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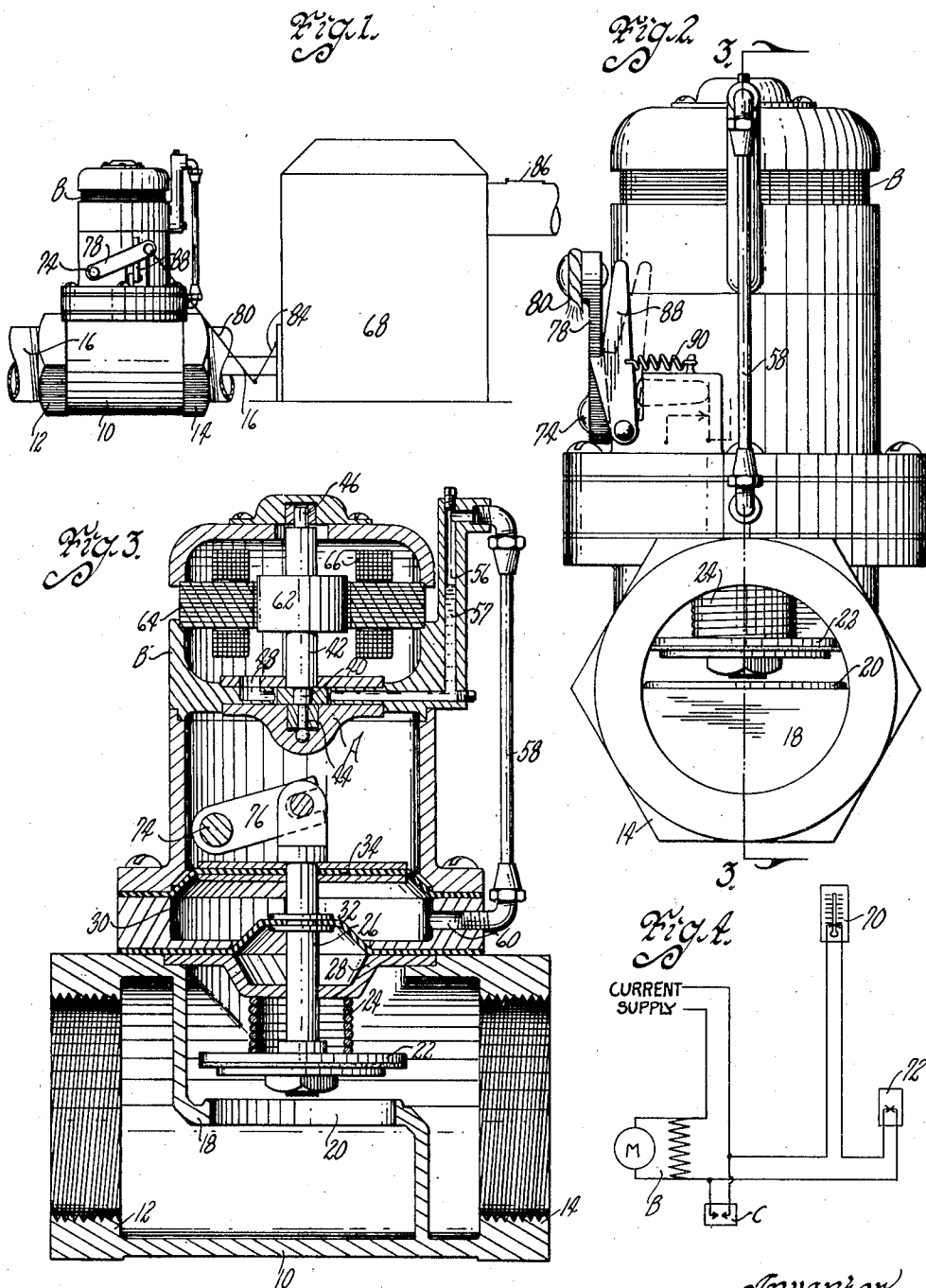
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2,020,618

