

Sept. 22, 1953

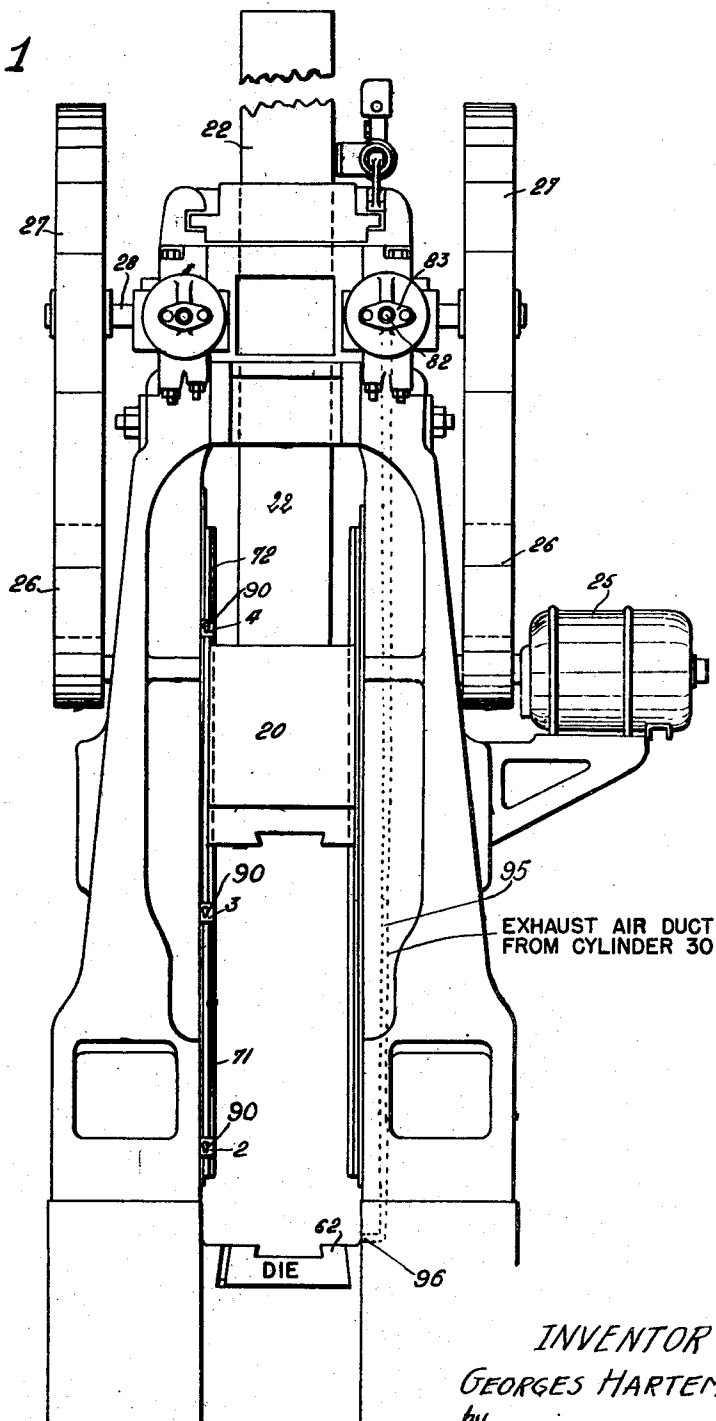
G. HARTEMANN
HYDRAULIC-ELECTRIC CONTROL SYSTEM
FOR TUPS FOR DROP FORGING

2,652,691

Filed Dec. 7, 1949

6 Sheets-Sheet 1

Fig. 1



EXHAUST AIR DUCT
FROM CYLINDER 30

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