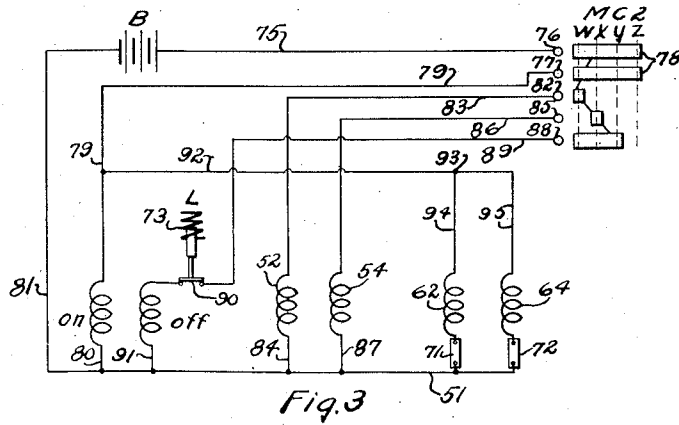
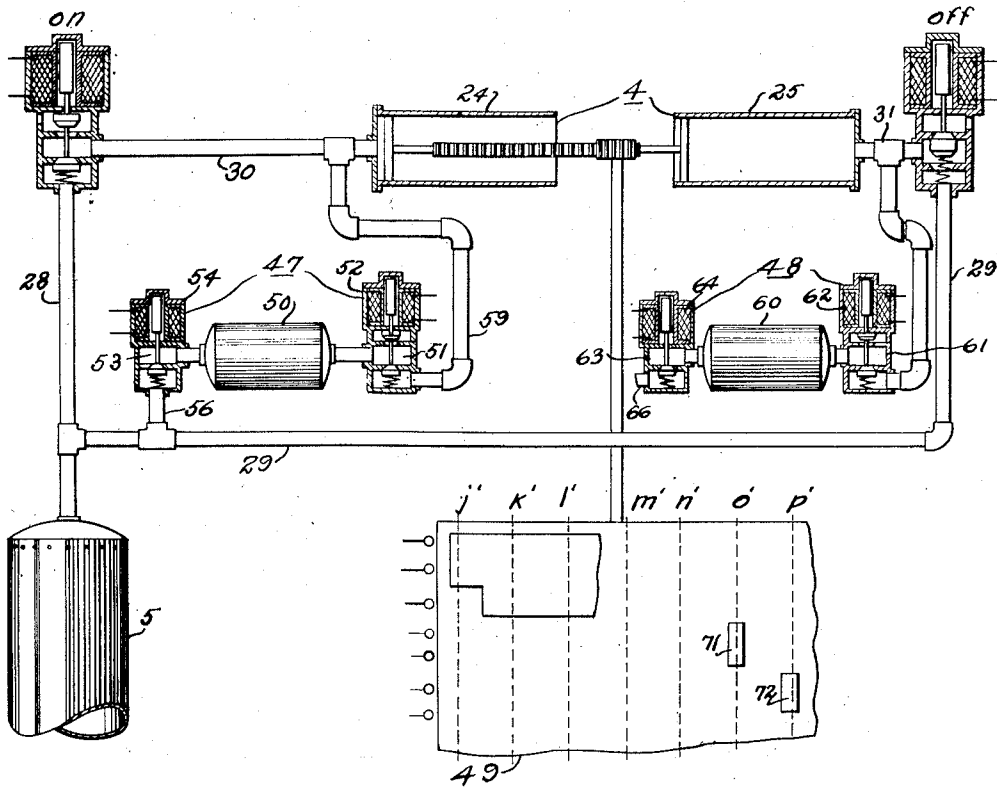


1,384,490.

K. A. SIMMON.
CONTROL APPARATUS.
APPLICATION FILED APR. 18, 1917.

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2 SHEETS—SHEET 2.



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CONTROL APPARATUS.

1,384,490.

Specification of Letters Patent. Patented July 12, 1921.

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To all whom it may concern:

Be it known that I, KARL A. SIMMON, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Control Apparatus, of which the following is a specification.

My invention relates to control apparatus and especially to electrically-controlled fluid-operated actuating mechanisms for drum controllers and the like.

