

**CPC****COOPERATIVE PATENT CLASSIFICATION****H02H**

**EMERGENCY PROTECTIVE CIRCUIT ARRANGEMENTS** (indicating or signalling undesired working conditions [G01R](#) , e.g. [G01R 31/00](#), [G08B](#) ; locating faults along lines [G01R 31/08](#); emergency protective devices [H01H](#) )

**NOTE**

This subclass covers only circuit arrangements for the automatic protection of electric lines or electric machines or apparatus in the event of an undesired change from normal working conditions

**Guidance heading:****H02H 1/00****Details of emergency protective circuit arrangements**

- H02H 1/0007 . {concerning the detecting means (in general [G01R](#) or other subclasses of [G01](#) ; reed switches [H01H 71/2445](#)) }
- H02H 1/0015 . . {Using arc detectors }
- H02H 1/0023 . . . {sensing non electrical parameters, e.g. by optical, pneumatic, thermal or sonic sensors }
- H02H 1/003 . . {Fault detection by injection of an auxiliary voltage (same for detection of earth fault currents [H02H 3/17](#); for monitoring earth connection [H02H 5/105](#)) }
- H02H 1/0038 . {concerning the connection of the detecting means, e.g. for reducing their number }
- H02H 1/0046 . . {Commutating the detecting means in dependance of the fault, e.g. for reducing their number }
- H02H 1/0053 . . {Means for storing the measured quantities during a predetermined time }
- H02H 1/0061 . {concerning transmission of signals (transmission of measured quantities or switching orders; sectionalised protection involving signal transmission between at least two stations [H02H 7/261](#); comparison of the voltage or current values at two spaced portions of a single system [H02H 3/28](#); transferring the output of a sensing member to another variable [G01D 5/00](#); electrical measuring arrangements using modulation of electromagnetic waves, e.g. light beams [G01R 15/24](#), [G01R 15/26](#)) }
- H02H 1/0069 . . {by means of light or heat rays }
- H02H 1/0076 . . {by superposition on the watched current }
- H02H 1/0084 . . {by means of pilot wires or a telephone network; watching of these wires }
- H02H 1/0092 . {concerning the data processing means, e.g. expert systems, neural networks }
- H02H 1/04 . . Arrangements for preventing response to transient abnormal conditions, e.g. to lightning {or to short duration over voltage or oscillations; Damping the influence of dc component by short circuits in ac networks }
- H02H 1/043 . . {to inrush currents ([H02H 1/046](#) takes precedence; differential protection of transformers [H02H 7/045](#)) }
- H02H 1/046 . . {upon detecting saturation of current transformers (for differential protection [H02H 3/283](#)) }

- H02H 1/06 . Arrangements for supplying operative power { (power supply arrangements in general [G05F](#) , [H02M](#) ) }
- H02H 1/063 . . {primary power being supplied by fault current }
- H02H 1/066 . . . {and comprising a shunt regulator }
  
- H02H 3/00** **Emergency protective circuit arrangements for automatic disconnection directly responsive to an undesired change from normal electric working condition with or without subsequent reconnection** (specially adapted for specific types of electric machines or apparatus or for sectionalised protection of cable of line systems [H02H 7/00](#); systems for change-over to standby supply [H02J 9/00](#)) {integrated protection (for motors [H02H 7/0822](#)) }
  
- H02H 3/003 . {responsive to reversal of power transmission direction (reversal of direct current [H02H 3/18](#)) }
  
