No. 848,988. PATENTED APR. 2, 1907.

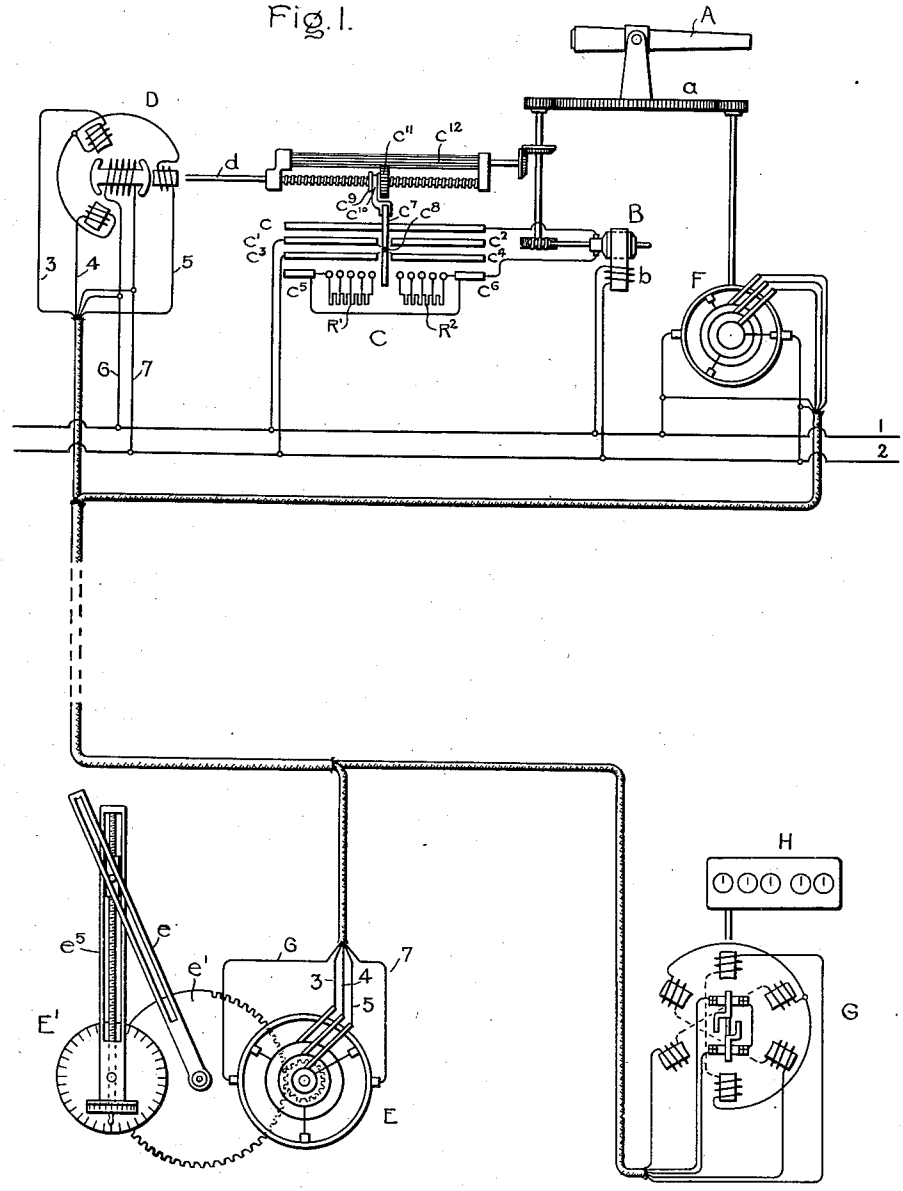
J. L. HALL.

SYSTEM OF GUN CONTROL.

