

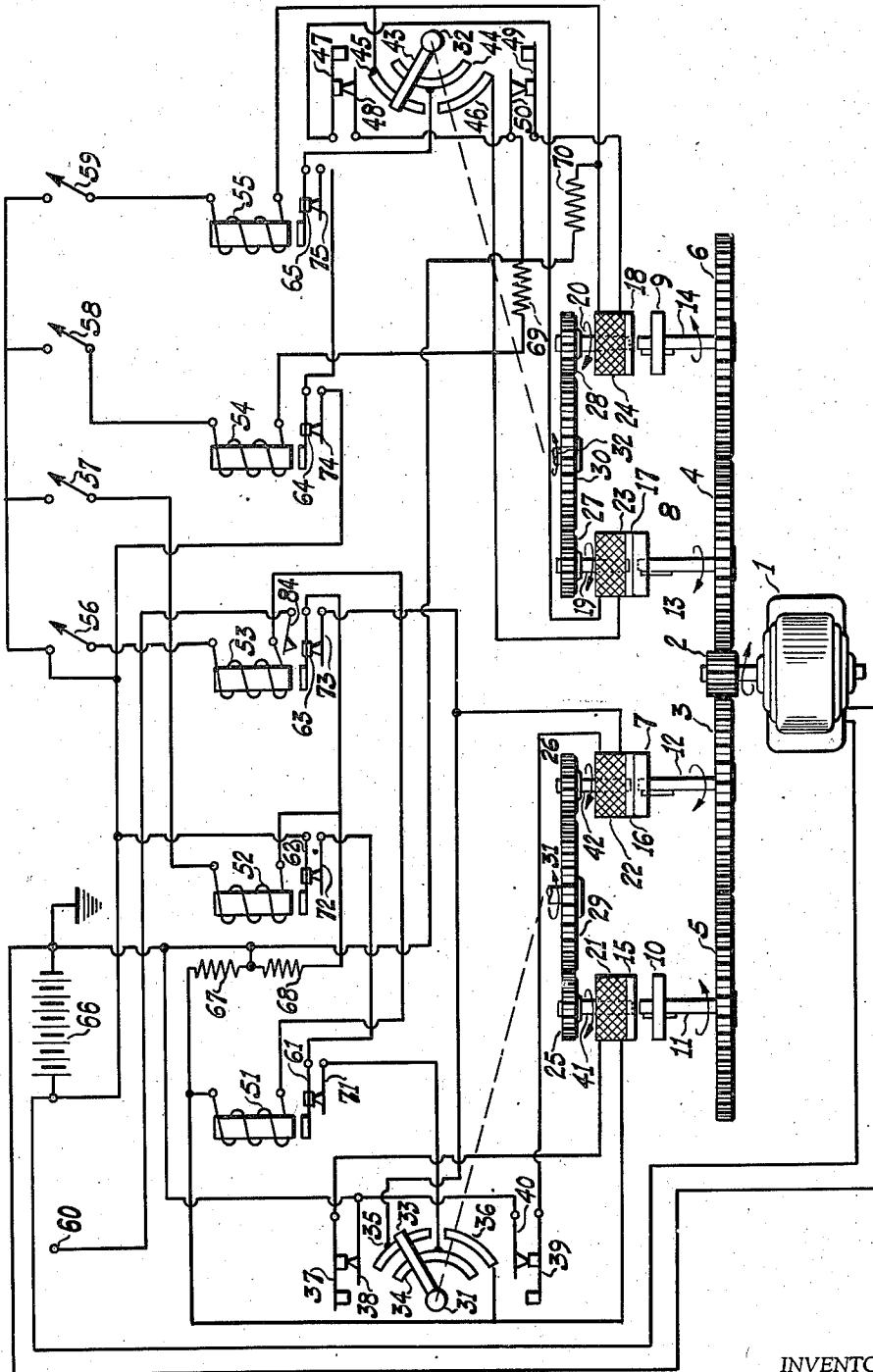
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REMOTE CONTROL SYSTEM

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REMOTE-CONTROL SYSTEM

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This invention relates generally to remote control systems and particularly to an electrical remote control system for controlling the angular displacement of one or more rotatable elements, which includes means for restoring the rotatable element to a predetermined angular position after each operation of the remote control means.

