Dec. 9, 1930. L. R. HUFF 1,784,009

CONSTANT VOLUME REGULATOR

Filed Jan. 30, 1930 3 Sheets-Sheet 1

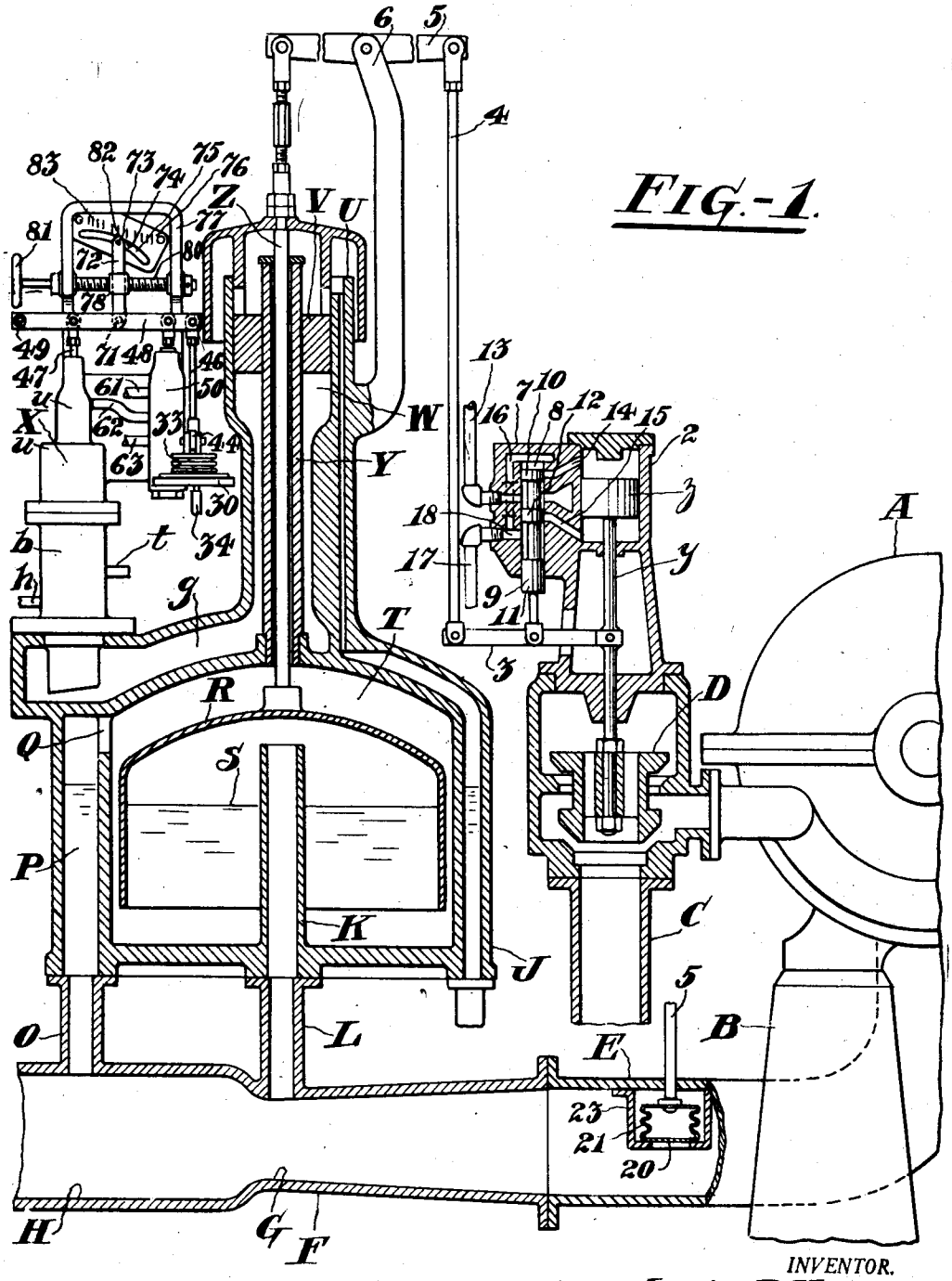


FIG.-1.

