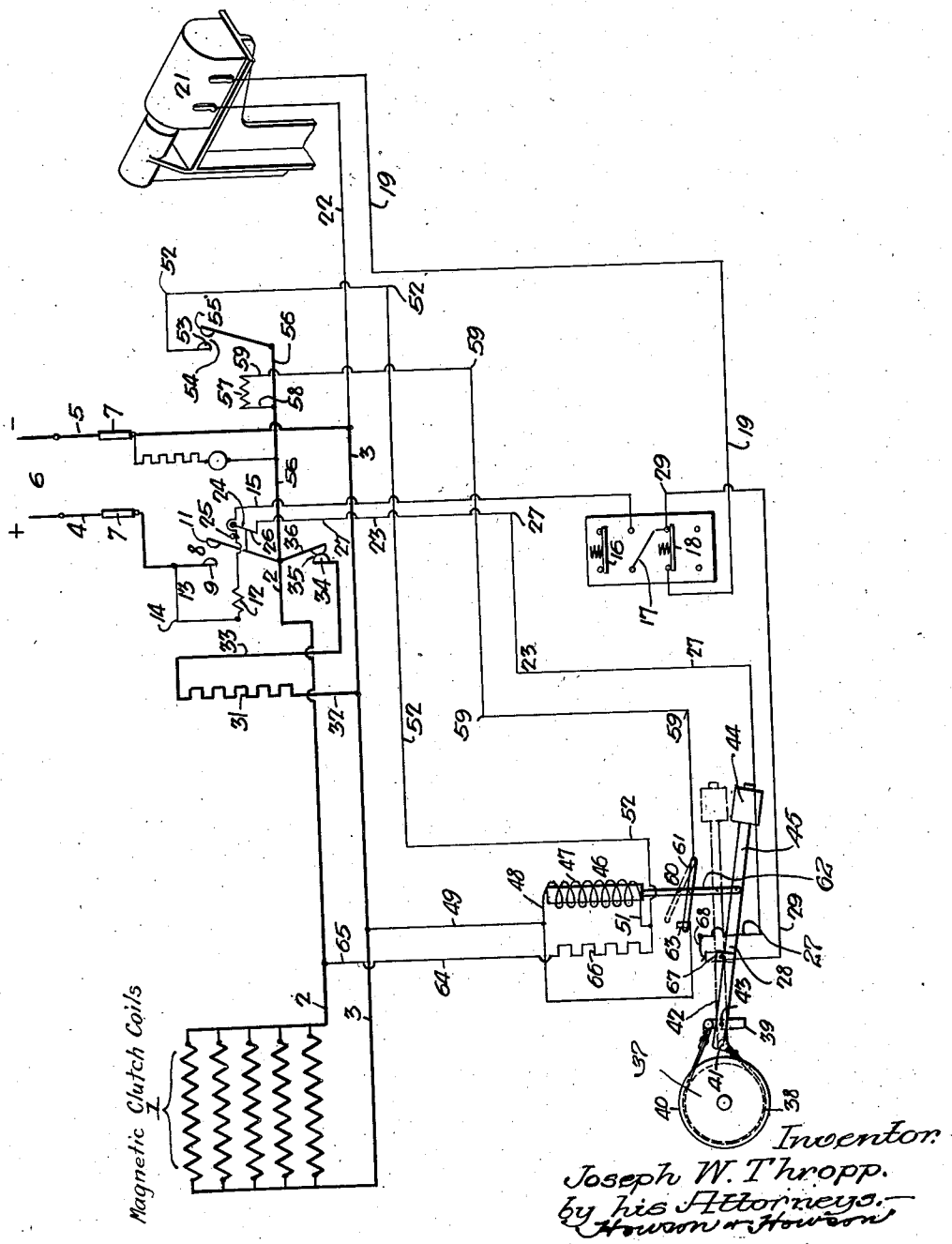
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J. W. THROPP

CONTROL SYSTEM

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JOSEPH W. THROPP, OF TRENTON, NEW JERSEY.

CONTROL SYSTEM.

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My invention relates to control systems, having particular relation to such systems as are applicable to electric clutches. It is particularly applicable to power transmission systems such as set forth in my copending application Ser. No. 731,890, filed Aug. 13, 1924.

