COOPERATIVE PATENT CLASSIFICATION

H  ELECTRICITY
   (NOTE omitted)

H02  GENERATION; CONVERSION OR DISTRIBUTION OF ELECTRIC POWER

H02M  APPARATUS FOR CONVERSION BETWEEN AC AND AC, BETWEEN AC AND DC, OR BETWEEN DC AND DC, AND FOR USE WITH MAINS OR SIMILAR POWER SUPPLY SYSTEMS; CONVERSION OF DC OR AC INPUT POWER INTO SURGE OUTPUT POWER; CONTROL OR REGULATION THEREOF (systems for regulating electric or magnetic variables in general, e.g. using transformers, reactors or choke coils, combination of such systems with static converters G05F; {digital function or clock generators} for digital computers G06F 1/00, {G06F 1/025, G06F 1/04}; transformers H01F; connection or control of one converter with regard to conjoint operation with a similar or other source of supply H02J; dynamo-electric converters H02K 47/00; controlling transformers, reactors or choke coils, control or regulation of electric motors, generators or dynamo-electric converters H02P; pulse generators H03K; {static converters specially adapted for igniting or operating discharge lamps H05B 41/28})

NOTES

1. This subclass covers only circuits or apparatus for the conversion of electric power, or arrangements for control or regulation of such circuits or apparatus. The electrotechnical elements employed are dealt within the appropriate subclasses, e.g. inductors, transformers H01F, capacitors, electrolytic rectifiers H01G, mercury rectifying or other discharge tubes H01J, semiconductor devices H01L, impedance networks or resonant circuit not primarily concerned with the transfer of electric power H03H.

2. In this subclass, the following term is used with the meaning indicated:
   • "conversion", in respect of an electric variable, e.g. voltage or current, means the change of one or more of the parameters of the variable, e.g. amplitude, frequency, phase, polarity.

WARNINGS

1. The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:
   H02M 9/00 covered by H03K 3/53
   H02M 9/02 covered by H03K 3/53
   H02M 9/04 covered by H03K 3/53
   H02M 9/06 covered by H03K 3/53

2. In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

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| 2001/0025 | [Arrangements for modifying reference value, feedback value or error value in the control loop of a converter] |
| 2001/0029 | [Circuits or arrangements for limiting the slope ("slew rate") of switching signals] |
| 2001/0032 | [Control circuits allowing low power mode operation, e.g. "standby"] |
| 2001/0035 | [by burst mode control] |
| 2001/0038 | [Circuits or arrangements for suppressing, e.g. by masking incorrect turn-on or turn-off signals, e.g. due to current spikes in current mode control] |
| 2001/0041 | [Control circuits in which a clock signal is selectively enabled or disabled] |
Means for starting or stopping converters

Circuits or arrangements for reducing losses (using snubbers H02M 1/34)

Diode reverse recovery losses

Transistor switching losses (periodically suspending operation of switching converter in low power mode H02M 2001/0055)

by employing soft switching techniques, i.e. commutation of transistor when voltage applied to it is zero and/or when current flowing through it is zero (in resonant inverters H02M 2007/4815; in inverters operating from a resonant dc source H02M 7/4826; using an auxiliary actively switched resonant commutation circuit connected to an intermediate dc voltage or between two push-pull branches of an inverter bridge H02M 2007/4811)

using discharge tubes

Magnetic structures combining different functions, e.g. storage, filtering, transformation

Converter structures employing plural converter units, other than for parallel operation of the units on a single load

Plural converter units in cascade (push-pull dc/dc converters with preregulator H02M 3/3374; dc-ac converters following a dc-dc stage which includes a high frequency transformer H02M 7/4807, dc-ac converters following a dc-dc conversion stage which generates a periodically varying voltage H02M 7/4826)

Plural converter units whose inputs are connected in series

Plural converter units whose outputs are connected in series

Plural converter units for generating at least two independent, non-parallel outputs, e.g. systems with plural point of load switching regulators

Converters characterized by their input or output configuration

adapted for receiving as input a current source

having more than one output with independent control (for dc-dc converter with intermediate ac H02M 3/33561)

 wherein the output is created by adding a regulated voltage to or subtracting it from an unregulated input