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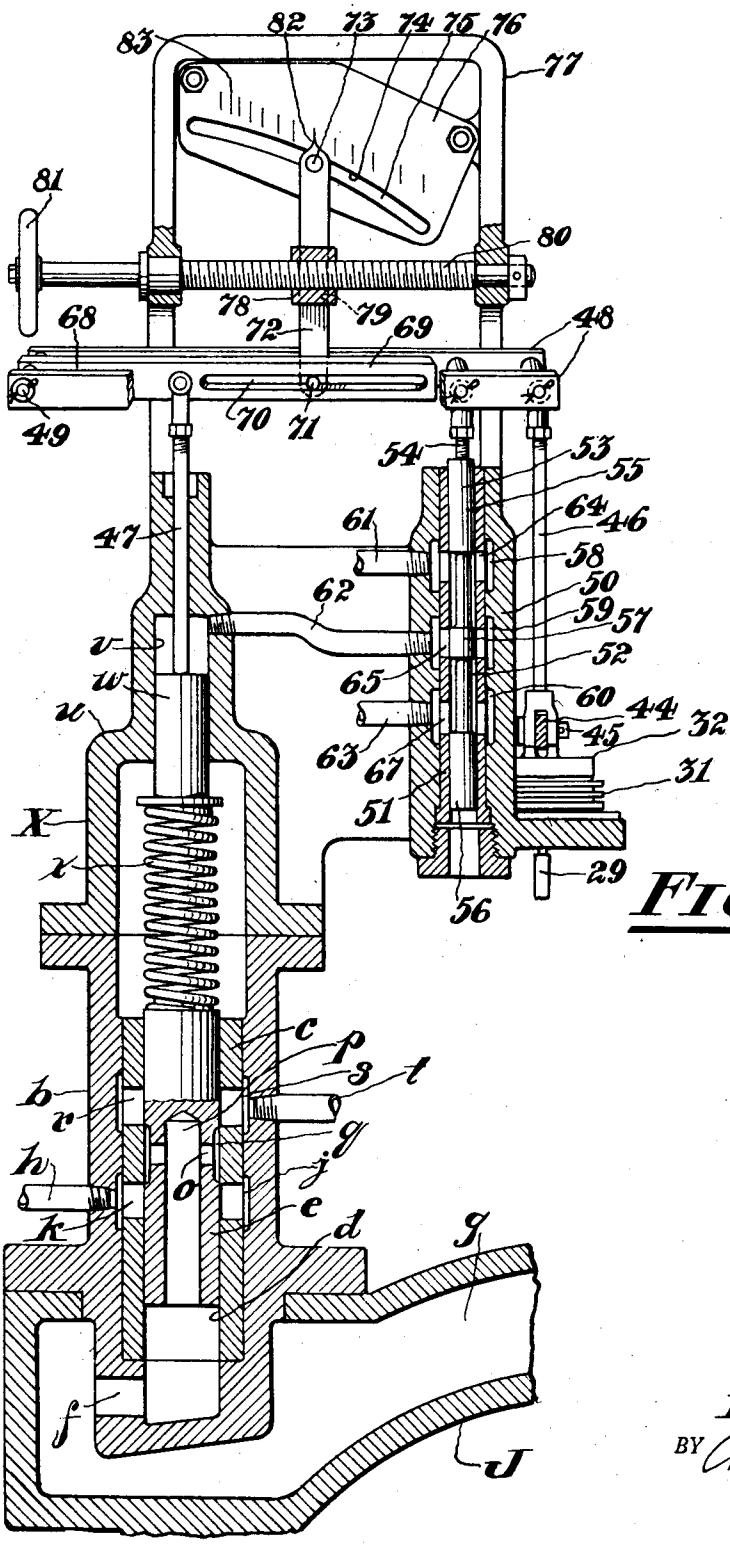


FIG.-2.

