

CPC**COOPERATIVE PATENT CLASSIFICATION****H02P****CONTROL OR REGULATION OF ELECTRIC MOTORS, ELECTRIC GENERATORS OR DYNAMO-ELECTRIC CONVERTERS; CONTROLLING TRANSFORMERS, REACTORS OR CHOKE COILS****NOTES**

1. This subclass covers arrangements for starting, regulating, electronically commutating, braking, or otherwise controlling motors, generators, dynamo-electric converters, clutches, brakes, gears, transformers, reactors or choke coils, of the types classified in the relevant subclasses, e.g. [H01F](#), [H02K](#).
2. This subclass does not cover similar arrangements for the apparatus of the types classified in subclass [H02N](#), which arrangements are covered by that subclass.
3. In this subclass, the following terms or expressions are used with the meanings indicated:
 - “control” means influencing a variable in any way, e.g. changing its direction or its value (including changing it to or from zero), maintaining it constant or limiting its range of variation;
 - “regulation” means maintaining a variable at a desired value, or within a desired range of values, by comparison of the actual value with the desired value.
4. In this subclass, it is desirable to add the indexing codes of groups [H02P 2101/00](#) and [H02P 2103/00](#)

H02P 1/00

Arrangements for starting electric motors or dynamo-electric converters
 (starting of synchronous motors with electronic commutators except reluctance motors, [H02P 6/20](#), [H02P 6/22](#); starting dynamo-electric motors rotating step by step [H02P 8/04](#); vector control [H02P 21/00](#))

- [H02P 1/02](#) . Details
- [H02P 1/021](#) . . {Protection against "no voltage condition"}
- [H02P 1/022](#) . . {Security devices, e.g. correct phase sequencing}
- [H02P 1/023](#) . . . {Protection against sparking of contacts or sticking together}
- [H02P 1/024](#) . . . {Protection against simultaneous starting by two starting devices}
- [H02P 1/025](#) . . . {Protection against starting if starting resistor is not at zero position}
- [H02P 1/026](#) . . . {Means for delayed starting}
- [H02P 1/027](#) . . {Special design of starting resistor}
- [H02P 1/028](#) . . {wherein the motor voltage is increased at low speed, to start or restart high inertia loads}
- [H02P 1/029](#) . . {Restarting, e.g. after power failure}
- [H02P 1/04](#) . . Means for controlling progress of starting sequence in dependence upon time or upon current, speed, or other motor parameter
- [H02P 1/06](#) . . . Manually-operated multi-position starters
- [H02P 1/08](#) . . . Manually-operated on/off switch controlling power-operated multi-position switch or impedances for starting a motor

- H02P 1/10 . . . Manually-operated on/off switch controlling relays or contactors operating sequentially for starting a motor ([sequence determined by power-operated multi-position switch H02P 1/08](#))
- H02P 1/12 . . . Switching devices centrifugally operated by the motor
- H02P 1/14 . . . Pressure-sensitive resistors centrifugally operated by the motor
- H02P 1/16 . for starting dynamo-electric motors or dynamo-electric converters
- H02P 1/163 . . {for starting an individual reluctance motor}
- H02P 1/166 . . {Driving load with high inertia}
- H02P 1/18 . . for starting an individual dc motor
- H02P 1/20 . . . by progressive reduction of resistance in series with armature winding
- H02P 1/22 . . . in either direction of rotation
- H02P 1/24 . . for starting an individual ac commutator motor ([starting of ac/dc commutator motors H02P 1/18](#))

NOTE

Group [H02P 1/029](#) takes precedence over groups [H02P 1/26](#) to [H02P 1/54](#)

- H02P 1/26 . . for starting an individual polyphase induction motor
- H02P 1/265 . . . {Means for starting or running a triphase motor on a single phase supply}
- H02P 1/28 . . . by progressive increase of voltage applied to primary circuit of motor
- H02P 1/30 . . . by progressive increase of frequency of supply to primary circuit of motor
- H02P 1/32 . . . by star-delta switching
- H02P 1/34 . . . by progressive reduction of impedance in secondary circuit
- H02P 1/36 the impedance being a liquid resistance
- H02P 1/38 . . . by pole-changing
- H02P 1/40 . . . in either direction of rotation
- H02P 1/42 . . for starting an individual single-phase induction motor {([H02P 27/04](#) takes precedence)}
- H02P 1/423 . . . {by using means to limit the current in the main winding}
- H02P 1/426 . . . {by using a specially adapted frequency converter}
- H02P 1/44 . . . by phase-splitting with a capacitor
- H02P 1/445 {by using additional capacitors switched at start up}
- H02P 1/46 . . for starting an individual synchronous motor {([H02P 27/04](#) takes precedence)}
- H02P 1/465 . . . {for starting an individual single-phase synchronous motor}
- H02P 1/48 . . . by pole-changing
- H02P 1/50 . . . by changing over from asynchronous to synchronous operation ([H02P 1/48](#) takes precedence)
- H02P 1/52 . . . by progressive increase of frequency of supply to motor
- H02P 1/54 . . for starting two or more dynamo-electric motors
- H02P 1/56 . . . simultaneously
- H02P 1/58 . . . sequentially

H02P 3/00

Arrangements for stopping or slowing electric motors, generators, or dynamo-electric converters (stopping of synchronous motors with electronic commutators except reluctance motors, [H02P 6/24](#); stopping dynamo-electric motors rotating step by step [H02P 8/24](#); vector control [H02P 21/00](#))