- H02H 3/006 . {Calibration or setting of parameters }
  
- H02H 3/02 . Details
- H02H 3/021 . . {concerning the disconnection itself, e.g. at a particular instant, particularly at zero value of current, disconnection in a predetermined order (disconnection at zero value in general [H03K 17/18](#)) }
- H02H 3/023 . . . {by short-circuiting }
- H02H 3/025 . . {Disconnection after limiting, e.g. when limiting is not sufficient or for facilitating disconnection }
- H02H 3/027 . . with automatic disconnection after a predetermined time ([H02H 3/033](#), [H02H 3/06](#) take precedence; {timing in overcurrent protection circuits [H02H 3/093](#); in undervoltage protection circuits [H02H 3/247](#); staggered disconnection [H02H 7/30](#) })
- H02H 3/033 . . with several disconnections in a preferential order, {e.g. following priority of the users, load repartition } ([H02H 3/06](#) takes precedence)
- H02H 3/04 . . with warning or supervision in addition to disconnection, e.g. for indicating that protective apparatus has functioned { (watching of pilot wires [H02H 1/0084](#); protection of protective arrangements [H02H 7/008](#); indication of the state of electronic switches [H03K 17/18](#)) }
- H02H 3/042 . . . {combined with means for locating the fault (locating faults in cables [G01R 31/08](#)) }
- H02H 3/044 . . . {Checking correct functioning of protective arrangements, e.g. by simulating a fault (for differential current circuit breakers [H02H 3/335](#)) }
- H02H 3/046 . . . {Signalling the blowing of a fuse (detecting non functioning of a lamp [H05B 37/03](#)) }
- H02H 3/048 . . . {Checking overvoltage diverters }
- H02H 3/05 . . with means for increasing reliability, e.g. redundancy arrangements { (for logic circuits [H03K 19/003](#)) }
- H02H 3/06 . . with automatic reconnection
- H02H 3/063 . . . {Details concerning the co-operation of many similar arrangements, e.g. in a network (sectionalised protection [H02H 7/26](#)) }
- H02H 3/066 . . . {Reconnection being a consequence of eliminating the fault which caused disconnection }
- H02H 3/07 . . . and with permanent disconnection after a predetermined number of reconnection cycles

- H02H 3/08 . responsive to excess current (responsive to abnormal temperature caused by excess current [H02H 5/04](#))
- H02H 3/081 . . {and depending on the direction }
- H02H 3/083 . . {for three-phase systems }
- H02H 3/085 . . {making use of a thermal sensor, e.g. thermistor, heated by the excess current (also responsive to the temperature of the protected device [H02H 5/041](#), thermal images [H02H 6/00](#)) }
- H02H 3/087 . . for dc applications
- H02H 3/093 . . with timing means { (in general [H02H 3/027](#); thermal delay [H02H 3/085](#); timing means for undervoltage protection [H02H 3/247](#)) }
- H02H 3/0935 . . . {the timing being determined by numerical means }
- H02H 3/10 . . additionally responsive to some other abnormal electrical conditions
- H02H 3/105 . . . {responsive to excess current and fault current to earth }
- H02H 3/12 . responsive to underload or no-load { (for motors [H02H 7/0827](#)) }
- H02H 3/13 . . for multiphase applications, e.g. phase interruption
- H02H 3/14 . responsive to occurrence of voltage on parts normally at earth potential { (monitoring earth connection [H02H 5/105](#)) }
- H02H 3/16 . responsive to fault current to earth, frame or mass (with balanced or differential arrangement [H02H 3/26](#); {monitoring earth connection [H02H 5/105](#) })
- H02H 3/162 . . {for ac systems }
- H02H 3/165 . . . {for three-phase systems }
- H02H 3/167 . . {combined with other earth-fault protective arrangements }
- H02H 3/17 . . by means of an auxiliary voltage injected into the installation to be protected { (using summation current transformers [H02H 3/33](#)) }
- H02H 3/18 . responsive to reversal of direct current
- H02H 3/20 . responsive to excess voltage
- H02H 3/202 . . { for dc systems }
- H02H 3/205 . . {using a spark-gap as detector }
- H02H 3/207 . . {also responsive to under-voltage (window comparators for indication [G01R 19/165](#)) }
- H02H 3/22 . . of short duration, e.g. lightning
- H02H 3/24 . responsive to undervoltage or no-voltage { ([H02H 3/207](#) takes precedence) }
- H02H 3/243 . . {for DC systems }
- H02H 3/247 . . having timing means
- H02H 3/253 . . for multiphase applications, e.g. phase interruption
- H02H 3/26 . responsive to difference between voltages or between currents; responsive to phase angle between voltages or between currents
- H02H 3/265 . . {responsive to phase angle between voltages or between currents }
- H02H 3/28 . . involving comparison of the voltage or current values at two spaced portions of a single system, e.g. at opposite ends of one line, at input and output of apparatus {

