March 19, 1963 J. F. PUETZ 3,081,845

THREE-WAY ADJUSTABLE TIMING DEVICE

Filed May 22, 1961 4 Sheets-Sheet 1

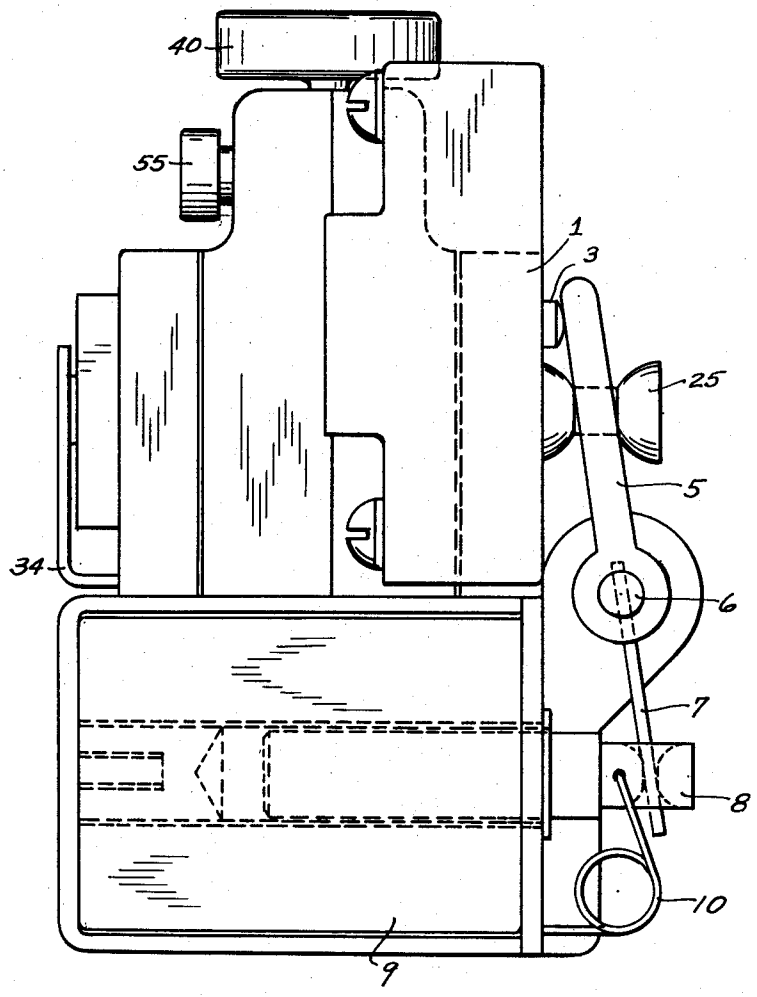


FIG. 1

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THREE-WAY ADJUSTABLE TIMING DEVICE

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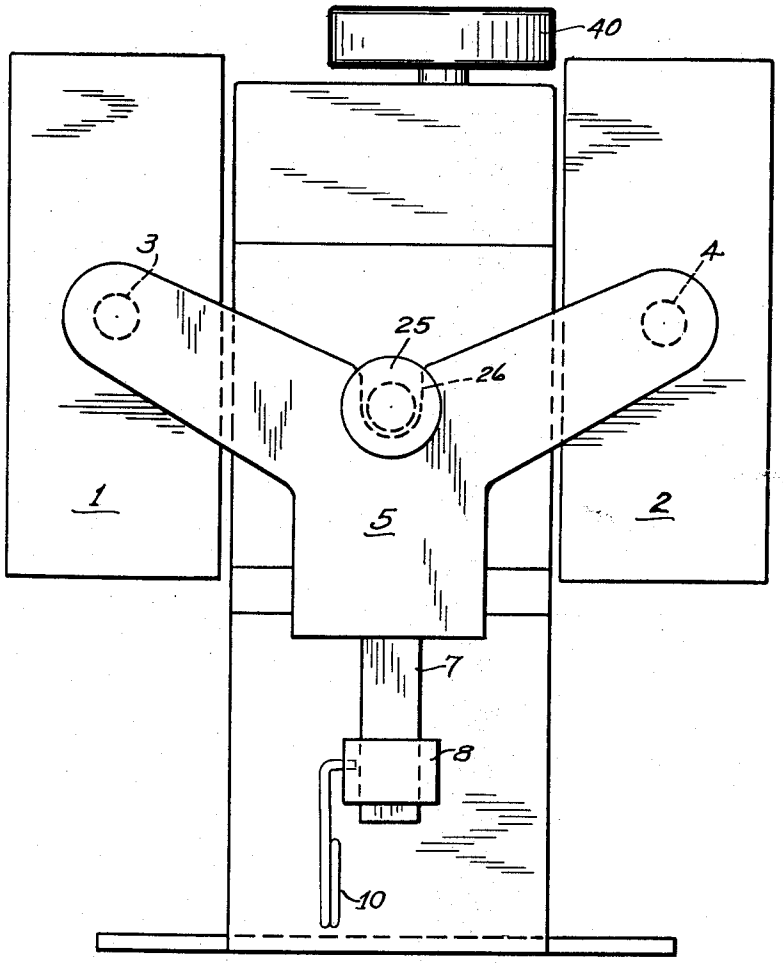


