

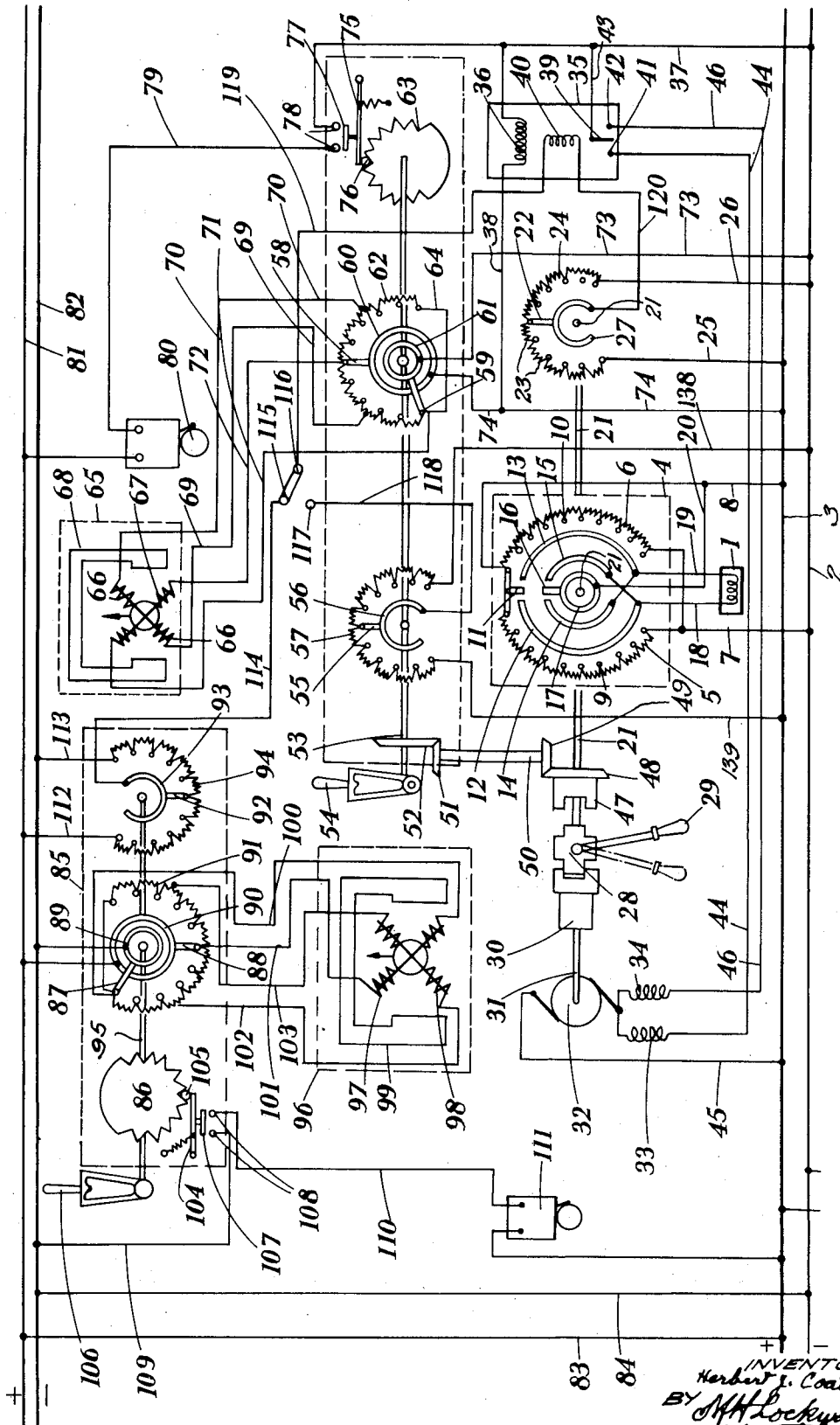
April 26, 1938.