H02P 3/02

- Details

H02P 3/025

- • {holding the rotor in a fixed position after deceleration}

H02P 3/04

- • Means for stopping or slowing by a separate brake, e.g. friction brake, eddy-current brake ([brakes F16D](#), [H02K 49/00](#))

H02P 3/06

- for stopping or slowing an individual dynamo-electric motor or dynamo-electric converter

H02P 3/065

- • {for stopping or slowing a reluctance motor}

H02P 3/08

- • for stopping or slowing a dc motor

H02P 3/10

- • • by reversal of supply connections

H02P 3/12

- • • by short-circuit or resistive braking

H02P 3/14

- • • by regenerative braking

H02P 3/16

- • • by combined electrical and mechanical braking

H02P 3/18

- • for stopping or slowing an ac motor

H02P 3/20

- • • by reversal of phase sequence of connections to the motor

H02P 3/22

- • • by short-circuit or resistive braking

H02P 3/24

- • • by applying dc to the motor

H02P 3/26

- • • by combined electrical and mechanical braking

H02P 4/00

Arrangements specially adapted for regulating or controlling the speed or torque of electric motors that can be connected to two or more different voltage or current supplies (starting [H02P 1/00](#); stopping or slowing [H02P 3/00](#); vector control [H02P 21/00](#))

H02P 5/00

Arrangements specially adapted for regulating or controlling the speed or torque of two or more electric motors (starting [H02P 1/00](#); stopping or slowing [H02P 3/00](#); {synchronous motors or other dynamo-electric motors with electronic commutators in dependence on the rotor position [H02P 6/00](#); motors rotating step by step [H02P 8/00](#);} vector control [H02P 21/00](#))

H02P 5/46

- for speed regulation of two or more dynamo-electric motors in relation to one another

H02P 5/48

- • by comparing mechanical values representing the speeds

H02P 5/483

- • • {using differential movement}

H02P 5/486

- • • {by intermittently closing or opening electrical contacts}

H02P 5/50

- • by comparing electrical values representing the speeds

H02P 5/503

- • • {using equalising lines}

H02P 5/506

- • • {Direct ratio control}

H02P 5/52

- • additionally providing control of relative angular displacement {of relative angular position or phase}

H02P 5/523

- • • {Speed and position comparison by mechanical means}

H02P 5/526

- • • {Speed and position comparison by electrical means}

- H02P 5/60 . controlling combinations of dc and ac dynamo-electric motors ([H02P 5/46 takes precedence](#))
- H02P 5/68 . controlling two or more dc dynamo-electric motors ([H02P 5/46](#), [H02P 5/60 take precedence](#))
- H02P 5/685 . . electrically connected in series, i.e. carrying the same current
- H02P 5/69 . . mechanically coupled by gearing
- H02P 5/695 . . . Differential gearing
- H02P 5/74 . controlling two or more ac dynamo-electric motors ([H02P 5/46](#), [H02P 5/60 take precedence](#))
- H02P 5/747 . . mechanically coupled by gearing
- H02P 5/753 . . . Differential gearing

H02P 6/00 **Arrangements for controlling synchronous motors or other dynamo-electric motors with electronic commutators in dependence on the rotor position; Electronic commutators therefor** ([stepping motors H02P 8/00](#); [vector control H02P 21/00](#); [reluctance motors H02P 25/08](#))

NOTE

Groups [H02P 6/006](#) and [H02P 6/008](#) take precedence over groups [H02P 6/001](#) to [H02P 6/005](#) and [H02P 6/04](#) to [H02P 6/24](#)

- H02P 6/001 . {Details, e.g. modelling, simulation, comparisons, control principles in general}
- H02P 6/002 . {Arrangements for controlling current ([H02P 6/10 takes precedence](#))}
- H02P 6/003 . {Controlling the direction of rotation}
- H02P 6/005 . {Arrangements for controlling doubly fed motors}
- H02P 6/006 . {Controlling linear motors}
- H02P 6/007 . {wherein the position is detected using the ripple of the current caused by the commutation}
- H02P 6/008 . {Controlling single phase motors}
- H02P 6/04 . Arrangements for controlling or regulating speed or torque of more than one motor
- H02P 2006/045 . . {Control of current}
- H02P 6/06 . Arrangements for speed regulation of a single motor wherein the motor speed is measured and compared with a given physical value so as to adjust the motor speed
- H02P 6/08 . Arrangements for controlling the speed or torque of a single motor {([H02P 6/002 takes precedence](#))}
- H02P 6/085 . . {in a bridge configuration}
- H02P 6/10 . . providing reduced torque ripple; controlling torque ripple
- H02P 6/12 . Monitoring commutation; Providing indication of commutation failure
- H02P 6/14 . Electronic commutators
- H02P 6/142 . . {Changing commutation time}
- H02P 6/145 . . . {wherein the commutation is advanced from position signals phase in function of the speed}
- H02P 6/147 . . . {wherein the commutation is function of electro magnetic force [EMF]}

