

## SECTION G — PHYSICS

### G05 CONTROLLING; REGULATING

**G05B CONTROL OR REGULATING SYSTEMS IN GENERAL; FUNCTIONAL ELEMENTS OF SUCH SYSTEMS; MONITORING OR TESTING ARRANGEMENTS FOR SUCH SYSTEMS OR ELEMENTS** (fluid-pressure actuators or systems acting by means of fluids in general F15B; valves per se F16K; characterised by mechanical features only G05G; sensitive elements, see the appropriate subclasses, e.g. G12B, subclasses of G01, H01; correcting units, see the appropriate subclasses, e.g. H02K)

#### Note(s)

1. This subclass covers features of control systems or elements for regulating specific variables, which are clearly more generally applicable.
2. This subclass does not cover :
  - a. systems for controlling or regulating non-electric variables in general, which are covered by subclass G05D;
  - b. systems for regulating electric or magnetic variables in general, which are covered by subclass G05F;
  - c. systems specially adapted for the control of particular machines or apparatus provided for in a single other subclass, which are classified in the relevant subclass for such machines or apparatus, provided that there is specific provision for control or regulation relevant to the special adaptation (see Note (5), below). Otherwise, classification is made in the most appropriate place in this subclass.
3. In this subclass, the following terms or expressions are used with the meanings indicated:
  - "automatic controller" means a system, circuit, or device in which a signal from the detecting element is compared with a signal representing the desired value and which operates in such a way as to reduce the deviation. The automatic controller generally does not include the sensitive element, i.e. that element which measures the value of the condition to be corrected, or the correcting element, i.e. that element which adjusts the condition to be corrected;
  - "electric" includes "electromechanical", "electrohydraulic" or "electropneumatic".
4. In this subclass, details of specific control systems are classified in the group relevant to the system, if not otherwise provided for.
5. This Note lists places in the IPC where there is specific provision of the kind referred to in Note (2)(c), above; where such provision is at a general level, the places are listed under the heading "General references"; where the provision is related to programme control, the places are listed under the heading "Places related to group G05B 19/00".

#### General references

A01K 73/04.....Spreading or positioning of drawn nets for fishing  
 A61G 13/02.....  
 A61G 15/02.....Adjustable operating tables, operating chairs, or dental chairs  
 B01D 3/42.....Distillation  
 B01D 24/48.....  
 B01D 29/60.....  
 B01D 37/04.....  
 B01D 46/44.....Filtration  
 B01D 53/30.....Separation of gases or vapours by gas-analysis apparatus  
 B01D 61/00.....Separation using semi-permeable membranes  
 B01J 4/00.....Feed or outlet in chemical or physical processes  
 B01J 38/14.....Oxygen content in oxidation gas for regeneration or reactivation of catalysts  
 B01J 47/14.....Ion-exchange processes  
 B05B 12/02.....Delivery in spraying systems  
 B21B 37/00.....  
 B21B 39/00.....Metal-rolling mills  
 B21K 31/00.....Positioning tool carriers for forging, pressing or hammering  
 B22D 11/16.....Continuous casting of metals  
 B22D 13/12.....Centrifugal casting of metals  
 B22D 17/32.....Pressure or injection die casting of metals  
 B22D 18/08.....Pressure or vacuum casting of metals  
 B22D 46/00.....Casting of metals in general  
 B23B 39/26.....Tool or work positioning for boring or drilling  
 B23D 36/00.....Machines for shearing or similar cutting stock travelling otherwise than in the direction of the cut  
 B23Q 5/00.....Driving or feeding mechanisms of machine tools  
 B23Q 15/00.....Feed movement, cutting velocity or position of machine tools  
 B23Q 35/00.....Copying from a pattern or master model for machine tools  
 B24B 47/22.....Position of grinding tool or work  
 B25J 13/00.....Manipulators  
 B26D 5/02.....Position of cutters in cutting machines  
 B29C 39/00to.....