FIG. 2

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THREE-WAY ADJUSTABLE TIMING DEVICE

Filed May 22, 1961 4 Sheets-Sheet 3

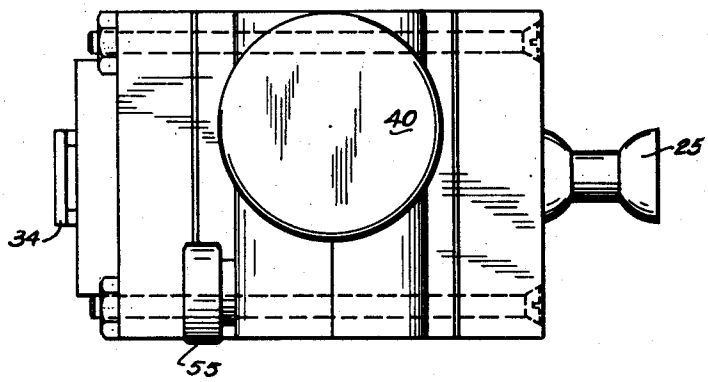


FIG. 3

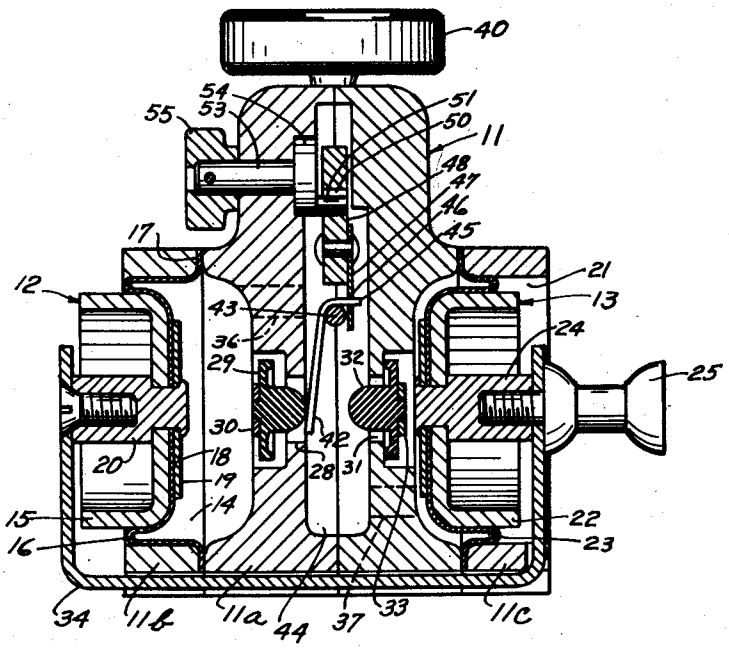


FIG. 5

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THREE-WAY ADJUSTABLE TIMING DEVICE