- for transformers [H02H 7/045](#) }
- H02H 3/283 . . . {and taking into account saturation of current transformers }
  - H02H 3/286 . . . {involving comparison of similar homopolar quantities }
  - H02H 3/30 . . . using pilot wires or other signalling channel
  - H02H 3/302 . . . . {involving phase comparison }
  - H02H 3/305 . . . . {involving current comparison }
  - H02H 3/307 . . . . {involving comparison of quantities derived from a plurality of phases, e.g. homopolar quantities; using mixing transformers }
  - H02H 3/32 . . involving comparison of the voltage or current values at corresponding points in different conductors of a single system, e.g. of currents in go and return conductors
  - H02H 3/325 . . . {involving voltage comparison ([H02H 3/347](#) takes precedence) }
  - H02H 3/33 . . . using summation current transformers ([H02H 3/347](#) takes precedence)
  - H02H 3/331 . . . . {responsive to earthing of the neutral conductor ([H02H 3/338](#) takes precedence) }
  - H02H 3/332 . . . . {with means responsive to dc component in the fault current }
  - H02H 3/334 . . . . {with means to produce an artificial unbalance for other protection or monitoring reasons or remote control ([H02H 3/338](#) takes precedence) }
  - H02H 3/335 . . . . . {the main function being self testing of the device }
  - H02H 3/337 . . . . {avoiding disconnection due to reactive fault currents }
  - H02H 3/338 . . . . {also responsive to wiring error, e.g. loss of neutral, break }
  - H02H 3/34 . . . of a three-phase system
  - H02H 3/343 . . . . {using phase sequence analysers }
  - H02H 3/347 . . . . using summation current transformers
  - H02H 3/353 . . . . involving comparison of phase voltages
  - H02H 3/36 . . involving comparison of the voltage or current values at corresponding points of different systems, e.g. of parallel feeder systems
  - H02H 3/365 . . . {one of the systems simulating the other system }
  - H02H 3/38 . responsive to both voltage and current; responsive to phase angle between voltage and current
  - H02H 3/382 . . {involving phase comparison between current and voltage or between values derived from current and voltage }
  - H02H 3/385 . . {using at least one homopolar quantity }
  - H02H 3/387 . . {using phase-sequence analysing arrangements }
  - H02H 3/40 . responsive to ratio of voltage and current
  - H02H 3/402 . . {using homopolar quantities }
  - H02H 3/405 . . {using phase sequence analysing arrangements }
  - H02H 3/407 . . {using induction relays }
  - H02H 3/42 . responsive to product of voltage and current
  - H02H 3/422 . . {using homopolar quantities }
  - H02H 3/425 . . {using phase sequence analysing arrangements }
  - H02H 3/427 . . {using induction relays }
  - H02H 3/44 . responsive to the rate of change of electrical quantities

- H02H 3/445 . . {of DC quantities }
- H02H 3/46 . responsive to frequency deviations
- H02H 3/48 . responsive to loss of synchronism
- H02H 3/50 . responsive to the appearance of abnormal wave forms, e.g. ac in dc installations
- H02H 3/52 . . responsive to the appearance of harmonics
  
- H02H 5/00** **Emergency protective circuit arrangements for automatic disconnection directly responsive to an undesired change from normal non-electric working conditions with or without subsequent reconnection** (using simulators of the apparatus being protected [H02H 6/00](#); specially adapted for specific types of electric machines or apparatus or for sectionalised protection of cable or line systems [H02H 7/00](#))
  
- H02H 5/005 . {responsive to ionising radiation; Nuclear-radiation circumvention circuits (radiation detectors [G01T](#) ; nuclear-explosion detection [G21J 5/00](#)) }
- H02H 5/04 . responsive to abnormal temperature {specially adapted for electric machines [H02H 7/0852](#) }
- H02H 5/041 . . {additionally responsive to excess current ([H02H 5/048](#) takes precedence) }
- H02H 5/042 . . {using temperature dependent resistors }
- H02H 5/043 . . . {the temperature dependent resistor being disposed parallel to a heating wire, e.g. in a heating blanket }
- H02H 5/044 . . {using a semiconductor device to sense the temperature }
- H02H 5/045 . . {using a thermal radiation sensor }
- H02H 5/046 . . {using a thermocouple }
- H02H 5/047 . . { using a temperature responsive switch }
- H02H 5/048 . . . {additionally responsive to excess current due to heating of the switch }
- H02H 5/06 . . in oil-filled electric apparatus
  