APPLICATION FILED NOV. 28, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

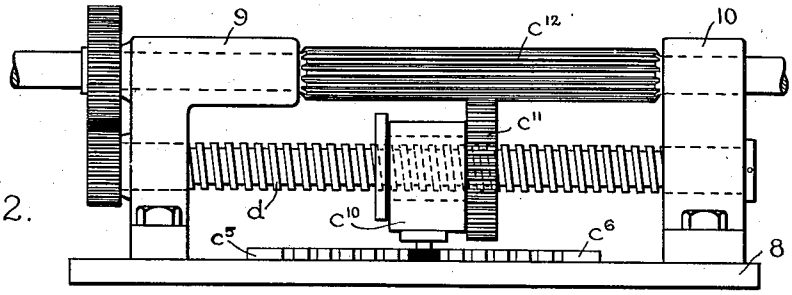


Fig. 3.

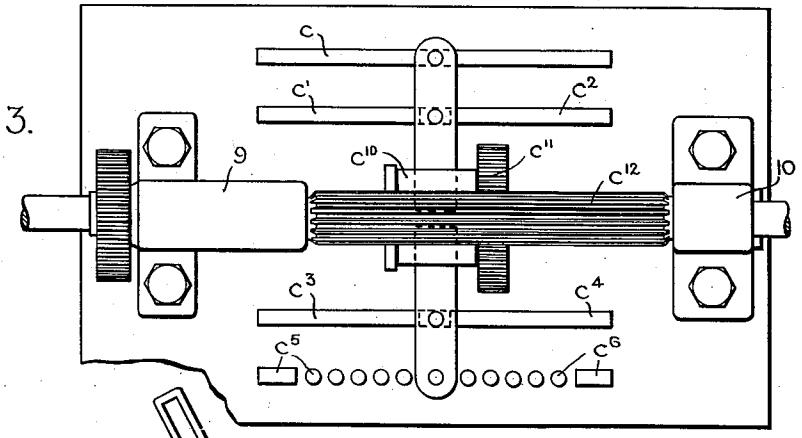


Fig. 4.

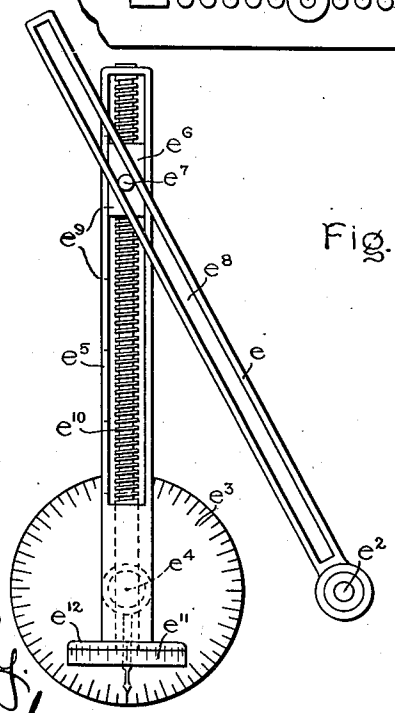
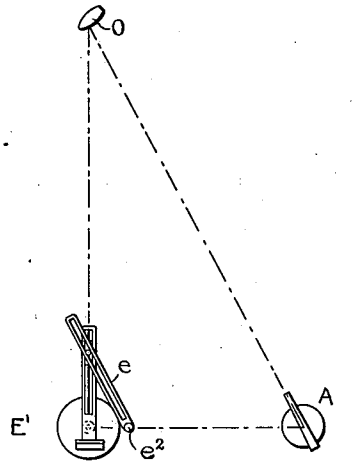


Fig. 5.



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UNITED STATES PATENT OFFICE.

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SYSTEM OF GUN-CONTROL.

No. 848,988. Specification of Letters Patent. Patented April 2, 1907.

Application filed November 28, 1904. Serial No. 234,469.

To all whom it may concern:

Be it known that I, JOHN L. HALL, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Systems of Gun Control, of which the following is a specification.

The present invention relates to systems for operating and controlling guns or similar mechanism, and particularly to systems of remote control for the same.