- H02P 6/16
 - . Circuit arrangements for detecting position ([structural arrangement of position sensors H02K 29/06](#))
- H02P 6/165
 - . . {and generating speed information}
- H02P 6/18
 - . . without separate position detecting elements, e.g. using back-emf in windings ([H02P 6/165 takes precedence](#))
- H02P 6/181
 - . . . {using different methods depending on the speed}
- H02P 6/182
 - . . . {using back-emf in windings}
- H02P 6/183
 - . . . {using an injected high frequency signal}
- H02P 6/185
 - . . . {using pulse excitation}
- H02P 6/186
 - . . . {using difference of inductance or reluctance between the phases}
- H02P 6/187
 - . . . {using the star point voltage}
- H02P 6/188
 - . . . {using the voltage difference between the windings ([H02P 6/182 takes precedence](#))}
- H02P 6/20
 - Arrangements for starting ([H02P 6/08](#), [H02P 6/22 take precedence](#))
- H02P 6/205
 - . {Open loop start}
- H02P 6/22
 - Arrangements for starting in a selected direction of rotation
- H02P 6/24
 - Arrangements for stopping
- H02P 7/00**

Arrangements for regulating or controlling the speed or torque of electric DC motors ([starting H02P 1/00](#); [stopping or slowing H02P 3/00](#); {synchronous motors or other dynamo-electric motors with electronic commutators in dependence on the rotor position [H02P 6/00](#); motors rotating step by step [H02P 8/00](#);} [vector control H02P 21/00](#))
- H02P 7/0038
 - {Controlling the direction of rotation of DC motors}
- H02P 7/0044
 - . {by means of a H-bridge circuit}
- H02P 7/0066
 - . {by means of electronic switching}
- H02P 7/0094
 - {wherein the position is detected using the ripple of the current caused by the commutator}
- H02P 7/06
 - for regulating or controlling an individual dc dynamo-electric motor by varying field or armature current
- H02P 7/063
 - . {using centrifugal devices, e.g. switch, resistor}
- H02P 7/066
 - . {using a periodic interrupter, e.g. Tirrill regulator}
- H02P 7/08
 - . by manual control without auxiliary power
- H02P 7/10
 - . . of motor field only
- H02P 7/12
 - . . . Switching field from series to shunt excitation or vice versa
- H02P 7/14
 - . . . of voltage applied to the armature with or without control of field {[Ward-Leonard](#)}
- H02P 7/18
 - . by master control with auxiliary power
- H02P 7/20
 - . . using multi-position switch, e.g. drum, controlling motor circuit by means of relays ([H02P 7/24](#), [H02P 7/30 take precedence](#))
- H02P 7/22
 - . . using multi-position switch, e.g. drum, controlling motor circuit by means of pilot-motor-operated multi-position switch or pilot-motor-operated variable resistance ([H02P 7/24](#), [H02P 7/30 take precedence](#))
- H02P 7/24
 - . . using discharge tubes or semiconductor devices

- H02P 7/245 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/26 using discharge tubes
- H02P 7/265 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/28 using semiconductor devices

NOTE

Group [H02P 7/281](#) takes precedence over groups [H02P 7/282](#) to [H02P 7/298](#)

- H02P 7/2805 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/281 {the DC-motor being operated in the four quadrants}
- H02P 7/2815 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}

NOTE

Groups [H02P 7/2815](#) takes precedence over groups [H02P 7/2825](#), [H02P 7/2855](#)

- H02P 7/282 controlling field supply only
- H02P 7/2825 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/285 controlling armature supply only
- H02P 7/2855 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/288 using variable impedance
- H02P 7/2885 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/29 using pulse modulation
- H02P 7/2906 {with on-off control between two set points}
- H02P 7/2913 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/292 using static converters, e.g. ac to dc
- H02P 7/2925 {using phase control ([H02P 7/295](#) takes precedence)}
- H02P 7/295 of the kind having a thyristor or the like in series with the power supply and the motor
- H02P 7/298 controlling armature and field supply
- H02P 7/2985 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/30 using magnetic devices with controllable degree of saturation, i.e. transducers
- H02P 7/305 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/32 using armature-reaction-excited machines, e.g. metadyne, amplidyne, rototrol

- H02P 7/325 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 7/34 . . . using Ward-Leonard arrangements
- H02P 7/343 {in which only the generator field is controlled}
- H02P 7/346 {in which both generator and motor fields are controlled}
- H02P 7/348 . . . {for changing between series and parallel connections of motors}

H02P 8/00 Arrangements for controlling dynamo-electric motors of the kind having motors rotating step by step ([vector control H02P 21/00](#))

- H02P 8/005 . {of linear motors}
- H02P 8/02 . specially adapted for single-phase or bi-pole stepper motors, e.g. watch-motors, clock-motors

NOTE

Groups [H02P 8/005](#) and [H02P 8/02](#) take precedence over groups [H02P 8/04](#) to [H02P 8/42](#)

- H02P 8/04 . Arrangements for starting
- H02P 8/06 . . in selected direction of rotation
- H02P 8/08 . . Determining position before starting
- H02P 8/10 . . Shaping pulses for starting; Boosting current during starting
- H02P 8/12 . Control or stabilisation of current
- H02P 8/14 . Arrangements for controlling speed or speed and torque ([H02P 8/12](#), [H02P 8/22](#) take precedence)
- H02P 8/16 . . Reducing energy dissipated or supplied
- H02P 8/165 . . . {using two level supply voltage}
- H02P 8/18 . . Shaping of pulses, e.g. to reduce torque ripple
- H02P 8/20 . . characterised by bidirectional operation
- H02P 8/22 . Control of step size; Intermediate stepping, e.g. micro-stepping
- H02P 8/24 . Arrangements for stopping ([H02P 8/32](#) takes precedence)
- H02P 8/26 . . Memorising final pulse when stopping
- H02P 8/28 . . Disconnecting power source when stopping
- H02P 8/30 . . Holding position when stopped
- H02P 8/32 . Reducing overshoot or oscillation, e.g. damping
- H02P 8/34 . Monitoring operation ([H02P 8/36](#) takes precedence)
- H02P 8/36 . Protection against faults, e.g. against overheating, step-out; Indicating faults ([emergency protective arrangements with automatic interruption of supply H02H 7/08](#))
- H02P 8/38 . . the fault being step-out
- H02P 8/40 . Special adaptations for controlling two or more stepping motors
- H02P 8/42 . characterised by non-stepper motors being operated step by step

