(No Model.)

G. WESTINGHOUSE, Jr.

ELECTRICALLY ACTUATED FLUID PRESSURE MOTOR AND CIRCUITS THEREFOR.

No. 358,713. Patented Mar. 1, 1887.

FIG. 2.

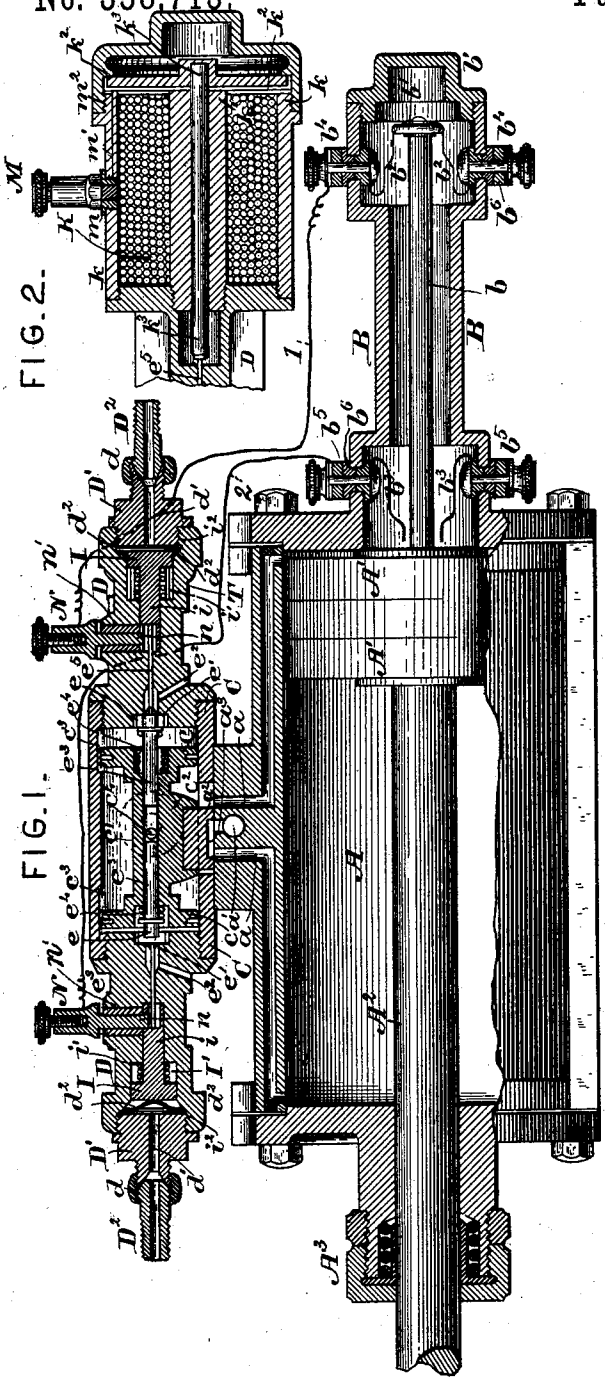
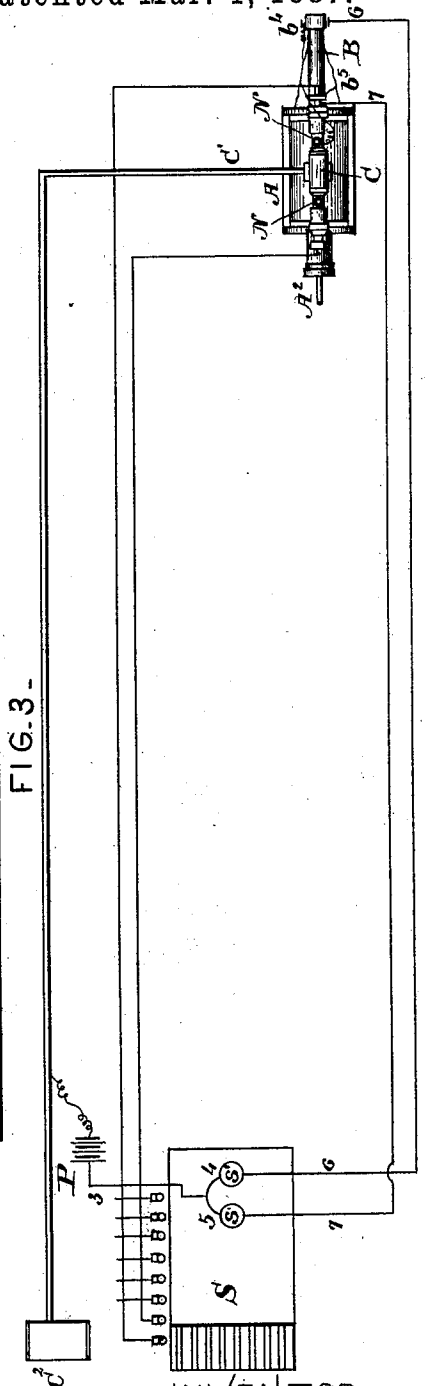


FIG. 1.