B29C 51/00.....	Shaping techniques for plastic substances
B30B 15/14.....	
B30B 15/16.....	Presses
B41B 27/00.....	Composing machines
B41F 33/00.....	Printing machines or presses
B41J 11/42.....	Feeding sheets or webs in typewriters
B41L 39/00.....	Apparatus or devices for manifolding, duplicating or printing for commercial purposes
B41L 47/56.....	Addressing machines
B60G 17/00to.....	
B60G 21/00.....	Vehicle suspension
B60T 7/00to.....	
B60T 15/00.....	Vehicle brakes
B65B 57/00.....	Machines for packaging
B65G 43/00.....	Conveyers
E02F 3/43.....	Sequence of drive operations for dredging or soil-shifting
E21B 44/00.....	Earth drilling operations
F01K 1/12.....	
F01K 1/16.....	Steam accumulators
F01K 3/00.....	
F01K 7/00.....	
F01K 13/02.....	Steam engine plants
F02C 7/05.....	Air intakes for gas-turbine or jet-propulsion plants
F02C 9/00.....	Gas-turbine plants; Fuel supply in air-breathing jet-propulsion plants
F02D.....	Combustion engines
F02K 1/15.....	
F02K 1/76.....	Jet pipes or nozzles in jet-propulsion plants
F02K 7/00to.....	
F02K 9/00.....	Jet-propulsion plants
F04B 1/00.....	
F04B 27/00.....	
F04B 49/00.....	Positive-displacement machines
F04D 15/00.....	
F04D 27/00.....	Non-positive-displacement pumps, pumping installations, or systems
F16D 43/00.....	
F16D 48/00.....	Clutches
F16F 15/02.....	Suppression of vibrations using fluid means
F16H 59/00to.....	
F16H 63/00.....	Gearings
F22B 35/00.....	Steam boilers
F23G 5/50.....	Incineration of waste
F23N.....	Combustion in combustion apparatus
F24B 1/18.....	Combustion in open fires using solid fuel
F24J 2/40.....	Solar heating
F26B 25/22.....	Drying processes of solid materials or objects
F28B 11/00.....	Steam or vapour condensers
F28D 15/06.....	Heat-exchange apparatus with intermediate heat-transfer medium in closed tubes passing into or through conduit walls, in which the medium condenses and evaporates
F28F 27/00.....	Heat-exchanges or heat-transfer apparatus in general
G06F 11/00.....	Computers
G08G.....	Traffic
G09G.....	Indicating devices using static means to present variable information
G11B 15/00.....	
G11B 19/00.....	Driving, starting or stopping of record carriers
G21C 7/00.....	Nuclear reaction
G21D 3/00.....	Nuclear power plant
H01J 37/30.....	Electron-beam or ion-beam tubes used for localised treatment of objects
H02P.....	Electric motors, generators, or dynamo-electric converters
<u>Places related to group G05B 19/00(programme-control systems)</u>	
A61J 7/04.....	Programmed medicine dispensers
A61L 2/24.....	Disinfection or sterilising
A61N 1/36.....	Heart pace-makers
A63H 17/39.....	Steering-mechanisms for toy vehicles
B04B 13/00.....	Centrifuges
B21B 37/24.....	Thickness of work produced by metal-rolling mills
B21D 7/12.....	Bending metal rods, profiles, or tubes
B23B 39/08.....	
B23B 39/24.....	Boring or drilling machines
B23H 7/20.....	Electrical discharge or electrochemical machining
B23P 21/00.....	Assembling of parts to compose units
B24B 51/00.....	Series of individual steps in grinding a workpiece
B25J 9/00.....	Manipulators

B30B 15/26.....	Presses
B41F 33/16.....	Sequence of operations in printing machines or presses
B41J 11/44.....	Feeding sheets or webs in typewriters
B41L 39/16.....	Sequence of operations in apparatus or devices for manifolding, duplicating or printing for commercial purposes
B41L 47/64.....	Selecting text or image to be printed in addressing machines
B60L 15/20.....	Traction-motor speed of electrically-propelled vehicles
B65H 31/24.....	Piling articles
B66C 13/48.....	
B66C 23/58.....	Crane drives
B67D 7/14.....	Dispensing, delivering or transferring liquids
D05B 19/00.....	
D05B 21/00.....	Sewing machines
D05C 5/04.....	Embroidering machines
D06F 33/00.....	Operations in washing machines
F02D 27/02.....	
F02D 28/00.....	Combustion engines
F02D 41/26.....	Supply of combustible mixture or its constituents to combustion engines
F15B 21/02.....	Fluid-pressure actuator systems
F23N 5/20.....	
F23N 5/22.....	Combustion in combustion apparatus
G01G 19/38.....	Weighing apparatus
G04C 23/08.....	
G04C 23/34.....	Electromechanical clocks or watches
G06C 21/00.....	Mechanically operating digital computers
G06F 9/00.....	Control units for electric digital data processing
G06F 13/10.....	Peripheral devices for electric digital data processing
G06F 15/00.....	Electrically operating digital computers
G06G 7/06.....	Electrically or magnetically operating analogue computers
G09B 7/04.....	
G09B 7/08.....	
G09B 7/12.....	Electrically-operated teaching apparatus or devices
H01H 43/00.....	Electric switches
H01J 37/30.....	Electron-beam or ion-beam tubes used for localised treatment of objects
H03K 17/296.....	Electronic switching or gating
H04Q 3/54.....	Selecting arrangements in electric communication technique

