

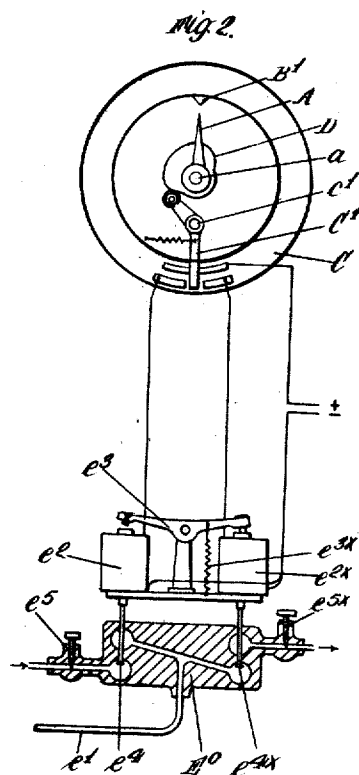
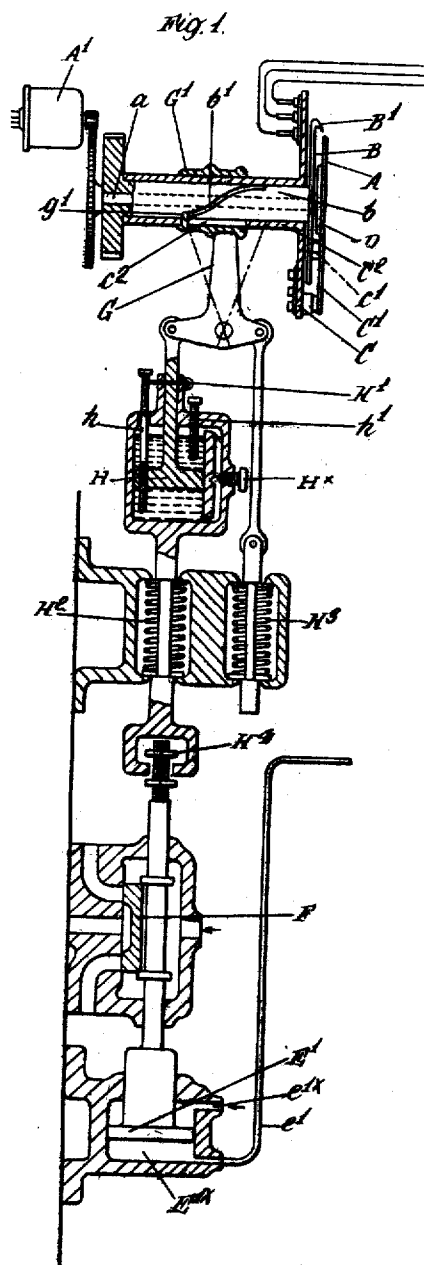
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CONTROL SYSTEM FOR GUN MOUNTING AND OTHER MECHANISM

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UNITED STATES PATENT OFFICE.

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CONTROL SYSTEM FOR GUN MOUNTING AND OTHER MECHANISM.

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To all whom it may concern:

Be it known that I, ARTHUR LEONARD PERHAM, a subject of the King of Great Britain, residing at Vickers House, Broadway, Westminster, in the county of London, England, have invented certain new and useful Improvements in or Relating to Control Systems for Gun Mounting and Other Mechanism, of which the following is a specification.

This invention relates to control systems for gun mountings and other mechanism particularly to systems of pointing ordnance in which the gun or guns are controlled in elevation or training, or in both elevation and training, from a sighting or controlling element arranged at a distant (or central) station and in which there is employed a receiving or indicating member or pointer driven by electrical means in synchronism with the vertical or horizontal movements of the distant sighting or controlling element; the said member or pointer is preferably arranged to rotate about the same axis as a follower member or pointer driven mechanically through multiplying gearing from the gun.

The gun is fitted with some form of motor for elevating or training (such motor being preferably hydraulic or being constituted by the motor unit of an hydraulic transmission device of the Janney type as this allows of exact adjustment of speed control) and power operated means are arranged to actuate the lever, valve or other device for controlling the speed and direction of movement of the elevating or training motor, these means being hereinafter referred to as the relay. This relay may be of any convenient type and is preferably arranged to be brought into operation by electro-magnetic means under the control of a switch, so that when the arm of this switch is displaced to one side or the other of its central position, a corresponding movement of the relay in one or other direction takes place, thus operating the control device of the elevating or training motor. The switch controlling the relay is arranged to be itself brought into action whenever the receiving and follower members are out of alignment. Instead of an electrical switch, a mechanical device having similar characteristics of bringing the relay into operation and cutting it out of operation may be used and the term "switch"

is intended to include this and similar arrangements.