Means for increasing hold-up time, i.e. the duration of time that a converter's output will remain within regulated limits following a loss of input power

Circuits specially adapted for the generation of grid-control or igniter-control voltages for discharge tubes incorporated in static converters

for tubes with grid control

wherein the phase of the control voltage is adjustable with reference to the AC voltage

(for multiphase systems)

(for ignition at the zero-crossing of voltage or current)

Circuits specially adapted for rendering non-conductive gas discharge tubes or equivalent semiconductor devices, e.g. thyatrons, thyristors

for discharge tubes

Circuits specially adapted for the generation of control voltages for semiconductor devices incorporated in static converters

wherein the phase of the control voltage is adjustable with reference to the AC source

(with digital control)

for the ignition at the zero crossing of the voltage or the current

using a control circuit common to several phases of a multi-phase system

digitally controlled (or with digital control)

for the simultaneous control of series or parallel connected semiconductor devices

the control signals being transmitted optically

the power supply of the control circuit being connected in parallel to the main switching element (H02M 1/092 takes precedence)

Arrangements incorporating converting means for enabling loads to be operated at will from different kinds of power supplies, e.g. from ac or dc

Arrangements for reducing harmonics from ac input or output

Suppression of common mode voltage or current

using passive filters

Arrangements for reducing ripples from dc input or output

using compensating arrangements (for reducing noise from the supply in transmission systems H04B 15/005)

using discharge tubes

using active elements

Means for providing current step on switching, e.g. with saturable reactor

Contact mechanisms of dynamic converters

incorporating collectors and brushes

incorporating rolling or tumbling contacts

incorporating cam-operated contacts

incorporating electromagnetically-operated vibrating contacts

incorporating liquid contacts

Means for protecting converters other than automatic disconnection (emergency protective circuit arrangements specially adapted for converters with automatic disconnection H02H 7/10)

Means for rapidly discharging a capacitor of the converter, in order to protect electrical components or prevent electrical shock

with means for allowing continuous operation despite a fault, i.e. fault tolerant converters

against abnormal temperatures

Snubber circuits

Active non-dissipative snubbers

Active dissipative snubbers

Passive non-dissipative snubbers

Passive dissipative snubbers

Means for starting or stopping converters

Means for preventing simultaneous conduction of switches
Conversion of dc power input into dc power output

- with means for correcting output voltage deviations introduced by the dead time
- Means for preventing magnetic saturation
- Circuits or arrangements for compensating for or adjusting power factor in converters or inverters
- Arrangements for improving power factor of AC input
- operating from a three-phase input voltage
- using a non-isolated boost converter
- using a bridge converter consisting of active switches
- using a resonant converter
- using a single converter stage both for correction of AC input power factor and generation of a high frequency AC output voltage
- using a single converter stage both for correction of AC input power factor and generation of a regulated and galvanically isolated DC output voltage
- using passive elements
- by adding an auxiliary output voltage in series to the input
- by adding a controlled rectifier in parallel to a first rectifier feeding a smoothing capacitor
- by using a Buck converter to switch the input current
- Circuits or arrangements for compensating for electromagnetic interference in converters or inverters

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- by using a Buck converter to switch the input current
- Circuits or arrangements for compensating for electromagnetic interference in converters or inverters
H02M

