b) a sudden demand for a decrease in the power or the torque output of the engine.

(1) Note. Acceleration or deceleration may be indicated by the rate of change of engine speed or load.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.25, for an internal combustion engine closed loop spark ignition timing electronic control responsive to engine speed roughness, and acceleration or deceleration.

406.36, for an internal combustion engine closed loop spark ignition timing electronic control responsive to engine knock, and acceleration or deceleration.

406.46, for an internal combustion engine spark ignition timing electronic control which also includes fuel or combustible mixture control and is responsive to engine acceleration or deceleration.

SEE OR SEARCH CLASS:

73, Measuring and Testing, subclasses 116+ for internal-combustion engine testing, per se.

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 110 for a digital or programmed data processing system associated with an internal combustion engine, designed to include the regulation of the vehicle speed, acceleration, or deceleration, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.51 Acceleration responsive:**

This subclass is indented under subclass 406.5. Subject matter wherein the regulating means to vary spark ignition timing is responsive to a sudden demand for an increase in the power or the torque output of the engine.

**406.52 Throttle position responsive:**

This subclass is indented under subclass 406.12. Subject matter wherein the regulating means to vary spark ignition timing is responsive to the orientation of a means for varying the cross-sectional area of a fuel and oxidant mixture forming conduit.

SEE OR SEARCH THIS CLASS, SUBCLASS:

406.74, for an internal combustion engine spark ignition timing control having a mechanical or hydraulic link to a throttle valve.

**406.53 Starting condition responsive:**

This subclass is indented under subclass 406.12. Subject matter wherein the regulating means to vary spark ignition timing detects and is responsive to an engine operational parameter during or before the engine is attempted to be put in operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:

179.5, for control of spark ignition during starting which does not include timing control.

594+, for spark ignition systems which do not include timing control, and especially, 639, for a multiple spark ignition system using a vibrator for multiple sparks upon starting, and subclass 641 for a dual ignition system having one ignition system for starting.

SEE OR SEARCH CLASS:

701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 113 for digital or programmed data processing system associated with an internal combustion engine, designed to sense or control the starting condition or warmup condition of the engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.54 Start detected by engine speed:**

This subclass is indented under subclass 406.53. Subject matter wherein the engine operational parameter is the rate of rotation of an engine output shaft during or before the engine is attempted to be put in operation that is sensed to be at a rate below a minimum normal operating rate.

**406.55 Temperature responsive (e.g., ambient, engine, etc.):**

This subclass is indented under subclass 406.12. Subject matter wherein the regulating means for varying spark ignition timing is responsive to the temperature of either (a) an engine component, (b) engine fluid, or (c) the ambient environment.

SEE OR SEARCH CLASS:

374, Thermal Measuring and Testing, subclasses 100+ for temperature measuring devices, per se.

**406.56 With magneto:**
This subclass is indented under subclass 406.12. Subject matter wherein an electric generator is driven by the engine, the electric generator has a rotating armature for converting energy from a mechanical to an electrical state by means of an electromagnetic effect, and the electric generator supplies ignition current for the internal combustion engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
149+, for internal combustion engine magneto structure, per se.

SEE OR SEARCH CLASS:
310, Electrical Generator or Motor Structure, appropriate subclasses for magneto structure of general utility, per se.

**406.57 And capacitor discharge for ignition spark energy:**
This subclass is indented under subclass 406.56. Subject matter wherein the regulating means to vary spark ignition timing includes (a) a capacitor, (b) means to charge the capacitor, and (c) means to discharge the capacitor through an ignition coil primary winding thereby creating the high voltage used for combustible mixture ignition.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.66, for an internal combustion engine spark ignition timing electronic control responsive to engine shaft rotational speed and including an RC timing circuit.
599+, for an internal combustion engine having a capacitor discharge powered by a magneto ignition circuit.

**406.58 Having engine shaft rotational position signal generator (e.g., crank shaft, cam shaft):**
This subclass is indented under subclass 406.12. Subject matter wherein (a) the engine includes an elongated member located in the engine block or in the cylinder head which continuously turns in the same direction about its axis during engine operation and transmits torque or motion and (b) the regulating means to vary spark ignition timing includes a transducer which generates an output signal indicative of the rotational displacement of the elongated member.

SEE OR SEARCH THIS CLASS, SUBCLASS:
612+, for an internal combustion engine high tension ignition system having an engine component position sensor.

**406.59 Speed responsive timing control:**
This subclass is indented under subclass 406.58. Subject matter wherein the regulating means to vary spark ignition timing is further responsive to the rate of rotation of the elongated member.

**406.6 Having counter or addressable memory (e.g., digital timing circuit):**
This subclass is indented under subclass 406.59. Subject matter wherein the regulating means to vary spark ignition timing includes a component which either (a) accumulates a total number of input pulses over a predetermined interval or (b) has an information storage section for a value for calculating ignition timing, the information storage section has a label (e.g., integer, symbol, other set of characters, etc.) designating a location where the information is stored for subsequent recall, and the information is directed to the respective label by a signal indicative of an engine parameter.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.33+, for an internal combustion engine spark ignition timing electronic control responsive to engine knock and having a digital memory.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 115 for a digital or programmed data processing system associated with an internal combustion engine, includes specific structure to function either as data storage or as an information interconnecting device, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.61 Plural engine shaft position sensors:**
This subclass is indented under subclass 406.6. Subject matter wherein the regulating means for varying spark ignition timing is responsive to more than one transducer which generate the output signal indicative of the rotational position of the same or a different elongated member.

**406.62 Position sensors at separate shafts:**
This subclass is indented under subclass 406.61. Subject matter wherein (a) one of the transducers that generates the output signal indicative of the rotational position of the elongated member monitors one elongated member and (b) another transducer generates another output signal indicative of the rotational position of another elongated member.

SEE OR SEARCH CLASS:
33, Geometrical Instruments, appropriate subclasses for position sensors, per se.
324, Electricity: Measuring and Testing, appropriate subclasses, especially subclasses 207.11+ for magnetic apparatus for measuring rotary displacement per se.

**406.63 Position sensors having different pulse rates:**
This subclass is indented under subclass 406.61. Subject matter wherein (a) the output signal from the transducer indicating rotational position of the elongated member is in the form of a momentary, sudden fluctuation in an electrical quantity (e.g., voltage or current) per unit of time, and (b) the output signal from another transducer indicating rotational position of an elongated member is in the form of another momentary, sudden fluctuation in an electrical quantity (e.g., voltage or current) per unit of time, and (c) the fluctuations per unit time are not the same.

**406.64 Memory addressed by engine speed or load:**
Subject matter under subclass **406.6** wherein (a) the information storage section has a label (e.g., integer, symbol, other set of characters, etc.) designating a location where the information is stored for subsequent recall, and (b) the information is directed to the respective label by (1) a signal indicative of the rate of rotation of the elongated member, or (2) a signal indicative of the resistance to rotation of the elongated member.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.35+, for an internal combustion engine spark ignition electronic timing control responsive to engine knock and engine speed or load.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclasses 101+ for a data processing system associated with an internal-combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, especially subclass 115 for a digital or programmed data processing system which includes specific structure to function either as data storage or as an information interconnecting device, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.65 With microprocessor:**
This subclass is indented under subclass 406.64. Subject matter wherein the regulating means for varying spark ignition timing includes an integrated computer circuit that performs all of the functions of a central processing unit for retrieving information from the information storage section according to a prestored program to either generate or change an output signal in response to a variation in an input signal, the input signal being indicative of the rate of rotation of the elongated member in the engine block.

SEE OR SEARCH CLASS:
701, Data Processing: Vehicles, Navigation, and Relative Location, subclasses 101+ for a data processing system associated with an internal-combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, especially subclass 115 for a digital or pro-

grammed data processing which includes specific structure to function either as data storage or as an information interconnecting device, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**406.66 With resistor/capacitor (RC) timing circuit (e.g., multivibrator):**
This subclass is indented under subclass 406.59. Subject matter wherein the regulating means for varying spark ignition timing includes both (a) an electrical conductor which opposes the passage of electrical current and (b) a component for accumulating and holding a charge of electricity, the component consisting of two equally charged conducting surfaces having opposite polarity signs, the surfaces being separated by a dielectric (e.g., condenser) and wherein the ignition timing is determined by a measured charge or discharge interval of the component for accumulating and holding a charge.

**406.67 Vacuum timing control:**
This subclass is indented under subclass 406.11. Subject matter wherein the regulating means for varying spark ignition timing includes an actuation device which has an enclosed space from which a gas (e.g., intake air) has been partially removed so that the gas remaining in the space exerts less pressure than the atmosphere.

**406.68 Barometric pressure responsive:**
This subclass is indented under subclass 406.67. Subject matter wherein the regulating means for varying spark ignition timing is responsive to the pressure of the ambient atmosphere.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.49, for an internal combustion engine spark ignition electronic control responsive to barometric pressure.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 384+ for barometric pressure measuring devices, per se.

**406.69 Condition responsive valve in fluid path from vacuum source:**
This subclass is indented under subclass 406.67. Subject matter wherein the actuation device includes a means for varying the cross-sectional area of a fluid conducting conduit between the enclosed space and a source of gas at less than atmospheric pressure in response to an operational parameter of the internal combustion engine.

**406.7 Temperature responsive:**
This subclass is indented under subclass 406.69. Subject matter wherein the regulating means for varying spark ignition timing is responsive to changes in temperature of either (a) an engine component, (b) an engine fluid, or (c) the ambient environment.

SEE OR SEARCH THIS CLASS, SUBCLASS:
406.55, for an internal combustion engine spark ignition timing electronic control responsive to temperature.

SEE OR SEARCH CLASS:
374, Thermal Measuring and Testing, subclasses 100+ for temperature measuring devices, per se.

**406.71 Fluid delay between vacuum source and actuator (e.g., fixed restriction):**
This subclass is indented under subclass 406.67. Subject matter wherein the regulating means includes an element which hinders the flow of gas at less than atmospheric pressure between (a) the source of the gas at less than atmospheric pressure and (b) the enclosed space that supplies and transmits a measured amount of energy for varying spark ignition timing.

**406.72 Increasing vacuum retards spark timing:**
This subclass is indented under subclass 406.67. Subject matter wherein an increase in the force provided by the gas at less than atmospheric pressure (i.e., a decrease in the pressure of the gas) causes a delay in occurrence of the short pulse or flow of electric current which arcs across the pair of electrodes in the combustion chamber during a combustion cycle.

**406.73 Plural diaphragms or actuators:**
This subclass is indented under subclass 406.67. Subject matter wherein the regulating means includes either (a) more than one thin flexible wall which separates a chamber for the gas at less than atmospheric pressure or (b) more than one actuation device.

**406.74 Mechanical or hydraulic link to throttle valve or accelerator:**
This subclass is indented under subclass 406.11. Subject matter wherein the regulating means for varying spark ignition timing includes either a mechanical or hydraulic linkage connection to either (a) a means for varying the cross-sectional area of a combustible mixture forming conduit, or (b) to a device which is manually adjusted by an operator for controlling the rate of rotation of an engine output shaft.

SEE OR SEARCH THIS CLASS, SUBCLASS:
395+, for an engine speed regulator which has an open loop condition responsive control.
406.52, for an internal combustion engine spark ignition timing electronic control responsive to engine throttle position.

**406.75 Centrifugal timing mechanism:**
This subclass is indented under subclass 406.11. Subject matter wherein the regulating means for varying spark ignition timing includes a rotating mass for producing a mechanical movement dependent upon the rate of rotation of the engine output shaft.

SEE OR SEARCH CLASS:
200, Electricity: Circuit Makers and Breakers, subclasses 19+ for a periodic circuit maker and breaker, and subclasses 80+ for a centrifugal circuit maker and breaker.
464, Rotary Shafts, Gudgeons, Housing, and Flexible Couplings for Rotary Shafts, appropriate subclasses, especially subclasses 6+ for a speed responsive device for adjusting the relative rotational position of coupled members.