The invention may be adapted to the control of any rotatable element. However, for the purpose of illustration only, the device to be described herein comprises two rotatable shafts driven by a common motor. The motor drives a chain of four gears, two of which rotate clockwise and the other two counter-clockwise. The four gears are coupled through individual electromagnetic clutches to a second group of four gears each of which may be driven in corresponding directions upon energization of the corresponding electromagnetic clutch. A driven gear connected to a work shaft is constantly meshed with a clockwise rotatable gear and a counter-clockwise rotatable gear of the second gear group. Therefore, by selective energization of two of the electromagnetic clutches, the work shaft may be selectively driven either clockwise or counter-clockwise from a uni-directional motor. A second work shaft may likewise be rotated in either direction by means of similar clutches and gears.

Mechanical systems such as described heretofore are well known in the art. The instant invention provides a new and improved means for controlling the operation of such a mechanical system whereby either or both of the shafts may be rotated through any desired angle, and automatically restored to a neutral position after each operation of the remote control system. In addition, means are provided for automatically limiting the angular displacement of both of the work shafts without necessarily interrupting the motor drive electrical circuit.

Among the objects of the invention are to provide a new and improved means for selectively controlling the rotation of one or more rotatable elements. Another object of the invention is to provide a new and improved means for continuously driving a gear train and remotely controlling the relative angular displacement of a plurality of rotatable elements within predetermined limits of angular displacement. A further object is to provide a new and improved remote control system for one or more rotatable elements, including means for restoring each rotatable element to a neutral position after each operation of the remote control device. Another object of the invention is to provide new and improved

means for operating an auxiliary control circuit upon simultaneous operation of two control elements of an otherwise independent remote control system.

The invention will be described by reference to the accompanying drawing in which the single figure is a schematic diagram of one embodiment thereof.

Referring to drawing, a uni-directional electric motor 1 is either continuously or selectively driven by power derived from a battery or other source 66. A gear 2, driven by the motor 1, drives two other gears 3 and 4 which in turn drive two additional gears 5 and 6, respectively. As the motor shaft is rotated in a clockwise direction, the gears 3 and 4 and their respective shafts 12 and 13 will rotate counter-clockwise and the gears 5 and 6 and their respective shafts 11 and 14 will be driven clockwise. An electromagnetic clutch, including a winding 21 and clutch faces 10 and 15, couples the shaft 11 to a second shaft 41 arranged coaxially thereto. The second shaft 41 is connected to a first driven gear 25. A second electromagnetic clutch, including a winding 22 and clutch faces 7 and 16, couples the shaft 12 to a shaft 42 connected to a second driven gear 26. The first and second driven gears 25 and 26 are disposed in operable relation with a third driven gear 29. If, as described heretofore, the shaft 12 is rotated in a counter-clockwise direction, by the gear 3 energization of the second electromagnetic clutch 7, 16, 22 will provide counter-clockwise rotation of the second driven gear 26 and, therefore, clockwise rotation of the third driven gear 29 which is connected to a first work shaft 31. Likewise, energization of the first electromagnetic clutch 10, 15, 21 will provide clockwise rotation of the first driven gear 25 and therefore counter-clockwise rotation of the third driven gear 29.

Similarly, a third electromagnetic clutch, including a winding 23 and clutch faces 8 and 17, couples the shaft 13 to a coaxially disposed shaft 19 connected to a fourth driven gear 27. A fourth electromagnetic clutch, including a winding 24 and clutch faces 9 and 18, couples the shaft 14 to a coaxially disposed shaft 20 which is connected to a fifth driven gear 28. The fourth and fifth driven gears 27 and 28 are connected in operable relation to a sixth driven gear 30 which is connected to a second work shaft 32. By selective energization of the magnetic clutches 8, 17, 23 and 9, 18, 24, the second work shaft 32 may likewise be rotated in either a clockwise or counter-clockwise direction.