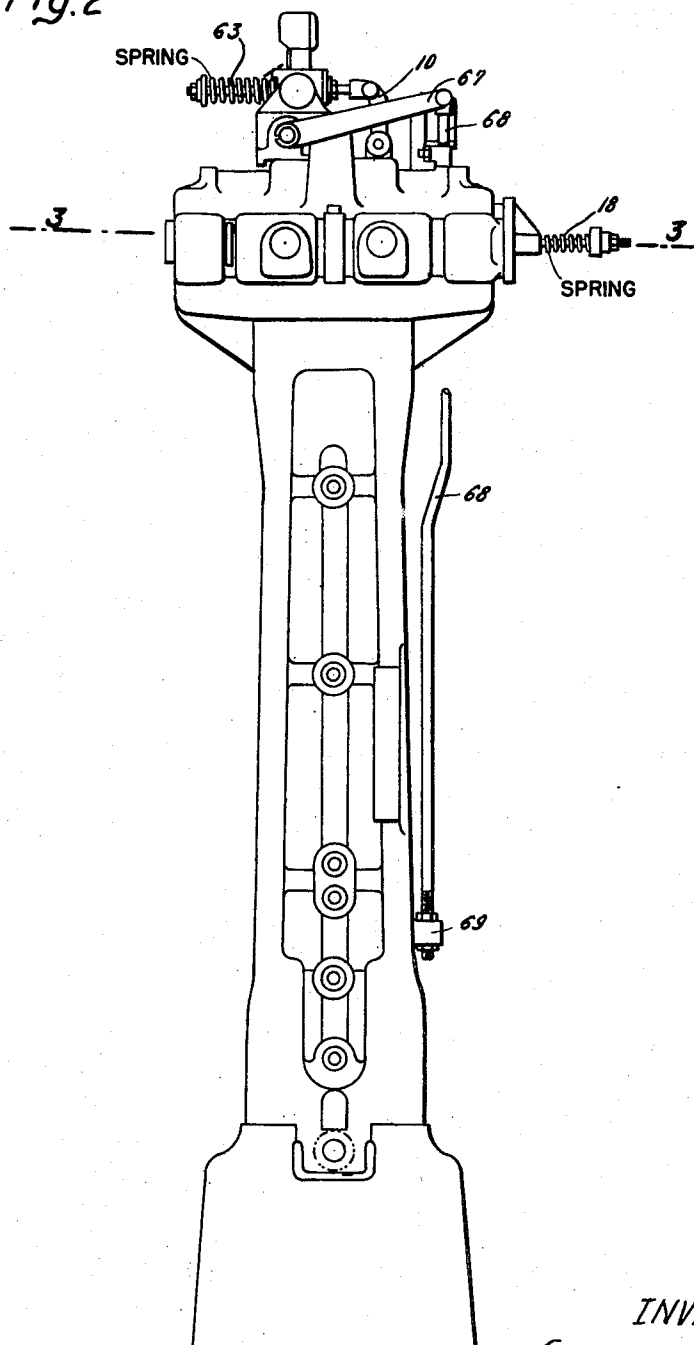
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Fig. 2



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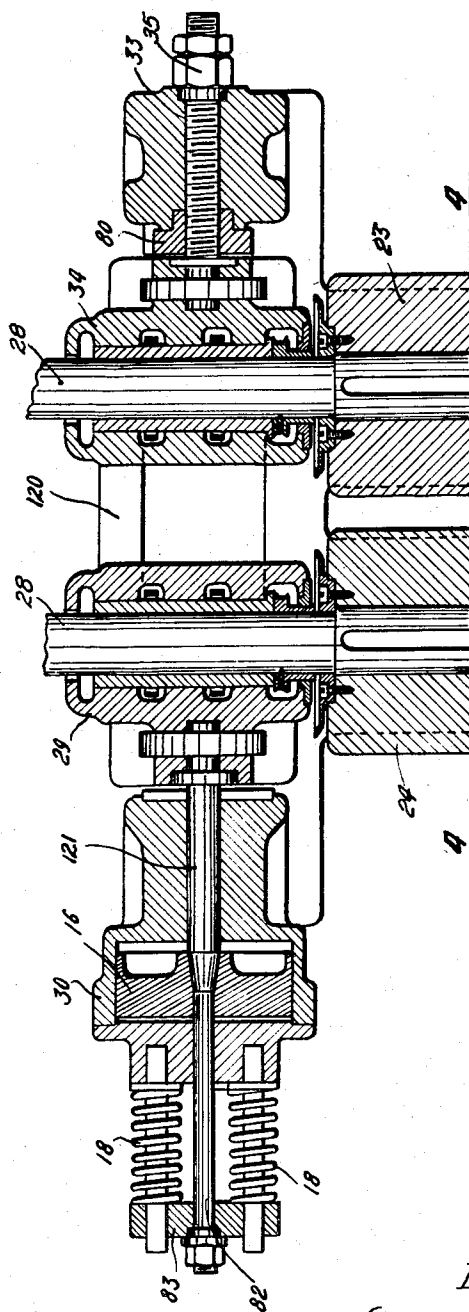
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Fig. 3