**406.76 Spark delay actuated or deactuated by starting device:**
This subclass is indented under subclass 406.11. Subject matter wherein the regulating means postpones spark ignition in response to operation of a device to initiate rotation of the engine.

(1) Note. The devices classified herein are typically used in an engine having a hand operated mechanical starter, or a starter motor operating device.

**429 COMBUSTION CHAMBER MEANS COMBINED WITH AIR-FUEL MIXTURE FORMING MEANS:**
This subclass is indented under the class definition. Subject matter in which a combination of combustion chamber means and charge-forming means is claimed.

(1) Note. A particular relationship between the cyclic movement of the piston within the cylinder or the design of the combustion chamber and the formation or disposition of the mixture charge within the combustion chamber is usually disclosed.

(2) Note. The charge-forming means may be of any type except direct fuel injection of "all" fuel into the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
294, for a combination of a combustion chamber and direct injection of all fuel.

**430 Stratification in combustion chamber:**
This subclass is indented under subclass 429. Subject matter in which the combination of combustion chamber and charge-forming device is designed to produce a nonhomogeneous combustible mixture or charge in the combustion chamber.

**431 Having a single combustible mixture inlet combined with means for injecting additional fuel into the combustion chamber:**
This subclass is indented under subclass 429. Subject matter in which the combustion chamber has a single inlet passage for mixture entry

and also has an injector means for injecting additional fuel directly into the combustion chamber.

**432 Air or combustible mixture entering the combustion chamber through plural inlets:**
This subclass is indented under subclass 429. Subject matter in which the combustion chamber contains more than one inlet port for air or the combustible mixture.

**433 One inlet is uncovered by piston travel:**
This subclass is indented under subclass 432. Subject matter in which one of the air or mixture inlet ports is constructed so as to be controlled by the engine piston.

**434 CHARGE-FORMING DEVICE (E.G., POLLUTION CONTROL):**
This subclass is indented under the class definition. Subject matter including means for forming a mixture of fuel and an oxidant, or an accessory therefor not provided for elsewhere.

(1) Note. The device may use airflow through it to entrain the fuel (carburetor) or may force the fuel under pressure into the air (fuel injection). Fuel may be injected into the air intake or directly into the combustion chamber of an associated engine.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclass 482 for control of fuel supply in response to variations of barometric pressure in combustion engine induction type flow control.
261, Gas and Liquid Contact Apparatus, subclasses 38+ for carburetors, per se, including those with thermostatic or vacuum controls.

**435 Including cylinder pressure or temperature responsive means:**
This subclass is indented under subclass 434. Subject matter in which the air-fuel mixture is adjusted in the charge former in response to cylinder pressure or temperature.

**436 Including means responsive to the instantaneous change in engine speed:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device includes means to determine instantaneous changes in engine speed (roughness) and adjust the quality of the air-fuel mixture accordingly.

**437 Auxiliary control of carburetor fuel metering:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device is a carburetor in which fuel flow is primarily controlled or adjusted by venturi metering means with auxiliary fuel flow control means responsive to engine parameters other than vacuum or temperature.

SEE OR SEARCH CLASS:
261, Gas and Liquid Contact Apparatus, subclasses 38+ for carburetors having auxiliary metering control means responsive to vacuum or temperature.

**438 By electrical or electronic control system:**
This subclass is indented under subclass 437. Subject matter wherein the auxiliary control means utilizes some form of electrical or electronic circuitry in its sensing or controlling action.

**439 Variable venturi carburetor:**
This subclass is indented under subclass 438. Subject matter in which the carburetor is of the type having an airflow venturi that is variable in size.

**441 By mechanical speed sensor:**
This subclass is indented under subclass 437. Subject matter in which the means used to adjust fuel flow is mechanically responsive to engine speed.

**442 Injection or carburetion system having a series of throttle valves:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device has more than one throttle valve in series flow relation in the engine intake.

**443 Alternate or simultaneous lean-rich:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device alternately or simultaneously supplies rich mixture to some of the engine cylinders and lean mixture to the remaining engine cylinders.

(1) Note. This subclass also includes those charge-forming devices which switch from a lean or rich mixture to all cylinders to a lean or rich mixture to less than all cylinders.

**444 Having fluidic logic control means:**
This subclass is indented under subclass 434. Subject matter wherein the charge-forming device includes some type of fluidic logic or fluidic amplifying device.

**445 Fuel injection system:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device is of the type that forces the fuel under pressure into the air to form the mixture.

**446 Fuel pump flow regulation:**
This subclass is indented under subclass 445. Subject matter in which means is provided between the output of a fuel injector supply pump and a fuel injector nozzle to control or adjust the amount of fuel delivered to the engine.

**447 With accumulator:**
This subclass is indented under subclass 446. Subject matter wherein the means used to regulate the flow includes some type of fuel accumulator used to store some quantity of fuel generally under system pressure.

(1) Note. These accumulators are commonly of the spring or air-compressing type.

**448 Sequential distributor:**
This subclass is indented under subclass 446. Subject matter in which the means between the pump and injector is a device that directs the fuel to the engine cylinders in a predetermined sequence.

**449 Rotary and reciprocating distributor:**
This subclass is indented under subclass 448. Subject matter wherein the distributor valving member rotates and reciprocates with one of these motions performing the distributing of the fuel.

(1) Note. Generally the rotary motion distributes the fuel and the reciprocating motion is a fuel-pumping stroke, or an injection-timing or fuel quantity-metering adjustment.

**450 Rotary distributor:**
This subclass is indented under subclass 448. Subject matter in which the device contains a valving member that rotates about its axis to sequentially direct the fuel to the engine cylinders.

**451 Reciprocating distributor:**
This subclass is indented under subclass 448. Subject matter in which the device contains a valving member that reciprocates to sequentially direct fuel to the respective engine cylinders.

**452 Nonsequential distributor:**
This subclass is indented under subclass 446. Subject matter wherein fuel is delivered to all said engine injectors simultaneously.

**453 Enrichment of the combustible mixture for cold starting or cold running:**
This subclass is indented under subclass 452. Subject matter containing means to effect mixture enrichment during engine cold starting or running conditions. Said means to enrich the mixture may be part of the distributor or a separate device.

**454 Equal pressure valve type:**
This subclass is indented under subclass 452. Subject matter wherein the distributor includes fuel metering valves that are operated by a difference in pressure.

(1) Note. This difference in pressure is the same for all metering valves. Pressurized fuel is usually used as the pressure source.

**455 Distributor and metering unit are in common housing:**
This subclass is indented under subclass 452. Subject matter wherein the distributor that directs the fuel to the individual injectors and the fuel flow metering unit that determines how much fuel will flow to the injectors are contained in a common enclosure.

**456 Common rail system:**
This subclass is indented under subclass 452. Subject matter wherein the distributor is a fuel supply conduit containing outlets for fuel to flow to all the injectors.

(1) Note. Pressurized fuel is always present in the conduit.

**457 Regulating means adjusts fuel pressure:**
This subclass is indented under subclass 446. Subject matter wherein the flow rate of the fuel is regulated by controlling the fuel pressure in the system.

**458 Electric regulator:**
This subclass is indented under subclass 457. Subject matter wherein the regulator means is electrically operated or electrically controlled to adjust the fuel pressure.

**459 Bleed off valve:**
This subclass is indented under subclass 457. Subject matter wherein the pressure regulator adjusts the fuel pressure by bleeding some of the fuel.

(1) Note. Usually the bleed fuel is returned to the tank or pump inlet.

**460 Series regulator:**
This subclass is indented under subclass 457. Subject matter wherein said regulating means is between the pump and injector, and all fuel pumped flows through the regulator.

(1) Note. The regulator adjusts or throttles the fuel flow by changing the area of the fuel flow path.

**461 Having vapor returned to tank or pump inlet:**
This subclass is indented under subclass 457. Subject matter including means to recycle fuel vapor to the fuel tank or to the inlet of the fuel pump.

(1) Note. The vapor returned means may or may not be part of the pressure regulator.

**462 By throttle control:**
This subclass is indented under subclass 457. Subject matter including means to adjust fuel pressure in accordance with the position of the engine throttle valve.

**463 Manifold pressure responsive:**
This subclass is indented under subclass 457. Subject matter including means to adjust the fuel pressure in accordance with the pressure in the intake manifold of the engine.

**464 Temperature responsive:**
This subclass is indented under subclass 457. Subject matter wherein said regulating means is a temperature sensor.

**465 Barometric responsive:**
This subclass is indented under subclass 457. Subject matter wherein the regulating means responds to barometric or atmospheric pressure.

**466 Having an antitampering device:**
This subclass is indented under subclass 457. Subject matter wherein said regulating means includes means to sense or determine if said regulating means has been tampered with.

(1) Note. The device may sense abnormal fuel pressure and take corrective action, such as engine shutoff, or may only indicate that the regulating means has been tampered with.

**467 Drip prevention means at injector nozzle:**
This subclass is indented under subclass 445. Subject matter wherein the system includes means to prevent drip or drool at the nozzle when injection is not occurring.

(1) Note. The device may, for example, positively hold the injector closed, or bleed

excess fuel from the injector or fuel line to a fuel storage tank means.

SEE OR SEARCH CLASS:

239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 533.02+ for injector nozzle structure.

**468 Having a specific shape, material, or location of the fuel line:**

This subclass is indented under subclass 445. Subject matter wherein significance is attributed to the construction, material, or position of the fuel line.

**469 Specific fuel line mounting means:**

This subclass is indented under subclass 468. Subject matter wherein means is provided for fastening or mounting said fuel line.

**470 Injection nozzle mounting means:**

This subclass is indented under subclass 445. Subject matter including means to secure the injection to the engine.

**471 Nozzle isolated from manifold vacuum effect:**

This subclass is indented under subclass 470. Subject matter wherein said injection nozzle is secured to the engine in a manner that prevents manifold vacuum from sucking fuel from the nozzle, or otherwise modifying fuel flow from said nozzle.

**472 Electrically actuated injector:**

This subclass is indented under subclass 445. Subject matter in which the fuel injection system includes a valve means that is electrically actuated to control the flow of pressurized fuel into the engine intake or combustion chamber, and further includes switching means to direct electrical current to actuate the injection valve.

SEE OR SEARCH THIS CLASS, SUBCLASS:

478+, for subcombinations that include electronic calculating or computing circuitry between the switching means and a nominal injector.

SEE OR SEARCH CLASS:

239, Fluid Sprinkling, Spraying, and Diffusing, subclasses 585.1+ for electromagnetic injector valves, per se.

251, Valves and Valve Actuation, subclasses 129.01+ for electromagnetic valves, per se.

**473 Mechanically actuated switching:**

This subclass is indented under subclass 472. Subject matter having means whereby the switch means which controls the fuel valve-actuating current is mechanically actuated, e.g., by a cam.

**474 Ignition distributor used as a switch:**

This subclass is indented under subclass 473. Subject matter in which the switching means is the distributor switch used to direct the electrical energy to the individual spark plugs of the engine.

**475 Actuated by ignition pulse:**

This subclass is indented under subclass 472. Subject matter in which the injector valve actuating current is controlled by means that senses current flow in the primary or secondary of the engine ignition coil.

**476 Magnetically actuated switching:**

This subclass is indented under subclass 472. Subject matter in which magnetic means is used to effect switching of the electrical current to actuate the injector valve.

**477 Radiation actuated switching:**

This subclass is indented under subclass 472. Subject matter in which the injector valve-actuating current is switched by a radiation actuated device (e.g., light, etc.).

**478 Actuator circuit (e.g., engine condition responsive electronic circuit actuates injector valve):**

This subclass is indented under subclass 472. Subject matter wherein the said fuel injector valve is controlled by an electronic circuit having at least one engine parameter sensing means to determine the correct amount of fuel to be metered to the engine.