ELECTRIC CONTROL STRUCTURE

Filed Sept. 6, 1932

3 Sheets-Sheet 1



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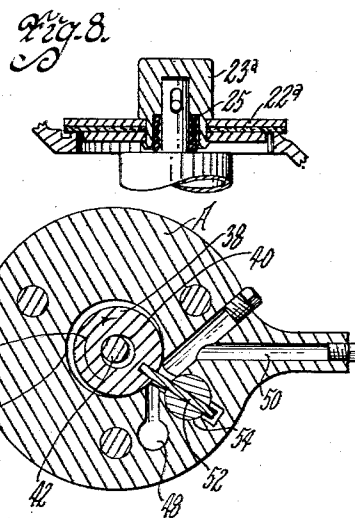
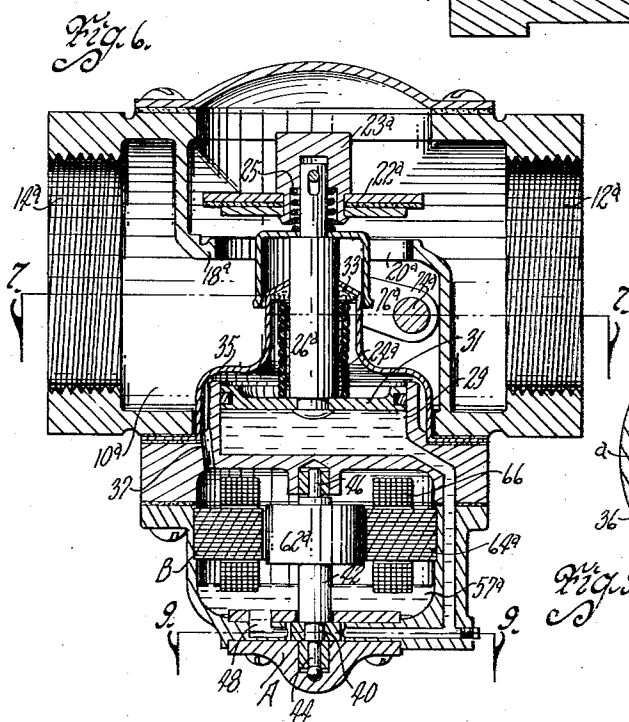
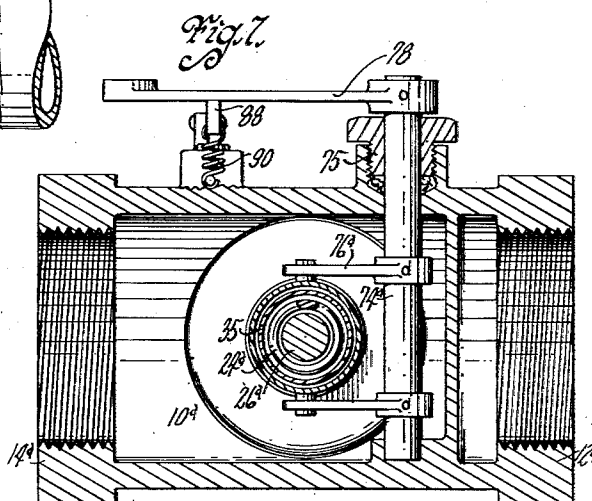
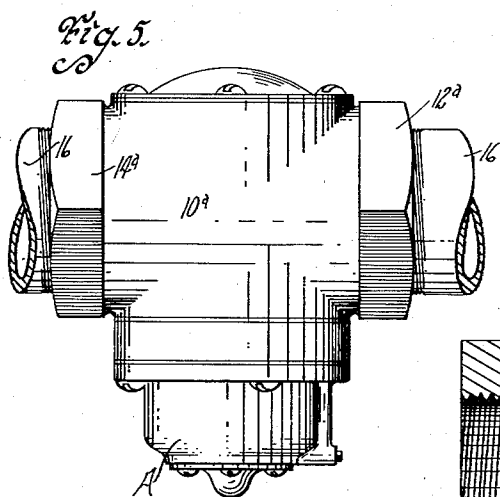
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ELECTRIC CONTROL STRUCTURE

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3 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRIC CONTROL STRUCTURE

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a corporation of Iowa

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6 Claims. (Cl. 60—52)

The object of my invention is to provide an electric control structure which is simple, durable and comparatively inexpensive to manufacture.

5 A further object is to provide a control structure electrically operated for the purpose of opening a valve or operating other controlling devices whenever energized, said structure upon being de-energized allowing said valve or other device to
10 return to its initial position.