3/22 . . . . . . with intermediate conversion into ac
3/24 . . . . . . by static converters
3/26 . . . . . . using discharge tubes without control electrode or semiconductor devices without control electrode to produce the intermediate ac
3/28 . . . . . . using discharge tubes with control electrode or semiconductor devices with control electrode to produce the intermediate ac
3/285 . . . . . . [Single converters with a plurality of output stages connected in parallel (parallel operation of a plurality of converters in dc distribution networks H02J 1/10)]
3/305 . . . . . . using devices of a thyatron or thyristor type requiring extinguishing means
3/31 . . . . . . using discharge tubes only
3/315 . . . . . . using semiconductor devices only
3/3155 . . . . . . [with automatic control of the output voltage or current]
3/325 . . . . . . using devices of a triode or a transistor type requiring continuous application of a control signal
3/33 . . . . . . using discharge tubes only
3/335 . . . . . . using semiconductor devices only
3/33507 . . . . . . [with automatic control of the output voltage or current (H02M 3/33561, H02M 3/33562 take precedence)]
3/33515 . . . . . . [with galvanic isolation between input and output]
3/33523 . . . . . . [with galvanic isolation between input and output]
3/3353 . . . . . . [having at least two simultaneously operating switches on the input side, e.g. "double forward" or "double (switched) flyback" converter]
3/33538 . . . . . . [of the forward type (H02M 3/3353, H02M 3/33562 take precedence)]
3/33546 . . . . . . [with automatic control of the output voltage or current (H02M 3/33561 take precedence)]
3/33553 . . . . . . [with galvanic isolation between input and output]
3/33561 . . . . . . [having more than one output with independent control]
3/33569 . . . . . . [having several active switching elements (H02M 3/3353 takes precedence)]
3/33576 . . . . . . [having at least one active switching element at the secondary side of an isolation transformer]
3/33584 . . . . . . [Bidirectional converters]
3/33592 . . . . . . [having a synchronous rectifier circuit or a synchronous freewheeling circuit at the secondary side of an isolation transformer]
3/337 . . . . . . in push-pull configuration
3/3372 . . . . . . [of the parallel type]
3/3374 . . . . . . [with preregulator, e.g. current injected push-pull]
3/3376 . . . . . . [with automatic control of output voltage or current]
3/3378 . . . . . . [in a push-pull configuration of the parallel type (H02M 3/3374 takes precedence)]
3/338 . . . . . . in a self-oscillating arrangement
3/3381 . . . . . . [using a single commutation path]
3/3382 . . . . . . [in a push-pull circuit arrangement]
3/3384 . . . . . . [of the parallel type]
3/3385 . . . . . . [with automatic control of output voltage or current (H02M 3/33561 takes precedence)]
3/3387 . . . . . . [in a push-pull configuration]
3/3388 . . . . . . [of the parallel type]
3/34 . . . . . . by dynamic converters
3/36 . . . . . . using mechanical parts to select progressively or to vary continuously the input potential
3/38 . . . . . . using mechanical contact-making and -breaking parts to interrupt a single potential
3/40 . . . . . . wherein the parts are rotating and collectors co-operate with brushes or rollers
3/42 . . . . . . with electromagnetically-operated vibrating contacts, e.g. chopper (self-interrupters in general H01H 51/34)
3/44 . . . . . . by combination of static with dynamic converters; by combination of dynamo-electric with other dynamic or static converters