**479 Backup systems, fail-safe, and failure indicator:**

This subclass is indented under subclass 478. Subject matter wherein the system includes means to provide backup operation, or physical indication upon failure of any part of the system.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclass 114 for backup, interrupt, reset, test of internal-combustion engines which include digital or programmable data processors.

**480 Having microprocessor:**
This subclass is indented under subclass 478. Subject matter wherein the injector valve-actuating circuit includes a microprocessor.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, particularly subclass 102 for microprocessor control of a power plant.

**481 Engine cylinder cutout:**
This subclass is indented under subclass 478. Subject matter in which fuel injection to some portion of but not all of the engine cylinders is interrupted in response to a predetermined condition.

(1) Note. The condition is usually low load.

SEE OR SEARCH THIS CLASS, SUBCLASS:
198, for other devices which cutout one or more cylinders.

**482 Circuit activates valve for continuous fuel flow:**
This subclass is indented under subclass 478. Subject matter wherein said circuit controls the injector valve for metered continuous fuel flow.

SEE OR SEARCH THIS CLASS, SUBCLASS:
497+, for a circuit that generates a continuous output signal that drives an electric pump.

**483 Having plural multivibrators:**
This subclass is indented under subclass 478. Subject matter wherein said injector valve control means includes a circuit having more than one multivibrator circuit therein.

**484 Having single multivibrator:**
This subclass is indented under subclass 478. Subject matter wherein said injector valve control means includes a circuit which employs a single monostable, bistable, or a stable multivibrator circuit at some stage between the input parameter sensor and a means motivating the injector valve.

**485 Having ramp generator:**
This subclass is indented under subclass 478. Subject matter wherein said injector valve control means includes a circuit which utilizes a ramp or staircase generator in a computing or decision making process.

**486 Having a digital memory addressed by an engine parameter:**
This subclass is indented under subclass 478. Subject matter wherein a digital memory is addressed by the output of an engine parameter sensor to retrieve a stored valve corresponding to the correct fuel output for each particular input from the sensor, thereby actuating the injector valve to provide the correct amount of fuel to the engine.

**487 Having an up or up-down counter in circuit:**
This subclass is indented under subclass 478. Subject matter wherein said injector valve control means includes up or up-down counter means.

**488 Subcircuit operates on a parameter sensor output before input to main fuel control (e.g., function generator):**
This subclass is indented under subclass 478. Subject matter wherein the circuit employs a subcircuit, generally a type of function generator, between the engine parameter sensor and the input to the decision making or computing section of the circuit, so that for every input to the subcircuit there is a predetermined output to the injector fuel control valve.

**490 Injector solenoid drive:**
This subclass is indented under subclass 478. Subject matter wherein said circuit has a decision making or computing section and employs a particular subcircuit connected to the output of that section to amplify or alternatively switch the output of said circuit to a particular injector valve or group of valves.

SEE OR SEARCH CLASS:

361, Electricity: Electrical Systems and Devices, subclasses 139+ for circuits for driving electromagnetic devices.

**491 Starting condition responsive:**
This subclass is indented under subclass 478. Subject matter wherein said circuit responds to an engine-starting condition or engine warm-up period to alter the fuel metering accordingly.

**492 Acceleration or full load condition responsive:**
This subclass is indented under subclass 478. Subject matter wherein said circuit responds to (a) an engine acceleration (rapid load or power output increase), or (b) full load operating mode to alter fuel metering accordingly.

(1) Note. This usually enriches the mixture.

**493 Deceleration condition responsive:**
This subclass is indented under subclass 478. Subject matter wherein said circuit responds to an engine "deceleration" condition, generally denoted by high manifold vacuum and rpm above idle, signifying a rapid power decline of the engine, or where the engine is driven by the load.

**494 Having specific transducer:**
This subclass is indented under subclass 478. Subject matter in which the construction or other feature of a sensor or transducer used in the system is significantly claimed.

**495 With fuel pump:**
This subclass is indented under subclass 434. Subject matter (a) for supplying fuel to a charge-forming device, or (b) for supplying fuel directly to the working cylinder or combustion chamber of an engine.

SEE OR SEARCH CLASS:

184, Lubrication, subclasses 26+ for lubricating oil pumps.

261, Gas and Liquid Contact Apparatus, subclasses 34.1+ for accelerator pumps for carburetors.

417, Pumps, subclasses 236+ and 321+ for pumps, per se, and pumps with nominal engine recitation for a statement of the line between Class 123 and Class 417; see the search note to Class 417 in the class definition of this class.

418, Rotary Expansible Chamber Devices, subclasses 40+ for rotary expansible chamber devices, per se.

**496 Variable rate of injection stroke:**
This subclass is indented under subclass 495. Subject matter wherein the pump includes means to vary the speed of a pump working member so as to vary the rate at which fuel is forced from the pump chamber.

**497 Electric fuel pump:**
This subclass is indented under subclass 495. Subject matter wherein the pump is electrically driven or its operation is electrically controlled.

**498 Piezoelectric drive:**
This subclass is indented under subclass 497. Subject matter wherein the pump has a working member which is driven by a piezoelectric crystal or the crystal itself is the pump working member.

**499 Solenoid drive:**
This subclass is indented under subclass 497. Subject matter wherein the pump has a working member which is driven by an electromagnetic solenoid.

(1) Note. Pump working member may be the solenoid armature.

**500 Variable beginning and ending of pumping stroke:**
This subclass is indented under subclass 495. Subject matter wherein the pump has a working member having constant length strokes and a control means to vary the points during the travel of working member pumping stroke where pumping action will both begin and end.

**501 Variable beginning of pumping stroke:**
This subclass is indented under subclass 495. Subject matter wherein the pump has a working member having constant length strokes and a control means to vary the point during the travel of the working member pumping stroke where pumping action will begin.

(1) Note. Control means may vary the angular relationship between pump drive

shaft and the driven shaft powered by the engine to control timing.

**502 Fluid pressure control:**
This subclass is indented under subclass 501. Subject matter wherein said control means utilizes fluid pressure in its operation, e.g., air, lubricant, fuel.

**503 Variable ending of pumping stroke:**
This subclass is indented under subclass 495. Subject matter wherein the pump has a working member having constant length strokes and a control means to vary the point during the travel of the working member pumping stroke where pumping action will end.

**504 Variable stroke:**
This subclass is indented under subclass 495. Subject matter wherein the actual physical stroke length of the pump may be varied to control fuel delivery, e.g., as with a variable stop which limits the pump piston travel.

**505 Fuel pump and intake air controls interconnected:**
This subclass is indented under subclass 495. Subject matter in which means is provided to associate the engine air intake control means with the pump output control means to provide a desired relationship between fuel and air flow.

**506 Having pressure relief valve:**
This subclass is indented under subclass 495. Subject matter wherein valve means is provided to relieve the pump output pressure under certain conditions.

(1) Note. This means may be incorporated in the pump or may be located externally.

**507 Pumping member driven by a piston or valve of the internal combustion engine:**
This subclass is indented under subclass 495. Subject matter in which the pump has a working member which is driven either by (a) a working piston, or (b) a valve of the associated internal combustion engine.

**508 Pumping member driven by the internal combustion engine valve operating mechanism:**
This subclass is indented under subclass 495. Subject matter wherein the pump has a working member which is actuated by some part of the engine intake or exhaust valve driving mechanism, e.g., injection pump piston is driven by rocker arm or intake valve actuating mechanism.

**509 Specific location or mounting of pump:**
This subclass is indented under subclass 495. Subject matter in which a special (a) location, or (b) mounting means for the pump is claimed.

**510 Fuel flow regulation between the pump and the charge-forming device:**
This subclass is indented under subclass 434. Subject matter having regulator means located in a fuel flow path between a pump discharge and a charge-forming device (e.g., carburetor) to modify or control the fuel pressure or rate of flow to said device.

(1) Note. The device may be a simple pressure-regulating valve controlled by a spring or a regulator controlled by engine parameters.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclasses 455+ for pressure regulators and flow-regulating devices, per se.
261, Gas and Liquid Contact Apparatus, subclasses 34.1+ for condition-responsive control of fuel flow into a carburetor float bowl.

**511 Regulator means adjusts fuel pressure:**
This subclass is indented under subclass 510. Subject matter wherein means in the fuel path regulates the pressure of the fuel delivered to the charge former.

**512 Engine parameter responsive:**
This subclass is indented under subclass 511. Subject matter in which the regulating means adjusts fuel pressure in response to an operating condition of the associated internal combustion engine.

**513 Environmental condition responsive:**
This subclass is indented under subclass 511. Subject matter wherein the regulator responds to some environmental condition such as ambient air temperature or pressure.

**514 Excess fuel returned to tank:**
This subclass is indented under subclass 510. Subject matter in which the regulator includes means to return excess fuel delivered by the pump to the fuel tank or pump inlet.

(1) Note. The means to return excess fuel may be a single constant bleed-off orifice.

**515 Regulator controls flow of a plurality of fuels:**
This subclass is indented under subclass 510. Subject matter in which the regulator means controls the flow of more than one type of fuel or different qualities of the same fuel to the charge-forming device.

SEE OR SEARCH THIS CLASS, SUBCLASS:
575+, for a charge-forming device that may be operated with diverse fuels.

**516 Air or fuel vapor purging system:**
This subclass is indented under subclass 510. Subject matter wherein the regulator has means to purge, or store air bubbles or fuel vapor; the purging or storage means may itself be considered the means to regulate fuel flow.

SEE OR SEARCH THIS CLASS, SUBCLASS:
518+, for fuel vapor storage systems with subsequent feed to engine.

**517 Carburetor float bowl drain:**
This subclass is indented under subclass 510. Subject matter in which the charge-forming device is a carburetor which has a fuel receiving float bowl and a means to drain the fuel from said bowl.

**518 Having fuel vapor recovery and storage system:**
This subclass is indented under subclass 434. Subject matter in which means is provided to collect fuel vapor from a fuel tank, float bowl, etc., store it in a tank, canister, or equivalent storage means, and then feed the stored vapor to the associated engine during its operation.

SEE OR SEARCH THIS CLASS, SUBCLASS:
525, for a vapor converting system that feeds vapor to the engine without storage.

SEE OR SEARCH CLASS:
220, Receptacles, subclasses 749+ for vapor recovery and vapor storage systems, respectively.

**519 Having an adsorbent canister:**
This subclass is indented under subclass 518. Subject matter wherein the fuel vapor storage means is a container enclosing a material that will collect condensed fuel on a surface.

(1) Note. Generally the adsorbent material is activated charcoal.

SEE OR SEARCH CLASS:
96, Gas Separation: Apparatus, subclasses 108+ for solid sorbent apparatus, per se.

**520 Purge valve controlled by engine parameter:**
This subclass is indented under subclass 519. Subject matter in which a valve means (purge valve) is provided between the canister and the engine, said valve being operable to control the rate at which stored vapors are drawn from the canister in response to an operating condition or parameter of the associated engine.

**521 Responsive to secondary air pressure:**
This subclass is indented under subclass 520. Subject matter wherein the engine parameter controlling the purge valve means is the pressure of the air injected into the engine exhaust, i.e., secondary air pressure.

**522 Liquid fuel evaporating by submerged air supply:**
This subclass is indented under subclass 434. Subject matter having means wherein at least part of the air supply for the engine is bubbled through a volume of fuel to form at least part of the combustible charge.

SEE OR SEARCH THIS CLASS, SUBCLASS:

530, for means to evaporate fuel by passing it in the form of a continuous stream across an engine air intake conduit.

**523 Liquid fuel evaporating by extended fuel film:**
This subclass is indented under subclass 434. Subject matter includes means for spreading the fuel over a relatively large surface area to provide a film of fuel to enhance evaporation when contacted with air.

**524 Screen or mat:**
This subclass is indented under subclass 523. Subject matter wherein the surface on which the fuel is spread is porous or sievelike.