### Subclass index

#### CONTROL SYSTEMS

Adaptive.....	13/00
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#### SYSTEM DETAILS

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Internal feedback arrangements.....	6/00
Obtaining smooth engagement or disengagement of automatic control.....	7/00
Safety arrangements.....	9/00
Automatic controllers.....	11/00

#### TESTING, MONITORING.....23/00

#### SUBJECT MATTER NOT PROVIDED FOR IN OTHER GROUPS OF THIS SUBCLASS.....99/00

<b>1/00</b>	<b>Comparing elements, i.e. elements for effecting comparison directly or indirectly between a desired value and existing or anticipated values</b> (comparing phase or frequency of two electric signals H03D 13/00)
1/01	• electric [2]
1/02	• • for comparing analogue signals [2]
1/03	• • for comparing digital signals [2]
1/04	• • with sensing of the position of the pointer of a measuring instrument
1/06	• • • continuous sensing
1/08	• • • stepwise sensing
1/11	• fluidic [2]

<b>5/00</b>	<b>Anti-hunting arrangements</b>
5/01	• electric
5/04	• fluidic [2]
<b>6/00</b>	<b>Internal feedback arrangements for obtaining particular characteristics, e.g. proportional, integral, differential</b> (in automatic controllers G05B 11/00)
6/02	• electric
6/05	• fluidic [2]
<b>7/00</b>	<b>Arrangements for obtaining smooth engagement or disengagement of automatic control</b>
7/02	• electric [2]