5/00 Conversion of ac power input into ac power output, e.g. for change of voltage, for change of frequency, for change of number of phases
5/005 . . . . . . [using discharge tubes]
5/002 . . . . . . without intermediate conversion into dc
5/004 . . . . . . by static converters (controlling transformers, reactors or choke coils, e.g. by tap changing (H02P 13/00)
5/006 . . . . . . using impedances
5/008 . . . . . . using capacitors only
5/10 . . . . . . using transformers
5/12 . . . . . . for conversion of voltage or current amplitude only
5/14 . . . . . . for conversion between circuits of different phase number
5/16 . . . . . . for conversion of frequency
5/18 . . . . . . for conversion of waveform
5/20 . . . . . . using discharge tubes without control electrode or semiconductor devices without control electrode
5/22 . . . . . . using discharge tubes with control electrode or semiconductor devices with control electrode
5/225 . . . . . . [comprising two stages of AC-AC conversion, e.g. having a high frequency intermediate link]
5/25 . . . . . . using devices of a thyatron or thyristor type requiring extinguishing means (H02M 5/225), H02M 5/27 take precedence)
5/253 . . . . . . using discharge tubes only
5/257 . . . . . . using semiconductor devices only
5/2573 . . . . . . [with control circuit]
5/2576 . . . . . . [with digital control]
5/27 . . . . . . for conversion of frequency
5/271 . . . . . . [from a three phase input voltage]
5/272 . . . . . . [for variable speed constant frequency systems]
5/273 . . . . . . . . . . [with digital control]
5/275 . . . . . . . . . . using devices of a triode or transistor type
requiring continuous application of a control signal (H02M 5/225; H02M 5/297 take precedence)
5/29 . . . . . . . . . . using discharge tubes only
5/293 . . . . . . . . . . using semiconductor devices only
2005/2932 . . . . . . . [with automatic control of output voltage, current or power]
2005/2935 . . . . . . . [using reverse phase control, i.e. turn-on of switch in series with load at
zero crossing of input voltage, turn-off before next zero crossing]
2005/2937 . . . . . . . [using whole cycle control, i.e. switching an integer number of whole
(half) cycles of the ac input voltage]
5/297 . . . . . . . . . . for conversion of frequency
5/32 . . . . . . . . . . by dynamic converters
5/34 . . . . . . . . . . using mechanical contact-making and -
breaking parts
5/36 . . . . . . . . . . wherein the parts are rotating and collectors
co-operate with brushes or rollers
5/38 . . . . . . . . . . by combination of static with dynamic converters; by combination of dynamo-electric with other
dynamic or static converters
5/40 . . . . . . . . . . with intermediate conversion into dc
5/42 . . . . . . . . . . by static converters
5/44 . . . . . . . . . . using discharge tubes or semiconductor devices
 to convert the intermediate dc into ac
5/443 . . . . . . . . . . using devices of a thyatron or thyristor type
 requiring extinguishing means
5/447 . . . . . . . . . . using discharge tubes only
5/45 . . . . . . . . . . using semiconductor devices only
5/4505 . . . . . . . . . . [having a rectifier with controlled elements]
5/451 . . . . . . . . . . with automatic control of output voltage
requiring continuous application of a control signal
5/453 . . . . . . . . . . using devices of a triode or transistor type
requiring continuous application of a control signal
5/456 . . . . . . . . . . using discharge tubes only
5/458 . . . . . . . . . . using semiconductor devices only
5/4585 . . . . . . . . . . [having a rectifier with controlled elements]
5/46 . . . . . . . . . . by dynamic converters
5/48 . . . . . . . . . . by combination of static with dynamic converters; by combination of dynamo-electric with other
dynamic or static converters
7/00 Conversion of ac power input into dc power output; Conversion of dc power input into ac
power output
7/003 . . . . . . . . . . [Constructional details, e.g. physical layout, assembly, wiring, busbar connections]
7/006 . . . . . . . . . . [using discharge tubes]
7/02 . . . . . . . . . . Conversion of ac power input into dc power output
without possibility of reversal
7/04 . . . . . . . . . . by static converters
7/043 . . . . . . . . . . [using transformers or inductors only]
7/046 . . . . . . . . . . [using discharge tubes]
7/06 . . . . . . . . . . using discharge tubes without control electrode
or semiconductor devices without control electrode
7/062 . . . . . . . . . . [Avoiding or suppressing excessive transient voltages or currents]
7/064 . . . . . . . . . . [with several outputs]
7/066 . . . . . . . . . . [particular circuits having a special characteristic]
7/068 . . . . . . . . . . [mounted on a transformer]
7/08 . . . . . . . . . . arranged for operation in parallel
7/10 . . . . . . . . . . arranged for operation in series, e.g. for
multiplication of voltage
7/103 . . . . . . . . . . [Containing passive elements
(capacitively coupled) which are ordered in cascade on one source]
7/106 . . . . . . . . . . [With physical arrangement details]
7/12 . . . . . . . . . . using discharge tubes with control electrode or
semiconductor devices with control electrode
7/125 . . . . . . . . . . [Avoiding or suppressing excessive transient voltages or currents]
7/145 . . . . . . . . . . using devices of a thyatron or thyristor type
requiring extinguishing means
7/15 . . . . . . . . . . using discharge tubes only
7/151 . . . . . . . . . . [with automatic control (H02M 7/153
takes precedence)]
7/153 . . . . . . . . . . [arranged for operation in parallel]
7/155 . . . . . . . . . . using semiconductor devices only
7/1552 . . . . . . . . . . [in a biphase or polyphase arrangement
(voltage multipliers H02M 7/19)]
7/1555 . . . . . . . . . . [with control circuit]
7/1557 . . . . . . . . . . [with automatic control of the output
voltage or current]
7/162 . . . . . . . . . . in a bridge configuration
7/1623 . . . . . . . . . . [with control circuit]