**525 Combined liquid and gaseous fuel:**
This subclass is indented under subclass 434. Subject matter having means by which the charge-forming device may produce a mixture of air, gaseous fuel, and liquid fuel, or may be switched to operate with either gaseous or liquid fuel.

**526 Diesel engine convertible from liquid to gas:**
This subclass is indented under subclass 525. Subject matter in which the associated engine is of the compression ignition type and having means to convert the engine to operate on either liquid or gaseous fuel.

**527 Gaseous fuel and air mixer:**
This subclass is indented under subclass 434. Subject matter having means by which the charge-forming device mixes air and gaseous fuel to form a combustible mixture which is fed to the associated engine.

**528 Supercharged engine:**
This subclass is indented under subclass 527. Subject matter having means by which the associated engine, fed by the mixer, receives its combustion air under pressure greater than atmospheric.

**529 Safety device (e.g., cutoff):**
This subclass is indented under subclass 527. Subject matter wherein the gaseous fuel and air mixer includes a safety device that cuts off the flow of fuel or air-fuel mixture in the event of leaks, accidents, etc.

**530 Constant flow fuel supply:**
This subclass is indented under subclass 434. Subject matter in which the charge-forming device has means to pass a continuous stream of fuel across the air intake conduit whereby the air evaporates or atomizes a portion of the fuel; the liquid fuel not evaporated by the air is drained from the device for subsequent recycling.

**531 Auxiliary air or gas used to inject fuel:**
This subclass is indented under subclass 434. Subject matter in which means is provided that uses a small amount of pressurized air or other gas, insufficient to form a combustible charge, to force the liquid fuel into the combustion air.

SEE OR SEARCH THIS CLASS, SUBCLASS:

69, for a two-stroke engine having separate pumps for air and gaseous fuel.

SEE OR SEARCH CLASS:

261, Gas and Liquid Contact Apparatus, subclasses 19+ for carburetors using auxiliary air.

**532 Air is bled from the cylinder on the compression stroke in that cylinder:**
This subclass is indented under subclass 531. Subject matter in which means is provided to bleed a small amount of air or other gas from the cylinder to which it will be fed during that cylinder's compression stroke.

**533 Having a separate pump for the air or gas:**
This subclass is indented under subclass 531. Subject matter having means whereby the air or other gas used to atomize or inject the fuel is compressed by pump means.

**534 Air is bled from another engine cylinder:**
This subclass is indented under subclass 531. Subject matter in which means is provided to bleed the air or other gas to be used for injecting fuel from any engine cylinder, except the cylinder to which the air will be fed, during the compression stroke of said any engine cylinder.

**535 Constant fuel level:**
This subclass is indented under subclass 531. Subject matter including means to provide a constant level (e.g., reservoir) of fuel to be atomized, vaporized, or injected by the auxiliary air or gas.

**536 Combustible mixture ionization, ozonation, or electrolysis:**
This subclass is indented under subclass 434. Subject matter having treating means whereby the charge or any component of the charge is subjected to ionization, or wherein ozone is generated from the charge, or wherein electrolysis is utilized to form any component of the charge.

SEE OR SEARCH THIS CLASS, SUBCLASS:
585, for ozone from a separate source which is added to the charge.

**537 Before intake valve (e.g., in manifold):**
This subclass is indented under subclass 536. Subject matter wherein the treatment occurs before the charge component reaches the engine intake valve.

**538 Fuel only:**
This subclass is indented under subclass 536. Subject matter in which said means operates on the fuel only.

**539 Air only:**
This subclass is indented under subclass 536. Subject matter wherein said means operates on the air for the charge only.

**540 Cooling of combustible mixture:**
This subclass is indented under subclass 434. Subject matter including means for cooling (a) the charge-forming device or a part thereof, (b) for cooling the combustible mixture formed by the charge-forming means, or (c) those elements (e.g., fuel, air, etc.) as they are fed to the charge former to form the charge.

(1) Note. Any cooling combined with supercharging should be classified in subclass 563 below.

(2) Note. If the cooling is done to the exhaust gas to be recycled to the engine, classification should be in subclass 570 below.

**541 Fuel only:**
This subclass is indented under subclass 540. Subject matter wherein the engine fuel alone is cooled.

**542 Air only:**
This subclass is indented under subclass 540. Subject matter wherein only the air is cooled.

SEE OR SEARCH THIS CLASS, SUBCLASS:
559, for air coolers between a supercharger and an internal-combustion engine.

**543 Heating of combustible mixture:**
This subclass is indented under subclass 434. Subject matter including means for heating (a) the charge-forming device or a part thereof, (b) for heating the combustible mixture formed by the charge-forming means, or (c) those elements (e.g., fuel, air, etc.) as they are fed to the charge former to form the charge.

SEE OR SEARCH CLASS:
261, Gas and Liquid Contact Apparatus, subclasses 127+ for devices for mixing and heating liquid and gas.
431, Combustion, subclasses 207+ for a fuel burner of general application with means for heating its feed line.

**544 Lighter fuel is used during starting:**
This subclass is indented under subclass 543. Subject matter in which the charge-forming devices uses a lighter, more easily vaporized fuel which is heated and utilized during starting of the associated internal-combustion engine.

**545 Heating medium surrounds combustible mixture:**
This subclass is indented under subclass 543. Subject matter wherein the heating medium completely surrounds a conduit or passage containing the combustible mixture.

**546 Combustible mixture surrounds heating medium:**
This subclass is indented under subclass 543. Subject matter in which a passage or conduit that conveys the air-fuel mixture to the engine

completely encircles or surrounds the source of heat.

**547 Combustible mixture and heating medium adjoin one another:**
This subclass is indented under subclass 543. Subject matter wherein the passages carrying the heating medium and the mixture are integral or adjoining at some point for heat transfer.

**548 Trap for liquid particle vaporization:**
This subclass is indented under subclass 543. Subject matter in which means is provided to trap, heat, and vaporize liquid particles of fuel present in the air fuel mixture before they are inducted into the engine combustion chamber.

**549 Electric heater:**
This subclass is indented under subclass 543. Subject matter wherein the means for heating is electrically powered.

**550 Combustion heater:**
This subclass is indented under subclass 543. Subject matter in which the means for heating uses combustion of a fuel as the source of heat.

**551 Part of combustible mixture is burned:**
This subclass is indented under subclass 550. Subject matter wherein a means is provided to draw off a portion of the normal fuel-air mixture to be combusted externally of the combustion chamber to supply heat for the remaining mixture.

(1) Note. The combustion products from this process may be exhausted or reintroduced into the charge.

**552 Automatic control:**
This subclass is indented under subclass 543. Subject matter in which an engine temperature sensor or other condition-responsive means is provided to control the operation of the heating means.

**553 Intermediate fluid used for heating:**
This subclass is indented under subclass 543. Subject matter in which the source of heat is used to heat an intermediate fluid (other than engine coolant, lubricant, or exhaust gas) that is in heat transfer relationship with the fuel, air, combustible mixture, or charge-forming device.

**554 Combustible mixture, air, and fuel are heated separately:**
This subclass is indented under subclass 543. Subject matter in which separate means is provided to heat each of the air, fuel, and mixture.

**555 Air and fuel heated separately:**
This subclass is indented under subclass 543. Subject matter having means wherein the air alone and fuel alone are heated separately before they are mixed.

**556 Air only:**
This subclass is indented under subclass 543. Subject matter in which the heating means is used to heat the engine combustion air only.

**557 Fuel only:**
This subclass is indented under subclass 543. Subject matter in which the heating means is used to heat the fuel only.

**558 Fuel is heated to ignition temperature:**
This subclass is indented under subclass 557. Subject matter in which the heating means heats the fuel to the temperature at which it will spontaneously ignite when exposed to air at ambient temperature.

**559.1 Supercharger:**
This subclass is indented under subclass 434. Subject matter wherein means is employed to increase the pressure of the inlet air or charge over that which would be present in a normally aspirated (piston suction alone) engine.

SEE OR SEARCH CLASS:
60, Power Plants, subclasses 598+ for exhaust gas driven superchargers.

**559.2 Pressure exchange with exhaust gas:**
This subclass is indented under subclass 559.1. Subject matter wherein the means to increase the pressure of the intake air is a pressure exchange wherein the engine exhaust gas directly contacts the intake air.

SEE OR SEARCH CLASS:
417, Pumps, subclass 64 for pressure exchanges, per se.

**559.3 With clutch:**
This subclass is indented under subclass 559.1. Subject matter wherein the supercharger is connected to the engine by a clutch.

**560 Two-cycle compressor feeds a four-cycle engine:**
This subclass is indented under subclass 559. Subject matter having a two-cycle compressor which is used to feed air or mixture at a pressure greater than atmospheric to an associated four-cycle internal-combustion engine.

**561 Variable ratio compressor driven supercharger:**
This subclass is indented under subclass 559. Subject matter having a compressor to supercharge the air or mixture wherein the drive ratio between the compressor and its driving means (generally the engine) is capable of being varied.

**562 Multiple superchargers:**
This subclass is indented under subclass 559. Subject matter having more than one pump or compressor which are used to feed air or mixture under pressure to a common internal-combustion engine.

(1) Note. This subclass includes plural stage compressors.

(2) Note. Multiple superchargers with intercooling are properly classified in subclass 563.

SEE OR SEARCH THIS CLASS, SUBCLASS:
563, for an intercooler between an engine and single supercharger.

**563 Intercooler:**
This subclass is indented under subclass 559. Subject matter wherein means is employed to lower the temperature of the air or mixture leaving the supercharger before its entry into the engine or another supercharger.

(1) Note. Any cooling combined with non-supercharged charged forming should be classified in subclasses 540+ above.

**564 Boost control:**
This subclass is indented under subclass 559. Subject matter including manual or condition responsive means to control the degree of pressurization of the air or mixture by the supercharger.

**565 Supercharger is driven independently of the engine:**
This subclass is indented under subclass 559. Subject matter wherein the supercharger is driven by means other than the associated engine or its exhaust gas (such as an electric motor).

**566 Funnel-type supercharger (e.g., ram-air):**
This subclass is indented under subclass 559. Subject matter in which the pressure-increasing means is a funnel-shaped conduit into which air is forced, e.g., ram-air effect.

(1) Note. The air is fed from the funnel outlet to the engine.

**567 Oxidant is solely oxygen:**
This subclass is indented under subclass 434. Subject matter wherein the fuel (which may be a gas) is mixed or burned solely in oxygen and no gas other than fuel or oxygen is present.

**568.11 Exhaust gas used with the combustible mixture (e.g., emission control exhaust gas recirculation (EGR) valve):**
Subject matter under subclass **434** wherein the means for forming a mixture of fuel and oxidant is provided with a means to return the products of combustion exhausted from the engine combustion chamber (i.e., exhaust gas recirculation (EGR)) either (a) to a passage in communication with an inlet port of the combustion chamber (i.e., an intake manifold) or (b) directly to the combustion chamber for subsequent re-burning.

(1) Note. Subject matter wherein the exhaust gas is treated before recirculation is found eslewhere. Subject matter wherein the exhaust gas enters the exhaust gas return passage and then it is treated is found in class. See Search Class below.

(2) Note. This and the indented subclasses include disclosures wherein the exhaust

gas products are exhausted from one combustion chamber and returned to another combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:

200+, for rotary engine exhaust gas recirculation.

672+, for a charge forming device having exhaust gas condition responsive control means.

SEE OR SEARCH CLASS:

60, Power Plants, subclasses 278 and 279 for treatment or handling of the exhaust gas from an internal combustion engine before recirculation to the engine, and subclass 605.2 for recirculating exhaust gas in a turbocharged internal combustion engine with specific turbocharger details.

**568.12 Exhaust gas cooled during recirculation:**

Subject matter under subclass 568.11 provided with means to reduce the temperature of the returned products of combustion after the products enter an EGR conduit, but prior to the products of combustion being returned to the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:

540+, for cooling of the combustible mixture, or cooling of the combustible mixture mixed with another constituent (e.g., exhaust gas).

