Jan. 19, 1932. R. PIGEOLET 1,841,629

SERVO MOTOR

Filed March 27, 1929 2 Sheets-Sheet 1

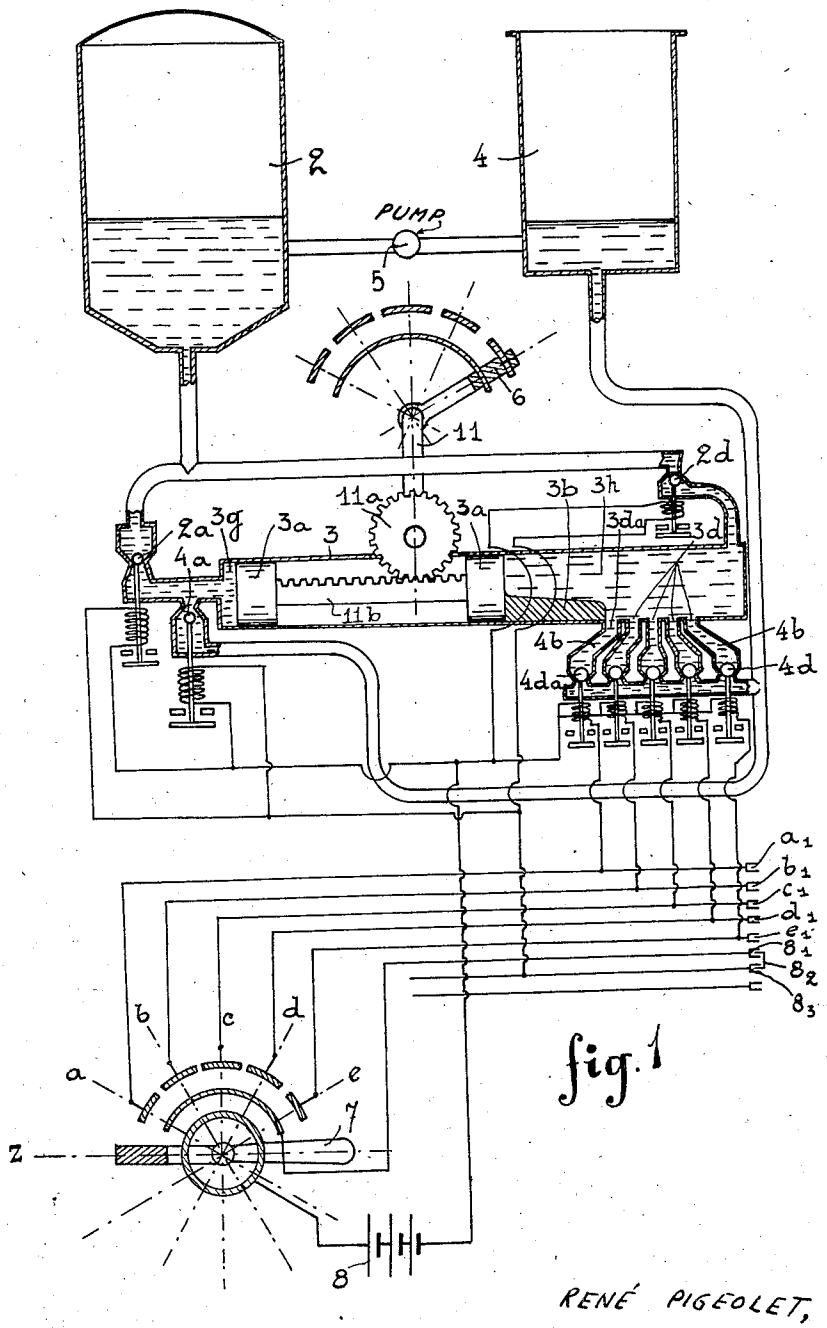


fig. 1

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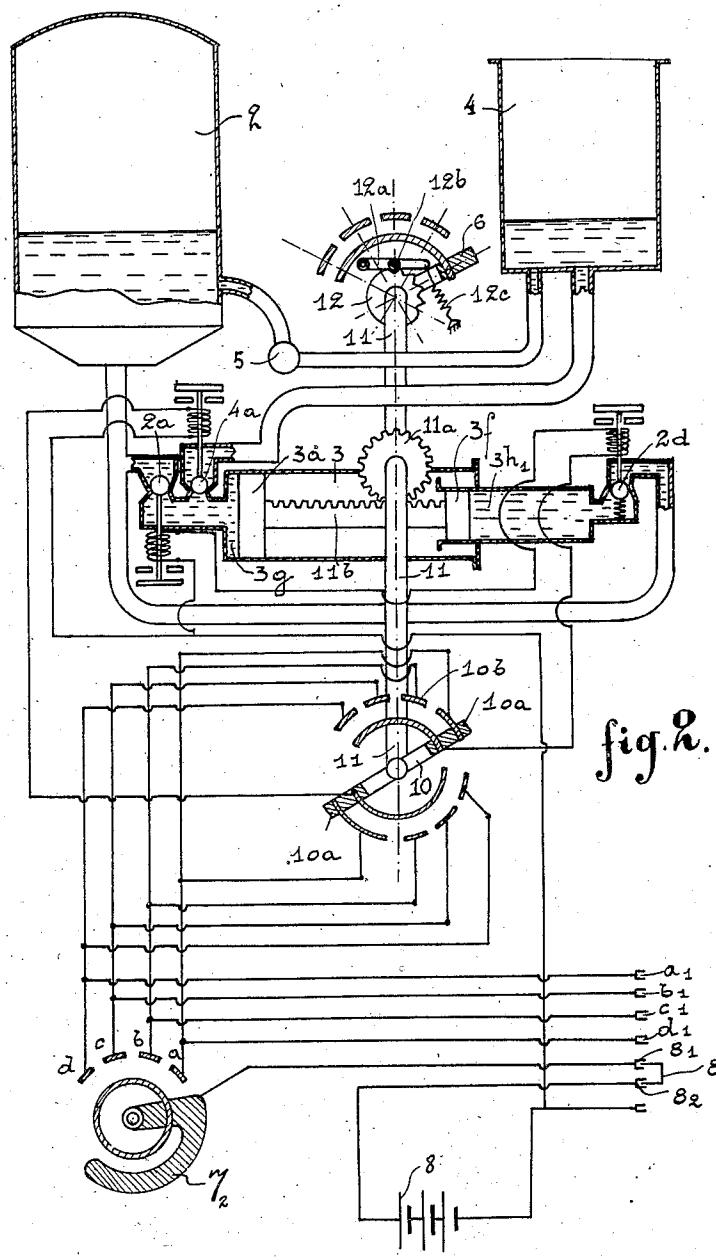


fig. 9.

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Patented Jan. 19, 1932 1,841,629

UNITED STATES PATENT OFFICE

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SERVO-MOTOR

Application filed March 27, 1929, Serial No. 350,261, and in Belgium March 27, 1928.

The present invention relates to a servo-motor driving a device which can be held in any of several positions determined by points graduated on its trajectory.

These servo-motors are particularly suitable for governing controllers on electric driving locomotives in multi-unit trains. In this case, the graduated marks correspond to the different contacts of the controllers.

Servo-motors generally employed for governing the above-mentioned controllers use as propelling fluid air under pressure. These controllers or driven devices possessing a certain inertia, it is necessary, in order to obtain an absolute stability of the controller at the different points, to employ a locking system for the controllers, thus increasing and complicating the number of mechanisms used.

The purpose of the present invention is to simplify the construction of servo-motors by the elimination of these supplementary locking devices.

In order to obtain a perfect retention of the controller in the above-mentioned positions, the present invention provides for the control of the servo-motor by means of a liquid under pressure, the action of which is balanced by a controlling system which is released when the controller reaches a point determined by the position given to an operating gear.

The annexed drawings show by way of example and in a non-limiting manner a preferred embodiment of the invention, the latter including the various parts and features which the arrangement illustrated comprises.

Figure 1 is a diagram of the servo-motor according to the invention in which the driven device or controller is moved in both directions under the action of a liquid under pressure.

Fig. 2 is a diagram of a modified arrangement in which the driven device or controller returns to its off position when the electric current supplying the different circuits of the servo-motor is cut off.

A charging reservoir 2 contains, for example, a compressed gas acting on an intermediate liquid capable of being put in communication, through appropriate ducts, with a driving cylinder 3. The liquid contained in this cylinder 3 can be discharged through appropriate ducts into a discharge or storage reservoir 4, whence it can be taken back to the reservoir 2 by a pump 5.