FIG. 3.



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ELECTRICALLY-ACTUATED FLUID-PRESSURE MOTOR AND CIRCUITS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 358,713, dated March 1, 1887.

Application filed September 7, 1886. Serial No. 212,913. (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, and a citizen of the United States, have invented or discovered a certain new and useful Improvement in Fluid-Pressure Motors and Circuits Therefor, of which improvement the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1 shows a vertical central section of a fluid-pressure engine adapted for use in carrying out my invention. Fig. 2 is a sectional view of a detached portion, illustrative of certain modifications in the make and break mechanism, and in the means employed for actuating the valve mechanism; and Fig. 3 is a diagrammatic view of one form of application of my invention.

My present invention relates to certain improvements in electrically-actuated mechanism for operating some movable part or appliance on or connected with railway-tracks; and, in general terms, it consists of certain combinations of a valve-governed fluid-pressure engine for operating a switch or other part of or appliance connected with a track, an electrically-controlled mechanism operating a signal or lock or other device connected with the operating mechanism of the track, and an electric circuit or circuits controlling the signal, lock, or equivalent mechanism, such circuit or circuits being made and broken by movement both of the valve-shifting mechanism of the engine and by movement of its piston or the mechanism operated thereby, as hereinafter more fully described and claimed.

It is frequently required in operating mechanism connected with or relating to the movements of trains on railways that some one operation or act—for instance, clearing a signal or moving a lock—should follow or be dependent upon some other operation—for example, the setting of a switch. It is also desirable in many cases to make use of valve-governed fluid-pressure motors or engines to effect the desired switch and signal or other movements. Such fluid-pressure mechanisms have been used heretofore, and in securing the relative dependence of one operation upon another an electric circuit or circuits controlling the dependent mechanism—say that for the signal or for a lock—has been made and broken by the first or switch mechanism at the limits of its piston-stroke.

My invention relates more particularly to certain provisions in this class of mechanism for making and breaking such controlling circuit or circuits, both by the piston movement, as heretofore, and also by the movement of the valve-actuating mechanism.

In the drawings I have illustrated my invention applied to a valve-governed fluid-pressure engine for shifting a switch or other movable part or appliance on or connected with a railway-track, and also to the locking mechanism of interlocking apparatus employed for operating switches and signals in predetermined order, and in the use illustrated the electrically-controlled locking mechanism is made dependent upon the movements of both the main piston and the valve-shifting mechanism of the switch-engine or equivalent motor.

The fluid-pressure engine shown is constructed as follows: Within a metal cylinder, A, is a packed piston, A′, carrying a stem, A^2, which latter passes outward through any suitable stuffing-box, A^3, and makes connection, as may be desired, with the part or appliance to be operated by movement of the piston. Fluid (by preference air) under pressure is supplied to either side of the piston through passages *a a*, and is exhausted through these passages and the passage *a′*, opening through the case to the external air. The flow of fluid is directed or distributed by a slide-valve, a^2, movable back and forth across the ports upon the seat a^3, so as to open one of these passages to the supply and the other to the exhaust when the valve is moved in either direction, one such position being illustrated in Fig. 1. The valve is moved upon its seat by means of pistons *c c*, secured on the ends of the tubular stem *c′* and inclosed within the cylindrical chamber-case C, which latter is secured to or forms a part of the main case A of the apparatus. Connection is made between the valve a^2 and stem *c′* by means of a recessed enlargement or rider, c^2, formed on the under side of the stem, which receives the upper part of the valve.

The chamber C inclosing the valve and its two pistons is supplied by pipe C′ with any

desired fluid under pressure. Air is preferred, though other suitable fluid may be employed; and in Fig. 3 the pipe C′ is shown leading from a reservoir, C^2, which may be supplied by any suitable air-compressing apparatus.