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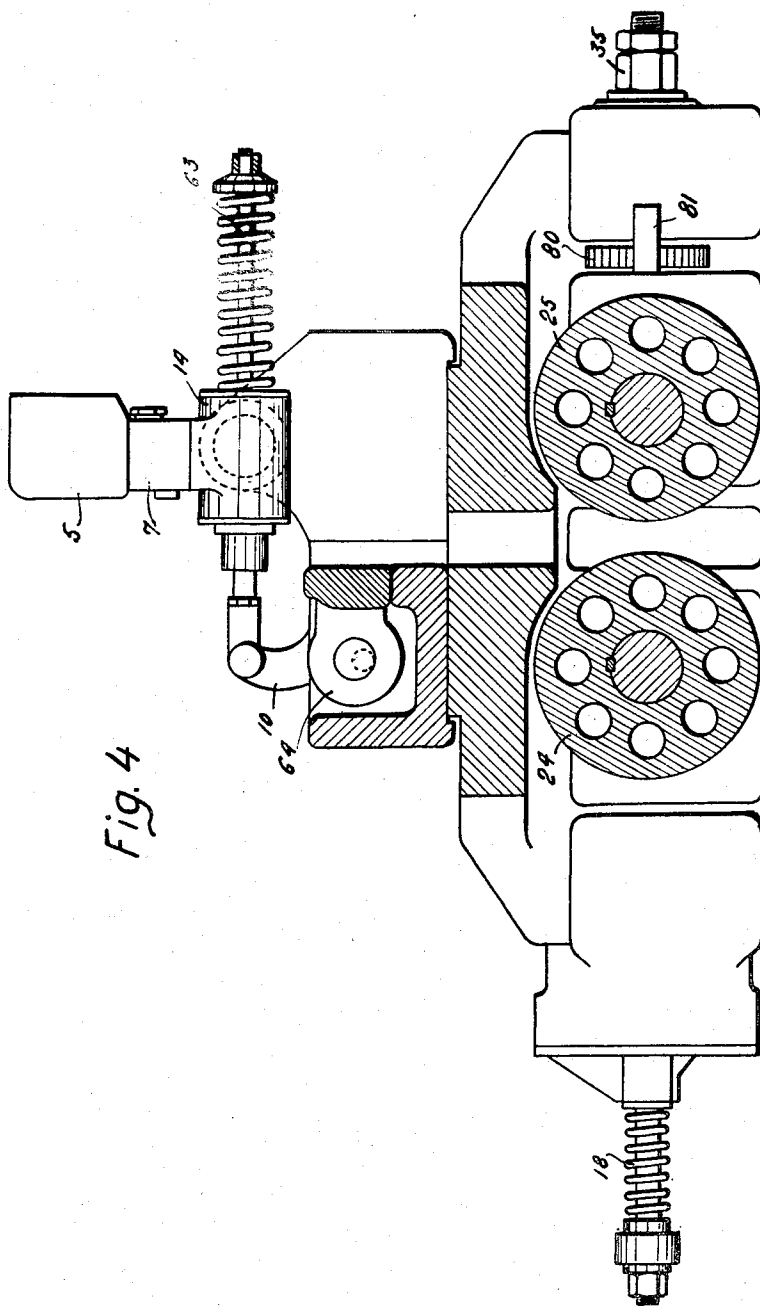