H02P 9/00	Arrangements for controlling electric generators for the purpose of obtaining a desired output (Ward-Leonard arrangements H02P 7/34 ; vector control H02P 21/00 ; feeding a network by two or more generators H02J ; for charging batteries H02J 7/14)
H02P 9/006	<ul style="list-style-type: none"> • {Means for protecting the generator by using control (H02H 7/06 takes precedence; control effected upon generator excitation circuit to reduce harmful effects of overloads or transients H02P 9/10)}
H02P 9/007	<ul style="list-style-type: none"> • {Control circuits for doubly fed generators}
H02P 9/008	<ul style="list-style-type: none"> • {wherein the generator is controlled by the requirements of the prime mover}
H02P 9/009	<ul style="list-style-type: none"> • {Circuit arrangements for detecting rotor position}
H02P 9/02	<ul style="list-style-type: none"> • Details
H02P 9/04	<ul style="list-style-type: none"> • Control effected upon non-electric prime mover and dependent upon electric output value of the generator (effecting control of the prime mover in general, see the relevant class for such prime mover)
H02P 9/06	<ul style="list-style-type: none"> • Control effected upon clutch or other mechanical power transmission means and dependent upon electric output value of the generator (effecting control of the power transmission means, see the relevant class for such means)
H02P 9/08	<ul style="list-style-type: none"> • Control of generator circuit during starting or stopping of driving means, e.g. for initiating excitation
H02P 9/10	<ul style="list-style-type: none"> • Control effected upon generator excitation circuit to reduce harmful effects of overloads or transients, e.g. sudden application of load, sudden removal of load, sudden change of load
H02P 9/102	<ul style="list-style-type: none"> • . {for limiting effects of transients}
H02P 9/105	<ul style="list-style-type: none"> • . {for increasing the stability}
H02P 9/107	<ul style="list-style-type: none"> • . {for limiting effects of overloads}
H02P 9/12	<ul style="list-style-type: none"> • . for demagnetising; for reducing effects of remanence; for preventing pole reversal
H02P 9/123	<ul style="list-style-type: none"> • . . {for demagnetising; for reducing effects of remanence}
H02P 9/126	<ul style="list-style-type: none"> • . . {for preventing pole reversal}
H02P 9/14	<ul style="list-style-type: none"> • by variation of field (H02P 9/08, H02P 9/10 take precedence)
H02P 9/16	<ul style="list-style-type: none"> • . due to variation of ohmic resistance in field circuit, using resistances switched in or out of circuit step by step
H02P 9/18	<ul style="list-style-type: none"> • . . the switching being caused by a servomotor, measuring instrument, or relay
H02P 9/20	<ul style="list-style-type: none"> • . due to variation of continuously-variable ohmic resistance
H02P 9/22	<ul style="list-style-type: none"> • . . comprising carbon pile resistance
H02P 9/24	<ul style="list-style-type: none"> • . due to variation of make-to-break ratio of intermittently-operating contacts, e.g. using Tirrill regulator
H02P 9/26	<ul style="list-style-type: none"> • . using discharge tubes or semiconductor devices (H02P 9/34 takes precedence)
H02P 9/28	<ul style="list-style-type: none"> • . . using discharge tubes
H02P 9/30	<ul style="list-style-type: none"> • . . using semiconductor devices
H02P 9/302	<ul style="list-style-type: none"> • . . . {Brushless excitation}
H02P 9/305	<ul style="list-style-type: none"> • . . . {controlling voltage (H02P 9/302 takes precedence)}

- H02P 9/307 {more than one voltage output}
- H02P 9/32 . . using magnetic devices with controllable degree of saturation ([H02P 9/34 takes precedence](#))
- H02P 9/34 . . using magnetic devices with controllable degree of saturation in combination with controlled discharge tube or controlled semiconductor device
- H02P 9/36 . . using armature-reaction-excited machines
- H02P 9/38 . . Self-excitation by current derived from rectification of both output voltage and output current of generator
- H02P 9/40 . by variation of reluctance of magnetic circuit of generator
- H02P 9/42 . to obtain desired frequency without varying speed of the generator
- H02P 9/44 . Control of frequency and voltage in predetermined relation, e.g. constant ratio
- H02P 9/46 . Control of asynchronous generator by variation of capacitor
- H02P 9/48 . Arrangements for obtaining a constant output value at varying speed of the generator, e.g. on vehicle ([H02P 9/04 to H02P 9/46 take precedence](#))

- H02P 11/00** **Arrangements for controlling dynamo-electric converters** ([starting H02P 1/00; stopping or slowing H02P 3/00; vector control H02P 21/00; feeding a network in conjunction with a generator or another converter H02J](#))
- H02P 11/04 . for controlling dynamo-electric converters having a dc output
- H02P 11/06 . for controlling dynamo-electric converters having an ac output