543+, for heating of the combustible mixture, or heating of the combustible mixture mixed with another constituent (e.g., exhaust gas).

**568.13 Having recirculation path formed entirely in the cylinder block or head:**

Subject matter under subclass 568.11 wherein the means to return the products of combustion has an EGR conduit which is located completely within a structure that either (a) surrounds the combustion chamber or (b) closes an upper end of the combustion chamber.

**568.14 Internal exhaust gas recirculation (e.g., exhaust gas retained in the combustion chamber):**

This subclass is indented under subclass 568.11. Subject matter including means to cause a portion of the products of combustion either (a) to remain in the combustion chamber after the combustible mixture has been burned or (b) to be drawn back into the combustion chamber from either (1) the intake passage or (2) the exhaust passage.

(1) Note. All engines will retain a portion of the products of combustion within the combustion chamber after combustion however, the subject matter included herein is designed to cause more of the products to remain.

**568.15 Having exhaust gas mixed with a constituent before entry into intake manifold:**

This subclass is indented under subclass 568.11. Subject matter wherein the products of combustion are combined with another fluid prior to admission into the intake manifold.

SEE OR SEARCH THIS CLASS, SUBCLASS:

3, for recirculating of the products of combustion to cause a chemical reaction with the fuel prior to combustion (e.g., alcohol reforming, hydrogen releasing, etc.).

25+, for the addition of water to the combustible mixture (e.g., fuel and oxidant, EGR) before entrance into the combustion chamber.

**568.16 With electrical means for fail-safe, backup, or malfunction detecting of EGR system:**

Subject matter under subclass **568.11** wherein the means for forming a mixture of fuel and oxidant includes electrical means that upon detecting failure in an EGR system element (a) shifts operation (1) into a substitute circuit or (2) to a substitute mechanism to accomplish the same function, or (b) indicates functioning of the EGR system or EGR system element outside of acceptable parameters.

(1) Note. The EGR system itself need not be electrically operated, however, the mere inclusion of an electrical switch

whose state (i.e., on or off) is changed in response to abnormal operation of the EGR system to turn on an indicating device is sufficient for placement in this subclass.

SEE OR SEARCH CLASS:

701, Data Processing: Vehicles, Navigation, and Relative Location, subclasses 101+ for a data processing system associated with an internal-combustion engine, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, especially subclasses 102+ for a data processing system associated with an internal-combustion engine having a digital or programmed data processor, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, subclass 107 for a digital or programmed data processing system associated with an internal-combustion engine is designed to detect an abnormality in operating conditions and carry out the appropriate sequence of instructions to stabilize the air/fuel ratio or fuel injection operation, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed, subclass 114 for digital or programmed data processing system associated with an internal-combustion engine includes specific structure to function as either a backup, interruption, reset, or test circuit,where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**568.17 Having specific exhaust gas outlet structure at intake manifold:**

This subclass is indented under subclass 568.11. Subject matter wherein the means to return the products of combustion includes a particular structural aspect (e.g., shape, size) of an opening at a juncture of the conduit conducting the products of combustion from the combustion chamber to the intake manifold.

SEE OR SEARCH THIS CLASS, SUBCLASS:

184.21+,for specific intake manifold details.

**568.18 Having a valve located at the outlet of the EGR passage:**

This subclass is indented under subclass 568.17. Subject matter wherein the means to return the products of combustion includes a mechanical device having a closing element that controls fluid flow through the EGR conduit (a) either by (1) closing the EGR conduit or (2) restricting the EGR conduit by a definite predetermined motion of the closing element, and (b) the closing element being positioned at the point of connection of the EGR conduit to the intake manifold.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, appropriate subclasses, for specific valve structure of general utility.

**568.19 EGR valve position controlled only in relationship to intake throttle valve position:**

This subclass is indented under subclass 568.11. Subject matter where the engine includes (a) a closing member that regulates fluid flow through the intake manifold leading to the combustion chamber, (b) the EGR conduit includes a closing element that regulates fluid flow through the EGR conduit, and (c) wherein the motion of the closing element is related <u>only</u> to the position of the closing member.

(1) Note. There does not have to be a linear relationship between movement of the intake throttle valve and the EGR valve for proper placement in this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

319+, for specific intake throttle valve control.

337, for specific intake throttle valve structure.

SEE OR SEARCH CLASS:

251, Valves and Valve Actuation, appropriate subclasses, for specific valve structure.

**568.2 Plural EGR valves in the recirculation passage:**
This subclass is indented under subclass 568.11. Subject matter wherein a conduit returns the products of combustion to the combustion chamber and the conduit includes more than one closing element that regulates fluid flow through the EGR conduit.

**568.21 Having electrically actuated control means:**
This subclass is indented under subclass 568.11. Subject matter wherein the means for adjusting the flow of the products of combustion to the combustion chamber is powered by electrical energy.

SEE OR SEARCH CLASS:
251, Valves and Valve Actuation, subclasses 129.01+, for electrically operated valves of general utility.
701, Data Processing: Vehicles, Navigation, and Relative Location, subclass 108 for a digital or programmed data processing system associated with an internal-combustion engine designed to control the air/fuel ratio or fuel injection to change the exhaust gas system, where significant details of the mechanical construction of the component or subsystem within a vehicle are not claimed.

**568.22 Ambient condition responsive (e.g., atmospheric temperature, atmospheric pressure):**
This subclass is indented under subclass 568.21. Subject matter wherein the means for adjusting the flow of the products of combustion is responsive to an atmospheric characteristic or parameter.

**568.23 Having rotary actuator control of EGR valve:**
This subclass is indented under subclass 568.21. Subject matter wherein the means to return the products of combustion includes a device having a closing element that controls fluid flow through the EGR passage (a) either by (1) closing the EGR passage or (2) restricting the EGR passage by a definite predetermined motion of the closing element, and (b) the closing element being adjusted by means including a member turned about an axis by a source of electrical energy.

**568.24 Electrical rotary actuator rotates the EGR valve:**
This subclass is indented under subclass 568.23. Subject matter wherein the member turned about the axis is a rotary electromagnetic device (e.g., electric motor, rotary solenoid, etc.) and the member turns the closing element about an axis.

**568.25 Vacuum actuator control of EGR valve:**
This subclass is indented under subclass 568.23. Subject matter wherein the electrically powered adjusting means regulates the flow of a fluid through a passage connected to an expansible chamber of negative fluid pressure and the negative fluid pressure in the chamber is used to actuate the closing element to vary the flow of the products of combustion.

**568.26 Having electromechanical actuator control of EGR valve:**
This subclass is indented under subclass 568.21. Subject matter wherein the means to return the products of combustion includes a closing element that controls fluid flow through the EGR passage (a) either by (1) closing the passage or (2) restricting the EGR passage by a definite predetermined motion of the closing element, and (b) the closing element being adjusted by means of electrical energy.

SEE OR SEARCH CLASS:
251, Valves and Valve Actuation, subclasses 129.01+, for electrically operated valves of general utility.

**568.27 Controlling vacuum actuator:**
This subclass is indented under subclass 568.26. Subject matter wherein the electrical actuator regulates the position of a fluid flow adjusting means which regulates the flow of a fluid through a passage connected to an expansible chamber of negative fluid pressure and the negative fluid pressure in the chamber is used to actuate the EGR closing element to vary the flow of the products of combustion.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclass 907 for a vacuum actuated valve, per se.

**568.28 Including auxiliary vacuum pump:**
This subclass is indented under subclass 568.27. Subject matter including a supplementary device to evacuate a gaseous fluid from the chamber to create a negative fluid pressure to actuate the EGR closing element.

(1) Note. Many of the supplementary devices are used in conjunction with a diesel engine.

**568.29 Vacuum actuator control of EGR valve:**
This subclass is indented under subclass 568.11. Subject matter wherein (a)the means to return the products of combustion includes a mechanical device having a closing element that controls fluid flow through the EGR conduit either by (1) closing the EGR conduit or (2) restricting the EGR conduit by a definite predetermined motion of the closing element, and (b) negative fluid pressure is applied through a passage connected to an expansible chamber and the negative fluid pressure in the chamber is used to actuate the closing element which varies the flow of the products of combustion back to the combustion chamber for subsequent re-burning.

**568.3 Including auxiliary vacuum pump:**
Subject matter under subclass 568.29 including a supplementary device to evacuate a gaseous fluid from the chamber to create a negative fluid pressure to actuate the EGR closing element.

(1) Note. Many of the supplementary devices are used in conjunction with a diesel engine.

**568.31 Temperature responsive:**
This subclass is indented under subclass 568.29. Subject matter wherein the adjusting means is responsive to changes in temperature (e.g., of an engine component, engine fluid, or the ambient environment).

**568.32 Having fixed restriction in vacuum line:**
Subject matter under subclass **568.29** wherein the adjusting means includes a region of non-adjustable reduced cross-sectional area in a conduit conveying the fluid of negative pressure.

**572 Crankcase vapor used with combustible mixture:**
This subclass is indented under subclass 434. Subject matter in which means is provided to introduce part or all of the crankcase blow by gases to the engine intake manifold or directly to the combustion chamber for burning.

**573 Vapor treated before mixing with combustible mixture (e.g., cooling):**
This subclass is indented under subclass 572. Subject matter in which means is provided to cool or otherwise treat the crankcase vapors before they are mixed with the charge.

**574 Specific control valve (PCV valve):**
This subclass is indented under subclass 572. Subject matter wherein said means include a valve having a specifically disclosed construction.

(1) Note. The valve is often referred to as a PCV (positive crankcase ventilation) valve.

**575 Diverse fuel supply:**
This subclass is indented under subclass 434. Subject matter wherein the engine may be operated from different qualities of fuels.

**576 Fuel switched in response to engine starting condition:**
This subclass is indented under subclass 575. Subject matter in which means are provided for switching from one fuel to another in response to a starting condition of the associated engine.

**577 Fuel switched, condition responsive to load:**
This subclass is indented under subclass 575. Subject matter wherein the separate fuel supplies are switched or alternated in response to the engine load condition.

**578 Fuel switched in response to engine temperature:**
This subclass is indented under subclass 575. Subject matter in which means are provided for switching from one fuel source to another in response to a temperature of the associated engine.

**579 Multiple carburetors:**
This subclass is indented under subclass 434. Subject matter wherein said charge-forming device includes a plurality of separate means, each of which employs a moving stream of oxidant (e.g., air) to aspirate a fluid fuel into the oxidant stream.

(1) Note. Each carburetor is operative to independently meter fuel into the air flowing therethrough.

(2) Note. The carburetors need not be identical in construction.

SEE OR SEARCH CLASS:
261, Gas and Liquid Contact Apparatus, subclass 23.1 for a single carburetor with multiple barrels.

**580 Each carburetor feeds a cylinder or group of cylinders (e.g., split engine):**
This subclass is indented under subclass 579. Subject matter wherein a separate fuel aspirating means feeds a particular cylinder or group of cylinders.

**581 Separate carburetor for starting:**
This subclass is indented under subclass 579. Subject matter in which one of the fuel aspirating means is designed particularly for or is operative only during starting and warm-up of the associated engine.

**582 Separate carburetor for high load:**
This subclass is indented under subclass 579. Subject matter wherein one of the fuel aspirating means is utilized for high load operation of the associated engine.

**583 With linkage between carburetor throttle valves:**
This subclass is indented under subclass 579. Subject matter in which means is provided to interconnect the throttle valves of multiple fuel aspirating means to effect coordinated movement thereof.

**584 Staged opening of carburetor throttle valves:**
This subclass is indented under subclass 583. Subject matter wherein the mechanical means is arranged so that the opening of the throttle valves is not coincident, or the rates of movement of the throttle valves are unequal.

**585 Auxiliary air or oxygen added to combustible mixture:**
This subclass is indented under subclass 434. Subject matter in which means is provided to add an additional oxidant to the combustible mixture produced by a charge-forming device before the mixture is fed to the engine cylinders.