The second work shaft 32 is connected in operable relation to a first sliding contact arm 43 which engages, first, second and third concentrically arranged commutator segments 44, 45 and 46 in such a manner that the first segment 44 is alternately connected to either the second segment 45 or the third segment 46 except in one neutral position. The first sliding contact 43 is arranged to have the same angular displacement as the driven shaft 32. For the required predetermined limits of angular displacement of the first sliding contact 43, and the second work shaft 32, a pair of circuit-opening contacts 47 and 48 are provided to limit clockwise rotation, and a second pair of circuit opening contacts 49 and 50 are provided to limit counter-clockwise rotation. Similarly, the first driven shaft 31 is connected to a second sliding contact arm 33 in operable relation to the fourth, fifth and sixth commutator segments 34, 35 and 36, to a third pair of circuit opening contacts 37 and 38, and to a fourth pair of circuit-opening contacts 39 and 40, which correspond in construction and operation to the contact arrangement for the second driven shaft 32.

One terminal of a first relay winding 55 is connected through a first switch 59 to one terminal of the source of power 66. The remaining terminal of the first relay winding 55 is connected to one terminal of a first resistor 70, to the second segment 45, and to one terminal of the fourth electromagnetic clutch winding 24. The remaining terminal of the fourth electromagnetic clutch winding 24 is connected through the second pair of circuit opening contacts 49, 50 to the remaining terminal of the first resistor 70, and to the remaining, preferably grounded, terminal of the power supply 66. Likewise, one terminal of a second relay winding 54 is connected through a second switch 58 to the ungrounded terminal of the power supply 66. The remaining terminal of the second relay winding 54 is connected to one terminal of a second resistor 69, to the third segment 46 and to one terminal of the third electromagnetic clutch winding 23. The remaining terminal of the third clutch winding 23 is connected through the first pair of circuit opening contacts 47 and 48, to the remaining terminal of the second resistor 69, and the grounded side of the power supply 66.

The first relay 55 includes a first fixed contact 75, and a first circuit-opening armature contact 65. The armature contact is connected to the first commutator segment 44. The second relay 54 includes a second fixed relay contact 74 which is connected to the ungrounded side of the power supply 66, and a second circuit-opening armature contact 64, which is connected to the first fixed relay contact 75 of the first relay 55.

One terminal of a third relay winding 53 is connected through a third switch 56 to the ungrounded terminal of the source of power 66. The remaining terminal of the third relay winding 53 is connected to one terminal of a fourth relay winding 51. The remaining terminal of the fourth relay winding 51 is connected to one terminal of a third resistor 67, to the sixth commutator segment 36, and to one terminal of the first electromagnetic clutch winding 21. The remaining terminal of the first electromagnetic clutch winding 21 is connected through the third pair of circuit-opening contacts 37 and 38 to the remaining terminal of the third resistor 67 and to the grounded terminal of the power supply 66.

One terminal of a fifth relay winding 52 is

connected through a fourth switch 57 to the ungrounded terminal of the power supply 66. The remaining terminal of the fifth relay winding 52 is connected to one terminal of the fourth resistor 68 and to the armature contact 63 of the third relay 53. The remaining terminal of the fourth resistor 68 is connected to the grounded terminal of the power supply 66, and through the fourth pair of circuit-opening contacts 39 and 40 to one terminal of the second electromagnetic clutch winding 22. The remaining terminal of the electromagnetic clutch winding 22 is connected to the fifth commutator segment 35, and to a stationary contact 73 which is connected to the armature 63 when the third relay 53 is not energized. A second stationary contact 84, which connects to the armature contact 63 when the third relay 53 is energized, is connected to a terminal 69 provided for energization of an auxiliary load circuit, now shown.

The armature contact 62 of the fifth relay 52 is connected to the ungrounded terminal of the power supply 66. A stationary contact 72, which is connected to the armature contact 62 when the fifth relay is not energized, is connected to the armature contact 61 of the fourth relay 51. A stationary contact 71, which is connected to the armature contact 61 when the fourth relay 51 is not energized, is connected to the fourth commutator segment 34.