Still a further object is to provide in combination with a controlling device constrained to remain in one position, a means for moving it to an opposite position whenever such means is energized and for maintaining the controlling device
15 in such opposite position until deenergization of the means so that the controlling device can then be returned to its first position because of being constrained toward such position.

20 Still a further object is to provide a controlling device and means for moving it from one position to another comprising an expansible pressure chamber in operative connection with the controlling device and an electrically operated
25 pump for placing a medium in the pressure chamber under pressure, the controlling device being arranged with stop means so that when it assumes a position because of expansion of the pressure chamber, the pump can continue to operate because of the slippage of the medium relative thereto, so that when an electric motor is used for
30 operating the pump, it will then continue to operate as long as energized, the continuing operation being at a relatively lower speed but not stalling the motor.

35 Still a further object is to have the pump force air into the pressure chamber and to provide an oil seal in connection with the pump which when forced back through the pump when the motor is de-energized will thereafter permit air to quickly
40 pass through the pump and thus permit the controlling device to assume its initial position with a snap action.

45 Still a further object is to provide a connection between an oil pump and a valve to be opened thereby, which includes a movable member automatically operable to permit by-passing of oil from the pressure chamber and around the pump
50 when return movement of the valve to closed position occurs.

Still a further object is to provide a modified form of pump having novel features of construction.

55 Still a further object is to provide a starting switch for the controlling device.

With these and other objects in view my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in
5 my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a side elevation of an electric control structure embodying my invention and showing it diagrammatically connected with a gas
10 burning furnace.

Figure 2 is an elevation on an enlarged scale of the right side of the device shown in Figure 1.

Figure 3 is a vertical sectional view on the line 3—3 of Figure 2.

15 Figure 4 is an electrical diagrammatic view showing my control structure as applied to a room heating electric circuit.

Figure 5 is a side elevation of a modified form of the invention.

20 Figure 6 is a vertical sectional view on an enlarged scale of the device shown in Figure 5.

Figure 7 is a sectional view on the line 7—7 of Figure 6.

25 Figure 8 is a partial sectional view showing the valve closing parts of Figure 6 in a different position.

Figure 9 is an enlarged sectional view on the line 9—9 of Figure 6.

30 Figure 10 is a side elevation of a modified form of construction in which the pump is of a different type.

Figure 11 is a vertical central sectional view through the valve shown in Figure 10.

35 Figure 12 is a sectional view on the line 12—12 of Figure 11.

Figure 13 is a sectional view on the line 13—13 of Figure 11; and

40 Figure 14 is a view somewhat similar to the lower part of Figure 11 showing the parts in a different position.

On the accompanying drawings, I have used the reference numeral 10 to indicate a valve casing. The valve casing 10 has an inlet 12 and an outlet 14. The valve is adapted to control
45 the flow of gas through a pipe line 16, although it can be used for controlling air or liquid.

The valve casing 10 has therein a partition 18 in which is located a valve seat 20. A valve disk 22 is adapted for coaction with the valve seat 20 and is normally retained in contact there-
50 by a spring 24.

The valve disk 22 is mounted on a valve stem 26 slidably mounted in a cover plate 28. Above the cover plate 28 I provide a pressure chamber

30 through which the valve stem extends. The valve stem is sealed relative to the pressure chamber by diaphragms 32 and 34. The diaphragms are of different effective areas whereby expansion of the pressure chamber will move the valve disk 22 upwardly against the action of the spring 24.

Thus far a normally closed valve has been described which can be opened by introducing a medium under pressure into the pressure chamber 30 or placing a medium therein under pressure. In Figure 3, the medium is merely air. The air can be placed under pressure, or in other words, compressed and for this purpose I provide a pump A operated by an electric motor B.

The pump A includes a chamber 36 (see Figure 9 wherein the pump shown is the same as the one in Figure 3). Within the chamber 36, a rotor 38 is mounted on an eccentric portion 40 of a motor shaft 42.

The motor shaft 42 has ends 44 and 46 suitably journaled in bearings. It will be obvious that rotation of the motor shaft 42 will cause the rotor 38 to wobble within the chamber 36.