The chief object of the present invention is to devise a control system which is simpler in construction and operation than that forming the subject of the prior English Patent No. 16295 of 1911 and in which, in particular, the receiving member is purely rotary and does not require to move axially to perform its proper function.

The switch is so constructed and arranged that when relative displacement occurs between the said receiving and follower members and the switch is actuated in consequence, the resulting movement of the relay will act upon the switch so as to stop the relay's own movement, the arrangement being such that the greater the relative displacement between the receiving and follower members, the greater distance must the relay travel in order to open the switch, and according to the present invention we provide means whereby the ratio of relay movement to relative displacement between the receiving and follower members decreases as the latter increases. Accordingly we preferably arrange that the movable switch arm shall be controlled by a cam the movement derived from which varies with the amount of the relative displacement between the receiving and follower members.

The action of the apparatus is that the gun always follows behind the receiving member if the latter is in motion, the gun slowing up and stopping in line with this member when the latter stops. This effect is desirable when it is intended to stop elevating or training the gun at or about the moment of firing. But in some cases, particularly with guns mounted on land, it may be desirable that at all speeds of elevating and training, the receiving and follower members shall always be in exact alignment, and in this case we slightly modify the construction of the apparatus to secure absence of angular lag; the means employed for obtaining this effect may comprise a dash-pot device which is preferably capable of being put out of use when desired or of being employed only with those speeds of elevating and training at which continuous aiming is practicable. We may also employ a lost motion coupling in the connections between the relay and the switch so as to provide against lag occurring by reason of the lap

of the elevating or training control valve in cases where hydraulic power is used.

In order that the said invention may be clearly understood and readily carried into effect the same will be more fully described with reference to the accompanying drawings in which:—

Figure 1 is a sectional view of apparatus constructed in accordance with the invention, the relay control element being omitted from this figure, and

Figure 2 is a view showing the said relay control element and also shewing the front view of the receiving and follower members and the cam actuated switch arm together with the switch and its contacts.

It will be assumed that the apparatus shewn is intended for controlling the training of the gun and will be described in this connection, it being understood however that the said apparatus is also applicable to the elevation control and also to the control of searchlights, range finders and other apparatus.

A is the receiving or indicating member in the form of a pointer mounted on a spindle *a* which is geared to a step-by-step electric motor A'. This motor is operated from the distant sighting or controlling station in accordance with the angle of training to be given to the gun. B is the follower member in the form of a disc mounted on a shaft *b* which surrounds the spindle *a* and is driven through multiplying gearing from a training part of the gun. This disc has an index mark or pointer B' which is brought or maintained opposite the pointer A by training the gun. C is the switch, C' is the switch arm which is pivoted at *c'* to the disc B and D is the cam which operates upon the switch arm and is in contact with pointer A.

In the construction shown the control valve E of the training motor is connected to a relay piston E' working, in a cylinder E'' one end of which is in constant communication with pressure fluid through a port *e''* and the other end of which is connected to a pipe *e'* leading to a valve chamber E⁰. The relay control element comprises two electro-magnets *e*², *e*^{2x} which are electrically connected to the contacts on the switch C and the armature *e*³ of which operates upon one or the other of two valves *e*⁴, *e*^{4x} controlling the supply and exhaust of pressure fluid to and from the relay cylinder E'' through the pipe *e'*, the arrangement being such that when the switch arm C' moves in one direction the valve *e*⁴ will be moved from its seat to admit pressure fluid to the relay cylinder E'' and when the said switch arm moves in the other direction the valve *e*^{4x} will be moved from its seat to exhaust pressure fluid from the relay cylinder, the valve E being displaced ac-

cordingly in one direction or the other. The stems of the valves *e*⁴, *e*^{4x} pass through the cores of the electro-magnets *e*², *e*^{2x} in order that the armature *e*³ may operate them, and adjustable needle valves *e*⁵, *e*^{5x} are provided for adjusting the rate of movement of the relay piston E'. A spring *e*^{6x} operating on one of the limbs of the armature *e*³ serves to prevent the armature from remaining in a balanced position when both the magnets are energized this being a condition which occurs when two pairs of indicating and follower members (one pair moving at a greater speed than the other) are used instead of one pair as is described in the specification of the aforesaid prior patent.