- H02P 13/00** **Arrangements for controlling transformers, reactors or choke coils, for the purpose of obtaining a desired output** ([regulation systems using transformers, reactors or choke coils G05F; transformers H01F; feeding a network in conjunction with a generator or a converter H02J; control or regulation of converters H02M](#))
- H02P 13/06 . by tap-changing; by rearranging interconnections of windings
- H02P 13/08 . by sliding current collector along winding
- H02P 13/10 . by moving core, coil winding, or shield, e.g. by induction regulator
- H02P 13/12 . by varying magnetic bias

- H02P 15/00** **Arrangements for controlling dynamo-electric brakes or clutches** ([controlling speed of dynamo-electric motors by means of a separate brake H02P 29/04, vector control H02P 21/00 {see provisionally also H02K 49/00 and H02P 29/0022}](#))
- WARNING**
- Not complete, see also [H02K 49/00](#) and [H02P 29/0022](#)
- H02P 15/02 . Conjoint control of brakes and clutches

- H02P 17/00** **Arrangements for controlling dynamo-electric gears** ([vector control H02P 21/00](#))

- H02P 21/00** **Arrangements or methods for the control of electric machines by vector control, e.g. by control of field orientation**
- NOTES**
- 1. Groups [H02P 21/06 to H02P 21/12](#) cover vector control arrangements or methods involving the use of rotor position or speed sensors.

H02P 21/00

(continued)

2. Vector control arrangements or methods not involving the use of rotor position or speed sensors are classified in groups [H02P 21/0039](#) and subgroups
3. When classifying in this group, it is desirable to also classify in groups [H02P 25/00](#) to [H02P 27/00](#) if the kind of AC motor, structural details, or the kind of supply voltage are of interest.

- H02P 21/0003 . {Control strategies in general, e.g. linear type e.g. P, PI, PID, using robust control}
- H02P 21/0007 . . {using sliding mode control}
- H02P 21/001 . . {using fuzzy control}
- H02P 21/0014 . . {using neural networks}
- H02P 21/0017 . . {Model reference adaptation, e.g. MRAS or MRAC, useful for control or parameter estimation}
- H02P 21/0021 . . {using different modes of control depending on a parameter, e.g. the speed}
- H02P 21/0025 . . {implementing a off line learning phase to determine and store useful data for on-line control}
- H02P 21/0032 . {Arrangements for starting}
- H02P 21/0035 . {Current control}
- H02P 21/0039 . {not involving the use of rotor position or speed sensors}
- H02P 21/0042 . . {Rotor flux based control}
- H02P 21/0046 . . {Stator flux based control}
- H02P 21/005 . . . {Direct torque control [DTC] or field acceleration method [FAM]}
- H02P 21/0053 . . {Determining the initial rotor position ([arrangements for starting H02P 21/0032](#); [position detection in general H02P 6/16-H02P 6/185](#))}
- H02P 21/0085 . {specially adapted for high speeds, e.g. above nominal speed}
- H02P 21/0089 . . {using field weakening}
- H02P 21/0092 . {Arrangements for braking or slowing; Four quadrants control}
- H02P 21/0096 . {Vector control arrangements or methods not otherwise provided for in [H02P 21/00-H02P 21/148](#)}
- H02P 21/02 . specially adapted for optimising the efficiency at low load
- H02P 21/04 . specially adapted for very low speeds {([arrangements for starting H02P 21/0032](#); [determining the initial rotor position H02P 21/0053](#))}
- H02P 21/05 . specially adapted for damping motor oscillations, e.g. for reducing hunting
- H02P 21/06 . Rotor flux based control {involving the use of rotor position or speed sensor}
- H02P 21/08 . . Indirect field-oriented control, e.g. field phase angle calculation based on rotor voltage equation by adding slip frequency and speed proportional frequency; {Rotor flux feed-forward control}
- H02P 21/085 . . . {adding slip frequency and speed proportional frequency}
- H02P 21/10 . . Direct field-oriented control; {Rotor flux feed-back control}
- H02P 21/12 . Stator flux based control, {involving the use of rotor position or speed sensor}
- H02P 21/13 . Observer control, e.g. using Luenberger observers or Kalman filters
- H02P 21/14 . Estimation or adaptation of machine parameters, e.g. rotor time constant, flux, speed, current or voltage

- H02P 21/141 . . {Flux estimation}
- H02P 21/143 . . {Inertia or moment of inertia estimation}
- H02P 21/145 . . {constants estimation, e.g. of the rotor time constant}
- H02P 21/146 . . {Position or speed estimation}
- H02P 21/148 . . {Torque estimation}

H02P 23/00

Arrangements or methods for the control of AC motors characterised by a control method other than vector control (starting [H02P 1/00](#); stopping or slowing [H02P 3/00](#); of two or more motors [H02P 5/00](#); of synchronous motors with electronic commutators [H02P 6/00](#); of DC motors [H02P 7/00](#); of stepping motors [H02P 8/00](#))

NOTE

When classifying in this group, it is desirable to also classify in groups [H02P 25/00](#) to [H02P 27/00](#) if the kind of AC motor, structural details, or the kind of supply voltage are of interest.