Operation

If the motor 1 is rotated in a clockwise direction when energized by the power source 66 and the first switch 59 is closed, current from the ungrounded terminal of the source of power 66 will pass through the first relay winding 55, the fourth electromagnetic clutch winding 24, and the second pair of contacts 49 and 50 to the grounded terminal of the power source 66. The energization of the fourth electromagnetic clutch winding 24 will provide, through the clutch faces 9 and 18, clockwise rotation of the fifth driven gear 28 and counter-clockwise rotation of the sixth driven gear 30 and the second work shaft 32. As soon as the switch 59 is closed, the first sliding contact 43 attached to the second work shaft 32 will rotate counter-clockwise with the shaft until it reaches the contact 49, thereby opening the circuit between the second pair of contacts 49 and 50. When the contacts 49 and 50 are opened, the resistor 70 provides a return path for the first relay 55 to the grounded terminal of the power source 66, while the fourth electromagnetic clutch winding 24 is deenergized, stopping the rotation of the second work shaft 32.

While the first switch 59 is closed, the energization of the first relay winding 55 opens the circuit between the armature 65 and the fixed contact 75 of the relay. When the first switch 59 is open, the circuit is closed between the contacts of the first relay 55, and the ungrounded terminal of the power source 66 is thereby connected through the contacts of the first and second relays to the first commutator segment 44. Since the first sliding contact 43 is in a counter-clockwise position, the first and third commutator faces 44 and 46 are thereby connected together, and current flows through the third electromagnetic clutch winding 23 and the closed first pair of contacts 47 and 48 to the grounded terminal of the power supply 66. The energization of the third electromagnetic clutch winding 23 will provide clockwise rotation of the second work shaft 32 until the first sliding contact 43, carried there-

by, reaches a neutral position between the second and third commutator faces 45 and 46, at which point the circuit is opened. Similar operation is provided by the second relay 54 for clockwise rotation of the second work shaft 32, and the return of the second work shaft 32 to its neutral position is accomplished through the second commutator segment 45 in the same manner as described heretofore for the third commutator segment 46.

If the third switch 56 is closed, current from the ungrounded terminal of the power supply 66 is connected through the third relay winding 53 and the fourth relay winding 51, to the sixth commutator segment 36, and to one terminal of the first electromagnetic clutch winding 21. The circuit is completed from the other terminal of the first electromagnetic clutch 21 through the third pair of contacts 37 and 38 to the grounded terminal of the power supply 66. The first work shaft 31 will be driven counter-clockwise when the first electromagnetic clutch winding 21 is energized, until the second sliding contact 33 opens the circuit between the third pair of contacts 37 and 38, at which time the first clutch is deenergized. The third resistor 67 then completes the circuit through the third and fourth relays 53 and 51 to the grounded terminal of the power supply 66. While the third switch 56 is closed, the armature 63 of the third relay 53 is connected to the second stationary contact 84, and the circuit between the contacts of the fourth relay 51 is opened. As soon as the third switch 56 is opened, the ungrounded terminal of the power supply is connected through the contacts of the fourth and fifth relays 51 and 52 to the fourth commutator segment 34. The second sliding contact 33, connected to the first work shaft 31, thereby completes the circuit between the fourth and fifth commutator segments 34 and 35, and energizes the second electromagnetic clutch winding 22 to provide clockwise rotation of the first work shaft 31 until the second sliding contact 33 reaches a neutral point between the fifth and sixth commutator segments 35 and 36.

Similarly, when the fourth switch 57 is closed, the second electromagnetic clutch winding 22 is energized, providing clockwise rotation of the first work shaft 31. The shaft will be returned to its neutral position after the fourth switch 57 is opened by means of the circuit provided by the slide contact 33 between the commutator segments 34 and 36.