## G05B

- 7/04 • fluidic [2]
- 9/00 Safety arrangements** (G05B 7/00 takes precedence; safety arrangements in programme-control systems G05B 19/048, G05B 19/406; safety valves F16K 17/00; emergency protective circuit arrangements in general H02H)
  - 9/02 • electric
  - 9/03 • • with multiple-channel loop, i.e. redundant control systems [2]
  - 9/05 • fluidic [2]
- 11/00 Automatic controllers** (G05B 13/00 takes precedence)
  - 11/01 • electric
  - 11/06 • • in which the output signal represents a continuous function of the deviation from the desired value, i.e. continuous controllers (G05B 11/26 takes precedence)
  - 11/10 • • • the signal transmitted being dc
  - 11/12 • • • the signal transmitted being modulated on an ac carrier
  - 11/14 • • in which the output signal represents a discontinuous function of the deviation from the desired value, i.e. discontinuous controllers (G05B 11/26 takes precedence)
  - 11/16 • • • Two-step controllers, e.g. with on/off action
  - 11/18 • • • Multi-step controllers
  - 11/26 • • in which the output signal is a pulse-train
  - 11/28 • • • using pulse-height modulation; using pulse-width modulation
  - 11/30 • • • using pulse-frequency modulation
  - 11/32 • • with inputs from more than one sensing element; with outputs to more than one correcting element
  - 11/36 • • with provision for obtaining particular characteristics, e.g. proportional, integral, differential
  - 11/38 • • • for obtaining a proportional characteristic
  - 11/40 • • • for obtaining an integral characteristic
  - 11/42 • • • for obtaining a characteristic which is both proportional and time-dependent, e.g. P. I., P. I. D.
  - 11/44 • pneumatic only
  - 11/46 • • without auxiliary power
  - 11/48 • • with auxiliary power
  - 11/50 • • • in which the output signal represents a continuous function of the deviation from the desired value, i.e. continuous controllers
  - 11/52 • • • in which the output signal represents a discontinuous function of the deviation from the desired value, i.e. discontinuous controllers
  - 11/54 • • • • Two-step controllers, e.g. with on/off action
  - 11/56 • • • • Multi-step controllers
  - 11/58 • • with inputs from more than one sensing element; with outputs to more than one correcting element
  - 11/60 • hydraulic only
- 13/00 Adaptive control systems, i.e. systems automatically adjusting themselves to have a performance which is optimum according to some preassigned criterion** (G05B 19/00 takes precedence; details of the computer G06F 15/18) [3]
  - 13/02 • electric
  - 13/04 • • involving the use of models or simulators [3]
- 15/00 Systems controlled by a computer** (G05B 13/00, G05B 19/00 take precedence; automatic controllers with particular characteristics G05B 11/00; computers per se G06) [3]
  - 15/02 • electric
- 17/00 Systems involving the use of models or simulators of said systems** (G05B 13/00, G05B 15/00, G05B 19/00 take precedence; analogue computers for specific processes, systems or devices, e.g. simulators, G06G 7/48) [3]
  - 17/02 • electric
- 19/00 Programme-control systems** (specific applications, see the relevant places, e.g. A47L 15/46; clocks with attached or built-in means operating any device at a preselected time interval G04C 23/00; marking or sensing record carriers with digital information G06K; information storage G11; time or time-programme switches which automatically terminate their operation after the programme is completed H01H 43/00)
  - 19/02 • electric
  - 19/04 • • Programme control other than numerical control, i.e. in sequence controllers or logic controllers (G05B 19/418 takes precedence; numerical control G05B 19/18)
  - 19/042 • • • using digital processors (G05B 19/05 takes precedence) [6]
  - 19/045 • • • using logic state machines, consisting only of a memory or a programmable logic device containing the logic for the controlled machine and in which the state of its outputs is dependent on the state of its inputs or part of its own output states, e.g. binary decision controllers, finite state controllers [6]
  - 19/048 • • • Monitoring; Safety [6]
  - 19/05 • • • Programmable logic controllers, e.g. simulating logic interconnections of signals according to ladder diagrams or function charts [5]
  - 19/06 • • • using cams, discs, rods, drums, or the like (mechanical programme-control apparatus G05G 21/00)
  - 19/07 • • • where the programme is defined in the fixed connection of electrical elements, e.g. potentiometers, counters, transistors [6]
  - 19/08 • • • using plugboards, cross-bar distributors, matrix switches, or the like
  - 19/10 • • • using selector switches
  - 19/12 • • • using record carriers
  - 19/14 • • • • using punched cards or tapes
  - 19/16 • • • • using magnetic record carriers
  - 19/18 • • Numerical control (NC), i.e. automatically operating machines, in particular machine tools, e.g. in a manufacturing environment, so as to execute positioning, movement or co-ordinated operations by means of programme data in numerical form (G05B 19/418 takes precedence) [6]
  - 19/19 • • • characterised by positioning or contouring control systems, e.g. to control position from one programmed point to another or to control movement along a programmed continuous path [3, 6]

### Note(s)

In this group, the measuring system for an axis is used to measure the displacement along that axis. This measurement is used as position-feedback in the servo-control system.