In communication with the chamber 36, I provide an inlet 48 and an outlet 50. The inlet and outlet are sealed relative to each other by a blade 52 secured to the rotor 38 and slidably extending between a pair of oscillating members 54. Rotation of the rotor 38 in the direction of the arrow *a* will pump air, oil, or the like from the inlet 48 to the outlet 50.

The outlet 50 is connected by a stand pipe 56 and a tube 58 with an intake port 60 of the pressure chamber 30. The motor B includes an armature or rotor 62 on the motor shaft 42, stator laminations 64 and stator windings 66. The motor may be of any desired type, the one shown being for alternating current in which the windings 66 only are energized. The rotor 62 has short circuited windings and the stator 64 is of the shaded pole type.

Heretofore it has been customary to provide an electric motor mechanically connected with a valve to open the valve and when it is fully opened, the motor stalls while still energized, a spring or other means being provided to return the valve to closed position when the motor is de-energized. The spring rotates the motor backwards usually through a train of gearing.

Such a device has the disadvantage of making considerable noise and producing considerable heat in the motor due to the fact that a stalled motor will carry more current than one which is operating. Especially when alternating current is used, noise is produced which is objectionable. I have provided a construction, however, which operates as follows.

Upon energization of the coils 66, the rotor 62 will rotate for operating the pump rotor 38. A small quantity of oil 57 is carried in the casing of the motor B and at first this oil will be pumped into the stand pipe 56 and thereafter air will be pumped from the motor casing through the oil and into the pressure chamber 30 for expanding it. This opens the valve disk 22. When spring 24 has been fully compressed, it acts as a positive stop so that the valve cannot be opened any further. The parts of the pump A need not be accurately machined because it is desirable to have a slight leakage through the parts. This is so that when the valve 22 is fully opened, the rotor 62 will continue to rotate with the air

slipping relative to the pump so that although the pressure in the chamber 30 may be slightly increased, the valve will not be opened any further and the electric motor will simply continue to rotate at a relatively lower speed, such speed, of course, depending on the amount of slippage.

The oil seal 57 serves to lubricate and seal the parts of the pump so that air can be pumped at a substantial pressure thereby and also serves the purpose of providing snap-like action.

When the coils 66 are de-energized, the spring 24 will tend to close the valve 22. This contracts the pressure chamber 30 forcing the air back through the tube 58 and through the stand pipe 56.

At first, the oil 57 will slowly leak through the pump and back to the motor casing. As soon as all the oil has passed the pump, the air will quickly leak through the pump, thereby insuring a snap action for the closing of the valve disk 22.

In Figure 1, I have shown how my control device may be connected with a gas burning furnace 68. It merely controls the flow of gas through the pipe 16, a suitable pilot light being provided to prevent extinguishment of the flame. The motor B is connected in an electric circuit with a room thermostat 70 as shown in Figure 4 and a furnace thermostat 72 in the ordinary manner. By this arrangement, when the room temperature lowers to a predetermined degree, the motor will be energized and when the temperature rises to a predetermined degree because of operation of the furnace, the motor will be de-energized. The furnace thermostat 72 cuts off the supply of current to the motor B if the furnace becomes excessively hot before the room thermostat is satisfied.

In connection with my control device I have shown a starting switch C which can be used for initially starting the operation of the control structure or starting it after repairs are made.

I have also shown a damper control which can be used in connection with the furnace 68 if desired. The damper control is merely a rock shaft 74 connected by a yoke 76 with the valve stem 26 and by an arm 78 and a chain 80 with the draft door 84 of the furnace. Thus when the valve 22 is opened, the draft door 84 will be opened and vice versa. A check door 86 is illustrated, but in a furnace converted to use a gas burner, this door is left in closed position.

The starting switch C is associated with the arm 78 in the following described manner. The switch C is normally open as caused by a latch 88 and a spring 90. When it is desired to start the operation of the furnace, the lever 78 may be swung upwardly for opening the valve 22 and the latch 88 may then be swung to position under the lever 78 whereafter the lever 78 may be allowed to raise and the spring 24 will swing the lever down against the shoulder of the latch 88 for holding it in the full line position of Figure 2. Thereafter the pump A will again slightly compress the spring 24, which will release the latch 88, allowing it to return to its initial position and the control device can then operate automatically.