It is now the practice to determine at a range-finding station the range of the ship or other object at which it is desired to fire and to telephone or otherwise communicate the range to the control-stations adjacent the gun or guns of a battery or batteries. Not only must the range be communicated to the control-stations from the distant range-finding stations, but the orders for firing any particular gun or guns must also be transmitted from the battery-commander's station to the man in charge of each gun. It is evident that in the confusion of actual warfare there is danger of misunderstanding telephonic or other communications, necessitating, perhaps, series delays or causing orders to be executed improperly. The guns must be directed to fire from points within the zone of operation of opposing guns, and where the number of guns is large it is difficult to control them perfectly, so as to secure the most rapid and efficient operation and coöperation of all of the guns.

The object of the present invention is to provide means for rapidly and accurately positioning a gun or other object from a remote station.

A further object of the present invention consists in a peculiar construction and organization of parts constituting a system of remote control for a motor or an electric circuit.

Further objects of the present invention will appear in connection with the following description of one embodiment thereof, which is illustrated in the accompanying drawings, wherein—

Figure 1 represents diagrammatically a gun and means for controlling the gun from a remote point in accordance with the present invention. Figs. 2 and 3 are detail views of a motor-controller employed in connection with the present invention. Fig. 4 is a detail of the master controlling element whereby the position of the gun is determined. Fig. 5 is a diagram illustrating the operation of the present invention.

Similar reference characters will be used throughout the specification to indicate corresponding parts.

The present invention comprises a gun and operating means therefor, with controlling mechanism for the operating means comprising an arm arranged to be adjusted parallel to the line connecting the gun and target, with apparatus for causing the gun to be moved into parallelism with the arm. The arm is preferably associated with a master-controller at a remote point, and a motor-controller is provided near the gun and is arranged to be controlled by the master-controller.

In the embodiment of the invention illustrated the motor-controller is of the "hunting" type, being caused to move to definite running positions from a distant station and returned to its "off" position by the gun-carriage or other object being moved. The position to which the motor-controller is caused to move from its off position determines the angle through which the gun may move before it is brought to rest by reason of the interruption of the circuit of its propelling-motor upon the return of the motor-controller to its off position.

Reference being had to the drawings, A represents the gun, and *a* the gun-carriage.

B is a motor for driving the gun-carriage through any suitable connecting medium. The field *b* of the motor is connected directly across lines 1 and 2, which are respectively the positive and negative leads from a source of current-supply. The motor is controlled by regulating the strength and direction of current-flow through its armature.

C is the motor-controller, which consists, preferably, of a series of fixed contacts, some of which are associated with resistance-sections, a movable contact-arm, and means for moving the arm. The fixed contacts of the controller comprise an elongated strip *c* and two shorter sets of strips c' c^3 and c^2 c^4, together with the resistance-controlling contacts c^5 and c^6. The contact *c* extends

throughout the length of the controller, while the remaining contacts do not cross the center of the controller, thereby leaving a space at the center in which there is no electrical connection between the fixed contacts and the movable contacts carried by the arm c^7, except at contact c. c' and c^4 are connected together, as are also contacts c^3 and c^2. The arm c^7 is divided into two portions insulated from each other by a piece of insulation c^8 or is otherwise arranged so that it serves to connect together c and c' or c^2 and c^3 and c^5 or c^4 and c^6. Contacts c' and c^3 are connected to lines 1 and 2, respectively, while contacts c, c^5, and c^6 are connected to the brushes of the motor. When the movable contact-arm c^7 is in the position shown in Fig. 1, the circuit through the armature of the motor is broken. If, however, this arm is moved to the left, engaging with contacts c', c^3, and c^5, current will pass from line 1 to contact c', to contact c, armature of motor B, contact c^5, contact c^3, to line 2. On the other hand, if arm c^7 is moved to the right, the direction in which current passes through the motor-armature is reversed, since contact c will now be connected to line 2 instead of to line 1, as before. Contacts c^5 and c^6 include each a series of contacts connected to points in resistances R′ and R², respectively, whereby when the controller is moved to its first running position to the right or to the left of its off position one or the other of the resistances R′ or R² will be in series with the armature, this resistance being subsequently cut out step by step as the movable element of the controller passes over the contacts. Only a small number of resistance-controlling contacts are illustrated; but it is evident that this number may be increased to any desired extent without changing the principle or mode of operation of the controller.