One object of my invention is to provide a device of the above-indicated character whereby a piston or other movable member that is adapted to travel in a step-by-step manner may be caused to consume substantially equal time elements in traversing certain steps at different portions of the piston stroke.

More specifically stated, it is an object of my invention to provide an actuating mechanism, of the class under consideration, wherein the distance traversed by the successive control steps is so proportioned that substantially equal time elements are required by all of the steps throughout the movement of the apparatus.

In another aspect, my invention comprises the addition of a reservoir or storage member to one or both ends of an air-cylinder constituting a part of the operating mechanism under discussion, whereby steps at different portions of the piston stroke may be caused to consume time elements that are equal or bear any other predetermined ratio to each other but are different from the time elements corresponding to the remaining control steps.

My invention may best be understood from the accompanying drawings, wherein Figure 1 is a diagrammatic view of a control system embodying actuating apparatus constructed in accordance with my present invention; Fig. 2 is a diagrammatic view, chiefly in section, of a modification of the operating device shown in Fig. 1; and Fig. 3 is a diagrammatic view of a control system for governing the apparatus illustrated in Fig. 2.

Referring to Fig. 1, the system shown comprises a control drum 1 or the like having a main-circuit portion 2 and an auxiliary or interlocking portion 3; an electrically-controlled fluid-pressure-actuated operating

mechanism 4 for the control drum; a source of fluid pressure such as a tank or reservoir 5, for the actuating mechanism 4; a master controller MC1 that is adapted to occupy a plurality of operative positions *a*, *b*, *c*, etc. for governing the control drum 1 through its several operative positions *a'*, *b'*, *c'*, etc.; and a battery B or other suitable source of energy.

The main-circuit portion 2 of the control drum 1 may be employed for any well-known purpose, such as the exclusion of resistance from the accelerating circuit of an electric motor, and is shown as comprising a movable contact segment 8 of suitable configuration for engaging a plurality of control fingers 9 in any desired sequence.

The interlock drum 3 likewise embodies a movable contact segment 10 for successively engaging a set of stationary control fingers 11 to 15, inclusive, as hereinafter set forth in detail.

The actuating mechanism 4 comprises a pinion 19 which is rigidly secured to the operating shaft 20 of the control drum 1 and is adapted to mesh with a horizontally movable rack member 21, the opposite ends of which constitute pistons 22 and 23 that travel within suitable parts 24 and 25, respectively, of an operating cylinder. A normally closed valve 26 is associated with the outer end of the cylinder member 24 while a normally open valve communicates with the outer end of the other cylinder member 25. An actuating coil "On" is provided for reversing the position of the normally closed valve 26, and an actuating coil "Off" is provided for a similar function with respect to the normally open valve 27.

The mechanical operation of the actuating mechanism 4, without regard to the electrical connections effected thereby, may be set forth as follows: since the valve 27 is normally open, fluid pressure is admitted from the tank or reservoir 5, through a pipe or passage 29, to the valve and thence, through a pipe or passage 31, to the cylinder member 25, thereby normally biasing the apparatus to the illustrated position. By concurrently energizing the "on" and the "off" coils, the initial unbalanced fluid-pressure condition is reversed, that is, fluid pressure is admitted from the main reservoir 5 through a pipe 28, the opened valve 26 and pipe 30 to the cylinder member 24, whereas

fluid pressure is exhausted from the other cylinder member 25 through pipe 31 and the closed valve 27 to the atmosphere. Consequently, a movement of the pistons toward the right, in the present instance, is produced.

To arrest such movement at any time, it is merely necessary to deenergize the "off" coil, whereupon, balanced fluid-pressure conditions obtain in the mechanism, and a positive and reliable stoppage thereof is effected. To return the apparatus to the position shown, the actuating coils are concurrently deenergized to thereby cause a reversion of fluid-pressure conditions in the mechanism to the original unbalanced state and thus produce the desired backward movement.

It should be observed that, contrary to usual practice, the control steps or distances between successive notches of the control drum 1 are unequal, the length of step gradually increasing from the initial position *a'* to the illustrated final position *e'*. The positions of the piston 22 that correspond to the successive notches of the control drum 1 are designated as *a''*, *b''*, etc., and the function of the interlock drum 3 is to so govern the actuating mechanism 4 that the piston 22 is caused to halt at the successive illustrated positions. Consequently, by a suitable proportioning of parts, the time elements consumed by the apparatus in moving from notch to notch may be made substantially equal, thus tending toward greater uniformity and reliability of operation.