- H02P 23/0004 . {Control strategies in general, e.g. linear type e.g. P, PI, PID, using robust control (control strategies related to the motor [H02P 23/0036](#))}
- H02P 23/0009 . . {using sliding mode control}
- H02P 23/0013 . . {using fuzzy control}
- H02P 23/0018 . . {using neural networks}
- H02P 23/0022 . . {Model reference adaptation, e.g. MRAS or MRAC, useful for control or parameter estimation}
- H02P 23/0027 . . {using different modes of control depending on a parameter, e.g. the speed}
- H02P 23/0031 . . {implementing a off line learning phase to determine and store useful data for on-line control}
- H02P 23/0036 . {Control strategies related to the functioning of the motor}
- H02P 23/004 . . {Direct torque control [DTC]; Field acceleration method [FAM]}
- H02P 23/0045 . {Control of angular speed of one shaft by controlling the prime mover ([H02P 23/005](#) takes precedence)}
- H02P 23/005 . {Control of angular speed together with angular position or phase}
- H02P 23/0054 . . {of one shaft without controlling the prime mover}
- H02P 23/0059 . . {of one shaft by controlling the prime mover}
- H02P 23/0063 . {Control of acceleration or deceleration}
- H02P 23/0068 . {Digital speed control using a reference oscillator, a speed proportional pulse rate feedback and a digital comparator}
- H02P 23/0072 . {Controlling the direction, e.g. clockwise - counterclockwise}
- H02P 23/0077 . {Characterised by the use of a particular software algorithm}
- H02P 23/0081 . {Power Factor Control}
- H02P 23/0086 . {specially adapted for high speeds, e.g. above nominal speed}
- H02P 23/009 . . {using field weakening}
- H02P 23/0095 . {controlled by the switch frequency of the switches connected to a DC supply and the motor phases}
- H02P 23/02 . specially adapted for optimising the efficiency at low load

- H02P 23/03 . specially adapted for very low speeds
- H02P 23/04 . specially adapted for damping motor oscillations, e.g. for reducing hunting
- H02P 23/06 . Controlling the motor in four quadrants
- H02P 23/065 . . {Polyphase or monophas asynchronous induction motors}
- H02P 23/08 . Controlling based on slip frequency, e.g. adding slip frequency and speed proportional frequency
- H02P 23/10 . Controlling by adding a dc current ([dc current braking H02P 3/24](#))
- H02P 23/12 . Observer control, e.g. using Luenberger observers or Kalman filters
- H02P 23/14 . Estimation or adaptation of motor parameters, e.g. rotor time constant, flux, speed, current or voltage

H02P 25/00

Arrangements or methods for the control of AC motors characterised by the kind of AC motor or by structural details ([starting H02P 1/00](#); [stopping or slowing H02P 3/00](#); [of two or more motors H02P 5/00](#); [of synchronous motors with electronic commutators H02P 6/00](#); [of DC motors H02P 7/00](#); [of stepping motors H02P 8/00](#))

NOTE

When classifying in this group, it is desirable to also classify in groups [H02P 21/00](#), [H02P 23/00](#) or [H02P 27/00](#) if the control method or the kind of supply voltage are of interest.

- H02P 25/02 . characterised by the kind of motor
- H02P 25/021 . . {Synchronous motors}
- H02P 25/022 . . . {controlled by supply frequency}
- H02P 25/023 {thereby detecting the rotor position}
- H02P 25/025 . . . {Four quadrant control}
- H02P 25/026 . . . {with brushless excitation}
- H02P 25/027 . . {Control of reciprocating, oscillating or vibrating motors ([Note: see also H01F](#))}
- H02P 25/028 . . {Control of voice coil motors ([Note: see also H01F](#))}
- H02P 25/04 . . Single phase motors, e.g. capacitor motors
- H02P 25/06 . . Linear motors
- H02P 25/08 . . Reluctance motors
- H02P 25/081 . . . {Modifications for increasing the switching speed from one coil to the next one}
- H02P 25/082 . . . {Commutation}
- H02P 25/083 {Sensorless control, see also direct torque control [H02P 23/004](#)}
- H02P 25/085 . . . {Converters specially adapted for controlling reluctance motors}
- H02P 25/086 {wherein the converter comprises only one switch per phase}
- H02P 25/087 . . . {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 25/088 . . . {Arrangements for reducing torque ripple}
- H02P 25/10 . . Commutator motors, e.g. repulsion motors
- H02P 25/102 . . . {Repulsion motors}

- H02P 25/105 . . . {Four quadrant control}
- H02P 25/107 . . . {Polyphase or monophaser commutator motors}
- H02P 25/12 . . . with shiftable brushes
- H02P 25/14 . . . Universal motors ([H02P 25/12](#) takes precedence)
- H02P 25/145 {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value, speed feedback}
- H02P 25/16 . characterised by the circuit arrangement or by the kind of wiring
- H02P 25/18 . . with arrangements for switching the windings, e.g. with mechanical switches or relays
- H02P 25/182 . . . {whereby the speed is regulated by using centrifugal devices, e.g. switch, resistor}
- H02P 25/184 . . . {wherein the motor speed is changed by switching from a delta to a star, e.g. wye, connection of its windings, or vice versa.}
- H02P 25/186 . . . {whereby the speed is regulated by using a periodic interrupter ([H02P 25/30](#) takes precedence)}
- H02P 25/188 . . . {wherein the motor windings are switched from series to parallel or vice-versa to control speed or torque}
- H02P 25/20 . . . for pole-changing
- H02P 25/22 . . Multiple windings; Windings for more than three phases
- H02P 25/24 . . Variable impedance in stator or rotor circuit
- H02P 25/26 . . . with arrangements for controlling secondary impedance
- H02P 25/28 . . using magnetic devices with controllable degree of saturation, e.g. transducers
- H02P 25/30 . . the motor being controlled by a control effected upon an ac generator supplying it
- H02P 25/32 . . using discharge tubes
- H02P 25/325 . . . {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}