The cam D that operates the switch arm C' is so formed that the movement of the switch arm is not in direct proportion to the movement of the pointer A and to facilitate as far as possible the experimental work of obtaining a suitable cam shape we make the cam readily detachable and cut it from a sheet of thin stiff material such as metal or fibre so that different profiles of cam can quickly and cheaply be cut out and tried.

The relay piston E' may be directly connected to a bell-crank lever G (although in the example shown it is indirectly connected thereto through mechanism which will be hereinafter described) which operates upon a collar G' having a pin *g'* engaging in a curved slot *b'* in the aforesaid shaft *b* of the disc B and also engaging in a straight slot *c*² in a sleeve C² which is connected to the switch C and is interposed between the collar G' and the shaft *b*. This is the arrangement whereby the relay acts upon the switch C to break the circuit through the electro-magnets *e*², *e*^{2x} in order to stop the movement of the relay.

In the example shown there is a dash-pot H in the connections between the relay piston E' and the bell-crank lever G for the purpose of preventing angular lag between the gun and the pointer A as aforesaid. The stroke of the dash-pot may be limited by adjustable stops *h*, *h'* on the piston and cylinder and a pin H' is provided for connecting the piston rod to the cylinder when it is desired to place the dash-pot out of action and obtain the said angular lag. An adjustable screw H^x is provided on the dash-pot to control the rate of leakage of the fluid from one side of the piston to the other. The cylinder is controlled by a spring H² and the bell-crank lever G is under the control of a centering spring H³ which is weaker than the spring H².

In order to provide against lag occurring by reason of the lap of the control valve E as aforesaid, an adjustable lost-motion coupling H⁴ is provided between the stem of the valve E and a part connected to the cylinder of the dash-pot.

The operation of the apparatus is as follows: Assuming the receiving pointer A to move to the left (Figure 2) the cam D carried by this pointer operates the switch arm C' and moves it on to the right hand contact strip of the switch C. The valve e^* of the relay controlling mechanism is thereby opened and the lower part of the relay cylinder E' thereby placed to exhaust. The relay piston E' is thus moved downwards under the influence of constant pressure in the upper part of the cylinder E' and the control valve E is consequently opened to operate the prime mover which drives the disc B so as to cause the mark B' to follow the movement of the receiving pointer A. The switch C is carried round with the disc B as is also the switch arm C', but in order to stop the movement of the relay piston E' the latter operates through the pin g' and the slots c^2, b' to displace the switch C relatively to the disc B so as to bring the latter to the neutral position in which the switch arm C' lies between the two contact strips of the switch and so brings the relay to rest, in which condition the said disc, switch and switch arm continue to rotate so long as the pointer A is moving. If there is a rigid connection between the parts E' and G (i. e., if the aforesaid dash-pot H is put out of action), the pointer A will be continually in advance of the mark B'. When the pointer A stops moving the disc B continues to move for a time and in so doing the switch arm C' is moved on to the left hand contact strip of the switch C and the relay piston E' is therefore moved in the reverse direction to that mentioned above and the control valve E thereby moved towards the closed position during which time the switch C is also moved in the reverse direction to that mentioned above and the control valve therefore brought to rest in the closed position with the pointer A opposite the mark B'.

If the switch arm C' were rigidly connected to the pointer A the amount by which it would always move away from the neutral point of the switch C and therefore the amount of movement given to the relay piston E' and the control valve E would be in exact proportion to the relative displacement between the pointer A and the mark B', which is not only unnecessary but results in an undesirable lapse of time before the prime mover is brought to rest when the pointer A stops moving; to hasten the cutting-off movement of the valve when the pointer A stops, the aforesaid cam D is introduced for operating the switch arm C' and is so formed that the latter instead of moving in exact proportion to the relative movement between the pointer A and the mark B' as mentioned above is given a reduced movement so that the ratio of relay

movement to relative displacement between the receiving and follower member (viz, the pointer A and the disc B) decreases as the latter increases.

