June 7, 1932. F. R. HOUSE 1,862,017

DISTANT CONTROL MECHANISM

Filed April 26, 1929

Fig. 2.

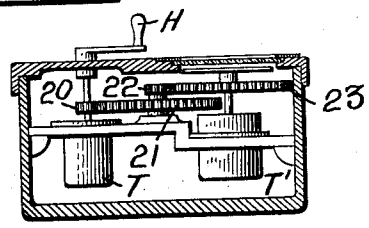


Fig. 1.

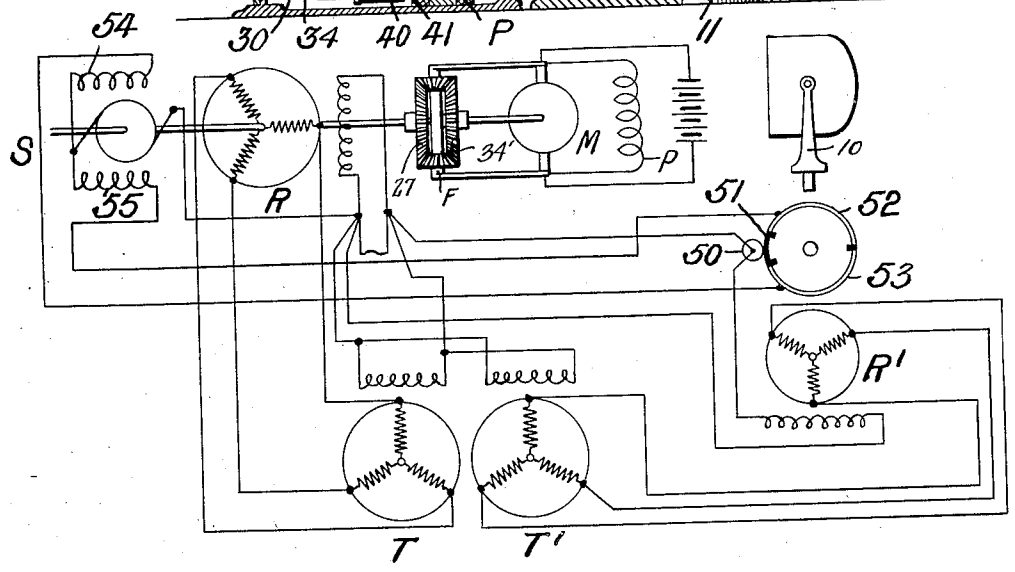


Fig. 3.

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Patented June 7, 1932 1,862,017

UNITED STATES PATENT OFFICE

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DISTANT CONTROL MECHANISM

Application filed April 26, 1929. Serial No. 358,209.

This invention relates to the distant control of the movements of objects, especially heavy objects such as searchlights, guns and similar apparatus and devices. It is one of the objects of my invention to provide a distant control means which shall be capable of actuating the object to be moved from a distance so that said object shall respond immediately to any desired amount and rate of movement and which shall be capable of operating through very small angular distances in spite of the size or weight of the object.

It is a further object of this invention to provide an automatic torque regulator, that is to say, a device wherein the necessary torque for moving a load or object is automatically varied in accordance with the load. Heretofore, motors for moving objects, such as searchlights and guns, have been employed, each operating on the potentiometer system or some familiar system for impressing a given torque upon said motor, and said torque remained constant so that at the beginning of moving the object the speed of said object picked up very slowly but once the static inertia was overcome the motor raced ahead unless the voltage across the fields was varied. In my invention I provide means whereby the torque generated by the motor automatically accommodates itself to the load to be overcome.

A further object of my invention is the provision of a motor capable of automatically varying its torque output in accordance with the load requirements as hereinbefore described and which can be reversed without requiring complicated mechanism in its structure for effecting such reversal.

A further object of my invention is the provision of a self-synchronous transmission system which will always maintain synchronism, or if such synchronism is temporarily destroyed, will automatically reestablish the synchronous relation.

Further objects of my invention will become apparent in the following detailed description thereof.

In the accompanying drawing,

Fig. 1 is a vertical section through the receiving end of one form of my invention as applied to moving a searchlight.

Fig. 2 is a vertical section through a transmitter for operating the receiver of Fig. 1.

Fig. 3 is a wiring diagram showng the inter-connections between the transmitter and receiver of Figs. 1 and 2.

Referring to the drawing, it will be observed that I have illustrated my invention in connection with the operation of a searchlight 10 in azimuth. Said searchlight is mounted for rotation about a vertical spindle 11 by means of an annular rack 12 engaging a pinion 13 and driven from the armature 14 of motor M through any suitable gearing, such as worm 15 and wormwheel 16, as shown.