The driven device or controller, represented by its handle 6, must be maintained in different positions corresponding to certain positions of the operating gear represented by the handle 7. The handle 6 is fastened to the end of a shaft 11 driven, through the medium of a pinion 11^a fixed thereon, by the rack 11^b provided on a piston 3^a which moves inside the driving cylinder 3; the member 11 coincides with the axis of rotation of the pinion 11^a and the arm 6, the arrangement being such that movement of the piston will thus be transmitted to said handle 6 to rotate the same. The movements and stops of the handle 6 are obtained by means of valves such as 2^a and 4^a, controlling, respectively, the inlet and outlet of the liquid in the cylinder 3; these valves being actuated electro-magnetically by means of solenoids inserted in electric circuits supplied from any source of energy, such as a storage accumulator 8.

In Fig. 1, the driving piston 3^a receives liquid against both faces.

The retention of the piston is obtained by stopping evacuation of liquid from one of the two chambers of the driving cylinder, each of which chambers can be put in communication either with the charging reservoir 2 or the discharge reservoir 4.

To provide for motion and stop of the driving piston, the valve governing the inlet of liquid to one of the cylinder chambers, and the exhaust valve of the other chamber are simultaneously controlled. To effect this, the solenoid governing valve 2^a is shunted to the solenoids of valves 2^d and 4^a, but these valves are placed in such a way that, when the current is off, valve 2^a is closed, whereas valves 2^d and 4^a are open.

To secure the retention of the controller handle 6 in different positions, chamber 3^b of the cylinder 3 comprises a series of orifices 3^d which can be closed by a member 3^b carried by the piston 3^a. These different orifices correspond each to an exhaust duct such as 4^b connected to the storage reservoir 4,

and they are governed by valves such as 4^d electromagnetically operated by solenoids, the control of which is effected by varying the position of handle 7. The valve 4^{da} is the first one to the left and the orifice 3^{da} is the one leading to the said valve.

The controller and operating handles 6 and 7 being in their off position, to move the former handle, the operating handle 7 is placed, for example, in position *a*, with the result that current is supplied to the solenoids of valves 2^a and 2^d, as well as to the solenoid of valve 4^{da}. The liquid under pressure enters chamber 3^g and pushes the driving piston 3^a to the right until the member 3^b shuts off orifice 3^{da}. At this moment, chamber 3^h is completely closed, and the piston 3^a and the controller handle 6 are effectively locked in a determined position. By moving the operating handle 7 to the positions *b*, *c*, . . . etc., the different operations continue in the same way.

The controller handle 6 is returned to its initial position, in the opposite direction, by placing the handle 7 in the position Z, the effect of this being to cut off the current in all the circuits of the different solenoids. Valve 2^a and the different valves 4^{da} then close, while valves 4^a and 2^d open; the liquid under pressure then entering chamber 3^h and pushing the driving piston leftward to its position of rest, while the liquid contained in chamber 3^g is evacuated to the discharge reservoir 4. The advantage of this arrangement is to return the different controllers to their off position in case of accidental failure of the electric current supplying the different solenoids.

In Fig. 2, the driven device or controller, or its handle 6, is operated by a differential or compound piston having heads 3^a and 3^f of different diameters which move in suitable cylinders 3^g and 3^{hi}. Chamber 3^g of greater diameter can be put in communication either with the charge reservoir 2 or the discharge reservoir 4, while chamber 3^{hi} of smaller diameter can only communicate with the charging reservoir 2. The said handle 6 has fastened to its hub a toothed disc 12 which coacts with a detent 12^a pivotally mounted adjacent said disc and fitted with a tooth or lug 12^b to engage the teeth of the disc; said detent being pulled toward the disc by a spring 12^c.

When no electric current flows in the solenoids controlling the different valves, valve 2^a is closed, whereas valves 4^a and 2^d are open, and the driving piston can then be moved leftward to its position of rest on account of the liquid under pressure working in cylinder 3^{hi} and the evacuation of the liquid from chamber 3^g.

The operating handle 7_2 and the different controllers being then in off position, to move them, the operating handle 7_2 is placed, for example, in position *a*. This supplies electric current to the solenoid of valve 2^a which thereupon opens, while valve 4^a closes and valve 2^d opens, the solenoids of the valves 2^a and 2^d being connected in series; the driving piston is displaced, thus operating the drum 10 which is fixed to common shaft 11 and which, by the movement of contact 10^a to 10^b, cuts off the current in the solenoid of valve 2^d which thereupon closes and prevents the evacuation of any liquid from the chamber 3^{hi}, the piston stopping in a determined position. To continue the displacement of the controller handle in the same direction, the handle 7_2 will be placed successively in positions *b*, *c*, etc., while to move the controller handle in the opposite direction, the operating handle 7_2 must be moved towards the pisition of rest. It should be noted that the handle 6, the drum 10 and the pinion 11^a are positioned respectively in different parallel planes, and that the common shaft 11 is perpendicular to these planes.