Movement is given to the pistons *c c* by difference of fluid-pressure thereon. To this end small vent-passages c^3 are made in the chamber-wall in the range of each piston, with reference to providing for passage of fluid in comparatively small quantities, but sufficient to secure and maintain equilibrium of pressure on the outer faces of the two pistons in case there is no escape at the ends; but if the fluid is permitted to escape from the outer side of either piston *c*, then the pistons will be moved toward the escape by reason of an excess of fluid-pressure in that direction. Provision is made for securing such escape, when desired, by means of small valves *e e* at either end, seated upon ports *e′*, which open to the exterior air by passages e^2. The valves *e* abut against the collared ends of stems e^3, which latter extend inward into the tubular passage of piston-stem *c′*, and they are pressed upon their seats by springs e^4, assisted somewhat by fluid-pressure upon the ends of the stems e^3, admitted through opening e^4.

I have illustrated two different methods of or means for opening the escape-valves *e e*—namely, by fluid-pressure, as in Fig. 1, and by electrical action, as in Fig. 2. In Fig. 1 a small rod or stem, e^5, extends outward from the center of each valve through port *e′*, and through a tubular passage in the axial line of cases D D, which latter screw into the ends of and in effect form heads for the piston-chamber C. These stems e^5 terminate at or near the extremities of the stems *i* of pistons I, which latter are inclosed within chambers I′ in the cases D. Springs *i′* press the pistons outward with a given degree of pressure, say, twenty-five pounds, (more or less,) as may be desired. The pistons are moved against the springs by fluid-pressure imparted through pipes D^2, coupled, as at *d*, to the head or plug D′, which is screwed into the open end of case D, thereby closing its piston-chamber, except the central supply-passage, *d′*, leading thereto from pipe D^2.

In order to pack the piston I as against passage of fluid, I make use of a diaphragm, i^2, secured at its periphery between the abutting shoulders d^2. Fluid-pressure upon the outer face of the diaphragms in excess of the pressure of the springs *i′* will move the pistons inward, thereby pushing the valves *e* from their seats and permitting escape from the chamber C. On the left, Fig. 1, I have illustrated the positions of parts in this operation of opening the valve *e* for the purpose of moving the distributing-valve a^2. As there shown, the diaphragm i^2 is curved inward under fluid-pressure on its concave side, having thereby moved the piston I, compressed the spring *i′*, and pushed the valve *e* from its seat. The escape thus afforded has caused the pistons *c* to be moved to the left, thereby opening the right-hand port *a* to the supply. The main piston A′ is shown, however, at the right, not having yet moved in response to the fluid-pressure which might enter behind it. When this movement does take place, the piston A′ will be carried to the left, or in the same direction as the valve a^2 was moved before it. When pressure upon diaphragm i^2 is released, the spring *i′* will immediately move the piston I outward, the valve *e* will be seated by spring e^4, aided by fluid-pressure on stem c^3, and the escape through port *e′* being thus closed equal pressure will soon be secured upon all sides of pistons *c c* by the flow through passage c^3.

In order to make provision for making and breaking an electric circuit by the movements of the valve-operating mechanism above described, binding-posts N are screwed into the cases D D, being insulated therefrom by sleeves *n′*, of any suitable material, as hard rubber. The insulated stems *n* of the posts pass into the chambers of piston-stems *i* in such position that the stems *i* make contact with the inner end of stems *n* when the pistons are forced into open valve *e*, as at the left of Fig. 1. If, then, circuit-connection be made with the post and with the metallic parts of the engine, such circuit will be made and broken by making and breaking contact between the stems *n* and *i* in the operation of opening the escape-valves *e* preliminary to moving the distributing-valve. Provision is also made for making and breaking circuits by the main piston at the ends of its stroke. To this end an extended hollow shell, B, is cast on or secured to one head of cylinder A, within which a stem, *b*, extends. This stem is secured to and carried by the piston. A button, *b′*, on the outer end of the stem makes contact at the two ends of the piston-stroke with springs b^2 b^3, secured to the inner ends of the posts b^4 b^5, which latter are secured to but electrically insulated from the shell B by rubber or equivalent sleeves b^6.

Provision may be made in the manner described for any desired number of circuits at either limit of piston movement and also in connection with either valve movement *e*, whereby such circuits may be made dependent upon both movements of the valves and of the piston. I have shown two such circuits, one being connected by wire 1 with posts b^4 and the right-hand post N, and the other by wire 2 with post b^5 and the left-hand post N; or, stated generally, each circuit is made and broken by movement of the mechanism for shifting the distributing-valves in one direction, and also by the piston at the completion of its movement resulting from such prior movement of the valve. The circuits are thus made doubly dependent upon the operation of the engine.