The motor M is of a novel type wherein the torque output thereof may be varied as desired. To accomplish this purpose I provide brushes B mounted in a movable frame F rotatable about the axis of the armature and engaging the commutator C fixed to said armature. The current entering the armature through the brushes divides in two opposite directions yielding opposite reactions between the armature and the field poles. If the brushes are in the plane of the field poles, that is, in the magnetic field established between the field poles, the division of the current is equal and opposite with respect to said field and hence the reactions between the armature and field poles are equal and opposite so that no movement is imparted to the armature. As the brushes are rotated, the division of current from the brushes becomes greater on one side of said field than the other, resulting in greater reaction between the armature and field on one side than the other, and hence yielding low torque and slow movement of the object in a given direction depending upon the direction of rotation of the brushes. Further rotation of the brushes in the same direction yields correspondingly greater torque until when the brushes are so positioned that the current through the armature divides at a point mid-way between two adjacent field poles the greatest torque is obtained. In general, therefore, the brushes are made rotatable within a maximum angle contained between a field pole and the ad-

jacent pole on either side thereof, which, in the case here shown, where but two field poles are employed is 180° on either side; and the maximum torque is obtained at a point substantially mid-way between the adjacent field poles, which, in the present case, is 90°. By rotating the brushes in the opposite direction, the torque may be diminished to zero and by passing beyond the plane of the field poles in the opposite direction the direction of rotation of the armature may be reserved. This construction is of great importance since it enables a large torque to be delivered when the load is great or in starting, and a much less torque when the object is set in motion or when the load is comparatively small. It enables the motor to be reversed without change of connections.

I provide the following self-synchronous means for controlling the operation of the motor M from a distance. This means may take the form of a pair of transmitters T, T′ constituting respectively fine and coarse transmitters and actuated through a handle H. As shown, one revolution of handle H accomplishes one revolution of transmitter T and through the gearing 20 to 23 inclusive rotates the transmitter T′ through much fewer turns and hence transmits a coarser movement. Said transmitters T and T′ control fine and coarse repeaters R and R′ respectively, the said repeaters being self-synchronous with their transmitters. Such self-synchronism may be D. C. or, as shown, A. C. transmission systems, such that one revolution of the transmitters accomplishes one revolution of the repeaters. I control the motor M normally through the fine repeater R by means of gearing, such as 25, 26, 27, operating the frame F through differential gearing 34, to displace the brushes B on the commutator C and thus generate a torque to move the searchlight 10. Said differential is shown as including said gear 27 as one arm thereof, gear 34′ as the opposite arm, and inter-meshing pinions 34 as the planetary arm, both of said pinions being mounted on the frame F which carries the brushes. Said pinions 34 not only mesh with each other but one meshes with the gear 34′ and the other with the gear 27. The motor M operates through an extension 30 of its shaft pinions 31 and 32 and internal gear 33, the other arm 34′ of said differential 34 to rotate the frame F in the reverse direction, which thus acts as a follow-up.

If the load upon the motor M is too great, as in starting for instance, the repeater R will displace the brushes B until they are in their maximum position, that is, 90° displaced from their original zero torque position, in which position a pin 40 will engage a stop 41. This is due to the lag of the motor and hence its inability to follow up the movements of the brushes. Thereafter further rotation of handle H and actuation of transmitter T will not produce any further rotation of repeater motor R, since such movement is prevented by said pin and stop. It is apparent that any further rotation of handle H at this time will mean loss of synchronism between the transmitter T and the repeater R, since said transmitter and receiver are synchronous only within a single revolution. To prevent permanent loss of synchronism and to bring the repeater R back into synchronism with transmitter T, I provide the following mechanism. The coarse transmitter T′ continues to actuate the coarse transmitter R′ and the gearing between handle H and transmitter T′ is such that one revolution of transmitter T′ corresponds to one revolution of the searchlight 10. The field structure of said repeater motor R′ is mounted directly on the rotatable base 10 of the searchlight while the armature of said motor carries a trolley 50 which normally operates upon an insulated segment 51 having a predetermined width and positioned between the live segments 52—53, all of which are mounted on the upper end of the stationary central spindle 11 on which the searchlight is rotatably mounted. The width of the insulated segment 51 corresponds to that degree of movement of the searchlight imparted thereto by one rotation of handle H causing one rotation of receiver R. From this it is apparent that when receiver R falls behind transmitter T more than one revolution, trolley 50 which stands still in space as long as synchronism is maintained by reason of the armature being reversely connected to its transmitter will leave insulated segment 51 and engage live contact segments 52—53 which control the respective fields 54—55 of a reversible synchronizing motor S geared through the same gearing 25 to 27 to the frame F and brushes B. So that, when the repeater R falls out of synchronism with transmitter T one revolution or more, synchronizing motor S takes control to hold the brushes in the maximum torque position until the motor has moved the object sufficiently so that trolley 50 again rests upon insulated segment 51. This is accomplished by reason of the fact that insulated segment 51 and contact segments 52—53 are stationary, while the trolley 50 and repeater motor R′ rotate with the searchlight in a direction to return trolley 50 to the insulated segment 51. As soon as trolley 50 is again upon insulated segment 51 the repeater motor R is less than one revolution out of synchronism with transmitter T, the synchronizing motor S is deenergized and repeater motor R is again in control of the movements of brushes B.