In Figs. 1 and 2, the conductors leading from *a*, *b*, *c* and *d* are provided with connectors a_1, b_1, c_1, d_1 which are utilized, particularly in the case of multi-unit trains, to govern the movements of the controllers fitted on each of the units of the train by means of a single controlling device 7. The connectors 8_1 and 8_2 are joined by a member 8_3, and in the case of trains the conductors such as 8_1 and 8_2 are extended along the entire length of the train and are connected by said member 8_3 to the last unit in such a manner that in the event of breakage of the connection the current fails in all the solenoids.

The arrangement providing liquid on both faces of the driving piston has the advantage of securing the retention or absolute stoppage of the controller.

I claim as my invention:

1. An hydraulic servo-motor for operating a controlling member adapted to occupy a limited number of positions stepped along its path, comprising a driving piston for shifting said controlling member; a cylinder for said piston; a closed reservoir containing liquid and gas under pressure; a discharge reservoir; electrically-actuated valves for controlling the flow of liquid between said cylinder and one of said reservoirs; an operating handle adapted to occupy a limited number of positions for controlling the circuits of said valves; means for effecting the opening of the valves by the displacement of said controlling member, so as to produce the movement of the piston in a given direction; and means controlled by the displacement of the piston itself for effecting the closing of the said valves when the piston has reached a position corresponding to that of the controlling member.

2. An hydraulic servo-motor for operating a controlling member adapted to occupy a limited number of positions stepped along its

path, comprising a driving piston for shifting said controlling member; a cylinder for said piston; a closed reservoir containing liquid and gas under pressure; a discharge reservoir; electrically-actuated valves for controlling the flow of liquid between said cylinder and one of said reservoirs; an operating handle movable over a limited number of electric contacts; a handle shifted by the piston adapted to occupy the same limited number of positions, and movable over contacts corresponding to each of said positions, the last-named contacts being electrically connected with those of the operating handle; electric circuits for controlling said valves in electric connection with both handles; means for closing the electric circuit of the valves which control the displacement of the piston in a given direction by the displacement of the operating handle in said direction; and means for opening the said circuit by the handle shifted by the piston when the latter has reached the position corresponding to that of the operating handle.

3. An hydraulic servo-motor for operating an electric controller adapted to occupy a limited number of positions stepped along its path, comprising a driving piston acting to shift said controller; a cylinder for said piston; a closed reservoir containing liquid and gas under pressure; a discharge reservoir; electrically-actuated valves for controlling the flow of liquid between said cylinder and one of the reservoirs; an operating handle movable over a limited number of electric contacts; a handle shifted by the piston adapted to occupy the same limited number of positions, and movable over contacts corresponding to each of said positions, the last-named contacts being electrically connected with those of the operating handle; electric circuits for controlling said valves in electric connection with both handles; means for closing the electric circuit of the valves which control the displacement of the piston in a direction determined by the displacement of the operating handle in said direction; means for opening said circuit by the handle shifted by the piston when the latter has reached the position corresponding to that of the operating handle; and means for displacing the piston in the opposite direction when the current fails in said circuits.

4. An hydraulic servo-motor for operating an electric controller adapted to occupy a limited number of positions stepped along its path, comprising a driving piston acting to shift said controller; a cylinder for said piston; a closed reservoir containing liquid and gas under pressure; a discharge reservoir; electrically-actuated valves for controlling the flow of liquid between said cylinder and one of the reservoirs; an operating handle movable over a limited number of electric contacts; a handle shifted by the piston adapted to occupy the same limited number of positions, and movable over contacts corresponding to each of said positions, the last-named contacts being electrically connected with those of the operating handle; electric circuits for controlling said valves in electric connection with both handles; means for closing the electric circuit of the valves which control the displacement of the piston in a direction determined by the displacement of the operating handle in said direction; means for opening said circuit by the handle shifted by the piston when the latter has reached the position corresponding to that of the operating handle; an electrically actuated valve disposed between the cylinder and the other reservoir and permitting the displacement of the piston in the opposite direction when the supplying current is cutting off; means for opening the electric circuit of said last-named valve by the movement of the operating handle in the opposite direction; and means for closing said last-named circuit by the handle shifted by the piston when the latter has reached the position corresponding to that of the operating handle.

In testimony whereof I have affixed my signature.

RENÉ PIGEOLET.