Fig. 4

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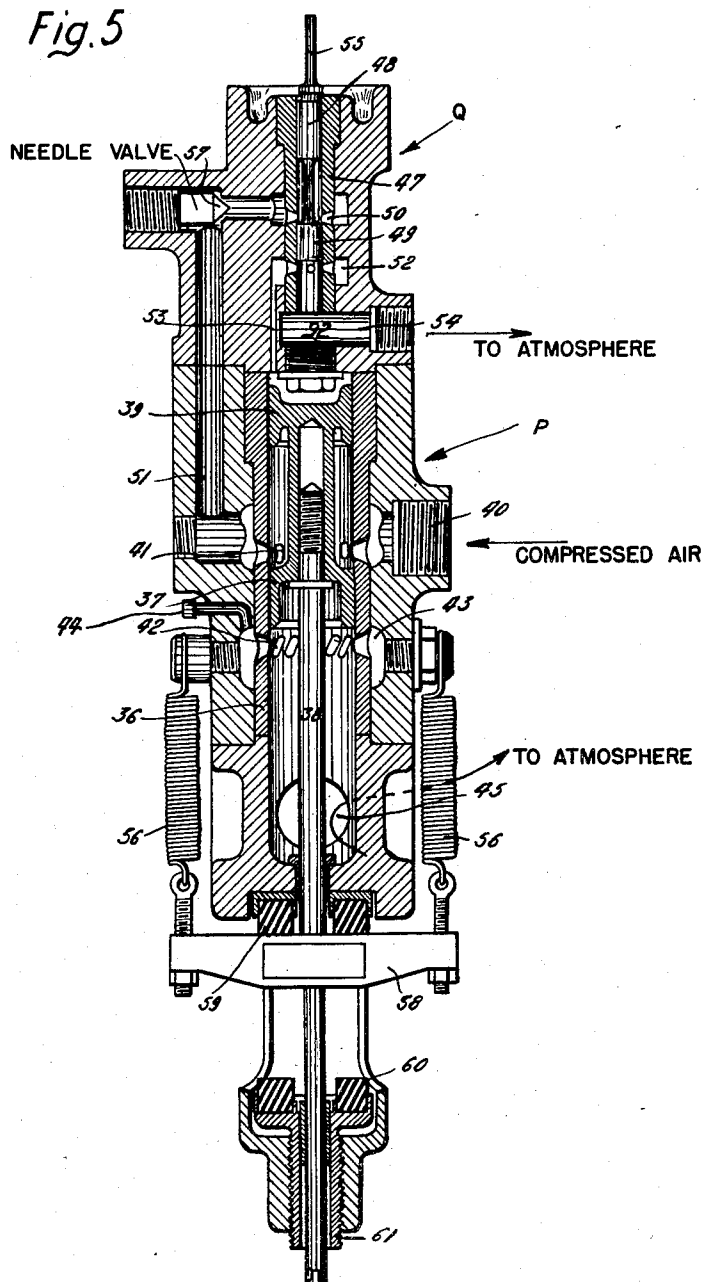
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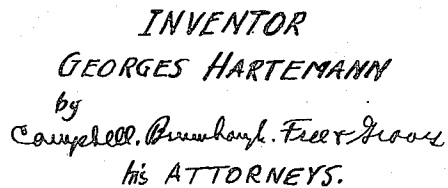


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UNITED STATES PATENT OFFICE

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HYDRAULIC-ELECTRIC CONTROL SYSTEM
FOR TUPS FOR DROP FORGINGGeorges Hartemann, Montbard, France, assignor
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7 Claims. (Cl. 60—97)

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This invention relates to an improved electro-pneumatically controlled tup which needs no appreciable effort on the part of the operator controlling it and which affords very great precision in drop forging.

One object of the invention is the accurate adjustment of the point at which the weight begins to ascend after the drop, the feature of which is that it allows a continuous upward movement to begin at the point to which the weight rebounds after striking the die.

Another object of the invention is the accurate regulation of the height at which the weight stops in its upward movement.

A further object of the invention is to enable the weight to be raised to any particular height so as to deliver blows of different strength as may be desired.

These results are obtained by means of electric contacts actuated by the passage of the weight at the required height. These contacts actuate relays which in their turn act on electro-pneumatic compressed-air distributors.