H. J. COATES

2,115,327

REMOTE ELECTRIC CONTROL SYSTEM

Filed Dec. 5, 1934



INVENTOR
Herbert J. Coates
BY *M. H. Lockwood*
ATTORNEY

UNITED STATES PATENT OFFICE

2,115,327

REMOTE ELECTRIC CONTROL SYSTEM

Herbert John Coates, Erdington, Birmingham,
England, assignor to The General Electric Com-
pany, Limited, London, England

Application December 5, 1934, Serial No. 756,116
In Great Britain December 5, 1933

7 Claims. (Cl. 177—311)

This invention relates to remote electric control systems, more particularly for use in connection with the control of the propulsion plant on board ship, although its field of utility is not restricted to such use. Remote control systems may be divided into two classes, those in which the control is effected without the intervention of human aid and those in which an order is remotely given and is carried out by an attendant or attendants. In the first class since the human element is eliminated less labour is necessary to effect control and a possible source of delay or mistake is avoided. On the other hand the first class necessitates executive gear, absent in the second class, which is liable to fail and render control entirely inoperative, and furthermore it is not always desirable that the human element shall be eliminated at the remote station, indeed it may at times be considered convenient or expedient that an attendant or attendants able to carry out orders shall be present at the said station. It will be seen, therefore, that both classes possess peculiar advantages and an object of the invention is the provision of an improved control system having at least in part the advantages of both.

A further object of the invention is the provision of a control system in which control is exerted by the same control member and by similar operation of the said member in order to exert control either without the intervention of human aid or by giving a remote order to an attendant. Another object of the invention is the provision of a remote control system in which certain of the principal parts at the two stations are similar. Other objects of the invention which is defined in the appended claims will be clear from the description following.

One arrangement of remote electric control system will now be described by way of example with reference to the figure of the accompanying diagrammatic drawing which shows an arrangement for exerting remote control from a master control station, indicated by the grouped apparatus in the upper half of the drawing, over the apparatus in the remote station indicated in the lower half of the drawing.

The arrangement is suitable for use in a marine electric propulsion system in which the master control apparatus is situated on the bridge of the vessel and the remaining gear in the engine room.

In the drawing, the arrangement is such as to exert control on the value and direction of current through a load device 1.

The load device 1 is supplied from two bus-

bars 2, 3 through a potentiometer device 4; the potentiometer device 4 comprises two equal resistances 5, 6 connected in parallel between the bus-bars 2, 3 over the lines 7, 8. The resistances 5, 6 are provided with tapping studs 9, 10 respectively, swept over by a rotary brush 11 which respectively connects the tappings 9 to the semi-annulus 12 or the tappings 10 to a semi-annulus 13. Concentric with these semi-annuli 12, 13 are arranged two further annuli 14, 15, which are arranged to be connected by a rotary brush 16 to a central contact 17.

The outer semi-annulus 12 is connected to the inner semi-annulus 15 and the outer semi-annulus 13 is connected to the inner semi-annulus 14, while the load device 1 is connected between the semi-annulus 12 and the semi-annulus 13 over lines 18, 19. The central ring 17 is connected by a line 20 and the line 8 to the bus-bar 3.

The rotary brushes 11 and 16 are insulatedly mounted on a central operating spindle 21 driven in a manner which will hereinafter be explained. The brushes 11, 16, have a central off position, the position shown, from which they can be moved in either direction. In the central off position it will be seen that there is no circuit through the load 1. Suppose, however, both brushes 11, 16 move in a counter-clockwise direction from the off position, then there is a circuit completed from the positive bus-bar 3 over line 8, line 20, ring 17, brush 16, semi-annulus 14, line 19, load 1, line 18, semi-annulus 12, brush 11, that part of the resistance 5 between the brush 11 and the line 7, and line 7 to the negative bus 2. Thus there is a current flow from right to left through the load device 1, the value of the current being determined by the position of the brush 11 on the resistance 5.

It will be seen that movement of the brushes 11 and 16 from the off position in a clockwise direction, results in a current flow in the load 1 from left to right, that is in the reverse sense to that previously described. Thus both the value and direction of the current flow through the load device 1 can be varied by variation of the position of the brushes 11 and 16 by rotation of the shaft 21.

Also carried on the shaft 21 towards one end is a further rotary brush 22 which sweeps over tappings 23 on a semicircular resistance 24, connected between positive and negative bus-bars 3, 2, by lines 25, 26, and also sweeps over a slip-ring 27.

The shaft 21 towards its other end is splined and carries a two faced dog clutch part 28 which

is adapted to be moved longitudinally of the shaft 21 by a pivoted clutch lever 29. When in its extreme left hand position, the clutch half 28 engages a corresponding clutch half 30 carried on a shaft 31 which is arranged to be driven by a motor 32, having a field coil 33 which when energized causes rotation of the motor 32 in one direction, for example, in a clockwise direction, and a field coil 34 which when energized causes rotation in a counter-clockwise direction.