- 19/21 • • • • using an incremental digital measuring device [3]
- 19/23 • • • • • for point-to-point control [3]
- 19/25 • • • • • for continuous-path control [3]
- 19/27 • • • • using an absolute digital measuring device [3]
- 19/29 • • • • • for point-to-point control [3]
- 19/31 • • • • • for continuous-path control [3]
- 19/33 • • • • using an analogue measuring device [3]
- 19/35 • • • • • for point-to-point control [3]
- 19/37 • • • • • for continuous-path control [3]
- 19/39 • • • • using a combination of the means covered by at least two of the preceding groups G05B 19/21, G05B 19/27 and G05B 19/33 [3]
- 19/40 • • • • Open loop systems, e.g. using stepping motor [3]
- 19/401 • • • • characterised by control arrangements for measuring, e.g. calibration and initialisation, measuring workpiece for machining purposes (G05B 19/19 takes precedence) [6]
- 19/402 • • • • characterised by control arrangements for positioning, e.g. centring a tool relative to a hole in the workpiece, additional detection means to correct position (G05B 19/19 takes precedence) [6]
- 19/404 • • • • characterised by control arrangements for compensation, e.g. for backlash, overshoot, tool offset, tool wear, temperature, machine construction errors, load, inertia (G05B 19/19, G05B 19/41 take precedence) [6]
- 19/406 • • • • characterised by monitoring or safety (G05B 19/19 takes precedence) [6]
- 19/4061 • • • • • Avoiding collision or forbidden zones [6]
- 19/4062 • • • • • Monitoring servoloop, e.g. overload of servomotor, loss of feedback or reference [6]
- 19/4063 • • • • • Monitoring general control system (G05B 19/4062 takes precedence) [6]
- 19/4065 • • • • • Monitoring tool breakage, life or condition [6]
- 19/4067 • • • • • Restoring data or position after power failure or other interruption [6]
- 19/4068 • • • • • Verifying part programme on screen, by drawing or other means [6]
- 19/4069 • • • • • Simulating machining process on screen (G05B 19/4068 takes precedence) [6]
- 19/408 • • • • characterised by data handling or data format, e.g. reading, buffering or conversion of data [6]
- 19/409 • • • • characterised by using manual data input (MDI) or by using control panel, e.g. controlling functions with the panel; characterised by control panel details, by setting parameters (G05B 19/408, G05B 19/4093 take precedence) [6]
- 19/4093 • • • • characterised by part programming, e.g. entry of geometrical information as taken from a technical drawing, combining this with machining and material information to obtain control information, named part programme, for the NC machine [6]
- 19/4097 • • • • characterised by using design data to control NC machines, e.g. CAD/CAM (G05B 19/4093 takes precedence; CAD in general G06F 17/50) [6]
- 19/4099 • • • • • Surface or curve machining, making 3D objects, e.g. desktop manufacturing [6]
- 19/41 • • • • characterised by interpolation, e.g. the computation of intermediate points between programmed end points to define the path to be followed and the rate of travel along that path (G05B 19/25, G05B 19/31, G05B 19/37, G05B 19/39, G05B 19/40 take precedence) [3, 6]
- 19/4103 • • • • • Digital interpolation [6]
- 19/4105 • • • • • Analog interpolation [6]
- 19/414 • • • • Structure of the control system, e.g. common controller or multiprocessor systems, interface to servo, programmable interface controller [6]
- 19/4155 • • • • characterised by programme execution, i.e. part programme or machine function execution, e.g. selection of a programme [6]
- 19/416 • • • • characterised by control of velocity, acceleration or deceleration (G05B 19/19 takes precedence) [6]
- 19/418 • • • • Total factory control, i.e. centrally controlling a plurality of machines, e.g. direct or distributed numerical control (DNC), flexible manufacturing systems (FMS), integrated manufacturing systems (IMS), computer integrated manufacturing (CIM) [6]
- 19/42 • • • • Recording and playback systems, i.e. in which the programme is recorded from a cycle of operations, e.g. the cycle of operations being manually controlled, after which this record is played back on the same machine
- 19/421 • • • • Teaching successive positions by mechanical means, e.g. by mechanically-coupled handwheels to position tool head or end effector (G05B 19/423 takes precedence) [6]
- 19/423 • • • • Teaching successive positions by walk-through, i.e. the tool head or end effector being grasped and guided directly, with or without servo-assistance, to follow a path [6]
- 19/425 • • • • Teaching successive positions by numerical control, i.e. commands being entered to control the positioning servo of the tool head or end effector [6]
- 19/427 • • • • Teaching successive positions by tracking the position of a joystick or handle to control the positioning servo of the tool head, master-slave control (G05B 19/423 takes precedence) [6]
- 19/43 • • • • fluidic [3]
- 19/44 • • • • pneumatic [3]
- 19/46 • • • • hydraulic [3]
- 21/00 **Systems involving sampling of the variable controlled** (G05B 13/00-G05B 19/00 take precedence; transmission systems for measured values G08C; electronic switching or gating H03K 17/00)
- 21/02 • • • • electric
- 23/00 **Testing or monitoring of control systems or parts thereof** (monitoring of programme-control systems G05B 19/048, G05B 19/406)
- 23/02 • • • • Electric testing or monitoring
- 24/00 **Open-loop automatic control systems not otherwise provided for** [2]
- 24/02 • • • • electric [2]
- 24/04 • • • • fluidic [2]
- 99/00 **Subject matter not provided for in other groups of this subclass** [2006.01]