Finally, a further object of the invention is the accurate timing of the air-blast on the lower die, the said blast being regulated by the said electro-pneumatic device.

In the drawings:

Figure 1 shows the machine in elevation,

Figure 2 shows the machine in side elevation,

Figure 3 is a half section on the line 3—3 in Figure 2,

Figure 4 is a section on a larger scale through the upper part of the machine on the line 4—4 in Figure 3,

Figure 5 is a sectional view of the compressed-air distributor.

Figure 6 shows diagrammatically the operation of the machine and the electric connections,

Figure 7 is another diagram of the electric connections showing the position where the tup reaches the bottom of its drop.

The tup comprises in the usual way a weight 20 to be dropped onto a die 62 (Figure 1).

According to the invention (Figures 1 and 6), the weight 20 automatically controls its own lift or drop by acting, for example, through a finger 21 on electric contacts 2, 3 and 4. The height of these contacts can be adjusted by any suitable means to afford a very accurate regulation of the moment at which the weight is raised and of the moment at which it commences to fall.

In Figure 1, the contacts 2, 3 and 4 are mounted on slides 71, 72 on which they can be fixed by means of pressure screws 90.

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According to the invention, two contacts are provided to determine the drop: the first contact 4 is situated in the neighbourhood of the upper end of the path of the weight and serves to determine the normal drop for the drop forging operation. The second contact 3 is situated at a substantially lower level and determines a much shorter drop serving, for example, to "finish" the drop-forged article after it has been trimmed.

The general operation of the machine is as follows: the weight 20 is attached in the usual manner to a board or thick belt 22 which is gripped between two rollers 23, 24 when they are brought together. These rollers are continuously driven with a rotational movement, for example from a motor 25 (Figure 1) which transmits its motion through a belt 26 to pulleys 27 keyed on the shafts 28 of the rollers. The roller 23 is fixed. The movement of the roller 24 towards or away from roller 23 is controlled by a piston 16 (Figure 3) on the rod 82 of which are mounted bearings 29 in which the shaft 28 of the roller 24 rotates and which slide on the slides 120. As the piston 16 moves in the cylinder 30, the movable roller 24 approaches or moves away from the fixed roller 23 and consequently the belt 22 is gripped or released. When the belt is gripped, it is driven upwards by the rollers and raises the weight 20. On the other hand when the rollers move away from each other, the weight 20 falls under its own weight.

According to the invention the movement of the piston 16 is regulated from a pneumatic distributor, the operation of which is in turn controlled by electric relays actuated by the contacts 2, 3 and 4. One embodiment of this control arrangement is described hereafter.

To maintain the tup in its raised position between two drop-forging operations, a retaining device or brake is provided comprising two jaws 31, 32 (Figure 6), one of which, 31, is controlled by the piston 3 moving in a cylinder 14. This movement is controlled by a distributor 7 which will be described in more detail. The distributor 7 is actuated by an electric relay 5, 6. The current is established or broken in this relay by a contact pedal 1 whose operation needs no effort.

Figures 2 and 4 show a return spring 63 which serves to bring the jaws 31, 32 together and to keep them closed when the piston 3 (Figure 6) is not actuated. Consequently, if the operation is stopped or if there is a breakdown the brake is applied automatically. The position of the fixed jaw 32 can be adjusted by means of an eccentric jaw 64 (Figures 4 and 6) which in turn is controlled

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by a lever 67 (Figure 2) and a rod 68 of which an adjustment nut 69 allows the position to be adjusted.

The normal operation is broadly as follows: when the operator applies pressure to the pedal 1, the jaws 31, 32 of the brake open and the weight falls. When the finger 21 touches the contact 2, the rollers 23, 24 approach and the weight rises until the instant when the finger 21 touches the contact 4. At this instant the rollers recede and the weight falls and so on.

But if it is desired that the weight should drop from a lower level, then instead of contact 4, contact 3 is introduced into the circuit by a mechanism which will be described below so that the height of the drop is reduced.

A detailed description of the various mechanisms and of the electric connections is given below.