One object of my invention is to provide an improved system of control for electric clutches, including means for absorbing the energy given up by the coils upon the interruption of the energizing circuit thereof.

Another object of my invention is to provide a control system for a differential electric clutch and brake, wherein heavy currents are supplied to the brake-actuating means only during the initial operation thereof.

A further object of my invention is to provide in a control system of the class described, a plurality of remote control safety switches, one of which is operated by the brake-setting means.

A still further object of my invention is to provide a differential electric clutch and brake-controlling system, wherein the operation of remote control switches may cause the deenergization of the clutch coils to effect the release thereof, the substantial simultaneous deenergization of the brake-actuating solenoid and the consequent application of the brake.

Other objects of my invention, as well as details of construction and operation, whereby my invention may be practiced, will be apparent more fully hereinafter, when taken in connection with the accompanying description, claims and drawing, wherein—

The single figure of the drawing is a diagrammatic view of circuits and apparatus embodying my invention.

In the illustrated form of embodiment of my invention shown in the drawing, a plurality of magnet clutch coils 1, have their opposite terminals connected by conductors 2 and 3 to positive and negative conductors 4 and 5 of an energizing circuit 6. The magnetic clutches may be of the type and for the purpose set forth in my copending application Ser. No. 648,525, filed June 29, 1923. Each of the conductors 2 and 3 may include the usual fuses 7. A contactor 8 comprising a stationary contact element 9 and a movable contact element 11 may be included in the conductor 2 intermediate the clutch coils 1 and the fuses 7, whereby the currents to the clutch coils 1 may be interrupted at will.

An actuating winding 12 for the contactor 8 is included in a control circuit 13, which extends from the stationary contact element 9, through a conductor 14, the actuating winding 12, a conductor 15, a normally-open switch of the push-button type 16, a conductor 17, a normally-closed switch of the push-button type 18, a conductor 19, a normally closed safety switch or so-called "cradle switch" 21, a conductor 22 and the conductor 3, to the negative conductor 5 of the energizing circuit 6.

When the push-button switch 16 is closed, the control circuit 13 provides a path for currents from the positive conductor 4 to the negative conductor 5, through the actuating winding 12 of the contactor 8, resulting in the closing of the latter. When the contactor 8 closes, a circuit is completed which extends from the positive conductor 4 through the conductor 2, the clutch coils 1 and the conductor 3 to the negative conductor 5, resulting in the operation of the clutch coils 1 to connect mechanically the desired clutch elements (not shown).

In order to provide for the control of the contactor 8 from a number of desired points when the push-button switch 16 is open, I provide a contact circuit 23 which includes a switch 24. The switch 24 comprises a stationary contact element 25, which is electrically connected to the positive conductor 15, and a movable contact element 26, which is so mechanically secured to the movable contact element 11 of the main contactor 8 that the switch 24 is closed in accordance with the closing of the main contactor 8. It will thus be seen that the closing of the switch 16 serves to automatically establish another control circuit which does not include the said switch.

The control circuit 23 extends from the stationary contact element 25, which is connected to the positive or actuating winding 12, through the movable contact element 26 of the switch 24, a conductor 27, a brake-operated switch 28, to be described hereinafter, a conductor 29, the normally-closed push-button switch 18, the conductor 19, the cradle switch 21, the conductor 22 and the conductor 3, to the negative conductor 5 of the energizing circuit 6. Attention is directed to the fact that when the control cir-

cuit 23 is closed by the engagement of the contact elements 25 and 26 of the switch 24 and by the closing of the switch 28, the energization of the actuating winding 12 of the contactor 8 is maintained, so that the contactor 8 may be held in its circuit-closing position independently of the push-button switch 16.

When it is desirable to deenergize the clutch coils 1, this may be accomplished by interrupting the control circuit 23 either at the normally-closed push-button switch 18, the brake switch 28 or the safety or cradle-switch 21. When such circuit interruption occurs, the movable contact element 11 of the contactor 8 moves under the force of gravity out of engagement with the stationary contact element 9, opening the positive conductor 2 and resulting in the deenergization of the clutch coils 1.