In Figures 5, 6, 7 and 8 I have shown a modified form of construction in which the gas valve is opened entirely by oil under pressure rather than by compressed air and an oil seal. Many parts in these figures correspond with the parts of the previous figures and are given the same reference

numerals with the addition of the distinguishing characteristic *a*.

The pressure chamber in this type of valve consists of a cylinder 29 and a piston 31 therein. A considerable quantity of oil 57*a* is carried in the housing of the motor B with the rotor 62*a* operating in the oil. It is necessary to provide a packing 33 in this type of valve. It is held tight by the spring 24*a*.

The valve disk 22*a* is carried by a head 23*a* which is slidable relative to the valve stem 26*a*. It is limited in its sliding movement and constrained toward one position by a spring 25. The purpose of this construction is to provide snap action which is lacking because oil is used instead of an air with oil seal arrangement as in the first three figures of the drawings.

The operation of the valve disk 22*a* from open position in Figure 6 to the closed position in Figure 8 is first; slow closing of the valve disk 22*a* until slightly spaced from the seat 20*a*, whereupon the gas pressure in the inlet 12*a* will act upon the valve disk to quickly close it against the tension of the spring 25. This is illustrated in Figure 8. In opening the valve, it will first be slowly opened until the tension of the spring 25 can overcome the pressure of the gas on the valve disk, whereupon the disk will be quickly opened by the spring 25 and will then assume the position of Figure 6.

It will be noted that a housing 35 is provided over the spring 24*a*. Any oil leaking past the piston 31 will enter this housing and can return to the housing of the motor B through a passageway 37.

In this type of valve, the rock shaft 74*a* must necessarily be packed as indicated at 75. I have provided an electric motor operated controlling device in which a motor can continue to operate as long as it is energized instead of being stalled when the controlling device assumes other than initial position as caused by operation of the electric motor. Continuing the rotation of the motor as long as it is energized takes less current than when the motor is stalled and there is less strain on the physical parts of the device. All of this is possible because of the slippage of the oil or air relative to the pump and this same slippage feature permits closing of the valve without the necessity of the closing spring having to be strong enough to rotate the motor reversely after it is de-energized.

In Figures 10 to 14 inclusive, I have shown a modified form of pump construction and an automatically operable member effective to by-pass oil from the pressure chamber to the reservoir of the controlling device instead of letting it flow back through the pump. Parts in these figures corresponding to parts of the previous figures are given the same reference numerals with the addition of the character *b*.

The pump comprises a casing 92 which, as illustrated on the drawings, forms an end plate for the motor B. The casing 92 is in the form of a disk and has cylinder bores 94 extending radially in the form of a cross, as best shown in Figure 12.

A crank shaft bore is indicated at 95. The heads of the cylinders 94 extend toward each other and communicate with the bore 95 by means of passageways 96.

Within each cylinder 94, is a piston 98 and each piston has a pin 100 extending therefrom. The pin 100 extends through a slot 102 of the casing 92.

A crank shaft 104 extends through the bore 95

and has a crank pin 106 thereon. A pair of disks 108 are rotatable on the pin 106 and are each rigidly connected with a connecting rod 110 aided by brazing or the like indicated at 111. The connecting rod 110 is pivoted to one of the pins 100, while three other connecting rods 112 are each pivoted to the pair of disks 108 and to the three remaining pins 100.

An intake 114 is provided in the casing 92 and an outlet depression 116 is provided between the disk 108 next to the casing 92 and the casing itself.

Depressions 118 and 120 are milled in the crank shaft 104 to serve as intake and exhaust ports, respectively. These ports are opposite each other 15 and arranged with respect to the pistons 98 so that the oil can be taken into one cylinder and discharged from the opposite cylinder during rotation of the motor armature. There are, accordingly, four intake strokes and four outlet 20 strokes per revolution of the crank shaft 104.

The outlet passageway 117 communicates at one end with the outlet space 116 and at its other end with the pressure chamber or cylinder 29*b*. Between the pump and the cylinder I provide a bore 122 in which a member 124 is movable. As shown in Figure 11, this member in one position closes a by-pass opening 126. The member 124 has a check valve 128 therein opening toward the pressure cylinder 29*b*. When the oil begins to flow from the pump to the pressure cylinder, the check valve 128 is held closed by its spring so that the member 124 moves bodily toward the left to block up the opening 126. Thereafter the pressure of the oil will open the check valve and the oil will then be permitted to flow into the cylinder 29*b*.