H02P 27/00 **Arrangements or methods for the control of AC motors characterised by the kind of supply voltage** ([starting H02P 1/00](#); [stopping or slowing H02P 3/00](#); [of two or more motors H02P 5/00](#); [of synchronous motors with electronic commutators H02P 6/00](#); [of DC motors H02P 7/00](#); [of stepping motors H02P 8/00](#))

NOTE

When classifying in this group, it is desirable to also classify in groups [H02P 21/00](#), [H02P 23/00](#) or [H02P 25/00](#) if the control method, the kind of AC motor or structural details are of interest.

- H02P 27/02 . using supply voltage with constant frequency and variable amplitude
- H02P 27/023 . . {wherein only rotor or only stator circuit is supplied with ac}
- H02P 27/026 . . {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 27/04 . using variable-frequency supply voltage, e.g. inverter or converter supply voltage
- H02P 27/042 . . {wherein only rotor or only stator circuit is supplied with ac}

- H02P 27/045
 - • {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}
- H02P 27/047
 - • {V/F converter, wherein the voltage is controlled proportionally with the frequency}
- H02P 27/05
 - • using ac supply for both rotor and stator circuits, the frequency of supply to at least one circuit being variable {(see also [H02P 6/005](#) or [H02P 9/007](#), doubly fed motors or generators respectively)}
- H02P 27/06
 - • using dc to ac converters or inverters ([H02P 27/05](#) takes precedence)
- H02P 27/08
 - • • with pulse width modulation
- H02P 27/085
 - • • • {wherein the PWM mode is adapted on the running conditions of the motor, e.g. the switching frequency}
- H02P 27/10
 - • • • using bang-bang controllers
- H02P 27/12
 - • • • pulsing by guiding the flux-, current-, or voltage-vector on a circle or a closed curve, e.g. direct torque control {(direct torque control per se, [H02P 23/004](#))}
- H02P 27/14
 - • • • with three or more levels of voltage
- H02P 27/16
 - • using ac to ac converters without intermediate conversion to dc ([H02P 27/05](#) takes precedence)
- H02P 27/18
 - • • varying the frequency by omitting half waves
- H02P 29/00**

Arrangements for regulating or controlling electric motors, appropriate for both ac- and DC motors (starting [H02P 1/00](#); stopping or slowing [H02P 3/00](#); control of motors that can be connected to two or more different voltage or current supplies [H02P 4/00](#); vector control [H02P 21/00](#))
- H02P 29/0005
 - {for preventing over- or under speed}
- H02P 29/0011
 - {for controlling one motor used for different sequential operations}
- H02P 29/0016
 - {Control of angular speed of one shaft without controlling the prime mover}
- H02P 29/0022
 - • {Controlling a brake between the prime mover and the load}
- H02P 29/0027
 - • {Controlling a clutch between the prime mover and the load}
- H02P 29/0033
 - {Controlling the mechanical load according to the amount of current drawn or delivered by the motor}
- H02P 29/0038
 - {Reduction of harmonics}
- H02P 29/0044
 - {Controlling or determining the motor or drive temperature (AC motor parameter estimation [H02P 23/14](#); motor parameter estimation for vector control [H02P 21/14](#); protection against overload [H02P 29/02](#); protection against faults of stepper motors [H02P 8/36](#))}
- H02P 29/005
 - • {for raising the temperature of the motor}
- H02P 29/0055
 - • {controlling or determining the winding temperature ([H02P 29/0072](#) takes precedence)}
- H02P 29/0061
 - • {controlling or determining the rotor temperature}
- H02P 29/0066
 - • • {the rotor having permanent magnets ([H02P 29/0083](#) takes precedence)}
- H02P 29/0072
 - • • {the rotor having windings}
- H02P 29/0077
 - • • • {by rotor current detection}
- H02P 29/0083
 - • {by back-emf evaluation to obtain the motor temperature (back-emf based rotor position determination [H02P 6/182](#))}

- H02P 29/0088 . . {based on the temperature of a drive component or a semiconductor component}
- H02P 29/0094 . . . {compensating for Hall sensor temperature non-linearity}
- H02P 29/02 . Providing protection against overload without automatic interruption of supply, e.g. monitoring {(protection during start [H02P 1/022](#); protection for stepper motors [H02P 8/36](#); generator overload and transient protection [H02P 9/10](#); protection with automatic interruption [H02H 7/0833](#))}

NOTE

Informative note

References listed below indicate places which could also be of interest when carrying out a search in respect of the subject matter covered by the preceding group:

Emergency protective circuit arrangements with automatic interruption if supply, in general [H02H 7/08](#);

Emergency protective circuit arrangements for limiting excess current or voltage without disconnection in general [H02H 7/08](#)

- H02P 29/021 . . {Detecting a fault condition, e.g. short circuit, locked rotor, open circuit or loss of load}
- H02P 29/022 . . . {the motor continuing operation despite a fault condition, e.g. eliminating, compensating or remediating for the fault}
- H02P 29/023 . . . {the fault being a broken phase}
- H02P 29/024 . . . {the fault being an overvoltage}
- H02P 29/025 . . . {the fault being a power interruption}
- H02P 29/026 . . . {the fault being a power fluctuations}
- H02P 29/027 . . . {the fault being an over-current}
- H02P 29/028 . . {Preventing damage to the motor, e.g. setting individual current limits for different drive conditions}
- H02P 29/04 . by means of a separate brake
- H02P 29/045 . . {whereby the speed is regulated by measuring the motor speed and comparing it with a given physical value}