Assuming that the master controller MC1 is actuated to its initial operative position *a*, a circuit is established from the positive battery conductor B+ through control fingers 35 and 36, which are bridged by contact segment 37 of the master controller, conductor 38, junction-point 39, where the circuit divides, one branch including conductor 40 and the actuating coil "On" for the operating mechanism 4 to the negative battery conductor B-, and the other branch including conductor 41, control fingers 12 and 11, which are bridged by contact segment 10 of the interlocked drum 3 in its normal position *a'*, conductor 42 and the actuating coil "Off" to the conductor B-. Since both actuating coils are concurrently energized, forward movement of the controller 1 occurs, in accordance with previously set forth principles, until the contact segment 10 of the interlock drum 3 becomes disengaged from the control finger 12, as the control drum reaches its initial operative position *b'* and as the piston 22 occupies its position *b''*, whereupon the movement of the mechanism is arrested.

To cause the main control drum 1 to take another forward step, the master controller

is actuated to its position *b*, whereby a new circuit is completed from the contact segment 37 through control finger 43, conductor 44, control finger 13, which now engages contact segment 10 of the control finger 11, and thence to the off coil, as previously described. Thus, a second control step occurs, the drum movement being halted in position *c'* by reason of the interruption of the engagement of the control finger 13 with the contact segment 10.

In a similar manner, control fingers 45 and 46, etc., of the master controller MC1 respectively engage the contact segment 37 thereof in the successive controller positions to energize control fingers 14, 15, etc., of the interlock drum 3 and thereby produces the desired step-by-step movement of the main control drum. The lengths of the various portions of the contact segment 10 that engage the control fingers 12, 13, 14, 15, etc., gradually increase in proportion to the desired length of control step or distance between successive notches, as will be understood.

That the previously-described arrangement of parts will cause the various control steps to consume substantially equal time elements may be briefly proved as follows: Initially, a relatively large volume of compressed air or other fluid medium must be exhausted from the cylinder member 25, which will be entirely emptied through the pipe 31 and the valve 27 to the atmosphere and an appreciable time interval is required, while the admission of fluid at the full supply pressure through the valve 26 and the pipe 30 to the other cylinder member 24 occurs at a relatively rapid rate. As the pistons 22 and 23 gradually move toward the right in the illustrated system, the volume of fluid medium at full pressure to be exhausted from the cylinder member, 25 and, therefore, the time required to effect such release, gradually decreases, whereas, although the volume of active fluid at full pressure to be admitted to the other cylinder member 24 gradually increases, the time required by such admission varies but slightly, as is well known to those familiar with apparatus of the type under consideration. Consequently, if the control steps are equal in length throughout the piston stroke, as is customary, the time per step gradually decreases as the pistons move toward the right. Conversely, by suitably increasing the length of control step as the controller moves forwardly, the time element per step may be maintained substantially constant.

Referring to Fig. 2, the structure shown comprises the actuating mechanism 4, as described in connection with Fig. 1 and, in addition, two auxiliary fluid-pressure appliances 47 and 48 that are associated with the outer ends of the respective operating

cylinder members 24 and 25, and a controller 49 that is adapted to occupy a plurality of equally spaced notches j' to p' , inclusive.

The auxiliary apparatus 47 comprises a supplementary fluid-pressure tank or supply reservoir 50, a normally closed valve 51 that communicates with one end of the tank 50 and is provided with an actuating coil 52, and a similar valve 53 that is connected to the opposite end of the supplementary reservoir 50 and is provided with an actuating coil 54. A pipe or passage 56 effects communication between the supply pipe 29 and the valve 53, while a pipe or passage 59 serves to connect the valve 51 with the pipe or passage 30; that is, with the outer end of the cylinder member 24.

The auxiliary apparatus 48 differs from the apparatus 47 only in that the pipe or passage 66 communicates with the atmosphere instead of with the supply pipe 29, as does the pipe 56 of the apparatus 47. The auxiliary exhaust tank or reservoir 60 is provided with normally closed valves 61 and 63 which are respectively controlled by actuating coils 62 and 64, as hereinafter set forth.