An important feature of my invention is the provision of means for absorbing the energy stored in the clutch coils 1, which is discharged upon the opening of the contactor 8. It will be understood that the said clutch coils 1 constitute inductance elements. I provide a discharge resistor 31, one terminal of which is connected by a conductor 32 to the negative conductor 3, and an opposite terminal of which is connected by a conductor 33 to a stationary contact element 34 of a switch 35. A movable contact element 36 of the switch 35 is electrically connected to the positive conductor 2 and it is so mechanically associated with the contactor 8 as to be actuated into engagement with the co-acting stationary contact member 34 when the contactor 8 opens by gravity. Hence, the opening of the contactor 8, and the consequent closing of the auxiliary switch 35, causes the discharge resistor 31 to be connected directly across the terminals of the clutch coils 1.

In the class of apparatus to which the invention is particularly applicable the quick stopping of the disengaged clutch parts is of primary importance. Accordingly, I provide a brake 40, comprising a brake disk 37, which is connected with one of the clutch parts, and a brake band 38. One end of the brake band 38 is rigidly secured to a supporting bracket 39, while the other end thereof is rigidly secured to one end 41 of a brake lever 42, the latter having a pivotal mounting 43 on the bracket 39. The brake 40 is preferably of the gravity-set type, a weight 44 on the end 45 of the brake arm 42 serving to provide the desired braking force.

The brake arm 42 may be actuated from the solid-line position, wherein the brake is applied, to the dot-and-dash-line position, wherein the brake is released, by means of a solenoid 46, an actuating winding 47 of which has one terminal 48 thereof connected by a conductor 49 to the negative conductor 3. The remaining terminal 51 of the actuating winding 47 is connected by a conductor 52 to a stationary contact element 53 of a second contactor 54. A movable contact element 55 of the latter is connected by a conductor 56 to the movable contact element 11 of the main contactor 8.

The operation of the secondary contactor 54 may be effected by means of an actuating winding 57, one terminal of which is connected by the conductor 58 to the conductor 56. The remaining terminal of the actuating winding 57 is connected by a conductor 59 to the negative conductor 49 through a so-called cut-out switch 60. A movable contact element 61 of the switch 60 is carried by a movable core 62 of the solenoid 46 and it is so operatively associated with a coacting stationary contact element 63 that the electrical engagement between the two contact elements continues until the solenoid 46 has been operated sufficiently to cause the release of the brake 36, all as will appear more fully hereinafter.

Hence, when the main contactor 8 has been closed, a circuit is completed which extends from the positive conductor 4 through the main contactor 8, the conductor 56, the contactor actuating winding 57, the conductor 59, the switch 60 and the conductor 49, to the negative conductor 3, resulting in the closing of the second contactor 54.

The closing of the second contactor 54 completes a circuit which extends from the positive conductor 4, through the main contactor 8, the conductor 56, the secondary contactor 54, the conductor 52, the solenoid actuating winding 46, the conductor 49 and the conductor 3, to the negative conductor 5, resulting in the energization of the solenoid actuating winding 46. The energization of the latter causes the brake arm 42 to move from the brake setting position shown in solid lines in the drawing to the brake releasing position shown in dot-and-dash-lines.

Inasmuch as it is desirable to hold the brake arm 42 normally in the brake releasing position while the clutch coils 1 are energized, my invention further contemplates the provision of means, whereby the currents traversing the solenoid actuating winding 46 may be materially decreased when the brake apparatus assumes this position. To this end, I provide an energizing circuit 64, which is secondary to that just described as controlled by the second contactor 54.

The secondary energizing circuit 64 extends from the positive conductor 4, through the main contactor 8, the conductor 2, a conductor 65, a resistor 66, the solenoid actuating winding 46, the conductor 49 and the conductor 3, to the negative conductor 5 of the energizing circuit 6. The currents trav-

ersing this circuit are obviously relatively small so long as the secondary contactor 54 is closed. When the latter is opened, however, the circuit 64 represents the only remaining means, whereby the solenoid actuating winding 46 may be energized.