Figure 6 shows how the distributor is actuated by the action of the relay 5. The armature 6 of the relay 5 is attached to the rod 101 of a double piston valve 102. By means of a channel 103 and a channel 104, 105 in which a valve 102 is located, the double piston valve 102 connects the ends of the interior of the cylinder 14 either with a duct 106 for compressed air from a line C, or with apertures 107, or 109 communicating with the outer atmosphere.

It is clear that when the armature 6 is activated, the double piston valve 102 occupies its upper position and connects the right hand end of the cylinder 14 (Figure 6) with aperture 109, that is to say with the outer atmosphere, and the left hand end of the cylinder with line C, that is to say with the pressure. The reverse is true when the relay 5 is de-energised and when the armature 6 falls under the action of a spring 110.

Returning now to the mechanism for raising the weight 20, that is to say the rollers 23, 24, it is clear (Figures 3 and 6) that the roller 23 is fixed, but it is also clear that its position can be adjusted by means of screws 33 acting on the bearings 34 of the roller 23. (Figure 3). The screw 33 may be advanced or retracted by means of a nut 80 which is provided with a dog 81 (Figures 3 and 4) and a locking nut 35. By means of this arrangement the distance between the rollers is regulated to accommodate it to the thickness of the belt 22.

The mechanism for controlling the piston 16 is shown diagrammatically in Figure 5 and 6. The admission of fluid into the cylinder 39 (Figure 6) is controlled by a distributor P shown in detail in Figure 5 and in turn actuated by an electro-pneumatic servo-valve Q. The distributor comprises a sleeve 36 inside which slides a rod 33 carrying at its upper end a double piston valve 37, 39. The sleeve 36 is in constant communication by means of a channel 40 and ports 42 with a source of compressed air, and by means of ports 42 with an annular chamber 43 leading into a channel 44 opening to the cylinder 39. The lower part of the sleeve 36 is provided with an aperture 45 through which the air contained in the cylinder 39 escapes.

It will be readily understood that according to whether the valve 37, 39 places the ports 42 into communication with the channel 40 or with the aperture 45, pressure is exerted on the piston 16 or is released from the piston. The rod of the piston 16 is moreover subjected to the action of powerful return springs 18 acting on a transverse member 83. (Figure 3). When the piston

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is no longer under pressure, these springs immediately draw it to the rear and consequently swing the roller 24 clear of roller 23.

But the operation of the piston valve 37, 39 needs far greater force for direct control than can be produced by an electric control such as a solenoid. Therefore, in accordance with the invention a pneumatic servo-valve is provided and is described below. (Figure 5). This servo-valve comprises a body 47 within which moves a double piston valve 48, 49. Two rows of ports are provided in the body 47. The first row 50 communicates through a channel 51 with the duct 40 through which compressed air is supplied; the second series 52 communicates through a channel 53 with the upper end of the sleeve 36. Further the lower part 92 of the body 47 is open and communicates through an aperture 54 with the atmosphere.

The double piston valve 37, 39 is actuated in the following way:

The rod 55 of the piston valve 48, 49 is connected to the core 12 of a solenoid 12 (Figure 6), the operation of which is regulated by the contacts 2, 3 and 4, as will be seen later. Under the action of the solenoid 12 and an opposing spring 93, the rod 55 is raised or lowered and carries the piston valve 48, 49 with it. When the piston valve 48, 49 is in its raised position, the compressed air arriving at the ports 50 through the channel 51 and past a needle valve 57 has no outlet (position shown in Figure 5). But if the rod 55 is lowered, the piston 49 descends below the apertures 52, the compressed air passes through the ports 52 and reaches through channel 53 the upper part of the cylinder member 36 so that it causes the piston valve 37, 39 to descend (since air pressure is then applied to the upper end of 39) while overcoming the action of the return springs 56 situated outside the member 36. The action of the said return springs will be described later.

If at this instant the pistons 48, 49 rise again and take up the position shown in Figure 5, compressed air ceases to reach the piston 39, but the upper part of this piston is brought into communication through the channel 53 and the ports 52 with the lower part 92 of the body 47, and consequently with the apertures 54. The springs 56 cause the piston valve 37, 39 to rise, driving the air out through 54. At 57 a regulating needle-valve is seen for controlling the air inlet to the ports 50.