It will also be observed that contact is made by button *b′*, and circuit-connection made thereby in either end position of the piston A′—that is, with springs b^2, when at the right, or with springs b^3, when at the left. On the

other hand, both circuits are opened at *n i* in the normal position of the valve mechanism. (Shown on the right, Fig. 1.) Consequently both circuits are normally open, and one of them is open at two points, which latter is always the one to be affected in the next movement of the engine. For example, with engine in normal position, both circuits, lines 1 and 2 will be opened between *n i*, line 1 will be closed through b^2 b' b^2, and line 2 will be open between b^3 b^3. The next movement of the engine, (see Fig. 1,) must carry piston A to the left, and the circuit open at two points is the one closed in effecting such movement, being first closed at *n i* by operating the left-hand valve *e*, as in Fig. 1, and subsequently closed by the button b' and springs b^3 b^3 at the left-hand limit of piston-stroke, resulting from the opening of left-hand valve *e*.

The right-hand valve *e* might be opened, thereby closing circuit for line 1; but this valve movement would not affect the piston A, because it is already in the position which it takes in response to such valve movement. If the piston A′ were at the left-hand end of its cylinder, the above-described relations would be reversed—that is, line 1 would be open at two points—namely, b^2 b^2 and *n i*, on the right, and line 2 at one point only—that is, *n i* on the left. If these circuits were made and broken only at the ends of the piston-strokes, as heretofore provided in the art, one or the other circuit would be closed for each position of rest of the piston. In such case it might be possible to open an escape-valve to effect piston movement, and before the piston movement began (an appreciable time intervening between opening the escape and the consequent movement of piston A′) the closed circuit through the piston make-and-break might be used to effect some result in conflict with that produced by the engine in response to the opened escape. This possibility is entirely removed by combining the make and break of the piston with that of the valve mechanism, because contact cannot be made at *n i* without opening an escape-valve, *e*, and if one valve *e* be opened to effect piston movement—say the left-hand valve, Fig. 1—and then, before the piston moves from the position there shown, contact be made between *n i* on the right, the piston will not be moved at all, because the act of closing *n i* on the right will necessarily open the right-hand escape *e*, thereby neutralizing the escape first made on the left. This provision for preventing possibility of using a circuit to produce conflict between the thing controlled by the circuit and that controlled by the engine is an important and useful feature in many applications of this class of apparatus on railways.

In Fig. 3 I have illustrated one of the many useful applications which may be made of the circuits thus controlled by the engine—namely, to operate locking mechanism forming a part of interlocking apparatus. Such interlocking apparatus is shown at S in diagram, and the electrically-controlled locking mechanism at *s s′*. This interlocking mechanism may be of any suitable or desired construction—for example, like that described and claimed in a separate application filed by me August 25, 1886.

The circuits shown are from battery P, by wires 3 and branches 4 5, to the helices of the locking mechanisms *s s′*, thence by wires 6 7 to posts b^4 b^5 on one side of shell B. From the other side the wires 1 2 lead to posts N, on the right and left, respectively, and thence, when contact is made between *n i*, to the metal case of the engine, and by pipe C′ and wire 8 to battery. For specific illustration of the advantages secured by my invention in its present application, it may be assumed that the interlocking apparatus S may be moved to operate the engine through suitable connection with the valve mechanism, but that it is locked by the electrically-controlled mechanisms *s s′* from effecting any other movements. Circuit for unlocking can be made only through the engine. If, then, the left-hand valve *e* be opened for piston movement to the left, it will not be possible to shift quickly and obtain an unlocking-circuit through line 1 and the right-hand contact, *n i*, without in so doing preventing the movement of the piston contemplated in opening the left-hand valve *e*. Conflict, therefore, between the circuits and the piston movement cannot be made. The same would be true if the engine were employed to shift a switch and the two circuits made and broken by the engine were employed to actuate conflicting signals for train movements over the switch. If such circuits were made and broken by the piston movement only, it might be possible to open an escape-valve, *e*, to be followed by a throw of switch, and before the piston began its movement in response thereto some signal might be displayed or some other act might be done with the closed circuit which would introduce danger. By making the circuits dependent upon both the piston movements and those of the valve mechanism, as described, this possibility is removed. These cases of specific application will suffice to illustrate the purpose and advantage of thus making the circuits doubly dependent upon the operation of the engine. Occasion for this is due in a measure to the time elapsing between the preliminary movements of the valve mechanism and the final position of the piston resulting therefrom. This lapse of time is an incident to the conditions of use, the engines often being removed long distances from the station where their movements are controlled, and comparatively long piston-stroke being required with short available movement for controlling the valve.