The arm c^7 is moved in one direction by means of the synchronous motor D, which drives the screw-shaft d, the screw-shaft being in turn threaded into a sleeve c^9, revolubly supported within the hub c^{10} of the controller-arm. The sleeve c^9 is provided with a pinion c^{11}, which meshes with an elongated complementary pinion c^{12}, geared to the gun-carriage. When the synchronous motor is operated to drive the screw-threaded shaft, the elongated pinion c^{12} is held stationary by means of its connection with the gun-carriage, thereby preventing the pinion c^{11} from rotating and causing it and the controller-arm to move along the screw-threaded shaft. When the motor B starts and the synchronous motor stops, the screw-threaded shaft d remains stationary, and the pinion c^{12} is rotated, rotating the pinion c^{11} and causing it to move backward along the shaft until the movable arm reaches its off position, whereupon the motor-circuit will be broken and the gun-carriage stopped. It is evident that by properly proportioning the gearing between the motor-controller and the synchronous motor and between the motor-controller and the gun-carriage and by providing means for rotating the synchronous motor definite amounts the gun may be brought to any desired position and caused to automatically stop itself in that position. By employing a controller of the type illustrated the gun is gradually retarded as it approaches the desired point by reason of the reinsertion of the resistance in the motor-circuit as the controller is returned to its off position, thereby permitting great accuracy to be obtained in training the gun.

Means including a commutating device E is provided at the remote control-station for delicately controlling the synchronous motor. The synchronous motor and the commutating device are illustrated diagrammatically in conventional forms, since they may be of any suitable types, it being only necessary that the synchronous motor be powerful enough to operate the screw-shaft properly. Reference may be had to my Patent No. 706,554, granted August 12, 1902, for a complete description of a commutating device and synchronous motor. The commutating device is connected to the synchronous motor by means of wires 3, 4, and 5, the opposite ends of which are secured, respectively, to the stationary member of the motor and the movable member of the commutating device. The movable member of the motor and the stationary member of the commutating device are connected directly to lines 1 and 2 by means of wires 6 and 7 in the usual manner. It is evident that upon turning the commutating device through a definite angle the synchronous motor will move through a similar angle, operating the screw-shaft d a predetermined amount. The commutating device may be operated in any suitable manner, as by means of an indicating-handle of some sort, which is moved to a predetermined point in order to cause the gun to assume a definite position. A preferred form of mechanism for operating the commutating device in order to train the gun with great accuracy is illustrated, although the present invention is not limited to this particular form. Reference being had to Fig. 5, A and E′ represent, respectively, the gun and the operating mechanism for the commutating device, while O indicates the object at which it is desired to fire. Since the commutating device and the gun may be so placed that their distance apart is accurately known, it is possible to point the gun accurately by means of a system of similar triangles, of one of which the gun, the operating mechanism for the commutating device, and the object to be fired at form the apexes and of the other of which portions of the commutating-device-actuating mechanism form the sides.

To this end the actuating mechanism E′ comprises an arm e, geared to the movable element of the commutating device by means of gearing e' and swinging about a fixed pivot e^2, and an arm e^5, carrying a sliding block e^6 and pivotally supported at the center e^4 of a dial e^3. It will of course be understood that the gearing between the commutating device and the arm e is such that the commutating device and the synchronous motor are responsive to slight movements of the arm. A pin e^7, projecting from the sliding block, engages within a slot e^8 in the arm e. The pivotal point e^2 of the arm e is located at some distance from the center of the dial e^3. Along the arm e^5 there is placed a series of graduations e^9, which represent yards or any other absolute dimension upon the same scale that the distance between the points e^2 e^4 represents the distance between the gun and the point e^4. If now, the range of the object being determined, the sliding block is moved along the arm e^5 to the proper range and the arm e^5 is turned so as to point at the object, then the arm e will be parallel to a line drawn from the center of the gun to the object. The arrangement of parts is such that when the arm e occupies any given position the gun will be rotated until brought into parallelism therewith. The dial e^3 is graduated, so that the arm e^5 may be positioned with great accuracy. Furthermore, in order to move the sliding block e^7 there is provided a screw e^{10}, which engages with threads upon the interior of the sliding block and which is provided at its outer end with a dial e^{11}, which, together with a disk e^{12}, fixed to the end of the arm, forms a vernier whereby the sliding block may be accurately adjusted.