When the dash-pot H is in use the operation is modified in the following respect, it being understood that the action of the cam D, the switch arm C' and the switch C is exactly the same as that described above. With the dash-pot in use it will be evident that there is a movement of the relay piston E' which is not transmitted through the pin g' and the slots c^2, b' to the switch C with the result that a lag is introduced which permits the switch C to move with the disc B further than it otherwise would have done and this results in the mark B' being permitted to catch up with the pointer A before the switch C has been returned to the cut off position and the relay thereby brought to rest with the control valve E open. The parts B, C, C' and D then continue to rotate in exactly the relative position shown in Figure 2 and when the pointer A stops the mark B' overruns it and reversal has to take place in order to restore alignment.

The lost motion device H' is for the purpose of permitting a small initial and final movement of the relay piston E' to occur in order to take up the lap of the control valve E without such movements being transmitted back to the switch C. Obviously as the movements of the control valve in taking up the lap are ineffective for the purpose of controlling the prime mover, such movements must not be taken into account in connection with the cutting off of the relay and the lost motion device H' ensures that this shall be so. The centering spring H² restores the parts to the central position when the apparatus is stationary.

Although in the construction shewn there is a mechanical connection between the relay piston E' and the switch, it is to be understood that any other suitable arrangement may be employed for causing the switch to be moved in accordance with the movements of the said piston.

Instead of the aforesaid form of "follow-the-pointer" mechanism involving the use of the pointer A and the index mark or pointer B', an equivalent arrangement involving the use of a "balanced pointer" may be employed; in this arrangement (which is in itself well known) a receiving member operated from the distant sighting or controlling station and a follower member operated by the gun are connected to a single balanced pointer through differential or epicyclic gearing, this balanced pointer remaining opposite a fixed zero mark so long as the follower member correctly follows the movement of the receiving member.

It is to be understood that the expression

"controlled element" in the claims is intended to cover the part of the apparatus which is moved or trained, for example, in the case of ordnance the gun itself, or in the case of remote control searchlights, the searchlight itself, &c.

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

1. In a remote control system the improvements which comprise a movable receiving member, a follower member connected with the controlled element, a relay, a relay switch, means for operating said switch by the relay's own movement so as to open the switch and stop the movement of the relay, and means for decreasing the ratio of relay movement to relative displacement between receiving and follower members as the displacement increases.

2. In a remote control system the improvements which comprise a movable receiving member, a follower member connected with the controlled element, a relay, a relay switch, means for operating said switch by the relay's own movement so as to open the switch and stop the movement of the relay, and means for preventing angular lag between the receiving member and the follower member.

3. In a remote control system the improvements which comprise a movable receiving member, a follower member connected with the controlled element, a relay, a relay switch, means for operating said switch by the relay's own movement so as to open the switch and stop the movement of the relay, an adjustable dash-pot device interposed between the relay and the switch opening means to prevent angular lag.

4. In a remote control system the improvements which comprise a movable receiving member, a follower member connected with the controlled element, a relay, a relay switch, means for operating said switch by

the relay's own movement so as to open the switch and stop the movement of the relay, an adjustable dash-pot device interposed between the relay and the switch opening means to prevent angular lag, a lost motion coupling and relay centering spring.

5. In a remote control system the improvements which comprise a movable receiving member, a follower member connected with the controlled element, a relay, a relay switch, means for operating said switch by the relay's own movement so as to open the switch and stop the movement of the relay, and means for decreasing the ratio of relay movement to relative displacement between receiving and follower members as the displacement increases, an adjustable dash-pot device interposed between the relay and switch opening means to prevent angular lag, a lost motion coupling and a relay centering spring.

6. In a remote control system a movable indicating pointer, a concentric follower member positively connected with the controlled element, a disc concentric with the follower and rotating with it, a relay switch on said disc, a switch arm pivoted on the follower and bearing on a cam rigidly attached to the pointer, said switch and cam being so proportioned that the ratio of relay movement to relative displacement between receiving pointed and follower member decreases as the displacement increases, a slide valve operated by the relay, a dash-pot device connected to the valve slide through an adjustable lost motion coupling, and means for rotating the switch disc with respect to the follower, said means being operated by the valve slide through the dash-pot device and lost motion coupling.

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Witnesses:

S. MARSH,

BASIL MARSH.