SEE OR SEARCH CLASS:
137, Fluid Handling, subclass 480 for the control of an auxiliary inlet to a combustion engine induction line in response to variations in engine inlet pressure.
261, Gas and Liquid Contact Apparatus, subclasses 38+ for carburetor air bypasses.

**586 Oxidant controlled by throttle:**
This subclass is indented under subclass 585. Subject matter in which an auxiliary device providing additional oxidant includes control means responsive to the position of the engine throttle valve.

**587 Oxidant controlled by intake manifold vacuum:**
This subclass is indented under subclass 585. Subject matter in which the means for providing additional oxidant is controlled in response to the pressure in the engine intake manifold.

**588 Oxidant controlled by engine temperature:**
This subclass is indented under subclass 585. Subject matter in which the device for providing additional oxidant includes control means responsive to engine temperature.

**590 Charge-mixing device in intake (e.g., device which insures the atomization of the combustible mixture):**
This subclass is indented under subclass 434. Subject matter including means to further commingle oxidant and the fuel mixture produced by a charge-forming device before the mixture is inducted into the engine cylinder.

**591 Having liquid fuel collector:**
This subclass is indented under subclass 590. Subject matter in which the device includes means to collect liquid fuel which has not been completely atomized.

**592 By fan means:**
This subclass is indented under subclass 590. Subject matter in which the means to commingle is a rotating device carrying fluid reactive blades thereon which is mounted in the intake pipe of the engine.

**593 By screen means:**
This subclass is indented under subclass 590. Subject matter in which the device is a foraminous member disposed across the intake of the engine.

**594 HIGH TENSION IGNITION SYSTEM:**
This subclass is indented under the class definition. Subject matter including means for supplying high voltage electricity to a mixture-igniting means associated with an internal-combustion engine and for subcombinations particular thereto where not provided for elsewhere.

SEE OR SEARCH CLASS:
315, Electric Lamp and Discharge Devices: Systems, subclasses 209+ for general use systems.

**595 Retrofit conversion ignition unit:**
This subclass is indented under subclass 594. Subject matter in which the ignition system or some component thereof is designed to replace or add to an existing system or component which is different in construction or effect.

(1) Note. This includes conversion of cam and breaker point timers to photoelectric, magnetic, etc., pickups.

**596 Using capacitive storage and discharge for spark energy:**
This subclass is indented under subclass 594. Subject matter in which the ignition system include a capacitor, means to charge the capacitor, and means to discharge the capacitor through an ignition coil primary thereby creating the high voltage used for mixture ignition.

SEE OR SEARCH THIS CLASS, SUBCLASS:
653, and 654, for an ignition system having an auxiliary capacitor, other than a breaker point capacitor, that does not discharge into an ignition coil primary to create a high voltage.

**597 Regulating sensed ignition capacitor voltage:**
This subclass is indented under subclass 596. Subject matter in which means is provided to sense or measure the voltage across the ignition capacitor.

**598 Having an oscillator:**
This subclass is indented under subclass 596. Subject matter in which the capacitor is charged by a voltage produced in an oscillator circuit which is either continuously or intermittently operative.

**599 Having a magneto:**
This subclass is indented under subclass 596. Subject matter in which the capacitor is charged by a voltage produced by an inductive generator called a magneto.

(1) Note. Usually of the rotary type.

**600 Triggering voltage obtained from capacitor charging winding:**
This subclass is indented under subclass 599. Subject matter in which means is provided to trigger the discharge of the capacitor across the coil primary, wherein the trigger voltage is derived from the magneto winding that charges the capacitor.

**601 Specific design of charge or trigger winding core:**
This subclass is indented under subclass 599. Subject matter in which significance is attributed to the particular core structure for the capacitor charging or trigger winding.

(1) Note. Both windings on a single magnetic core, etc.

**603 Antireverse protection:**
This subclass is indented under subclass 599. Subject matter in which means is provided in the ignition system to prevent running of the engine in the reverse direction.

**604 Inductive capacitive discharge system:**
This subclass is indented under subclass 596. Subject matter in which a capacitor is charged by a voltage produced in an inductive circuit other than a magneto or oscillator.

SEE OR SEARCH THIS CLASS, SUBCLASS:
599, for magneto capacitor discharge devices.

**605 Having a specific capacitor, ignition coil means, or switching element circuit path:**
This subclass is indented under subclass 596. Subject matter in which significance is attributed to the ignition capacitor, ignition coil, or capacitor discharge switching means.

**606 High frequency ignition system:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes means to generate a high frequency train of distinct sparks at a spark gap.

**607 Free running oscillator supplies coil primary:**
This subclass is indented under subclass 606. Subject matter in which the means to generate the high frequency train is a free running oscillator that supplies an oscillating voltage to the primary of the ignition coil.

**608 Having a specific spark plug:**
This subclass is indented under subclass 606. Subject matter in which significance is attributed to the design or construction of a spark plug to be used in the high frequency system.

**609 Having dwell control:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes means to adjust or control the amount of time that current flows through the primary of an ignition coil.

(1) Note. This amount of time is called "dwell time" or "dwell angle" and is measured in degrees of distributor shaft rotation. For a system having breaker points, the dwell is the amount of time that the points are closed.

**610 Using a monostable multivibrator:**
This subclass is indented under subclass 609. Subject matter in which the means to adjust or control the dwell time includes an oscillator circuit having one stable state, i.e., the circuit remains in a condition having a given output level (e.g., logical zero) until receiving a trigger signal, at which time the circuit will switch to its other output level (logical 1) and after a predeterminable time returns to its original level (logical zero).

**611 Dwell maintained at constant value:**
This subclass is indented under subclass 609. Subject matter in which dwell adjusting means function to keep the dwell time at a constant value.

**612 Having engine component position sensor:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes means to determine the position of one engine component relative to another.

(1) Note. The means usually determines the angular position of the distributor shaft, camshaft, or crankshaft of the associated engine.

**613 Optical sensing:**
This subclass is indented under subclass 612. Subject matter in which the position transducer is light activated.

**614 Including a zero crossing detector:**
This subclass is indented under subclass 612. Subject matter in which the position sensor includes means to detect a change in polarity of the voltage signal from the transducer, i.e., crosses a "zero" reference value.

**615 Including an oscillator:**
This subclass is indented under subclass 612. Subject matter in which the position sensor is provided with or which controls an oscillator from which a control signal is derived.

(1) Note. The oscillator is usually repeatedly turned on and off to indicate position.

**616 Piezoelectric sensor:**
This subclass is indented under subclass 612. Subject matter wherein the position sensor is a device in which charges of electricity are induced in a crystalline substance by pressure.

**617 Inductive or magnetic sensor:**
This subclass is indented under subclass 612. Subject matter in which the position sensor includes magnetic or inductive means that produces a control signal.

**618 Having specific trigger circuitry:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes trigger circuit means to shape the output signal of a position sensor for subsequent use in the system.

**619 Oscillatory trigger circuit:**
This subclass is indented under subclass 618. Subject matter in which the trigger circuit means is constructed as an oscillatory circuit.

**620 Additional spark energy supply:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes a device, in addition to an ignition coil, that adds energy to the discharge at the spark plug.

(1) Note. Said device may be inductive in design. Said additional energy may be used to extend the duration of the spark or merely increase the sparking voltage.

**621 Having an ignition coil with multiple primary or secondary windings:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes an ignition coil constructed to have more than one primary or secondary winding.

**622 Separate circuit for each winding:**
This subclass is indented under subclass 621. Subject matter in which each primary winding or secondary winding has an associated circuit to deliver energy to or to take energy from an ignition coil.

**623 Having supply voltage regulation:**
This subclass is indented under subclass 594. Subject matter in which means is provided in the system to compensate for changes in, or to hold supply voltage constant.

(1) Note. The supply voltage source is usually a battery.

**624 Having ballast resistor cutout or control:**
This subclass is indented under subclass 594. Subject matter in which the system includes a resistor to limit ignition coil primary current and has means to cut the resistor in and out of the system, or otherwise control the effect the resistor has on the operation of the system.

**625 Responsive to engine or environmental condition:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes means responsive to an engine parameter or an environmental condition.

**626 Oscillator or trigger circuit responsive to engine condition:**
This subclass is indented under subclass 625. Subject matter in which the means is an oscillatory circuit or trigger circuit which is responsive to an engine parameter.

**627 Having auxiliary spark ionization gap in series or parallel with the coil:**
This subclass is indented under subclass 594. Subject matter in which the system includes an auxiliary spark air gap or gaseous ionization gap in addition to the usual spark plug.

(1) Note. The auxiliary gap may be in series or parallel with an ignition coil primary or secondary and can be a neon tube.

**628 Having a continuous high voltage output to the high voltage distributor:**
This subclass is indented under subclass 594. Subject matter in which the system produces a continuous sparking voltage output which is directed to a high voltage distributor.

**629 Monostable multivibrator controls timing of coil primary current:**
This subclass is indented under subclass 594. Subject matter in which the system includes an oscillatory circuit having one stable state (e.g., low output level), that is capable of being triggered into a second state (high output level) for a predeterminable time before reverting to its original state; the output of this circuit is used to control the flow of electrical current through the primary of an ignition coil.

**630 Safety device:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes an accessory device to prevent operation of the system when an unsafe condition is detected.

**631 Reverse engine rotation protection:**
This subclass is indented under subclass 630. Subject matter in which the accessory device prevents reverse operation of the engine.

**632 Ignition switch opened when engine stops:**
This subclass is indented under subclass 630. Subject matter in which the accessory device opens the ignition switch to protect the ignition system components when the engine stops.

**633 Radio interference protection:**
This subclass is indented under subclass 594. Subject matter including means which shield or otherwise prevent electrical noise generated by the ignition system from adversely affecting other electrical devices.

(1) Note. The protection device must be attached to or be part of the ignition system.

**634 Having a specific ignition coil:**
This subclass is indented under subclass 594. Subject matter wherein significance is attributed to the construction of an ignition coil.

SEE OR SEARCH CLASS:
336, Inductor Devices, subclasses 199+ and 225+ for coils, per se.

**635 Specific coil location:**
This subclass is indented under subclass 594. Subject matter in which significance is attributed to mounting or location of an ignition coil.

**636 Multiple spark ignition system:**
This subclass is indented under subclass 594. Subject matter wherein the ignition system induces a plurality of separate sparks per complete engine operating cycle in each cylinder.

**637 System fires single spark plug per cylinder:**
This subclass is indented under subclass 636. Subject matter wherein an engine cylinder has a single spark plug and means are provided to induce a plurality of separate multiple sparks in that plug.

**638 System fires multiple spark plugs per cylinder:**
This subclass is indented under subclass 636. Subject matter wherein an engine cylinder contains more than one spark plug, each plug fired once each complete engine operating cycle.

**639 System using vibrator for multiple sparks upon starting:**
This subclass is indented under subclass 636. Subject matter wherein the multiple sparks are generated only at start-up using an electromechanical or electronic vibrator.

**640 Dual systems:**
This subclass is indented under subclass 594. Subject matter wherein the ignition system employs a plurality of independent ignition systems each of which is capable of producing an ignition spark.

(1) Note. These systems may operate in phase adding their outputs to produce a single spark, or may operate out of phase to produce multiple sparks in a single cylinder per combustion cycle.

(2) Note. This subclass may also include ignition systems with a separate system for each cylinder in a multicylinder engine.

**641 One for starting:**
This subclass is indented under subclass 640. Subject matter in which one of the systems is designed for use during starting of the associated engine.

(1) Note. The remaining system(s) may or may not be cutoff when the starting system is operative.

**642 Piezoelectric voltage generator:**
This subclass is indented under subclass 594. Subject matter in which primary or secondary ignition coil voltage is derived from a crystalline or other pressure sensitive device.

(1) Note. Generally the crystal is compressed by a rotating engine member at the proper time to produce the main ignition energy.