As above pointed out, the movable contact 61 of the switch 60 is actuated out of engagement with the co-acting stationary element 63 only when the brake apparatus has assumed the dot-and-dash line position shown in the drawing. When the switch 60 is thus opened, the energizing circuit of the actuating winding 57 of the second contactor 54 is broken, causing the latter to open by gravity, whereupon the currents are caused to traverse the secondary energizing circuit 64. As the result of the successive operation of the switch 60 and the secondary contactor 54, the latter is caused to carry the inductive discharge of the solenoid-actuating winding 46 rather than the switch 60.

With the opening of the second contactor 54, the apparatus is now in the position, wherein the clutch coils 1 are energized to effect the mechanical connection between the driving and driven parts (not shown), and the solenoid actuating winding 46 is energized through the resistor 66 so that the brake apparatus may be held in the brake releasing position shown in dot-and-dash lines in the drawing.

Should the voltage of the energizing circuit 6 fall below the required operating value, the force of the actuating winding 46 on the solenoid core 62 is insufficient to hold the brake arm 42 in the brake releasing position, so that the latter would fall, causing a frictional engagement of the brake band 38 and the brake disk 37. In order that clutch coils 1 may be deenergized at such instant, so that the brake will not operate against the driving means (not shown), I provide the switch 28, which comprises a movable contact element 67, mounted on the brake arm 42 and a stationary contact element 68, the latter engaging the former only when the brake arm 42 is in the brake releasing position.

Since the brake switch 28 is connected in series-circuit relation with the actuating winding 12 of the main contactor 8, the interruption of the control circuit 23 causes the opening of the main contactor 8. Hence the clutch coils 1 are deenergized upon the movement of the brake arm 42 into the brake setting position.

As above pointed out, the opening of the main contactor 8 causes the closing of the switch 34, whereby the discharge resistor 31 may be connected in shunt relation to the clutch coils 1. Since the actuating winding 47 of the solenoid 46 is connected in shunt relation to the clutch coils 1, the discharge resistor 31 is connected in series-circuit relation with the actuating winding 47 also, absorbing the discharge therefrom as well.

The clutch coils 1 may be also deenergized to disengage the magnetic clutch by the actuation of the push-button switch 18, or by the operation of the safety or so-called "cradle switch" 21, either of which interrupts the energizing circuit 23, causing the opening of the main contactor 8.

When the clutch coils 1 are to be again energized, the push-button switch 16 is operated to close the energizing circuit 13, which includes main contactor actuating winding 12, causing the foregoing cycle of operations to be repeated.

It will be obvious that if the solenoid 46 fails for any reason to release the brake 40, the switch 28 will remain open. This will prevent the closing of the control circuit 23, with the result that the contactor 8 will immediately reopen upon the release of the push button switch 16. Thus it is impossible for the clutch coils 1 to continue to be energized when the brake is applied to resist the operation of the clutch.

While I have described in detail one control system embodying my invention, and while I have pointed out certain of the most obvious principles and purposes thereof, I do not intend that the language employed in the following claims shall be limited to the present features described, but I also desire that the claims shall be construed to cover all combinations which are fairly included in the language thereof, when read in connection with prior art, regardless of the details and functions mentioned in the description or illustrated in the drawing.

I claim:

1. In a system of control, the combination with a brake, of a solenoid for actuating the same, an energizing circuit for said solenoid, including a resistor, a contactor for rendering effective and ineffective said resistor, an actuating winding for said contactor, and a limit switch operable to render ineffective said actuating winding upon a predetermined operation of said solenoid.

2. In combination, a clutch coil, an energizing circuit therefor, a discharge circuit for said coil, a switch operable to connect said coil to one or the other of said circuits, a solenoid, means for connecting said solenoid in parallel relation to said clutch coil, said means including a resistor, and a switch designed to render ineffective said resistor under predetermined operating conditions.

3. In combination, a clutch coil, an energizing circuit therefor, a discharge circuit for said coil, a contactor operable to connect said coil to one or the other of said circuits, a solenoid, means for connecting said solenoid in parallel relation to said clutch

coil, said means including a resistor and a switch designed to render ineffective said resistor under predetermined operating conditions, a brake operated by said solenoid, an actuating winding for said contactor, and a switch for opening said actuating winding when said brake is effective, whereby said clutch coil may be substantially simultaneously deenergized.

4. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, main circuits for the said coil and the said solenoid, a supplemental circuit for the solenoid including a resistor, switch mechanism for the said main circuits including a manually operable switch for causing the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, and a cut-out switch for automatically interrupting the main circuit to the solenoid when the brake is in its released position.

5. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, two main circuits for the said coil and the said solenoid respectively, a supplemental circuit for the solenoid including a resistor, two electrically-operated switches for the said circuits respectively, a manually operable switch for causing the operation of the two said switches to cause substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, and a cut-out switch for automatically interrupting the main circuit to the solenoid when the brake is in its released position.

6. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, electrically-operated switch mechanism for closing the said circuits to cause the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, two parallel circuits for supplying current to operate the said switch mechanism, a manually operable normally open switch for closing one circuit to operate the switch mechanism, and means acting automatically upon the closing of the said normally open switch for operatively connecting the other of said two circuits.

7. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, electrically-operated switch mechanism for closing the said circuits to cause the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, two parallel circuits for supplying current to operate the said switch mechanism, a manually operable normally open switch for closing one circuit to operate the switch mechanism, and means mechanically operated by a part of the said switch mechanism for operatively connecting the other of said two circuits.

8. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, and switch mechanism for the said circuits for causing the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, and means controlled by the brake for normally preventing the energization of the clutch coil when the brake is in applied position.

9. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, and switch mechanism for the said circuits for causing the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, and means controlled by the brake for causing the deenergization of the clutch coil when the brake moves to its applied position.

10. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, electrically-operated switch mechanism for closing the said circuits to cause the substantially simultaneous energization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, two parallel circuits for supplying current to operate the said switch mechanism, a manually operable normally open switch for closing one circuit to operate the switch mechanism, means acting automatically upon the closing of the said normally open switch for operatively connecting the other of said two circuits, and a switch in the last said circuit which is closed when the brake is in released position and open when the brake is in applied position.

11. The combination in a control system, of a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for the said coil and the said solenoid, electrically-operated switch mechanism for closing the said circuits to cause the substantially simultaneous ener-

gization of both the coil and the solenoid to thereby effect the engagement of the clutch and the release of the brake, two parallel circuits for supplying current to operate the said switch mechanism, a manually operable normally open switch for closing one circuit to operate the switch mechanism, and means acting automatically upon the closing of the said normally open switch for operatively connecting the other of said two circuits, and two switches in series in the last said circuit, one switch being normally closed and adapted to be manually opened and the other switch being closed when the brake is in released position and open when the brake is in applied position.

12. A system of control comprising a clutch coil, a brake, a solenoid for moving the brake from its applied position to its released position, circuits for said coil and said solenoid, switches for controlling said circuits adapted to cause a substantially simultaneous energization of both said coil and said solenoid and thereby effect the engagement of the clutch and release of the brake, actuating windings for said switches, respectively, one of said windings having two supply circuits, a manually operable switch for closing one of said two circuits to cause the energization of said last-mentioned winding, and means acting automatically upon the closing of said manually operated switch for operatively connecting the other of said two circuits to said last-mentioned winding, the other actuating winding having a control circuit provided with a switch operable to open said last-mentioned winding upon the releasing of said brake.

13. A clutch coil, a brake, a solenoid for moving the brake from the applied position to its released position, circuits for said coil and said solenoid, switches for controlling said circuits adapted to cause a substantially simultaneous energization of both said coil and said solenoid and thereby effect the engagement of the clutch and release of the brake, actuating windings for said switches, respectively, one of said windings having two supply circuits, a manually operable switch for closing one of said two circuits to cause the energization of said last-mentioned winding, means acting automatically upon the closing of said manually operative switch for operatively connecting the other of said two circuits to said last-mentioned winding, the other actuating winding having a control circuit provided with a switch operable to deenergize said last-mentioned winding upon the operation of said switch, and a supplemental energizing circuit including a resistor for said solenoid effective to cause the continued energization thereof upon the inoperation of said manually operative switch.

JOSEPH W. THROPP.