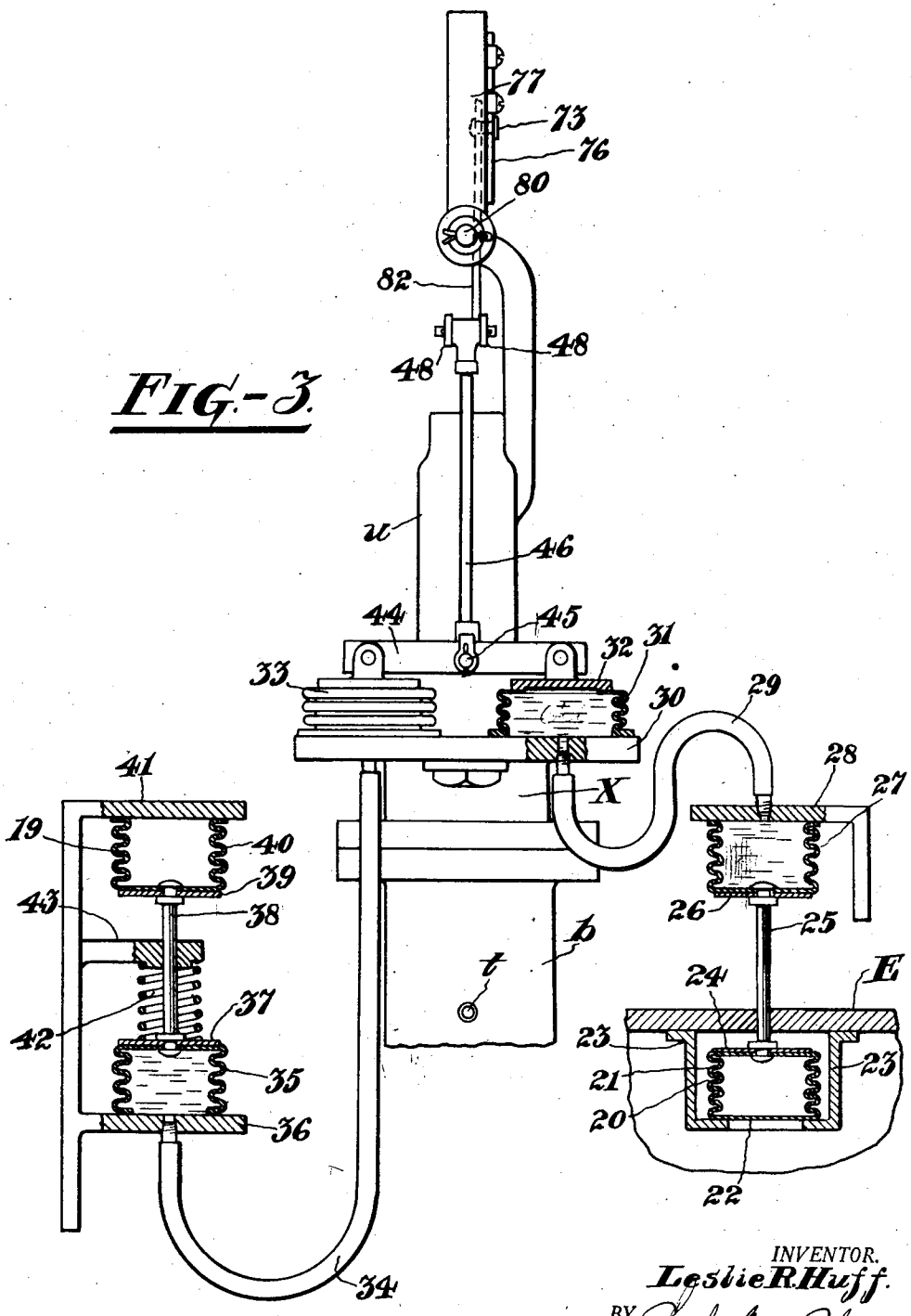
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Filed Jan. 30, 1930 3 Sheets-Sheet 3

FIG.-3.



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UNITED STATES PATENT OFFICE

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CONSTANT-VOLUME REGULATOR

Application filed January 30, 1930. Serial No. 424,708.

This invention relates to volume regulators, but more particularly to a constant volume regulator for turbo blowers, turbo compressors and the like.