SEE OR SEARCH THIS CLASS, SUBCLASS:
616, for piezoelectric devices used as position sensors.

**643 Electronic cylinder sequencing:**
This subclass is indented under subclass 594. Subject matter in which the ignition system employs an electronic sequencing device for directing voltage from an ignition coil secondary to the respective engine cylinders.

**644 Current or voltage sensing in coil primary:**
This subclass is indented under subclass 594. Subject matter wherein the ignition circuit includes means to sense the voltage or current level in an ignition coil primary.

**645 Maverick spark suppressor:**
This subclass is indented under subclass 594. Subject matter wherein the ignition circuit contains means which act to suppress or eliminate unwanted or out-of-time sparks due to interference, noise, power supply connections and disconnections, etc.

**646 Point bounce or arc suppression system:**
This subclass is indented under subclass 645. Subject matter wherein said means is generally located between the ignition breaker points and the main ignition circuit, to suppress, shape, or filter the signal from the points to eliminate interference or false triggering due to bouncing of the ignition breaker points.

**647 Having a specific mounting of system component:**
This subclass is indented under subclass 594. Subject matter wherein significance is attributed to the mounting or location of an ignition system component.

SEE OR SEARCH THIS CLASS, SUBCLASS:
635, for special ignition coil mounting.

**648 Having SCR triggered by lowering cathode voltage below ground:**
This subclass is indented under subclass 594. Subject matter wherein the ignition circuit uses a silicone control rectifier (SCR) to conduct the ignition coil primary current and wherein the SCR is triggered by lowering the cathode potential below ground (i.e., by applying a negative cathode potential).

**649 Multiple primary current interrupters:**
This subclass is indented under subclass 594. Subject matter wherein there are at least two switching elements carrying all or part of the ignition coil primary current.

(1) Note. These switching elements may be in series or in parallel and may be in circuit before or after the coil.

**650 Power supply, ignition coil primary, and interrupter element all in series:**
This subclass is indented under subclass 594. Subject matter in which the ignition system includes an interrupter means located in series with the power supply and the primary of the ignition coil, the interrupter means starting and stopping current flow through primary coil.

**651 Interrupter is multiple transistor circuit:**
This subclass is indented under subclass 650. Subject matter in which the interrupter means is a circuit containing more than one transistor, e.g., multistage switching current.

**652 Interrupter is single transistor:**
This subclass is indented under subclass 650. Subject matter in which the interrupter means is a transistor that starts and stops current flow in the coil primary.

**653 Additional capacitor other than breaker point capacitor is in series with coil primary or secondary:**
This subclass is indented under subclass 650. Subject matter in which a capacitor, other than the conventional breaker point capacitor, is placed in series with the primary or secondary of the ignition coil.

**654 Additional capacitor other than breaker point capacitor is in parallel with coil primary or secondary:**
This subclass is indented under subclass 650. Subject matter in which a capacitor, other than the conventional breaker point capacitor, is placed in parallel with the primary or secondary of the ignition coil.

**655 Diode is in series with coil primary or secondary:**
This subclass is indented under subclass 650. Subject matter in which a diode is placed in series with the primary or secondary of the ignition coil.

**656 Diode is in parallel with coil primary or secondary:**
This subclass is indented under subclass 650. Subject matter in which a diode is placed in parallel with the primary or secondary of the ignition coil.

**657 COMBUSTION CHAMBER:**
This subclass is indented under the class definition. Subject matter wherein significance is attributed to the form, construction, or other feature of the volume enclosed by the engine cylinder head, piston bore, and the top of the piston when ignition of the combustible mixture takes place or when the piston is at top dead center.

(1) Note. Includes relation of engine parts such as intake, exhaust, or igniting device to the combustion chamber.

SEE OR SEARCH THIS CLASS, SUBCLASS:
48, for a combustion chamber with means to vary the volume thereof.

SEE OR SEARCH CLASS:
60, Power Plants, subclasses 39.6+ for external combustion engines including a combustion chamber separated from the working cylinder by a transfer valve or equivalent means, communication between the combustion chamber and working cylinder being established subsequent to ignition with the combustion chamber.

**658 L- or T-shaped:**
This subclass is indented under subclass 657. Subject matter wherein the combustion chamber in the cylinder head extends laterally on one side of the top of the engine cylinder with the extension and cylinder bore in cross section forming an “L” shape, or two lateral extensions which in cross section with the cylinder bore form a “T” shape.

**659 Having groove to aid combustion:**
This subclass is indented under subclass 657. Subject matter in which at least one groove is provided on part or all of the surface of the combustion chamber.

(1) Note. The groove may be provided on the top, or the crown, or the piston.

**660 An acoustic cavity used to attenuate detonation shock waves (e.g., bodine):**
This subclass is indented under subclass 657. Subject matter in which an especially designed cavity or recess is provided in the combustion chamber to reduce or attenuate the force of a shock wave produced when the mixture detonates (engine knock).

**661 Having squish area:**
This subclass is indented under subclass 657. Subject matter in which part of the combustion chamber surface of the head extends toward the top of the piston so that when the piston reaches top dead center, only mechanical clearance space is left between the extended surface and piston and any fluid between said surface and piston top is squeezed out and into the remaining combustion chamber volume.

**662 Multiple annular combustion chambers:**
This subclass is indented under subclass 657. Subject matter wherein the combustion chamber is formed by rotating a plurality of noncontiguous planar shapes through 360° about a fixed central axis to form a plurality of ringlike or annular chambers.

SEE OR SEARCH THIS CLASS, SUBCLASS:
663, for rotated shapes that are connected or touching.

**663 Annular combustion chamber:**
This subclass is indented under subclass 657. Subject matter wherein the combustion chamber is formed by rotating a planar shape through 360° about a fixed central axis to form a ringlike or annular chamber.

**664 Combustion chamber shape is a figure of revolution:**
This subclass is indented under subclass 657. Subject matter wherein the combustion chamber is of a shape which may be formed by rotating at least one planar shape through 360° about a fixed central axis with the resulting volume being symmetrical about the central axis.

**665 Spherical:**
This subclass is indented under subclass 664. Subject matter in which the figure of revolution is ball-shaped.

**666 Hemispherical:**
This subclass is indented under subclass 664. Subject matter in which the figure of revolution is dome-shaped.

**667 Asymmetric combustion chamber:**
This subclass is indented under subclass 657. Subject matter in which the combustion chamber is asymmetrical.

**668 Having coating or liner:**
This subclass is indented under subclass 657. Subject matter in which at least part of the combustion chamber has a lamina on its inner surface.

(1) Note. Coating or liner may be polytetrafluoroethylene plastic, gold, etc.

**669 With means for mounting, coating, or liner:**
This subclass is indented under subclass 668. Subject matter including a liner or coating-securing means.

**670 Having catalytic combustion aid:**
This subclass is indented under subclass 657. Subject matter in which some part of the combustion chamber contains a catalytic material which acts as an aid to combustion.

**671 Cylinder head shape conforms to piston shape:**
This subclass is indented under subclass 657. Subject matter in which the general shape or contour of a significant portion of the cylinder head follows the piston shape.

**672 Including exhaust gas condition responsive means:**
This subclass is indented under subclass 434. Subject matter wherein the means for forming the mixture of fuel and oxidant senses at least one characteristic or parameter of the products of combustion (e.g., composition, or temperature or pressure, etc.) and uses such information to modify the relative proportion or ratio of fuel and oxidant in the mixture supplied to the internal combustion engine.

(1) Note. A combination of an internal combustion engine with an exhaust treating or exhaust handling means in more than name only recited in the claims is classified in Class 60. An internal combustion engine with the exhaust handled or treated only as necessary to evacuate the combustion chamber or to modify operation of the engine recited in the claims is found in Class 123.

(2) Note. A computer or digital control system recited in the claims in combination with an internal combustion engine in more than name only or wherein the control system includes an algorithm peculiar to subject matter under the class definition by claim disclosure is classified in Class 123.

SEE OR SEARCH THIS CLASS, SUBCLASS:

205+, for rotary-type internal combustion engines with charge forming means.

SEE OR SEARCH CLASS:

60, Power Plants, subclasses 272+ for an engine in which combusted gases are treated or handled after exhausting from the "working chamber".

73, Measuring and Testing, subclasses 23.31+ for analysis of combustion gases composition, per se.

204, Chemistry: Electrical and Wave Energy, subclasses 406+ for exhaust gas sensors, per se.

261, Gas and Liquid Contact Apparatus, appropriate subclasses for carburetors, per se.

701, Data Processing, Navigation, and Relative Location, subclasses 101+ for control means for internal-combustion engines including specific computer or data processing details.

**673 With sensor controlling each cylinder individually:**

This subclass is indented under subclass 672. Subject matter wherein a transducer is located in the flow path of the products of combustion which is sensitive to a particular component of the products of combustion, the engine has a plurality of cylinders or combustion chambers and the charge forming device responds to signals from the transducer to modify the ratio of fuel and oxidant supplied individually to the cylinders or combustion chambers. (i.e., the mixture ratio supplied to each cylinder or combustion chamber may be different)

SEE OR SEARCH THIS CLASS, SUBCLASS:

691, for multiple transducers located in the exhaust flow path controlling the air/fuel ratio conducted to the engine cylinders as a group.

**674 With modifying or updating memory (i.e., learning):**

This subclass is indented under subclass 672. Subject matter wherein a control means for the charge forming device has an information storage section for storing values at a plurality of memory locations for influencing fuel and oxidant mixture ratios and wherein the stored values may be replaced by newly determined values which will produce the desired products of combustion composition.

SEE OR SEARCH THIS CLASS, SUBCLASS:

693+, for exhaust condition responsive charge forming devices with compensation for sensor output and having an information storage section with a single memory location.

SEE OR SEARCH CLASS:

701, Data Processing, Navigation, and Relative Location, subclasses 103+ for control means for internal-combustion engines including specific computer or data processing details.

**675 Acceleration or deceleration responsive:**

This subclass is indented under subclass 674. Subject matter wherein a control means for the charge forming device is responsive to a sudden demand for an increase or decrease in the power or torque output of the engine.

**676 Exhaust gas temperature or pressure responsive:**

This subclass is indented under subclass 672. Subject matter wherein the mixture forming means has control means which varies the composition of the mixture of fuel and oxidant dependent upon the temperature or pressure of the products of combustion.

**677 Combined with ambient condition responsive means (e.g., pressure):**

This subclass is indented under subclass 672. Subject matter wherein the control means is also responsive to an atmospheric characteristic or parameter.

(1) Note. The ambient characteristic or parameter transducer may be located in an engine air/fuel mixture intake upstream of a throttling device.

**678 Ambient temperature responsive:**

This subclass is indented under subclass 677. Subject matter wherein the control means is responsive to the atmospheric temperature.

**679 Combined with engine condition responsive means:**
This subclass is indented under subclass 672. Subject matter wherein the mixture forming means additionally has control means responsive to an operational parameter of the internal combustion engine.

**680 Idling responsive:**
This subclass is indented under subclass 679. Subject matter wherein the control means is responsive to a no-load or minimum speed condition of the internal-combustion engine.

**681 Engine load responsive:**
This subclass is indented under subclass 679. Subject matter wherein the control means is responsive to a parameter indicative of the resistance to rotation of an output shaft of the engine.

**682 Acceleration or deceleration responsive:**
This subclass is indented under subclass 681. Subject matter wherein the control means is responsive to a sudden demand for an increase or decrease in the power or torque output of the engine.

SEE OR SEARCH THIS CLASS, SUBCLASS:
492, and 493, for charge forming devices having actuator circuits responsive to an acceleration or deceleration condition.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclasses 101+ for control means for internal-combustion engines including specific computer or data processing details and responsive to an acceleration or deceleration condition.

**683 Throttle position responsive:**
This subclass is indented under subclass 681. Subject matter wherein the control means is responsive to means for varying the cross-sectional area of a mixture forming conduit.