If both the third and fourth switches 56 and 57 are closed simultaneously, an auxiliary circuit, connected between the terminal 60 and the grounded terminal of the power supply 66, will be completed through the contacts 63 and 84 of the relay 53, through the relay winding 52 and the fourth switch 57 to the ungrounded terminal of the power supply 66.

Thus, a system has been described which provides for selective rotation of two work shafts, in either direction and within predetermined angular limits, in which provision is included for disconnecting the mechanical drive when the limits are reached and restoring the work shafts to a neutral position after each operation of the remote control means. In addition, a simple circuit is included for energizing an auxiliary load circuit upon simultaneous operation of two otherwise independent circuits.

I claim as my invention:

1. A remote control system for controlling the angular displacement of a rotatable shaft, said

system including a motor, a first electromagnetic clutch, a second electromagnetic clutch, means including said first clutch and said motor for driving said shaft in a clockwise direction, means including said second clutch and said motor for driving said shaft in a counter-clockwise direction, means connected to said shaft for selectively deenergizing said clutches to limit the clockwise or counter-clockwise rotation of said shaft to a predetermined angle, and means for automatically restoring said shaft to a predetermined angular position after each angular displacement thereof.

2. A remote control system for controlling the angular displacement of a rotatable shaft, said system including a motor, a first electromagnetic clutch, a second electromagnetic clutch, means including said first clutch and said motor for driving said shaft in a clockwise direction, means including said second clutch and said motor for driving said shaft in a counter-clockwise direction, means connected to said shaft for selectively deenergizing said clutches to limit the clockwise or counter-clockwise rotation of said shaft to a predetermined angle, a first relay means connected to said first clutch for restoring said shaft to a predetermined angular position after each operation of said second clutch, and a second relay means connected to said second clutch for restoring said shaft to said predetermined position after each operation of said first clutch.

3. A remote control system for controlling the angular displacement of a rotatable shaft, said system including a motor, a first electromagnetic clutch, a first relay means connected to said clutch, a second electromagnetic clutch, a second relay means connected to said second clutch, means including said first clutch and said motor for rotating said shaft in one direction, means including said second clutch and said motor for rotating said shaft in another direction, contact means operated by said shaft for selectively deenergizing said clutches to limit the angular rotation of said shaft, means including said first relay means for restoring said shaft to a predetermined angular position after each operation of said first clutch, means including said second relay means for restoring said shaft to said predetermined position after each operation of said second clutch, a third relay means, a utilization circuit connected to said system, and means including said third relay means for energizing said utilization circuit upon simultaneous energization of said first and said second relay means.

4. A remote control system for controlling the angular displacement of a rotatable shaft, including a motor, a first electromagnetic clutch, a first relay means serially connected to said clutch, a second electromagnetic clutch, a second relay means serially connected to said second clutch, means including said first clutch and said motor for rotating said shaft in one direction, means including said second clutch and said motor for rotating said shaft in another direction, contact means including said shaft for selectively deenergizing said clutches to limit the angular rotation of said shaft, means including said first relay means for restoring said shaft to a predetermined angular position after each operation of said first clutch, means including said second relay means for restoring said shaft to said predetermined position after each operation of said second clutch, a third relay means, a utilization circuit, and means including said third relay means for energizing said utilization circuit upon simul-

taneous energization of said first and said second relay means.

5. A system of the type described in claim 4 including a first resistor and a second resistor, means connecting said first resistor in parallel with said first clutch and an operative portion of said contact means, and means connecting said second resistor in parallel with said second clutch and another operative portion of said contact means for maintaining said shaft at said angular rotational limit upon actuation of said contact means.

6. A remote control system for controlling the angular displacement of a rotatable shaft, said

system including a motor, a first clutch, a second clutch, means including said first clutch and said motor for driving said shaft in a clockwise direction, means including said second clutch and said motor for driving said shaft in a counter-clockwise direction, means connected to said shaft for selectively de-energizing said clutches to limit the clockwise or counter-clockwise rotation of said shaft to a predetermined angle, and means for automatically restoring said shaft to a predetermined angular position after each angular displacement thereof.

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