The objects of the invention are to insure a constant discharge volume of the turbo blower or other similar machine irrespective of any fluctuations which may occur in the discharge pressure of the machine and irrespective of any fluctuations which may occur in the atmospheric pressure and the temperature of the air flowing to the blower.

Other objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawings and in which similar reference characters refer to similar parts,

Figure 1 is an elevation partly in section of a constant volume regulator constructed in accordance with the practice of the invention and showing the manner in which the regulator may be connected for controlling the intake volume of a turbo blower,

Figure 2 is a sectional elevation of the pressure fluid control valve and the means for applying pressure fluid to the control valve for actuating it, and

Figure 3 is a side elevation of the control valve and the elements whereby the said valve is controlled.

Referring to the drawings, A indicates a turbo blower which is shown supported by a foundation B. Steam may be conveyed to the motor whereby the blower A is driven through a pipe C containing a valve D for controlling the steam supply to the motor.

The turbo blower A is provided with the usual intake conduit E having interposed therein a Venturi tube F which accordingly has a restricted throat portion G and an outer enlarged portion H through which the air flows from the atmosphere to the restricted portion G.

Disposed adjacent the Venturi tube F is a receptacle J the interior of which communicates with the restricted throat portion G of the Venturi tube through a pipe K. The pipe K may form a part of the receptacle J and communicates with the Venturi tube through a pipe L illustrated as forming a part of the Venturi tube F.

Leading from the enlarged portion H of the conduit E is a pipe O which communicates with a passage P in the side of the receptacle J. The upper end of the passage P communicates with the interior of the receptacle J through a port Q.

Within the receptacle J is a bell float R which is inverted and into the interior of which extends the pipe K. The receptacle may be partially filled with a suitable liquid, such as water S, to prevent communication between the interior of the bell float and the upper portion of the chamber T in the receptacle J. In this way a suction may be created in the interior of the bell float R by the velocity of the air flowing through the restricted portion G of the conduit E and, by communicating the chamber T in the receptacle J with the enlarged portion H of the conduit E, a portion of the air in the chamber T will be exhausted or drawn therefrom. However, owing to the difference in the velocity of the air during its passage across the outlet openings of the pipes O and L a slightly higher pressure will exist exterior of the bell float R than will exist within said float.

Suitable means are provided for counterbalancing the force of the suction acting on the bell float R. To this end a cylinder U is disposed on the receptacle J to receive slidably a regulator piston V which is adapted to be actuated by liquid, such as oil under pressure.

The oil is admitted into the piston chamber W in the cylinder U by a control valve mechanism which is designated generally by X and in this instance is also supported by the receptacle J.

The piston V may encircle a sleeve Y which is threaded into the receptacle and may be of such length that its uppermost end will extend to a point above the piston V. The sleeve Y being hollow may serve as a guide for a rod Z which extends therethrough and is connected at one end to the bell float R and at a point near its other end to the piston V. The rod Z thus serves to hold the bell float

R and the piston V in spaced relation with respect to each other and preferably the connection between the rod Z and the bell float R is such that the bell float R may automatically adjust its position with respect to the level of the water S.

The control valve mechanism X may be of a known type comprising a casing *b* which may be suitably secured to the receptacle J. Within the casing *b* is a bushing *c* which has a bore *d* to form a guide for a control valve *e* which is adapted to reciprocate within the bushing *c*. At the lower end of the bore *d* and in the casing *b* is a port *f* which opens into a passageway *g* in the receptacle J and through which passageway oil or other liquid under pressure may pass into the piston chamber W to act against the piston V.

The oil under pressure used for this purpose is conveyed to the control valve *e* by a pipe *h* which opens into an annular port *j* in the casing *b*. Within the bushing *c* are a series of radial ports *k* which are in constant communication with the annular groove *j*.

The control valve *e* is in turn provided with radial ports *o* which are adapted to register with the ports *k* for admitting pressure fluid into a passage *p* in the valve *e* and opening at its lowermost end into the bore *d*.

In the periphery of the valve *e* is an annular passage *q* which communicates with the ports *o* and is also adapted to establish communication between the ports *o* and drain ports *r* in the bushing *c* and located above the ports *k*. Threaded into the casing *b* and adjacent the ports *r* wherewith it is adapted to communicate through an annular groove *s*, is a drain pipe *t* which may lead to a sump or a source of oil supply for returning thereto any oil which may be either by-passed from the bore *d* or which, through leakage, may find its way to the ports *r*.