It will be seen that the above synchronizing mechanism operates not only when repeater motor R loses synchronism by one

revolution or more with transmitter T due to lag of the object to be moved, but will also reestablish synchronism in the case where during the time that the current is off the object to be moved has been turned through an angle in excess of the angular distance allowed by insulated segment 51. If this has taken place while the current is turned off, then trolley 50 has engaged segment 52 or 53, and when the current is turned on it will be seen that synchronizing motor S will immediately have control to keep the brushes B in the hard-over position until the object has been rotated to such position that trolley 50 engages insulated segment 51, in which position repeater motor R is less than one revolution out of synchronism with transmitter T and again takes control of the brushes.

To sum up the action of this synchronizing mechanism, therefore, it may be stated that when the receiving apparatus falls out of synchronism with the transmitting apparatus by more than a predetermined amount, synchronizing means are brought into operation to restore synchronism within the said predetermined limits. During normal movements, however, the fine, self-synchronous motor R alone will control the brush displacement of the power motor and will do so at a rate corresponding to the rate of rotation of the control hand-wheel H. A soft action control of the motor is thus made possible during normal operation.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a self-synchronous remote control system for turning heavy objects, a reversible power motor for supplying the torque to turn the objects, a fine synchronous motor for normally governing the direction and torque of said power motor, a coarse self-synchronous motor connected to said object, an auxiliary normally inoperative power motor connected to the fine motor for counter-acting said fine motor, and means brought into action when the angle between said coarse motor and object exceeds a predetermined amount for operating said auxiliary power motor to cause actuation of said first-named power motor until substantial synchronism is restored within the limits of synchronism of said fine motor.

2. In a self-synchronous remote control system for turning heavy objects, a reversible power motor for supplying the torque to turn the objects, a fine synchronous motor, differential means for shifting the brushes of said power motor governed by said fine and power motors, a coarse self-synchronous motor connected to said object, a second normally inoperative power motor for counter-acting said fine motor, and means brought into action when the angle between said coarse motor and object exceeds a predetermined amount for operating said second power motor to restore synchronism.

3. In combination, a power motor for driving an object, said motor having field poles, an armature, a commutator, and brushes rotatably adjustable on said commutator to control the speed, torque, and direction thereof, means for controlling said motor from a distance, said last-named means comprising transmitting means, receiving means actuated by said transmitting means and connected to said brushes, auxiliary power means for operating said brushes, and means to render said power means effective when said receiving means falls out of synchronism with said transmitting means to a predetermined degree.

4. In combination, a power motor for driving an object, said motor having field poles, an armature, and a commutator relatively rotatable with respect to said poles, and brushes relatively adjustable with respect to said poles on said commutator to control the speed, torque, and direction of the motor, means for controlling said motor from a distance, said last-named means comprising fine and coarse transmitters, fine and coarse repeater motors actuated by said transmitters, and means for controlling said brushes from said coarse repeater motor within a predetermined degree of synchronism between said transmitters and said repeater motors.

5. In combination, a power motor for driving an object, said motor having field poles, an armature, a commutator, and brushes rotatably adjustable on said commutator to control the speed, torque, and direction thereof, means for controlling said motor from a distance, said last-named means comprising fine and coarse transmitters, fine and coarse repeater motors actuated by said transmitters, means for normally actuating said brushes from said fine repeater motor, an auxiliary power motor adapted to be controlled from said coarse motor and connected to said brushes, and means for bringing said auxiliary power motor into action when said brushes fall out of synchronism with the sending transmitters more than a predetermined degree.

6. In combination, a power motor for driving an object, said motor having field poles, an armature, a commutator, and brushes rotatably adjustable on said commutator to control the speed, torque, and direction thereof, means for controlling said motor from a distance, said last-named means comprising fine and coarse transmitters, fine and coarse repeater motors actuated by said transmitters, means for actuating said brushes from said fine repeater motor within a predetermined degree of loss of synchronism, and means for causing said coarse repeater motor to control said brushes when said limit is exceeded, including a power means and a two part controller for said power means, one part being actuated by said coarse repeater motor and the other part by said brushes.

In testimony whereof I have affixed my signature.

FRANK R. HOUSE.