The return springs 56 are attached to a transverse member 58 keyed on the rod 38 of the pistons 37, 39 and sliding to and fro between stops 59, 60 (preferably lined with a shock-absorbing material). The lower stop 60 may be adjusted by means of a screw 61, which allows the adjustment of the travel of the piston valve 37, 39.

According to a feature of the invention, the escape of the air contained in the cylinder 39 through the aperture 45 during the return of the piston to the rear is directed towards the lower die 62 through the duct 95 and the aperture 96 so that the air is projected on to this die. It will be noticed that this blowing action occurs at the precise moment when the rollers 23, 24 recede, that is to say at the beginning of the drop of the weight 20. This results in an automatic "timing" of the blast of air.

The electric connections for the control of the solenoid 12 from the contacts 2, 3 or 4 will now be described. These contacts are shown in Figure

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6, in continuous lines for the position of rest of the tup (2 open, 3 and 4 closed), and in dotted lines in the position they take up momentarily during the passage of the finger 21. The installation assembly is fed with current from any current source whatever 98 connected to the two terminals A, B (Figure 6).

The contact 3 lies in a shunt circuit with respect to contact 4 between the points M and N (wires I, VI, and II—Figure 7).

The electric circuit II completed by closing contact 4 comprises a commutator or switch 9 controlled from contact 1. In the example shown, the commutator 9 is actuated by a rod 70 connected to the lever 10 for controlling the jaw 31 of the brake. The commutator is of the reciprocating type so that through the successive opening and closing of the jaw 31 on the jaw 32 of the brake, it is successively opened and closed, the jaw 31 having no action.

The solenoid 12 is maintained energised by a contact 17.

When the operator depresses the pedal 1, the current is established in the conductors IV, V, and the relay 5 is energised. The latter then attracts its armature 6. The piston 8 moves under the action of the distributor 7. The jaw 31 recedes and the brake is thus released. The weight 20 falls and closes the contact 2.

The circuit of the relay is then established by A, the point T, contact 2, wire III, solenoid 12, the point U, wire IV, and B and, as has been seen, the distributor P of the cylinder 30 is actuated, the roller 24 approaches roller 23 and the weight 20 is raised. In this position the commutator 9 is closed by the rod 70. The circuit of solenoid 12 is kept closed through A, contact 4, wire II, commutator 9, N, contact 17, solenoid 12, point U, wire IV and B. When the contact 3 is opened by finger 21 during the ascent of the weight (Figure 7), the situation is unaffected, because commutator 9 is closed, but when the weight 20 during its ascent opens contact 4, the solenoid 12 is no longer excited, rod 55 ascends under the action of the spring 93, and, through the mechanism already described, the roller 24 recedes from roller 23 and this causes the weight 20 to fall. The weight 20 then ascends up to contacts 4 for the free drop for as long as the pedal 1 is depressed. If the operator releases the pedal 1, the relay 5 ceases to be energised, the distributor 7 functions in the reverse direction and moves the piston 8 to the position shown in Fig. 6 so that the brake 31, 32 is locked. But at the same time the position of the commutator 9 is altered by the rod 70 so that the commutator 9 is now opened. When the operator again depresses the pedal 1, the relay 5 is again excited, the weight 20 falls and, when the finger 21 touches the contact 2 the mechanism Q, P, actuated by the energised solenoid 12 causes the weight 20 to re-ascend. At this moment the circuit is established as follows: A, contact 4, M, wire VI, contact 3, wire I, N, contact 17, solenoid 12, U, wire IV, and B.

In the wiring scheme shown in Figure 7 it can be seen that when contact 4 is closed and commutator 9 open, it is the closing of contact 3 which causes a break in the current in the solenoid 12 and, consequently, the fall of the weight. As a result the weight 20 rises only up to the level for which the finger 21 touches the contact 3. At this moment the solenoid 12 is de-energised and, as has been seen, the weight drops. This ascent up to the contact 3 and then a free

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drop is continued for as long as the operator keeps the pedal 1 depressed.