Filed May 22, 1961 4 Sheets-Sheet 4

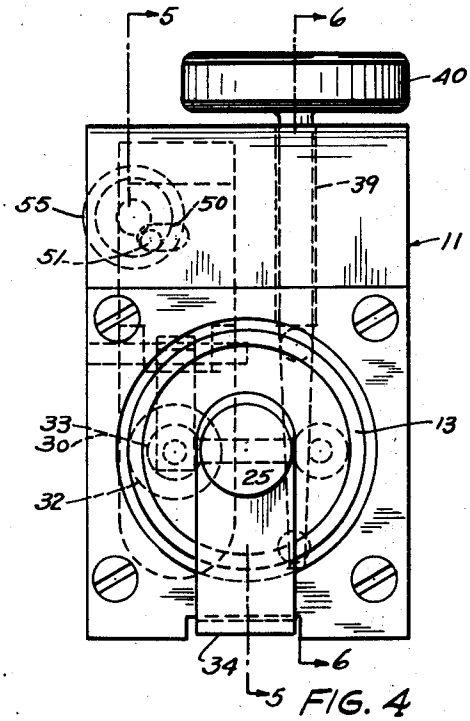


FIG. 4

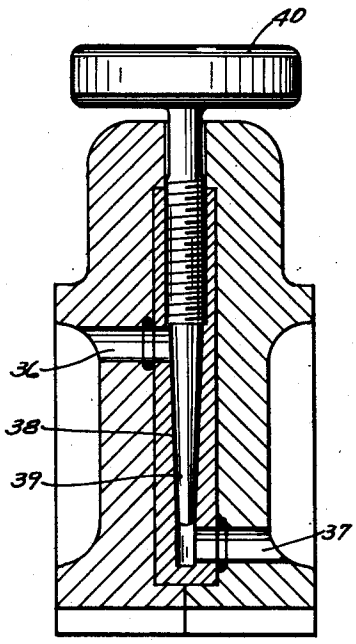


FIG. 6

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3,081,845

THREE-WAY ADJUSTABLE TIMING DEVICE

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12 Claims. (Cl. 188—87)

This invention relates to a three-way timing device for timing various types of equipment, and particularly to a three-way timing device which, selectively, can provide a time delayed action in both of two opposite directions, a time delay in one of the directions with a rapid return in the other direction, and a time delay in the other of the directions with a rapid return in said one direction, and in which device the amount of the selected time delay can be preselected readily.

For purposes of illustration, the invention is shown connected to a solenoid operated switch for controlling the switch operation in delayed relations to other equipment, its use in connection with other types of equipment being readily apparent from the illustrative example.

The various specific objects and advantages of the invention will become apparent from the following description wherein reference is made to the drawings, in which:

FIG. 1 is a side elevation of a timing device embodying the principles of the present invention and combined with a solenoid operated switch, showing the operative connection of the device and switch;

FIG. 2 is a right end elevation of the structure illustrated in FIG. 1;

FIG. 3 is a top plan view of the timing device;

FIG. 4 is a right end elevation of the timing device;

FIG. 5 is a vertical longitudinal sectional view of the device taken on the line 5—5 in FIG. 4; and

FIG. 6 is a fragmentary vertical longitudinal sectional view taken on the line 6—6 in FIG. 4.

Referring to the drawings, the device is shown in connection with a solenoid operated switch including switch units 1 and 2 with operating push buttons 3 and 4, respectively. The buttons are operated by a bifurcated rocker 5 which is mounted for rocking movement on a pivot 6. The rocker 5 has an arm 7 which is connected to a plunger 8 of a solenoid 9 of conventional construction. If desired, the solenoid can be one in which the plunger 8 is moved to retracted position within the coil by energization of the solenoid and is returned in the opposite direction by means of a return spring 10. The specific construction of the solenoid and switch forms no part of the present invention.

The timing device of the present invention comprises a body 11, having separable portions 11*a*, 11*b*, and 11*c*, respectively, held in assembled relation by suitable bolts, and which carries a pair of bellows 12 and 13, respectively. In the form illustrated, the bellows are the same in form and function and consequently the bellows 12 only will be described in detail.

The bellows 12 comprises a cylinder 14, which may be formed as a bore in the body 11, and a plunger 15 which is reciprocable in the cylinder. The clearance between the interior peripheral wall of the cylinder 14 and the exterior peripheral wall of the piston 15 may be suitably sealed to prevent the escape of pressure fluid therebetween. In the form illustrated, the seal is effected by means of a thin elastomeric annular diaphragm 16 having its outer peripheral margin 17 securely fastened to the body in sealed relation by clamping it between the body portions 11*a* and 11*b*. Its inner peripheral margin 18 is fastened in sealed relation against the inner face of the piston 15 by means of a washer 19 held by a suitable combined piston rod and rivet 20.