In operation it is simply necessary to direct the arm e^5 toward the object, either by means of a telescope or other sighting arrangement upon the arm, or if the location of the object does not permit such sighting then by means of the graduated dial, and then to move the sliding block to the proper range. The arm e is thus brought parallel to the line connecting the object and gun, moving the motor-controller to the proper point and causing the operating-motor to set the gun-carriage in motion in the proper direction. As the gun-carriage revolves it moves the motor-controller backwardly, cutting resistance into the motor-circuit, and thereby slowing down the motor as the gun approaches the desired position. Any suitable auxiliary means may be provided for positively stopping the gun-carriage when the motor-controller has been returned to its off position—such, for instance, as is illustrated in my Patent No. 798,335, granted to me August 29, 1905.

If desired, a second commutating device F may be geared to the gun-carriage, the commutating device being in turn connected to and controlling a synchronous motor G at the control-station, whereby as the gun revolves its changing positions are indicated to the operator. If desired, the synchronous motor G may operate indicating mechanism H, which contains a number of dials for registering the position of the gun in degrees, minutes, seconds, and fractions of a second.

The construction of the motor-controller is shown in Figs. 2 and 3. The fixed contacts c–c^6 are mounted upon a slab of insulating material 8, which also carries brackets 9 and 10, within which gear c^{12} and the screw-shaft d are revolubly supported. The screw-shaft may be geared to the shaft d', driven by the synchronous motor D, as at 11. The gearing between the screw-shaft and the motor depends entirely on the particular construction of motor and commutating device employed. If the synchronous motor is adapted to make a single revolution or less for causing the gun to turn to an extreme position, then the screw-shaft must be geared to the motor in such a manner that it makes enough revolutions during one revolution or less of the motor to move the controller to an extreme running position. On the other hand, the synchronous motor may be connected directly to the screw-shaft and be constructed and arranged to revolve a number of times in order to move the controller to an extreme or to an intermediate running position.

For elevating the gun the controlling means disclosed in my aforesaid application may be employed or else means similar to that herein used to train the gun upon the proper azimuth. In the latter case the member corresponding to arm e^5 may be fixed and represent any base-line, the angle between the arms e and e^5 determining the angle of elevation of the gun.

While I have described the present invention in detail, it is not limited to the particular embodiment illustrated and described, except to the extent indicated in the appended claims, since in its broader aspects it may be embodied in various forms.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a system of gun control, a gun and operating means therefor, and controlling mechanism for said operating means including an arm in the control-station and apparatus for causing the gun to be moved into parallelism with said arm together with means for adjusting said arm parallel to the line connecting the gun and target.

2. Means for training a gun or other apparatus upon any desired point, which comprises operating means including an arm and mechanism for causing the gun to be moved into parallelism with said arm, together with means for adjusting said arm parallel to the line connecting the gun and said point, when

the distance between the point and the gun and the direction of the point from the arm are known.

3. In a system of gun control, a gun and operating means therefor, controlling mechanism for said operating means including an arm in a remote control-station and apparatus for causing the gun to be moved into parallelism with the arm, and means for adjusting the arm in the remote station into parallelism with a line connecting the gun and any desired point when the distance of the point from the gun and the direction of the point with relation to the remote station are known.

4. In a system of gun control, a gun, an operating-motor, a master-controller including an operating-arm and means for bringing said arm into parallelism with the line along which the gun is to be trained, means controlled by said master-controller for bringing said gun into parallelism with said arm, and means controlled by said gun for stopping the gun when it reaches the position in which it is parallel with said arm.

In witness whereof I have hereunto set my hand this 25th day of November, 1904.

JOHN L. HALL.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.