The selective energization of a field coil 33 or 34 is under the control of a selector relay 35, having a voltage coil 36 connected by line 38 across the supply bus-bars 2, 3, over lines 37, 38 and 74, and having a moving contact 39 biased to a central or open position but adapted in dependence on the direction of current flow in an operating winding 40 to engage either a contact 41 or a contact 42. If the contact 39 engages with the contact 41 there is a circuit from the bus-bar 2 over lines 37 and 43, contact 39, contact 41, line 44, field 33, armature 32 of the motor 32 and line 45 to the bus-bar 3, thus causing rotation of the motor 32 in the clockwise direction while if the contact 39 engages the contact 42 a circuit is completed over line 46 and the other field coil 34, thus causing rotation of the motor 32 in the counter-clockwise direction.

In its other extreme position, i. e. in its right hand position, the clutch half 28 engages a co-operating clutch half 47 which is rotatably mounted on the shaft 21 and is formed in one with a bevel gear wheel 48, transmitting drive through a corresponding bevel gear wheel 49, a vertical shaft 50, a gear wheel 51 and a corresponding gear wheel 52 from a shaft 53 rotated by a handle 54 secured thereto.

The shaft 21 is thus arranged to be rotated either by the motor 32 or by the handle 54 dependent on the position of the clutch half 28.

The handle 54 is arranged in certain circumstances, hereinafter detailed, to act as the local (or engine room) control handle and for this purpose the shaft 53 operates a moving brush 55 connecting a slip-ring 56 withappings on a resistance 57, and angularly spaced moving brushes 58 and 59 connecting slip rings 60 and 61 respectively withappings on a resistance 62, and a star wheel 63.

The rheostat 62 is divided into four equal sections and is tapped at the ends of these sections and is rendered continuous by a line 64 connecting the ends of the rheostat.

A receiving instrument 65 is mounted at the master control point from which remote control is exerted, that is to say the bridge in a marine installation. The instrument 65 operates on the resultant field principle and comprises a galvanometer type instrument adapted to operate through substantially 360° and is provided with a moving system including two coils 66, 67 having their axes at right angles and a permanent magnet 68. The coil 66 is connected at its ends over pilot wires 69, 70 with what are in effect diametrically opposite tapping points on the rheostat 62; similarly the coil 67 is connected over its pilot wires 71, 72 with the remaining diametrically opposite tapping points on the rheostat 62. The slip rings 60 and 61 are respectively connected across the bus-bars 2, 3 by lines 73, 74. The number of pairs of tapping points on the resistance 62 connected to studs with which the brushes 58, 59 cooperate is equal to the number of signals which it is required to transmit from

the engine room i. e. the local control point, to the bridge, the master control point. Accordingly as the lever 54 moves to operate the shaft 53, the brushes 58, 59 are moved and the resultant field set up at the receiver 65 on the bridge; causes the moving system of the receiver to move to a position corresponding to the position of the handle 54.

A leaf spring 75 is arranged to force a roller 76 between the teeth of the star wheel 63; in this manner the operating handle 54 is biased to a definite number of positions. The leaf spring 75 carries an insulated moving contact 77 which is adapted to bridge stationary contacts 78 as the handle 54 moves from one position to another. The stationary contacts 78 are connected in a circuit between bus-bar 2, over line 37, line 79, bell 80, and auxiliary bus 81 of the pair of auxiliary bus bars 81, 82 respectively connected to the main bus bars 3 and 2 by lines 83, 84.

The bell 80 is located adjacent the master controller, that is to say, on the bridge.

The master control gear 85 on the bridge is similar to the control gear operated by the handle 54, and comprises a star-wheel 86, two spaced brushes 87, 88 respectively connecting slip rings 89, 90 withappings on a continuous rheostat 91, divided into four equal sections, and a further brush 92, connecting a slip ring 93 withappings on a resistance 94, the star wheel 86, and brushes 87, 88 and 92 all being mounted on and moving with the spindle 95 operated by the handle 106.

A receiver 96 is provided in the local control point i. e. in the engine room adjacent the local controller operated by the handle 54. This receiver is similar to the receiver 65 and also operates on the resultant field principle; the receiver 96 accordingly comprises two windings 97 and 98 constituting the moving system, being disposed with their respective long axes at right angles to one another, and also comprises a permanent magnet 99.