It can be seen that successive pressing of the pedal 1 by the operator causes the weight 20 to fall alternately from the level 4, or the higher level, and from the level 3, or the lower level, and this corresponds to the condition in which the tup is normally used. However, for one reason or another, it may be desired that successive depressions on the pedal should produce a succession of falls of the weight from the higher level. To this end a contact 99 shunting the commutator 9 (Figure 7 dotted lines), is introduced to enable, by a manual operation, the maintenance of the circuit established between the points M and N whether the commutator 9 is opened or closed, that is to say, to keep the contact 3 inactive.

I claim:

1. A control system for a tup comprising a first fluid motor to apply and release a brake, a second fluid motor to move a pair of rollers toward and away from each other, a source of electric current, first and second electric windings, a source of fluid pressure, first and second valves interposed between said source of fluid pressure and said first and second motors, respectively, to control the operation of said motors, said first and second valves being actuated by energization by said first and second windings, respectively, a first manually actuated switch connected between the source of current and the first winding, a lower electric switch and two upper electric switches, means to adjust the vertical spacing between said switches, said upper and lower switches being electrically connected between the source of current and the second winding, means movable to successively close the lower and upper switches, and another switch connected between the source of current and said second winding, the last-mentioned switch being actuated at each closing of the first switch to alternately render the second winding responsive to opening of one or the other of the two upper switches.

2. A control system for a tup comprising a first fluid motor to apply and release a brake, a second fluid motor to move a pair of rollers toward and away from each other, a first electric winding having an armature to control said first fluid motor, a second electric winding having an armature to control said second fluid motor, a source of electric current, electric circuits connecting the said source of current and the two electric windings, a first manually actuated switch connected in the circuit between the said source of current and the first winding, a series of three electric switches vertically arranged above each other, means to adjust the vertical spacing of said switches, means connecting said series of three switches in the electric circuit connected to the second winding, a member having a projection movable past said switches and cooperating with each one of the series of three switches to actuate them in succession, another switch in the circuit of the second winding to activate selectively one or the other of the two upper switches of the series of three switches, and means responsive to actuation of said first fluid motor to control said another switch.

3. The control system set forth in claim 2 in which said second fluid motor comprises a first distributor having a cylinder provided with inlet and exhaust ports, a double piston valve movable in said cylinder and another distributor having a double piston valve controlled by the second

electric winding to supply compressed fluid selectively to either side of the double piston of the first distributor and exhaust fluid from the other side.

4. A control system for a tug comprising a first fluid motor to apply and release a brake, a second fluid motor to move a pair of rollers toward and away from each other, a source of current, a first electric winding to control said first motor, a first manually actuated switch connected to said winding to actuate said first motor in one direction, a second electric winding to control said second fluid motor, three vertically spaced switches electrically connected to said second winding to de-energize and energize said winding, means to adjust each of said three switches vertically, a finger movable past said three switches for actuating each of said three switches when it passes in front of same, and a fifth switch responsive to actuation of the first fluid motor, said fifth switch selectively activating and inactivating the middle switch of said three switches.

5. The control system set forth in claim 4 comprising an armature attracted by the second winding when the lowest of said three switches is closed, a holding circuit having connected in series the uppermost of the three switches and the fifth switch, means connecting the armature to said fifth switch to alternately open and

close said fifth switch, and a shunt circuit containing the middle switch of said three switches for shunting the fifth switch.

6. The control system set forth in claim 4 comprising an armature attracted by the second winding when the lowest of said three switches is closed, a holding circuit having connected in series the uppermost of the three switches and the fifth switch and another manually operated switch to shunt the fifth switch to render the middle switch of said three switches ineffective.

7. The control system set forth in claim 2 in which the said second fluid motor comprises a first distributor having a cylinder provided with inlet and exhaust ports, a double piston valve movable in said cylinder, another distributor having a double piston valve controlled by the second electric winding to supply compressed fluid selectively to either side of the double piston of the first distributor and exhaust fluid from the other side and a conduit for conducting exhaust fluid to a predetermined point.

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