7/1626 . . . . . . . . . . [with automatic control of the output
voltage or current]
7/17 . . . . . . . . . . arranged for operation in parallel
7/19 . . . . . . . . . . arranged for operation in series, e.g. for
voltage multiplication
7/21 . . . . . . . . . . using devices of a triode or transistor type
requiring continuous application of a control signal
7/213 . . . . . . . . . . using discharge tubes only
7/217 . . . . . . . . . . using semiconductor devices only
7/2173 . . . . . . . . . . [in a biphase or polyphase circuit
arrangement (H02M 7/2176 takes precedence; voltage multipliers
H02M 7/25)]
7/2176 . . . . . . . . . . [comprising a passive stage to generate
a rectified sinusoidal voltage and a
directed switching element in series
between such stage and the output]
7/219 . . . . . . . . . . in a bridge configuration
2007/2195 . . . . . . . . . . [the switches being synchronously
commutated at the same frequency of
the AC input voltage]
7/223 . . . . . . . . . . arranged for operation in parallel
(7/2276 takes precedence)
7/25 . . . . . . . . . . arranged for operation in series, e.g. for
multiplication of voltage
7/26 . . . . . . . . . . using open-spark devices, e.g. Marx rectifier
7/28 . . . . . . . . . . using electrolytic rectifiers
7/30 . . . . . . . . . . by dynamic converters
7/32 . . . . . . . using mechanical contact-making and -breaking parts
7/34 . . . . . . . wherein the parts are rotating and collectors co-operate with brushes or rollers
7/36 . . . . . . . with electromagnetically-operated vibrating contacts, e.g. chopper (self-interrupters in general H01H 51/34)
7/38 . . . . . . . using one or more sparking electrodes rotating over counter-electrodes
7/40 . . . . . . . by combination of static with dynamic converters; by combination of dynamo-electric with other dynamic or static converters
7/42 . . . . . . . Conversion of dc power input into ac power output without possibility of reversal
7/44 . . . . . . . by static converters
7/46 . . . . . . . {using discharge tubes}
7/48 . . . . . . . using discharge tubes without control electrode or semiconductor devices without control electrode
7/50 . . . . . . . [using discharge tubes]
7/52 . . . . . . . the DC input voltage varies periodically, e.g.
7/54 . . . . . . . {having a high frequency intermediate AC stage}
7/56 . . . . . . . [having an auxiliary actively switched resonant commutation circuit connected to an intermediate dc voltage or between two push-pull branches]
7/58 . . . . . . . [Resonant converters (H02M 2007/4811 and H02M 7/4826 take precedence)]
7/60 . . . . . . . {with means for adaptation of resonance frequency, e.g. by modification of capacitance or inductance of resonance circuit}
7/62 . . . . . . . [arranged for operation in parallel]
7/64 . . . . . . . [operating from a resonant DC source, i.e. the DC input voltage varies periodically, e.g. resonant DC-link inverters]
7/66 . . . . . . . Converters with outputs that each can have more than two voltages levels
7/68 . . . . . . . {comprising a plurality of cells, each including a switchable capacitor, the capacitors having a nominal charge voltage which corresponds to a given fraction of the input voltage, the capacitors being selectively connected in series to determine the instantaneous output voltage}
7/70 . . . . . . . Neutral point clamped inverters
7/72 . . . . . . . Combination of the output voltage waveforms of a plurality of converters
7/74 . . . . . . . the static converters being arranged for operation in parallel
7/76 . . . . . . . sinusoidal output voltages being obtained by combination of several voltages being out of phase
7/78 . . . . . . . sinusoidal output voltages being obtained by the combination of several pulse-voltages having different amplitude and width
7/80 . . . . . . . using devices of a thyratron or thyristor type requiring extinguishing means (H02M 7/4807, H02M 7/483, H02M 7/493 and H02M 7/4826 take precedence)]
7/82 . . . . . . . using discharge tubes only
7/84 . . . . . . . using semiconductor devices only
7/86 . . . . . . . [with separate extinguishing means]
7/88 . . . . . . . [wherein each commutation element has its own extinguishing means]
7/90 . . . . . . . [wherein the extinguishing of every commutation element will be obtained by means of a commutation inductance, by starting another main commutation element in series with the first]
7/92 . . . . . . . Self-oscillating arrangements
7/94 . . . . . . . with special starting equipment
7/96 . . . . . . . in a push-pull configuration (H02M 7/517 takes precedence)
7/98 . . . . . . . in a bridge configuration
7/100 . . . . . . . with LC-resonance circuit in the main circuit
7/102 . . . . . . . {the commutation elements being in a push-pull arrangement}
7/104 . . . . . . . {in a series push-pull arrangement}
7/106 . . . . . . . with automatic control of output waveform or frequency (H02M 7/517 - H02M 7/523 take precedence)
7/108 . . . . . . . by pulse width modulation
7/110 . . . . . . . using digital control
7/112 . . . . . . . using devices of a triode or transistor type requiring continuous application of a control signal (H02M 7/4807, H02M 7/493 and H02M 7/4826 take precedence)
7/114 . . . . . . . using discharge tubes only
7/116 . . . . . . . using semiconductor devices only, e.g. single switched pulse inverters
7/118 . . . . . . . with special starting equipment
7/120 . . . . . . . in a push-pull configuration (H02M 7/5375 takes precedence ; with oscillating arrangements H02M 7/5383, H02M 7/53846))
7/122 . . . . . . . [with automatic control of output voltage or current]
7/124 . . . . . . . {in a push-pull configuration of the parallel type}
7/126 . . . . . . . Parallel type
7/128 . . . . . . . in a self-oscillating arrangement (H02M 7/538 takes precedence)
7/130 . . . . . . . {in a push-pull arrangement}
7/132 . . . . . . . (of the parallel type)
7/134 . . . . . . . using a single commutation path
7/136 . . . . . . . Control circuits