If desired, of course, the bellows may be in the form of a conventional piston with sealing rings and the like

substituted for the diaphragm 16, but the present structure is preferred as frictional resistance to movement of the piston is practically non-existent and leakage is eliminated. The term "bellows" is used herein to describe a device having an expansible and contractible chamber which can be expanded and contracted by movement of one part of the device relative to another.

The bellows 13 correspondingly comprises a cylinder 21 in which a piston 22 is arranged for reciprocation and is sealed at its periphery by a diaphragm 23. The piston 22 has a rod 24 which carries a connector 25 which is adapted for connection to a piece of equipment to be controlled. In the form illustrated, the connector 25 is connected to the rocker 5 of a solenoid switch by engagement in a slot 26 in the rocker 5. The cylinders are arranged with their outer ends exposed outwardly at opposite sides of the body and their inner ends adjacent to each other and terminating in spaced relation to each other interiorly of the body. The cylinder 14 is provided at its inner end with a port 28 which is controlled by a normally closed valve plug 29, the valve plug 29 being urged into closing relation to the port 28 by means of suitable yieldable means, such as the spring 30. The plug 29 is arranged to open inwardly of the cylinder 14 and to close in a direction outwardly therefrom. Correspondingly, the cylinder 21 is provided with a port 31 which is controlled by a normally closed valve plug 32 seated by a spring 33. The plugs 29 and 32 and the ports 28 and 31 associated therewith, respectively, provide valve means operable for selecting the direction of time delay movement. The pistons 15 and 22 are connected so that they move in predetermined relation to each other. In the form illustrated, they are directly connected to opposite ends of a suitable rigid spacing connector 34 so that their predetermined relation of movement is such that as one piston is moved inwardly of its cylinder, or to bellows contracting position, the opposite piston is moved outwardly of its cylinder, or to bellows expanding position.

The body 11 is provided with passages 36 and 37. The passage 36 is an exhaust passage for the cylinder 14, or bellows 12, and the passage 37 is an exhaust passage for the cylinder 21, or bellows 13. Each of these passages is restricted so as to slow down the passage of air therethrough from its associated cylinder as its associated piston or bellows is moved toward contracted position. It is desirable that the air or fluid from whichever bellows is being contracted passes to the bellows being expanded so that replacement air or fluid from the outside, which may carry in foreign matter, is not required. Since both passages are to be restricted for delaying the movement of the associated bellows to contracted position and since they are to be interconnected, an intermediate passage 38 is provided for connecting them. A needle valve 39, operable by a knob 40 at the exterior of the body, is arranged in the passage 38 so that the restriction of whichever passage 36 and 37 is discharging air from its cylinder or bellows can be regulated and thus vary the flow capacity of the passages 36 and 37.

With the arrangement hereinbefore described, when both plugs 29 and 32 are in closed position, all air must pass through the passages 36, 37 and 38 from one cylinder to the other as the pistons are moved in unison. Thus, when one bellows contracts, the opposite bellows expands and the restriction in the passages so limits the flow from the one of the bellows being contracted that it moves to fully contracted position with a time delay, the rate of movement, hence the time delay, being determined by the setting of the valve 39. Upon reversal, when the opposite bellows contracts and the first expands, the former moves to fully contracted position with a time delay determined by the setting of the valve 39. Thus a time delay is provided in each direction.

In the exemplary showing, therefore, there is a gradual operation of the push buttons 3 and 4 inwardly by the solenoid acting through the rocker 5 and a gradual return of them outwardly by the spring 10, both operations being under the control of the timing device.