Referring to Fig. 3, the auxiliary governing system shown comprises a master controller MC2 that is adapted to occupy a plurality of positions w , x , y , z ; the various actuating coils "On," "Off," 52, 54, 62 and 64; a plurality of movable contact segments 71 and 72 that are located upon the control drum 49 for governing certain circuit connections to be described; a battery B or other suitable source of energy; and a limit switch L, of a familiar type, for controlling the operation of the actuating mechanism 4.

The limit switch L has an actuating coil 73 that may be connected in series relation with the electric motor to be governed (not shown) in accordance with a familiar practice, whereby automatic operation of the motor, instead of the purely manual operation that was described in connection with Fig. 1, may be obtained.

Assuming that the auxiliary reservoirs 50 and 60 are respectively filled with air or other medium under high pressure and air at atmospheric pressure, and that the master controller MC2 is actuated from the illustrated off position toward the initial operative position w , one auxiliary circuit is established from the positive terminal of the battery B through conductor 75, control fingers 76 and 77, which are bridged by contact segment 78 of the master controller, conductor 79, the actuating coil "On" and conductors 80 and 81 to the negative battery terminal. A further circuit is completed from the contact segment 78 through control finger 82, conductor 83, the actuating coil 52 of the auxiliary appliance 47, and conductor 84 to the negative conductor 81.

Another circuit is completed from the con-

tact segment 78 of the master controller through control finger 88, conductor 89, co-operating contact members 90 of the limit switch L in its lower position, the actuating coil Off and conductor 91 to the negative conductor 81.

Since the actuating coils On and Off are thus concurrently energized, forward movement of the actuating mechanism 4 occurs and, in particular, a relatively rapid initial movement is imparted to the pistons by reason of the opening of the valve 51 and the resultant rush of an additional amount of fluid pressure to the outer end of the cylinder member 24, it being understood that the supplementary reservoir 50 is normally filled with a fluid medium under pressure, as previously mentioned.

Upon movement of the master controller MC2 to its second position x , the contact segment 78 becomes disengaged from the control finger 82 to effect the closure of the valve 51 and thus interrupt the communication between the supplementary reservoir 50 and the cylinder 24. Consequently, further steps of the main control drum 49, in accordance with the position of the limit switch L, occur at a slow rate compared to the initial control step, since the fluid pressure admitted to the cylinder member 24 must all come through the single valve 26. Furthermore, in position x of the master controller, control finger 85 engages the contact segment 78, whence circuit is completed through conductor 86, the actuating coil 54 of the auxiliary apparatus 47 and conductor 87 to the negative conductor 81, thereby effecting the admission of fluid pressure from the main reservoir 5 to the supplementary reservoir 50 in readiness for the next control operation.

In "running" position y of the master controller only the "on" and the "off" coils are energized and, consequently, the above-described slow step-by-step movement of the main controller 49, in accordance with the movements of the limit switch L, is permitted. To manually arrest such movement at any time, the master controller may be actuated to its final position z , whereby the energizing circuit of the off coil is interrupted to cause a stoppage of the actuating mechanism 4, as previously described.

When the main control drum 49 reaches its next-to-the-last position o' , in the illustrated case, a new auxiliary circuit is completed from the positively-energized conductor 79 through conductor 92, junction-point 93, conductor 94, the actuating coil 62 of the auxiliary appliance 48, and contact segment 71 of the main control drum in its position o' to the negative conductor 81. In this way, the valve 61 is opened to add further capacity to the operating cylinder 25, virtually increasing the length thereof and thus allowing a relatively rapid movement of the con-

troller from the next-to-the-last position o' to the last position p' , by reason of such provision of a double outlet for the cylinder 25.