**WARNING**

Group H02M 7/53846 and subgroups is not complete, see provisionally also H02M 7/5383 and subgroups

7/538463 . . . . . . . {for thyristor type converters}
7/538466 . . . . . . . {for transistor type converters}
7/53854 . . . . . . . using thyristor type converters
7/53862 . . . . . . . using transistor type converters
7/5387 . . . . . . . in a bridge configuration
7/53871 . . . . . . . {with automatic control of output voltage or current}
7/53873 . . . . . . . {with digital control}
Group H02M 7/5388 is not complete, see provisionally also H02M 7/5375 - H02M 7/5387 and subgroups.

- **7/539**: with automatic control of output waveform or frequency
  - (H02M 7/5375 - H02M 7/5387 take precedence)

- **7/5395**: by pulse-width modulation

- **7/54**: by dynamic converters

- **7/56**: using mechanical parts to select progressively, or to vary continuously, the input potential

- **7/58**: using mechanical contact-making and -breaking parts to interrupt a single potential

- **7/60**: wherein the parts are rotating and collectors co-operate with brushes or rollers

- **7/62**: with electromagnetically-operated vibrating contacts, e.g. chopper (self-interrupters in general H01H 51/34)

- **7/64**: by combination of static with dynamic converters; by combination of dynamo-electric with other dynamic or static converters

- **7/66**: with possibility of reversal

- **7/68**: by static converters

- **7/70**: using discharge tubes without control electrode or semiconductor devices without control electrode

- **7/72**: using discharge tubes with control electrode or semiconductor devices with control electrode

- **7/75**: using devices of a thyatron or thyristor type requiring extinguishing means (H02M 7/77 takes precedence)

- **7/753**: using discharge tubes only

- **7/757**: using semiconductor devices only

- **7/7575**: [for high voltage direct transmission link]

- **7/758**: with automatic control of output waveform or frequency

- **7/77**: arranged for operation in parallel

- **7/79**: using devices of a triode or transistor type requiring continuous application of a control signal (H02M 7/81 takes precedence)

- **7/793**: using discharge tubes only

- **7/797**: using semiconductor devices only

- **7/81**: arranged for operation in parallel

- **7/82**: using open-spark devices, e.g. Marx rectifier

- **7/84**: using electrolytic rectifiers

- **7/86**: by dynamic converters

- **7/88**: using mechanical parts to select progressively or to vary continuously the input potential

**WARNING**

- **11/00**: Power conversion systems not covered by the preceding groups.