The ends of the coil 97 are connected over pilot wires 100 and 101 with two diametrically opposite tapping points on the rheostat 91, whilst in a similar manner the ends of the coil 98 are connected over pilot wires 102 and 103 with the remaining two diametrically opposite tapping points on the same rheostat 91.

A leaf-spring 104 forces a roller 105 into engagement with the teeth of the star wheel 86, and thus biases the handle 106 to certain definite positions. A contact 107 insulatedly carried on the leaf spring 104 is arranged to bridge fixed contacts 108 when the handle 106 moves from one position to the next position.

The bridging of the fixed contacts 108 effects completion of the circuit to a bell 111 over lines 110 and 109. The bell 111 is located at the local control station, i. e. in the engine room and adjacent the controller operated by the handle 54.

The resistance 94 is connected across the auxiliary supply bus-bars 81, 82 by lines 112, 113, whilst the slip ring 93 associated with that resistance is connected over a line 114 to one contact 115 of a single pole double throw switch having a moving contact 116 which makes either with contact 115 or with contact 117. The contact 117 is connected over a line 118 with the slip ring 56 in the engine room i. e. local station controller. The resistance 57 with which the contact finger 55 cooperates is connected across the bus-bars 2, 3 by lines 138, 139.

The moving contact 116 of the single pole double throw switch is connected over a line 119 75

and through the coil 40 of the selector relay 35 and over line 120 to the slip ring 27.

In order now that the invention may be more clearly understood there will now be described the general operation of the arrangement shown; it is assumed initially that the various controllers are in the position shown, i. e. the "off" position.

Suppose now that it is desired that direct control should be exerted from the bridge or remote master controller 85, without human intervention in the engine room; the selector switch 116 is moved into its upper position to make with contact 115, whilst the clutch half 28 is moved into its extreme left hand position in which it is in engagement with the clutch half 30, by means of the lever 29.

The lever 106 is then moved, for example, a distance corresponding to three notches of the star wheel 86, in a clockwise direction. The bell 111 in the engine room accordingly sounds three times (as a tooth of the wheel causes the moving contacts 107 on the leaf-spring 104 to make with the stationary contacts 108). An indication is also given on the engine room receiver 96 in the manner previously described.

The brushes 92 and 22 respectively on the bridge controller and on the engine room gear, when the controller 85 is in its central off position, make at equipotential points on the resistances 94 and 24 respectively and accordingly there is no current flow through the selector relay coil 40. When, however, the control handle 106 is moved away from the central off position as stated above, the voltage balance is upset and a current flows from the brush 22 upwards through the relay coil 40 to the brush 92.

The selector relay 35 accordingly operates to cause its contact 39 to make with the contact 42. The circuit of the motor 32 is accordingly made from the positive bus-bar 3 over line 45, armature 32, field 34, line 46, contact 42, moving contact 39 and line 37 to the negative bus-bar 2.

The motor 32 then, through the clutch halves 30 and 28 causes a rotation of the shaft 21 in a counter-clockwise direction. Eventually the rotation of the shaft 21 brings the brush 22 into a position on the resistance 24 which corresponds with the position of the brush 92 on the resistance 94; when this equipotential position is reached the current through the selector relay coil 40 ceases and the moving contact 39 accordingly moves to its central position and, in consequence de-energizes the motor circuit.

The shaft 21 and thus the controller 4 for the load 1, are then arrested in a position which corresponds to the setting of the bridge control handle 106.

If, of course, the handle 106 is initially turned in a counter-clockwise direction from the "off" position, the motor circuit is then made at contact 41, the field 33 then being energized.

It will thus be seen that movement of the control handle 106 to a particular setting is immediately followed by a corresponding follow-up movement of the regulator 4, the current through the load device 1 thus being directly controlled by the remote controller.

If, however, it is desired that the remote controller should operate with the intervention of human aid, then the transfer switch 116 is moved to its downward position in which contact is made at contact 117. Accordingly the out of balance necessary for operating the selector relay 35 is obtained between the brush 22 and the brush

55 of the local (i. e. engine room) controller operated by the handle 54.

If now the bridge control handle 106 is moved say four positions in a clockwise direction, i. e. "notches" on the star wheel 86, the bell 111 in the engine room sounds four times and an indication of the position is given on the receiver 96. The engineer or attendant on watch, then moves his control handle 54 to a corresponding position; this causes firstly the bell 80 on the bridge to sound four times and the receiver 65 on the bridge to move to a corresponding position.