- 5 In the final position p' of the control drum 49, a further auxiliary circuit is completed from the junction-point 93 through conductor 95, actuating coil 64 of the auxiliary apparatus 48, and contact segment 72 of the controller 49 in its position p' to the negative conductor 81. Thus, the fluid pressure temporarily stored in the auxiliary tank 60 is released to the atmosphere and the other valve 61 is closed at this time.
- 10 It will be understood that, by suitably proportioning the various parts of the apparatus shown in Fig. 2, although the several control steps are of substantially equal length, the time elements consumed in the first and the last steps may be made materially less than the time elements required by the intermediate steps by reason of the employment of the auxiliary appliances 47 and 48, and such decreased time elements may be made either equal to each other or may bear any other desired ratio, dependent upon the size of the relative parts.

One advantage of the use of additional reservoir capacity, in connection with the initial movement of the controller, resides in the fact that the corresponding movement of the main control drum 49 to its initial circuit-closing position occurs almost instantaneously after the movement of the master controller, thus avoiding any undesirable time lag between the action of the train operator and the movement of the main control drum.

By providing the above-described additional reservoir capacity in connection with the last step of the control drum, the active volumes in the two cylinder members 24 and 25 may be made substantially equal, thus bearing the same ratio to each other as during the mid-portion of the piston stroke and, consequently, the same degree of accuracy of movement and reliability of stoppage as is ordinarily obtained at the middle of the stroke may thus be secured at the end of the stroke also, or at any other time that is selected, dependent upon the proper relation of parts and configuration of the master-controller contact segments, as will be understood.

Furthermore, if desired, auxiliary push-buttons may be provided near the master controller for the purpose of allowing manual manipulation of the various valves of the auxiliary appliances 47 and 48, whereby the above-described operating advantages may be obtained at any time during the travel of the main control drum 49.

I do not wish to be restricted to the specific circuit connections or arrangement of parts herein set forth, as various modifica-

tions thereof may be effected without departing from the spirit and scope of my invention. I desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. The combination with a hollow member and a second member movable therein, of means for moving said second member in a step-by-step manner and for causing steps taken at different portions of the movement to consume substantially equal time elements.

2. The combination with a cylinder and a piston member movable therein, of governing means for admitting fluid pressure to said cylinder to move said piston member in a step-by-step manner and for causing steps taken at different portions of the stroke to consume substantially equal time elements.

3. The combination with a cylinder and a piston member movable therein, of governing means for admitting fluid pressure to said cylinder to move said piston member in a step-by-step manner, and means for causing certain steps to bear a pre-selected time ratio to each other.

4. The combination with a cylinder and a piston member movable therein, of governing means for admitting fluid pressure to said cylinder to move said piston member in a step-by-step manner, and for causing all of the steps to consume substantially equal time elements.

5. The combination with a cylinder and a piston member and governing means operatively associated with the piston for causing the successive piston steps to so vary in length that substantially equal time elements are required thereby.

6. The combination with a cylinder and a piston member movable therein, of governing means for admitting fluid pressure to said cylinder to move said piston member in a step-by-step manner, and governing means operatively associated with the piston for causing a gradual increase in the length of the piston steps.

7. The combination with a cylinder and a piston member movable therein, of governing valves for normally admitting fluid pressure to one side of said piston member and for normally excluding fluid pressure from the other side thereof, means for manipulating said valves to produce step-by-step movement of the piston member, and means for governing said manipulating means to cause all of the steps to consume substantially equal time elements.

8. The combination with a cylinder and a piston member movable therein, of governing valves for normally admitting fluid pressure to one side of said piston member and for normally excluding fluid pressure from the other side thereof, actuating coils

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for said valves, and means for energizing one of said coils for a series of substantially equal periods.

9. The combination with a cylinder and a
5 piston member movable therein, of governing valves for normally admitting fluid pressure to one side of said piston member and for normally excluding fluid pressure from the other side thereof, actuating coils
10 for said valves, and electrical interlocking means movable with said piston member for energizing the coil of the first-mentioned valve for a succession of substantially equal periods irrespective of the piston position,
15 and a master controller for primarily governing said actuating coils.

10. The combination with a stationary member, of a cooperating fluid-pressure-operated member adapted for step-by-step actuation, and means for causing steps taken
20 at different portions of the movement to consume substantially equal time elements.

11. The combination with a controller adapted to be actuated through unequal distances in a step-by-step manner, of means
25 for actuating said controller through selected steps in equal time intervals.

In testimony whereof, I have hereunto subscribed my name this 29th day of March, 1917.

KARL A. SIMMON.