- H02H 5/08 . responsive to abnormal fluid pressure, liquid level or liquid displacement, e.g. Buchholz relays
- H02H 5/083 . . {responsive to the entry or leakage of a liquid into an electrical appliance (moisture alarm [G08B 21/00B1](#)) }
- H02H 5/086 . . {of cooling or lubricating fluids }
  
- H02H 5/10 . responsive to mechanical injury, e.g. rupture of line, breakage of earth connection
- H02H 5/105 . . {responsive to deterioration or interruption of earth connection (for preventing switching-on [H02H 11/001](#)) }
  
- H02H 5/12 . responsive to undesired approach to, or touching of, live parts by living beings
  
- H02H 6/00** **Emergency protective circuit arrangements responsive to undesired changes from normal non-electric working conditions using simulators of the apparatus being protected, e.g. using thermal images**
  
- H02H 6/005 . {using digital thermal images }
  
- H02H 7/00** **Emergency protective circuit arrangements specially adapted for specific types of**

**electric machines or apparatus or for sectionalised protection of cable or line systems, and effecting automatic switching in the event of an undesired change from normal working conditions** (structural association of protective devices with specific machines or apparatus and their protection without automatic disconnection, see the relevant subclass for the machine or apparatus)

- H02H 7/001 . {for supra-conducting apparatus, e.g. coils, lines, machines }
- H02H 7/003 . {for electrostatic apparatus }
- H02H 7/005 . {for remote controlled apparatus; for lines connecting such apparatus }
- H02H 7/006 . {for non-insulated low-voltage distribution systems, e.g. low-voltage halogen-lamp system }
- H02H 7/008 . {for protective arrangements according to this subclass ([H02H 9/042](#), [H02H 9/043](#) take precedence; protection of spark-gaps [H02H 7/24](#)) }
- H02H 7/04 . for transformers
- H02H 7/042 .. {for current transformers }
- H02H 7/045 .. Differential protection of transformers
- H02H 7/0455 ... {taking into account saturation of current transformers }
- H02H 7/05 .. for capacitive voltage transformers, e.g. against resonant conditions
- H02H 7/055 .. for tapped transformers or tap-changing means thereof
- H02H 7/06 . for dynamo-electric generators; for synchronous capacitors
- H02H 7/062 .. {for parallel connected generators }
- H02H 7/065 .. {against excitation faults }
- H02H 7/067 .. {on occurrence of a load dump (control on sudden change of load [H02P 9/10](#); safety devices for generators driven at varying speed [H02J 7/1461](#)) }
- H02H 7/08 . for dynamo-electric motors
- H02H 7/0805 .. {for synchronous motors }
- H02H 7/0811 .. {for dc motors ([H02H 7/0833](#) takes precedence) }
- H02H 7/0816 .. {concerning the starting sequence, e.g. limiting the number of starts per time unit, monitoring speed during starting }
- H02H 7/0822 .. {Integrated protection, motor control centres }
- H02H 7/0827 .. {responsive to underload or no-load, e.g. pump-off control circuits for pump motors }
- H02H 7/0833 .. {for electric motors with control arrangements }
- H02H 7/0838 ... {with H-bridge circuit }
- H02H 7/0844 ... {Fail safe control, e.g. by comparing control signal and controlled current, isolating motor on commutation error }
- H02H 7/085 .. against excessive load { ([H02H 6/00](#) takes precedence) }
- H02H 7/0851 ... {for motors actuating a movable member between two end positions, e.g. detecting an end position or obstruction by overload signal }
- H02H 7/0852 ... {directly responsive to abnormal temperature by using a temperature sensor (in a control circuit [H02H 7/0833](#)) }