The engine shown and described is designed with special reference to this class of work, and in a separate application filed by me, of even date herewith, I have described and claimed the same. I therefore make no claim to it herein alone considered; neither do I wish

to limit my invention to this or any specific form of engine or motor, nor to the means above described for operating the valves, because the valves may be actuated by direct mechanical connection—such, for example, as is ordinarily employed for such purpose—or electrical helices and circuits may be employed, as shown and described in separate applications filed by me August 30, 1886, Serial No. 212,180, and August 25, 1886, Serial No. 211,819. This latter feature of electrically-actuated escape-valve with circuit make-and-break mechanism, forming a part of my present invention, connected thereto, is illustrated in Fig. 2. Parts of this modified form of engine, so far as they correspond to those above described, are indicated by the same letters of reference, and a detail description of such parts need not be repeated. In the present instance, however, the escape-valves are opened in response to or by action of electrical current through helices K, having exterior and interior magnets, k k', and disk-like armatures k^2. Stems k^3 extend inward through the cores of the inner magnets and, abutting against the valve-rods e^5, push the valves from their seats when the armatures are attracted by the electrically-excited helices. In order to make and break other electric circuits by the movements thus effected, binding-posts M are secured on but electrically insulated from the shells of the helices, and from their inner ends, m, insulated wires m' are carried through suitable holes or passages in the shell to their outer ends, the wires protruding therefrom, as at m^2, sufficiently to make electrical contact with the armatures when the valves e are opened. When circuit through the helices K is broken, the springs e^4 will seat the valves e, and in so doing will push back the armatures, breaking contact between them and the wire terminals m^2. Wires 1 and 2 lead to these binding-posts from the posts b^4 b^5, as in Figs. 1 and 3, whereby the circuits dependent upon the engine will be made and broken both by movement of the valve mechanism and by the piston at the end or completion of its movement. The same results may be secured by securing the posts M at the ends of armature-stems k^3 in suitable position for the latter to make contact with the inner ends of the posts, substantially as in Fig. 1. I have shown these different methods both of actuating the escape-valves and of making and breaking circuits by such operation for the purpose of illustrating more fully different applications of my invention.

Other like modifications may be made both in the construction of the engine or motor and also in the make-and-break mechanism. For example, the make and break connected with the main piston may be connected with and operated by some movable part or parts of the switch or other part or appliance of or connected with the track, such as a locking bolt, whereby make and break is made at the completion of such movement. In so far, however, as the use of the locking-bolt or other part of the switch mechanism to make and break electric circuits may involve invention not covered by the claims hereinafter made, the same will be included in the subject-matter of other applications; also, in case direct mechanical connection is employed, the preliminary make and brake corresponding to the valve movements may be connected with and operated by the movable connecting mechanism. These and all other like modifications by which the circuits for operating the dependent power mechanism are themselves doubly dependent upon the operation of the controlling-engine or equivalent power mechanism, substantially as described, I consider as coming within my invention.

The specific application of the circuits to operate the locking mechanism of an interlocking apparatus is given herein simply for illustration. The combinations involved in such specific application are not claimed herein; but in so far as they may involve patentable invention such combinations will be claimed in a separate application, in which the construction of the interlocking apparatus and the mechanism controlled by such circuits will be shown and described more fully.

I claim herein as my invention—

1. In combination with a valve-governed fluid-pressure engine, an electric circuit or circuits made and broken by movement both of the piston and valve mechanism of the engine, and power mechanism actuated or controlled by such dependent circuit or circuits, substantially as set forth.

2. The combination of power mechanism for operating some movable part or appliance on or connected with a railway-track, electrically-controlled power mechanism for operating some part or appliance relating to the track in dependence upon the former mechanism, and an electric circuit or circuits actuating the latter mechanism, such circuit or circuits being made and broken both in the preliminary and final movements of the first or controlling mechanism, substantially as and for the purposes set forth.

3. A fluid-pressure engine having a piston, a distributing-valve with pistons, and valves for operating the distributing-valve, in combination with an electric circuit make-and-break mechanism operated by the valve mechanism and a make and break operated by the piston, substantially as and for the purposes set forth.

4. A fluid-pressure engine having a piston and distributing-valve with mechanism for moving the valve in opposite directions to operate the engine, in combination with two electric make-and-break mechanisms operated by the valve-shifting mechanism, one for each direction of valve movement, and two electric make-and-break mechanisms operated by the piston, one at each end of the piston-stroke, substantially as set forth.

5. In combination with the piston and valve mechanism of a fluid-pressure engine, an electrically-controlled power mechanism and two electric circuits for actuating the latter, both such circuits being made and broken both by movement of the valve-shifting mechanism of the engine and by movement of mechanism actuated by its piston, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:
R. H. WHITTLESEY,
C. M. CLARKE.