H02P 31/00 Arrangements for regulating or controlling electric motors not provided for in groups [H02P 1/00](#) to [H02P 5/00](#), [H02P 7/00](#) or [H02P 21/00](#) to [H02P 29/00](#)

Indexing scheme associated with groups relating to the arrangements for controlling electric generators

H02P 2101/00 Special adaptation of control arrangements for generators

- H02P 2101/10 . for water-driven turbines
- H02P 2101/15 . for wind-driven turbines
- H02P 2101/20 . for steam-driven turbines
- H02P 2101/25 . for combustion engines
- H02P 2101/30 . for aircraft
- H02P 2101/35 . for ships

- H02P 2101/40 . for railway vehicles
- H02P 2101/45 . for motor vehicles, e.g. car alternators

H02P 2103/00 Controlling arrangements characterised by the type of generator

- H02P 2103/10 . of the asynchronous type
- H02P 2103/20 . of the synchronous type

H02P 2201/00 Indexing scheme relating to controlling arrangements characterised by the converter used

- H02P 2201/01 . AC-AC converter stage controlled to provide a defined AC voltage
- H02P 2201/03 . AC-DC converter stage controlled to provide a defined DC link voltage ([general aspects of plural converters in cascade H02M](#))
- H02P 2201/05 . Capacitive half bridge, i.e. resonant inverter having two capacitors and two switches
- H02P 2201/07 . DC-DC step-up or step-down converter inserted between the power supply and the inverter supplying the motor, e.g. to control voltage source fluctuations, to vary the motor speed ([general aspects of plural converters in cascade H02M](#))
- H02P 2201/09 . Boost converter, i.e. DC-DC step up converter increasing the voltage between the supply and the inverter driving the motor ([general aspects of plural converters in cascade H02M](#))
- H02P 2201/11 . Buck converter, i.e. DC-DC step down converter decreasing the voltage between the supply and the inverter driving the motor ([general aspects of plural converters in cascade H02M](#))
- H02P 2201/13 . DC-link of current link type, e.g. typically for thyristor bridges, having an inductor in series with rectifier
- H02P 2201/15 . Power factor Correction [PFC] circuit generating the DC link voltage for motor driving inverter ([motor power factor control H02P 23/0081](#))

H02P 2203/00 Indexing scheme relating to controlling arrangements characterised by the means for detecting the position of the rotor

- H02P 2203/01 . Motor rotor position determination based on the detected or calculated phase inductance, e.g. for a Switched Reluctance Motor
- H02P 2203/03 . Determination of the rotor position, e.g. initial rotor position, during standstill or low speed operation
- H02P 2203/05 . Determination of the rotor position by using two different methods and/or motor models
- H02P 2203/07 . Motor variable determination based on the ON-resistance of a power switch, i.e. the voltage across the switch is measured during the ON state of the switch and used to determine the current in the motor and to calculate the speed
- H02P 2203/09 . Motor speed determination based on the current and/or voltage without using a tachogenerator or a physical encoder
- H02P 2203/11 . Determination or estimation of the rotor position or other motor parameters based on the analysis of high frequency signals ([position detection of motors with electronic commutators in dependence of the position H02P 6/185](#))

H02P 2205/00 Indexing scheme relating to controlling arrangements characterised by the control loops

- H02P 2205/01 . Current loop, i.e. comparison of the motor current with a current reference

H02P 2205/03	• Power loop, i.e. comparison of the motor power with a power reference
H02P 2205/05	• Torque loop, i.e. comparison of the motor torque with a torque reference
H02P 2205/07	• Speed loop, i.e. comparison of the motor speed with a speed reference
H02P 2207/00	Indexing scheme relating to controlling arrangements characterised by the type of motor
H02P 2207/01	• Asynchronous machines
H02P 2207/03	• Double rotor motors or generators, i.e. electromagnetic transmissions having double rotor with motor and generator functions, e.g. for electrical variable transmission
H02P 2207/05	• Synchronous machines, e.g. with permanent magnets or DC excitation
H02P 2207/055	• • Surface mounted magnet motors
H02P 2207/07	• Doubly fed machines receiving two supplies both on the stator only wherein the power supply is fed to different sets of stator windings or to rotor and stator windings
H02P 2207/073	• • wherein only one converter is used, the other windings being supplied without converter e.g. doubly-fed induction machines
H02P 2207/076	• • wherein both supplies are made via converters: especially doubly-fed induction machines; e.g. for starting
H02P 2209/00	Indexing scheme relating to controlling arrangements characterised by the waveform of the supplied voltage or current
H02P 2209/01	• Motors with neutral point connected to the power supply
H02P 2209/03	• Motors with neutral point disassociated, i.e. the windings ends are not connected directly to a common point
H02P 2209/05	• Polyphase motors supplied from a single-phase power supply or a DC power supply
H02P 2209/07	• Trapezoidal waveform
H02P 2209/09	• PWM with fixed limited number of pulses per period
H02P 2209/095	• • One pulse per half period
H02P 2209/11	• Sinusoidal waveform
H02P 2209/13	• Different type of waveforms depending on the mode of operation