- H02H 7/0853 . . . {specially adapted for motors rotating in both directions ([H02H 7/0851](#) takes precedence) }
- H02H 7/0854 . . . {responsive to rate of change of current, couple or speed, e.g. anti-kickback protection ([H02H 7/0851](#) takes precedence) }
- H02H 7/0855 . . . {avoiding response to transient overloads, e.g. during starting }
- H02H 7/0856 . . . {characterised by the protection measure taken }
- H02H 7/0857 . . . . {by lowering the mechanical load of the motor }
- H02H 7/0858 . . . . {by reversing, cycling or reducing the power supply to the motor }
- H02H 7/0859 . . . . {avoiding restarting after fault condition has disappeared }
- H02H 7/09 . . against over-voltage; against reduction of voltage; against phase interruption
- H02H 7/093 . . against increase beyond, or decrease below, a predetermined level of rotational speed ([centrifugal switches H01H 35/10](#))
- H02H 7/097 . . against wrong direction of rotation
  
- H02H 7/10 . for converters; for rectifiers { ([forming part of the control circuit of the converter, see the relevant group in H02M](#) ) }
- H02H 7/103 . . {for rotating converters }
- H02H 7/106 . . {for dynamic converters }
- H02H 7/12 . . for static converters or rectifiers { ([for discharge lamp power supplies using static converters H05B 41/2851, H05B 41/2921, H05B 41/2981](#)) }
- H02H 7/1203 . . . {Circuits independent of the type of conversion }
- H02H 7/1206 . . . . {specially adapted to conversion cells composed of a plurality of parallel or serial connected elements }
- H02H 7/1209 . . . {for converters using only discharge tubes }
- H02H 7/1213 . . . {for DC-DC converters }
- H02H 7/1216 . . . {for AC-AC converters }
- H02H 7/122 . . . for inverters, i.e. dc/ac converters
- H02H 7/1222 . . . . {responsive to abnormalities in the input circuit, e.g. transients in the DC input }
- H02H 7/1225 . . . . {responsive to internal faults, e.g. shoot-through ([avoiding shoot-through H02M 1/00P2](#)) }
- H02H 7/1227 . . . . {responsive to abnormalities in the output circuit, e.g. short circuit }
- H02H 7/125 . . . for rectifiers
- H02H 7/1252 . . . . {responsive to overvoltage in input or output, e.g. by load dump }
- H02H 7/1255 . . . . {responsive to internal faults, e.g. by monitoring ripple in output voltage }
- H02H 7/1257 . . . . {responsive to short circuit or wrong polarity in output circuit }
- H02H 7/127 . . . . having auxiliary control electrode to which blocking control voltages or currents are applied in case of emergency
  
- H02H 7/16 . for capacitors ([for synchronous capacitors H02H 7/06](#))
- H02H 7/18 . for batteries; for accumulators
  
- H02H 7/20 . for electronic equipment ([for converters H02H 7/10; for electric measuring instruments G01R 1/36; for dc voltage or current semiconductor regulators G05F 1/569; for amplifiers H03F 1/52; for electronic switching circuits H03K 17/08](#))
- H02H 7/205 . . {for controlled semi-conductors which are not included in a specific circuit }



## arrangement }

- H02H 7/22 . for distribution gear, e.g. bus-bar systems; for switching devices { (detecting mechanical or electrical defects in gas-insulated switchgears [H02B 13/065](#)) }
- H02H 7/222 . . {for switches }
- H02H 7/224 . . . {Anti-pump circuits }
- H02H 7/226 . . {for wires or cables, e.g. heating wires }
- H02H 7/228 . . {for covered wires or cables }
  
- H02H 7/24 . for spark-gap arresters
  
- H02H 7/26 . Sectionalised protection of cable or line systems, e.g. for disconnecting a section on which a short-circuit, earth fault, or arc discharge has occurred ([locating faults in cables G01R 31/08](#))
- H02H 7/261 . . {involving signal transmission between at least two stations ([transmission of signals in general H02H 1/0061](#)) }
- H02H 7/262 . . . {involving transmissions of switching or blocking orders }
- H02H 7/263 . . . {involving transmissions of measured values ([comparison of currents or voltages using pilot wires H02H 3/30](#)) }
- H02H 7/265 . . {making use of travelling wave theory }
- H02H 7/266 . . {involving switching on a spare supply ([in general H02J 9/00](#)) }
- H02H 7/267 . . {for parallel lines and wires }
- H02H 7/268 . . {for dc systems }
- H02H 7/28 . . for meshed systems
- H02H 7/30 . . staggered disconnection
  