**684 Pressure downstream of throttle valve responsive:**
This subclass is indented under subclass 681. Subject matter wherein the control means is responsive to means for detecting the pressure of fluid downstream from means for varying the cross-sectional area of a mixture forming conduit.

**685 Starting or warmup responsive:**
This subclass is indented under subclass 679. Subject matter wherein the control means detects and is responsive to at least one engine or environmental parameter which indicates the engine's condition (1) during or before a starting attempt or (2) during a period before the engine reaches normal operating temperature after starting.

SEE OR SEARCH THIS CLASS, SUBCLASS:
491, for charge forming devices with actuator circuits responsive to a starting condition.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclass 113 for control means for internal-combustion engines including specific computer or data processing details and responsive to a starting or warmup condition.

**686 Engine coolant temperature responsive:**
This subclass is indented under subclass 685. Subject matter wherein the control means is responsive to the temperature of a heat exchange cooling fluid circulating through the internal combustion engine.

**687 Speed responsive:**
This subclass is indented under subclass 679. Subject matter wherein the control means is responsive to the rate of rotation of the output shaft of the engine or of a component driven by the output shaft.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclass 110 for control means for internal-combustion engines including specific computer

or data processing details and responsive to engine speed.

**688 Inoperative sensor responsive:**
This subclass is indented under subclass 679. Subject matter wherein malfunction of the control means is prevented by the detecting of an abnormality of operational readiness in the functioning of a constituent transducer in the outflow of the products of combustion.

**689 Engine fluid or engine component temperature responsive:**
This subclass is indented under subclass 679. Subject matter wherein the control means is responsive to the temperature of a fluid within the engine or an engine component.

**690 With fail-safe, backup, or malfunction means:**
This subclass is indented under subclass 672. Subject matter in which the control means upon detecting failure in a circuit or circuit element shifts (1) operation into a substitute circuit to accomplish the same function or (2) indicates functioning of the circuit or circuit element outside of acceptable parameters.

SEE OR SEARCH THIS CLASS, SUBCLASS:
479, for charge forming devices with actuator circuits having backup, fail-safe or failure indicator systems.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclass 114 for control means for internal-combustion engines including specific computer or data processing details and having backup systems.

**691 Multiple sensors controlling group of cylinders:**
This subclass is indented under subclass 672. Subject matter wherein a plurality of transducers are located in the flow path of the products of combustion, which are sensitive to a particular component of the products of combustion for adjusting the ratio of fuel and oxidant supplied to a plurality of combustion chambers or cylinders of the engine.

**692 Controlling plural groups of cylinders:**
This subclass is indented under subclass 691. Subject matter wherein there are a plurality of banks of cylinders, each bank having its own combustion products flow path and the transducers transmit signals to the mixture control means for adjusting the fuel and oxidant ratio for each bank of cylinders.

**693 With compensator for sensor output (e.g., current or voltage):**
This subclass is indented under subclass 672. Subject matter wherein a signal from a transducer is adjusted or modified before being received by a control means for the mixture forming means.

(1) Note. This subclass includes modification or adjustment to the sensor output signal before it is produced by the transducer.

SEE OR SEARCH CLASS:
73, Measuring and Testing, subclasses 23.21+ for gas composition analysis with compensation for error or drift correction of a sensor or transducer.

**694 Output fed to compensating circuit::**
This subclass is indented under subclass 693. Subject matter wherein the signal is adjusted or modified after being produced by the transducer.

**695 Variable reference value:**
This subclass is indented under subclass 694. Subject matter wherein the output signal from the transducer is compared to a signal which is variable.

**696 Proportional or integral circuit:**
This subclass is indented under subclass 694. Subject matter wherein (1) the output signal of the transducer is a predetermined ratio of its input or (2) wherein the output signal of the transducer is fed to a circuit the output of which increases or decreases at a predetermined rate with respect to time.

**697 Heater for sensor or sensor environment:**
This subclass is indented under subclass 693. Subject matter wherein separate means is provided for raising the temperature of the prod-

ucts of combustion in the region of the transducer or of the transducer itself.

**698 With addition of secondary fluid (e.g., fuel or exhaust gas):**
This subclass is indented under subclass 672. Subject matter wherein means is provided to add an additional fluid to the combustible mixture produced by the charge forming device before the mixture is fed to the engine cylinders.

SEE OR SEARCH THIS CLASS, SUBCLASS:
217, for rotary-type internal combustion engines having charge forming devices with exhaust gas recirculation.
568.11+, for charge forming devices wherein at least some of the exhaust gas products are added to the combustible mixture.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclasses 108+ for control means for internal-combustion engines including specific computer or data processing details and exhausted gas recirculation.

**699 Secondary fluid is auxiliary air or oxygen (e.g., carburetor air bleed):**
This subclass is indented under subclass 698. Subject matter wherein the additional fluid is an oxidant.

SEE OR SEARCH THIS CLASS, SUBCLASS:
585, for charge forming devices having auxiliary air or oxygen added to the combustible mixture.

SEE OR SEARCH CLASS:
701, Data Processing, Navigation, and Relative Location, subclasses 103+ for control means for internal-combustion engines including specific computer or data processing details.

**700 Fed to air/fuel mixture:**
This subclass is indented under subclass 699. Subject matter wherein the additional oxidant is added to the combustion supporting and combustible fluid mixture.

**701 With auxiliary control of carburetor:**
This subclass is indented under subclass 672. Subject matter wherein the means for forming the charge forming mixture is a carburetor.

SEE OR SEARCH CLASS:
261, Gas and Liquid Contact Apparatus, appropriate subclasses for carburetors, per se.

**702 Variable venturi carburetor:**
This subclass is indented under subclass 701. Subject matter wherein the carburetor is of the type having a throat which is variable in cross-sectional area.

**703 Exhaust gas composition sensor:**
This subclass is indented under subclass 672. Subject matter wherein the transducer senses a constituent in the products of combustion.

SEE OR SEARCH THIS CLASS, SUBCLASS:
494, for charge forming devices having an actuator circuit and specific features of a system sensor or transducer.

SEE OR SEARCH CLASS:
204, Chemistry: Electrical and Wave Energy, subclasses 406+ for exhaust gas sensors, per se.

**704 Air/fuel ratio prior to combustion responsive means:**
This subclass is indented under subclass 434. Subject matter wherein the means for forming the mixture of fuel and oxidant (1) senses the relative proportion of oxidant and fuel in the mixture at a first location in an intake manifold prior to combustion and (2) uses such information to modify the relative proportion of oxidant and fuel at a second downstream location supplied to the engine.

FOREIGN ART COLLECTIONS

The definitions for FOR 100-FOR 128 below correspond to the definitions of the abolished subclasses under Class 123 from which these collections were formed. See the Foreign Art Collections schedule for specific correspondences. [Note: The titles and definitions for indented art collections include all the details of the one (s) that are hierarchically superior.

**FOR 100 Spark delaying:**
Apparatus having means for acting upon the electrical discharge device of the engine in such a manner as to postpone the ignition of the combustible charge while the operating member is engaged by a human operator.

**FOR 101 SPARK IGNITION TIMING CONTROL:**
Subject matter which adjust or control the timing of the ignition spark. "Timing" is defined as the point of piston travel or crankshaft rotation at which the igniting spark occurs.

**FOR 102 Vacuum timing control:**
Subject matter in which the motor or other means controlling the timing uses a vacuum as its motive or actuating power source.

**FOR 103 Multiple diaphragms:**
Subject matter in which the vacuum actuated control means utilizes a plurality of diaphragms.

**FOR 104 Fluid delay in fluid path line from vacuum source:**
Subject matter in which the fluid path to the actuating motor or means contains a fluid delay means, e.g., restrictive orifice.

**FOR 105 Including sensor responsive to barometric pressure to alter vacuum level:**
Subject matter wherein means responsive to barometric or atmospheric pressure acts to vary the pressure or level of the actuating vacuum.

**FOR 106 Increasing vacuum retards the spark:**
Subject matter wherein the actuating means acts to retard the ignition spark timing upon an increasing vacuum signal.

**FOR 107 Barometric pressure responsive controller:**
Subject matter wherein the ignition timing control means is responsive to barometric or atmospheric pressure.

**FOR 108 By mechanical or hydraulic link to throttle valve or accelerator:**
Subject matter wherein the timing is controlled at least in part by mechanical or hydraulic linkage between the engine throttle valve or accelerator and an ignition timing control member.

**FOR 109 Having engine shaft position sensor:**
Subject matter in which the timing control means has an engine shaft (crank, cam, etc.) position sensor that is significantly claimed.

**FOR 110 Analog electronic control:**
Subject matter wherein the timing control utilizes some electrical or electronic means which functions in analog manner where the data used or calculations made are represented by analogous physical magnitudes or electrical signals.

**FOR 111 Digital electronic control:**
Subject matter wherein the timing control utilizes a digital memory, digital counting operation, or other digital decision making circuit.

**FOR 112 Having microprocessor:**
Subject matter wherein the system employs a solid-state digital logic device that uses a prestored "program" (internal or external) to change or generate certain output signals in response to changes in the input signal(s).

**FOR 113 Speed responsive:**
Subject matter wherein the ignition timing control responds to engine rpm.

**FOR 114 Responsive to instantaneous changes in engine speed (e.g., roughness):**
Subject matter in which the timing control is responsive to instantaneous changes in engine speed, which signal at least partial misfires in combustion.

**FOR 115 Centrifugal timing mechanism:**
Subject matter wherein the engine spark timing control responds to a speed signal generated by a centrifugal device.

**FOR 116 Ambient or engine temperature responsive:**
Subject matter in which the means that controls the spark timing is responsive to ambient or engine temperature other than combustion temperature.

**FOR 117 Acceleration responsive:**

Subject matter in which the spark timing control device includes means to sense a demand for increased power output from the engine.

**FOR 118 Deceleration responsive:**
Subject matter in which the spark timing control device includes means to sense a decrease in the power output from the engine, i.e., the engine acts as a brake.

**FOR 119 Starting or cold running condition responsive:**
Subject matter in which the means that controls the spark timing detects, and is responsive to, at least one engine or environmental parameter which indicates the engine's condition during or before a starting attempt or during the engine warm-up period after starting.

**FOR 120 Cylinder pressure or cylinder temperature responsive:**
Subject matter in which the spark timing control means includes an input from a cylinder combustion temperature or a cylinder combustion pressure sensor.

**FOR 121 Feedback correction:**
Subject matter in which means is provided to measure the spark timing instituted by the output (desired timing) of the control means and compare this measured timing with the desired timing and, if necessary, correct the measured timing so that it equals the desired timing.

**FOR 122 Timing control derived from ignition capacitor:**
Subject matter in which the timing control means includes a circuit that charges and discharges a capacitor.

**FOR 123 Having circuit that alters response of an oscillatory engine shaft position sensing circuit:**
Subject matter in which the timing control means includes an oscillatory circuit responsive to the engine shaft position and further means to modify the position response of this circuit, to thereby adjust the ignition timing.

**FOR 124 Exhaust gas used with the combustible mixture (e.g., emission control e.g.r. valve):**
Subject matter in which means is provided to return part or all of the products of combustion exhausted from the engine to the intake manifold or directly to the combustion chamber for subsequent reburning.

**FOR 125 Diesel engine:**
Subject matter wherein the engine involved in the recycling is a Diesel or compression ignition engine.

**FOR 126 Exhaust gas cooled before recirculation:**
Subject matter in which means is provided to cool the returned products of combustion before they are directed to the intake manifold or combustion chamber.

**FOR 127 Electrical control of e.g.r. valve (e.g., between exhaust gas and intake manifold):**
Subject matter having a valve means controlling the exhaust gas recirculation (E.G.R.) controlled or actuated electrically.

**FOR 128 Having controllable timing means:**
Subject matter in which means is provided to regulate or adjust the timing of the discharge of the capacitor relative to the angular position of the engine crankshaft.

END