It sometimes happens, however, that in one direction, movement of the movable element of the controlled equipment or switches is to be rapid and the return slower. This requires that the rocker 5 have a time delay in its movement in one direction and be free from time delay upon return. Such operations may require that the rocker 5 rock with a time delay counterclockwise in FIG. 1 and be free to move rapidly clockwise, or have a rapid free movement counterclockwise and a time delay clockwise. The specific operation selected depends upon the equipment being timed. All of these movements can be obtained with the present device by manipulation of the valve plugs 29 and 32. By allowing both plugs to be in seated condition concurrently under the pressure of their respective springs, a time delay in each of the opposite directions, as heretofore described, is obtained. However, if a time delay in only one direction is required, then one of the plugs is held open, the cylinder port open generally being the one for the bellows which is being expanded, and the other plug is left closed. In order to move the plug 29 to open position while leaving the plug 32 in closed position, as illustrated in FIG. 5, or to move the plug 32 to open position and leave the plug 29 in closed position, a suitable rocking lever 42 is provided. The lever 42 is mounted on a pivot 43 which is rockably mounted in the body. The body has a chamber 44 which is isolated from the passages 36, 37 and 38, but into which the cylinder ports 28 and 31 open. The lever 42 is arranged to be rocked about the axis of the pivot 43 transversely of the chamber 44 so as to engage and unseat the plug 29, leaving the plug 32 seated in one rocked position of the lever, and to unseat the plug 32 leaving the plug 29 seated in another rocked position of the lever, and to leave both plugs seated in an intermediate rocked position of the lever. For rocking the lever, an arm 45 is provided. The arm 45 is received in an aperture 46 in a connecting element 47. The connecting element 47 is rigidly secured to a slide 48 which is mounted in the body for reciprocation toward and away from the axis of the pivot 43. Thus, upon movement of the slide 48 in one direction, the plug 29 is unseated and the plug 32 is released for seating. Movement of the slide 48 in the opposite direction causes the lever 42 to move to a neutral position in which both plugs are seated. Further movement of the slide in said opposite direction causes the lever to open the plug 32 and leave the plug 29 seated. To operate the slide 48 from the exterior of the body, the slide is provided with an aperture or bore 50 in which is received an eccentric pin 51 which is mounted on a rotatable disc 54 in eccentric relation to a shaft 53. The shaft 53 is rotatably mounted in the body and is held in fixed axial position by the disc 54 at its inner end and a detachable selector knob 55 which is detachably secured to the shaft 53 at the exterior of the body. Thus, movement of the selecting means or lever 42 can be effected from the exterior of the body.

With the structure illustrated, it is apparent that as the bellows 12 contracts, the bellows 13 expands, and as the bellows 13 contracts, the bellows 12 expands. In all instances, the air in the bellows which is contracting passes through the passages 36, 37 and 38 to the bellows which is expanding, the flow being restricted and controlled by the needle valve 39. With both plugs 29 and 32 seated, the movement of either bellows to contracted position is delayed under the control of the valve 39. Thus a time delay in each of opposite directions is provided.

By manipulating the knob 55 to unseat the plug 29 leaving the plug 32 seated, a time delay upon contraction

of the bellows 13 results due to the air therefrom passing the restriction introduced by the valve 39 in the bypass passages 36, 37 and 38. However, upon movement of the bellows 13 toward expanded position, air can pass freely from the bellows 12 through the port 28, the chamber 44, and port 31, into the bellows 13 in bypassing relation to the needle valve 39, and unseat the plug 32 under the pressure of air delivered from the bellows 12 and the sub-atmospheric pressure created in the bellows 13. Accordingly, there is substantially no opposition to expansion of bellows 13 and contraction of bellows 12.

Thus, a time delay in the direction to the left in FIG. 5 is obtained with a rapid return in the direction to the right. By moving the lever 42 to unseat the plug 32 and to permit the plug 29 to seat, contraction of the bellows 12 is delayed, the air being constrained to pass from the bellows 12 past the needle valve 39 en route to the bellows 13. Also, in this setting, contraction of the bellows 13 is free, the air passing readily from the bellows 13 through the now open port 31, chamber 44, and port 28, unseating the valve 29 and entering the bellows 12.

Summarizing briefly, a time delay in movement of the element 25 to the left is provided with the setting illustrated in FIG. 5, with a free return of the element 25 to the right. Upon moving the lever 42 to unseat the plug 32 and permit the plug 29 to seat, a delayed motion of the element to the right in FIG. 5 is provided, with a free movement of the element 25 to the left. By setting the lever 42 to an intermediate position in which both plugs 29 and 32 are seated, delayed movement of the element 25 in each direction is provided.

Thus, three different controlled movements are possible—one, a rapid movement to the left with a slow return to the right, a rapid movement to the right with a slow return to the left, or a slow movement in each direction.

In addition to these three movements which can be selected by manipulating the knob 55 at the exterior of the body, the degree of time delay can be controlled by setting of the needle valve 39 by manipulating the knob 40 at the exterior of the body.