- H02H 9/00** **Emergency protective circuit arrangements for limiting excess current or voltage without disconnection** ([structural association of protective devices with specific machines or apparatus, see the relevant subclass for the machine or apparatus](#))
  
- H02H 9/001 . {limiting speed of change of electric quantities, e.g. soft switching on or off ([progressive control of electronic switches for eliminating interferences H03K 17/16](#)) }
- H02H 9/002 . . {limiting inrush current on switching on of inductive loads subjected to remanence, e.g. transformers }
- H02H 9/004 . . {in connection with live-insertion of plug-in units ([involving communication with a central processing unit G06F 13/40](#)) }
  
- H02H 9/005 . {avoiding undesired transient conditions }
- H02H 9/007 . . {avoiding or damping oscillations, e.g. ferroresonance or travelling waves }
  
- H02H 9/008 . {Intrinsically safe circuits }
  
- H02H 9/02 . responsive to excess current { ([current limitation for voltage regulators G05F 1/573; disconnection after limiting H02H 3/025](#)) }
- H02H 9/021 . . {Current limitation using saturable reactors ([H02H 9/023](#) takes precedence) }
- H02H 9/023 . . {Current limitation using supraconducting elements }
- H02H 9/025 . . {Current limitation using field effect transistors }
- H02H 9/026 . . {Current limitation using PTC resistors, i.e. resistors with a large positive



- temperature coefficient }
- H02H 9/028 . . {Current limitation by detuning a series resonant circuit ([H02H 9/021](#), [H02H 9/023](#) take precedence) }
- H02H 9/04 . responsive to excess voltage (lightning arrestors [H01C 7/12](#), [H01C 8/04](#), [H01G 9/18](#), [H01T](#) )
- H02H 9/041 . . {using a short-circuiting device }
- H02H 9/042 . . {comprising means to limit the absorbed power or indicate damaged over-voltage protection device }
- H02H 9/043 . . {Protection of over-voltage protection device by short-circuiting }
- H02H 9/044 . . {Physical layout, materials not provided for elsewhere ([varistors H01C 7/12](#); [Ovshinsky devices H01L 45/00](#); [spark-gaps H01T](#) ) }
- H02H 9/045 . . {adapted to a particular application and not provided for elsewhere }
- H02H 9/046 . . . {responsive to excess voltage appearing at terminals of integrated circuits (protection by specific structural integration design [H01L 27/0248](#)) }
- H02H 9/047 . . . {Free-wheeling circuits }
- H02H 9/048 . . {Anti-latching or quenching devices, i.e. bringing the protection device back to its normal state after a protection action }
- H02H 9/049 . . {Circuit arrangements for limiting the number of protection devices }
- H02H 9/06 . . using spark-gap arresters
- H02H 9/08 . limitation or suppression of earth fault currents, e.g. Petersen coil
- H02H 11/00 Emergency protective circuit arrangements for preventing the switching-on in case an undesired electric working condition might result**
- H02H 11/001 . {in case of incorrect or interrupted earth connection ([disconnection by breaking of earth connection H02H 5/105](#)) }
- H02H 11/002 . {in case of inverted polarity or connection; with switching for obtaining correct connection }
- H02H 11/003 . . {using a field effect transistor as protecting element in one of the supply lines }
- H02H 11/004 . {in case of incorrect phase sequence; with switching for obtaining correct phase sequence ([protection of motors against wrong direction of rotation H02H 7/097](#)) }
- H02H 11/005 . {in case of too low isolation resistance, too high load, short-circuit; earth fault }
- H02H 11/006 . {in case of too high or too low voltage }
- H02H 11/007 . . {involving automatic switching for adapting the protected apparatus to the supply voltage }
- H02H 11/008 . {preventing unsafe switching operations in substations ([Schaltfehlerschutz](#)) }