At the same time, the movement of the brush 57 destroys the equipotential balance condition previously set up over the selector relay coil 40 at the brushes 57 and 22.

The selector relay 35 is then energized and causes the completion of the motor circuit through the field coil 34, at its contact 42.

Thereafter the operation is as previously described for direct bridge operation. With this mode of operation, it will be seen that the act of setting the engine room control handle to correspond with the indication on the engine room receiver 96, both effects the desired control and transmits an acknowledgment to the bridge that the required order has been carried out.

In the third possible mode of operation, which is for example only necessary when repair or access to the motor 32 is required, the clutch half 28 is moved to its right hand position, by means of the lever 29, in which it engages the clutch half 47.

Thereafter movement of the engine room control handle 54 effects direct operation of the regulator 4, through the gearing 52, 51, shaft 50, gearing 49 and 48, clutch halves 47 and 28 and shaft 21.

The engine room controller and receiver are preferably of similar construction. Generally, however, the ship propulsion system may be of any suitable type and conveniently the main controller effects both speed regulation and reversal of the motor or motors associated therewith. One master controller, main controller and associated gear as described above will be provided for controlling each propeller shaft.

In this case any movement of the bridge controller for effecting direct control, would preferably signal this control to the engine room; whilst when the engine room controller alone is exerting direct control, the officer on the bridge may use his controller to telegraph orders to the engine room, whilst the actual operation of the engine room controller in response to these orders, would notify the bridge of the execution of the orders. In this latter case, of course, the transfer switch 116 would operate to render ineffective the main control normally exerted by the bridge controller.

The arrangements described above rely on electrical interconnection between the engine room controller, regulator and the bridge master controller.

I claim:—

1. An electric control system comprising a controlled member having a plurality of positions, an electrical follow up mechanism for moving said controlled member, a remote controller, a second controller adjacent said controlled member, each movable to a plurality of controlling positions, means movable by the respective controllers for operating said follow up mechanism to move said controlled member to a position corresponding to that of one of the controllers which has been

moved, a controller position indicating means adjacent each controller and means operated by each controller for operating the position indicating means adjacent the other controller.

2. The electrical control system as in claim 1 wherein each of said controllers is provided with controller operated means for operating the follow up mechanism of the controlled member and means is provided for connecting one or the other of said controller operated means with said follow up mechanism for operating the same.

3. An electrical control system comprising a controlled member having a plurality of positions on each side of an off position, an electrical follow up mechanism including a motor for moving said controlled member in one direction or another from its off position, a remote controller and a controller adjacent said controlled member each provided with electrical means for individually operating said follow up mechanism and each movable to a plurality of controlling positions on each side of an off position, means for selecting one or the other of said controllers for operating the follow up mechanism, means operated by the selected controller for operating said follow up mechanism to position the controlled member to correspond with the position of the selected controller, means adjacent each controller for indicating operation of the other controller and means operated by the respective controllers for operating said indicating means.

4. The electrical control system as in claim 3 wherein said follow-up mechanism includes a relay for operating the motor and the respective controllers and said follow up mechanism are provided with balanced tapped potentiometer for operating said relay and for determining the direction and amount of rotation of said motor.

5. An electrical control system comprising a controller and a controlled member independently movable, follow up mechanism for moving said controlled member, means arranged to be brought into operation by movement of the controller for operating the follow up mechanism so as to position the controlled member to correspond with the position of the controller and means located at a distance from the controller and arranged to be operated by movement thereof for indicating operation of the controller.

6. An electrical control system comprising a controller and a controlled member independently movable, follow up mechanism for moving said controlled member, means controlled by the controller and brought into action by movement thereof for operating the follow up mechanism so as to position the controlled member to correspond with the position of the controller, means at a distant station for indicating operation of the controller and means operated by said controller for operating said indicating means.

7. An electrical control system comprising a controller at a control station, a controller and a controlled member at an operation station all independently movable, follow up mechanism for moving said controlled member, means for connecting the follow up mechanism for operation by one or the other of said controllers, means brought into action by movement of the controller so connected for operating the follow up mechanism and positioning the controlled member to correspond with the position of the connected controller and indicating means at the control and operating stations respectively for indicating at each station operation of the controller at the other station.

HERBERT JOHN COATES.