In the form illustrated, it is to be noted that the valve of each bellows is urged in a seating direction and held in firmly seated position by the fluid pressure developed in the bellows with which it is associated, and it opens in the opposite direction. If desired, of course, the valves may be arranged so that they are opened by the pressure developed in their own bellows and closed by the pressure delivered by the opposite bellows, in which case the opposite manipulation of the lever 42 would achieve essentially the same result.

While it is possible to make the arrangement such that the ports 28 and 31 communicate with the outside atmosphere as also could the passages 36 and 37, it is desirable that they all be confined in the body so that outside air with the foreign matter, moisture, and the like carried thereby are not introduced into the interior of the device.

Further, in the form illustrated, the fluid pressure used is assumed to be air, but it is apparent that other fluid may be used, if desired, depending upon the operations and the type of equipment to be controlled.

Having thus described my invention, I claim:

1. A timing device comprising a pair of bellows, bellows operating means operable selectively for concurrently expanding one bellows and compressing the other bellows, and for concurrently compressing said one bellows and expanding said other bellows, said bellows having exhaust ports, respectively, valve means for the ports, respectively, settable means connected to the valve means and operable independently of the bellows operating means and of the condition of the bellows relative to each other for setting the valve means in two operative

positions in one of which one port is in open condition and the other in sealed condition, and in the other of which said one port is in sealed condition and the other port is in open condition, each bellows having a restricted discharge passage with smaller flow capacity than its exhaust port, and means for connecting the operating means to equipment to be timed.

2. A timing device according to claim 1 wherein settable flow control means are arranged to vary the restriction of at least one of said passages.

3. A timing device according to claim 1 wherein said valve means are two independently operable valves, said valves have normal positions, respectively, in which they are in the same relation to their associated ports, and means are connected to the valves and yieldably urge them to said normal positions, respectively.

4. A timing device according to claim 1 wherein the valve means are two independently operable, normally closed valves, each valve is arranged with respect to the port with which it is associated so as to be moved to seating position by pressure fluid delivered by the bellows associated with said port, means yieldably urge the valves toward seated position, and conduit means are provided which have a closed chamber connected to said ports.

5. A timing device according to claim 1 wherein said settable means comprises a single movable knob, and means moved thereby and connected to the valve means for moving the valve means in predetermined relation to the movement of the knob.

6. A timing device according to claim 1 wherein the restricted passages of the bellows are connected to each other and sealed to prevent entry of outside atmosphere whereby the fluid expelled by either bellows flows into the other after passing the restriction in the one from which it is expelled.

7. A timing device according to claim 6 wherein the passages are restricted by a common adjustable needle valve.

8. A timing device according to claim 1 wherein the settable means is operable to set the valve means in a third operative position in which both ports are in the same condition.

9. A timing device according to claim 8 wherein said third operative position is one in which both ports are closed.

10. A timing device according to claim 1 wherein said valve means are two independently operable valves and

the valves and bellows are arranged so that one valve is urged to seated position by the fluid pressure delivered by one bellows and to unseated position by the fluid pressure delivered by the other bellows, and the other valve is urged to seated position by said other bellows and to unseated position by said one bellows.

11. A timing device according to claim 10 wherein each valve is arranged to be urged to seating position by the fluid pressure delivered by the bellows with whose port the valve is associated.

12. A timing device comprising a body, a pair of bellows therein, each of said bellows including a cylinder bore in the body and a piston reciprocable therein, said cylinders opening through opposite walls of the body at their outer ends and having their inner ends adjacent each other, said body having a chamber between said inner ends, and ports at said inner ends, respectively, connecting the cylinders to the chamber, normally closed valves for said ports, respectively, each valve opening toward the piston of its associated cylinder, means yieldably urging each valve to closed position, settable means in said chamber operatively connected to the valves and movable to one position in which both valves are released and closed, to another position in which one valve is open and the other closed, and to a third position in which said one valve is closed and said other valve open, said body having a passage interconnecting the cylinders and isolated from said ports and chamber, restricting means restricting said passage, means operable from the exterior of the body to operate the restricting means to vary the restriction of the passage, means operable from the exterior of the body to operate the settable means, and operating means interconnecting the pistons for moving them as a unit in opposite directions, and means for connecting the operating means to equipment to be timed.

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