The member 124 prevents the necessity of allowing the oil upon the return stroke, as caused by expansion of the spring 24*b* after the motor is de-energized, from passing through the pump. This is accomplished by the operation shown in Figure 14 wherein the member 124 is shown in its other position. As soon as the oil starts to return, the valve 128 will be closed by its spring and the member 124 will be moved bodily toward the right by the oil, whereupon the by-pass opening 126 will be opened so that the returning oil can pass directly through this opening and into the casing for the motor B. This permits a quicker return of the valve to closed position than when the oil has to be forced through the slight clearance spaces provided in the pump.

The member 124 has been illustrated in connection with the specific pump shown in Figure 11 but can be used with the pump shown in Figure 6 equally as well. In either construction it will function the same.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. In a control structure, a controlling device movable to opposite positions, means constraining said device to remain in one of said positions and mechanism to move said controlling device to its opposite position against such restraint, said mechanism comprising an expansible pressure chamber, air therein, said expansible pressure chamber being in operative connection with said controlling device to move it to such opposite

position upon said air being compressed to thereby expand said pressure chamber, pump and motor means to compress said air and means to limit the movement of said controlling device to said opposite position, a quantity of oil being provided to seal said pump relative to said pressure chamber, said oil being trapped adjacent said pump during operation thereof, the means constraining said controlling device to remain in its first mentioned position serving to contract said pressure chamber and force said oil past said pump and then allow escape of compressed air from the chamber all after said motor means ceases to operate.

2. In a controller, an expansible chamber, a gaseous medium therein, a pump for pumping said medium, means for operating said pump, a passageway connecting said pump with said expansible chamber, a trap portion in said passageway and a liquid seal normally filling said pump but entering said trap portion when the pump operates, and being held by gravity within the trap portion against the action of said medium, while it is being pumped into said expansible chamber, said medium being so pumped passing through said liquid seal.

3. In a controller, an expansible chamber, a gaseous medium therein, a pump for pumping said medium, means for operating said pump, a passageway connecting said pump with said expansible chamber, a trap portion in said passageway and a liquid seal normally filling said pump but entering said trap portion when the pump operates, and being held by gravity within the trap portion against the action of said medium, while it is being pumped into said expansible chamber, said medium being so pumped passing through said liquid seal, said liquid upon the return of the medium from said expansible chamber to said pump being first driven through the pump by the medium, whereafter the medium can leak rapidly through the pump for collapsing the expansible chamber.

4. In a controller, an expansible chamber, an air pump, means for operating said air pump, a passageway connection between said pump and said expansible chamber having a trap portion

extending upwardly from said pump and a liquid seal normally filling said pump but entering said trap portion when the pump operates and held by gravity within said trap portion against the action of air being pumped into said expansible chamber, such air being so pumped passing through said liquid.

5. In a controller, an expansible chamber, an air pump, means for operating said air pump, a passageway connection between said pump and said expansible chamber having a trap portion extending upwardly from said pump and a liquid seal normally filling said pump but entering said trap portion when the pump operates and held by gravity within said trap portion against the action of air being pumped into said expansible chamber, such air being so pumped passing through said liquid, said liquid, upon the return of air from said expansible chamber to said pump, being first driven through the pump by the air whereafter the air can leak rapidly through the pump for collapsing the expansible chamber.

6. In a control structure, a controlling device movable to opposite positions, means constraining said device to remain in one of said positions, and mechanism to move said controlling device to its opposite position against said restraint, said mechanism comprising an expansible pressure chamber, a gaseous medium therein, said expansible pressure chamber being in operative connection with said controlling device to move it to such opposite position upon said medium being compressed to thereby expand said pressure chamber, pump means to compress said medium, a quantity of liquid being provided to seal said pump relative to said pressure chamber, said liquid being trapped adjacent said pump during operation thereof, the means constraining the controlling device to remain in its first-mentioned position serving to contract said pressure chamber and force said liquid past said pump and then allow escape of the medium from said chamber, all after said pump ceases to operate.

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