On the top of the casing *b* is a cover *u* which may be secured to the casing *b* in any suitable manner and is provided with a chamber *v* wherein is disposed a reciprocatory plunger *w*. A spring *x* is interposed between the plunger *w* and the control valve *e* to transmit the movement of the plunger to the valve *e* and vice versa.

Connected to the valve D is a rod *y* having connected to its upper end a piston *z* reciprocable within a cylinder 2 which is supported by the pipe C. A lever 3 is pivotally connected to the rod *y* with one end and is pivotally connected at its other end to the end of a rod 4. The opposite end of the rod 4 is also pivotally connected to a lever 5 which itself is pivoted to an arm 6 carried by the cylinder U. The lever 5 in this instance overlies the piston V and is pivoted to the rod Z which carries the piston V.

The linkage between the piston V and the lever 3 and the connection between the lever 3 and the rod *y* is such that the said lever 3 is actuated upon movement of either the piston *z* or the piston V.

On the side of the cylinder 2 is a valve chest 7 having a valve chamber 8 therein to receive a reciprocable pilot valve 9 which is pivotally connected at one end to the lever 3 and at a point intermediate the ends of said lever. The pilot valve 9 comprises a pair of end heads 10 and 11 and an intermediate head 12.

The function of the pilot valve 9 is to control the admission of oil under pressure to the opposite ends of the cylinder 2. Such oil is conveyed to the valve chamber 8 by a pipe 13 leading from a source of supply and communicating with the valve chamber 8 at a point intermediate the heads 10 and 12 of the valve 9.

Leading from a point near the uppermost end of the valve chamber 8 is a passage 14 which opens into the top of the cylinder 2 and a second passage 15 leads from the valve chamber 8 to the cylinder 2 beneath the piston *z*. The passages 14 and 15 serve both as admission and exhaust passages for the ends of the cylinder 2, and the oil exhausted from the top of the cylinder 2 may pass through a drain passage 16 in the valve chest 7 to a drain pipe 17 connected to the valve chest 7 and leading to an oil reservoir. The passage 16 also has a branch passage 18 which opens into the valve chamber at a point below the passage 15 so that in certain positions of the valve 9 the oil may pass directly from beneath the piston *z* to the drain pipe 17.

The operation of the device so far described is as follows: Assuming the turbo blower A to be running at normal speed the air flowing through the conduit E will create a suction within the bell float R thus tending to draw the said bell float R downwardly in the direction of the pipe K. At the same time the air flowing through the enlarged portion H of the conduit E will also draw or exhaust air from the chamber T, although the pressure within the chamber T will remain of a higher value than that within the bell float R.

The downward movement of the bell float R will be counteracted by the oil under pressure acting against the piston V and as long as the conditions in the discharge line of the blower remain the same the bell float R and the piston V together with the connecting linkage may remain substantially stationary. The control valve *e* will then occupy a position in which oil under pressure will flow from the supply line *h* through the ports *k* in the bushing *c* and through the ports *o* and the passage *p* in the valve *e* into the bottom of the bore *d*, thence through the ports *f* and the passageway *g* into the piston chamber W.

Whenever an increase in the resistance to the discharge pressure of the turbo blower A occurs the velocity of the air flowing through the conduit E will of course decrease as will

also the suction within the bell float R. The oil acting against the piston V will then predominate over the suction on the bell float R and will rock the levers 5 and 3 and the rod 4 about their pivots so that the pilot valve 9 will be drawn downwardly to a position where communication will be afforded between the oil supply pipe 13 and the inlet passage 15.

With the pilot valve in this position oil under pressure will flow into the cylinder 2 beneath the piston *z* and will raise the said piston *z* together with the valve D to admit an increased supply of power to the motor or engine whereby the blower A is being driven.

When the resistance in the discharge pressure of the blower again decreases the velocity of the air flowing through the conduit E will increase as will also the suction within the bell float R, so that the bell float and the piston V will be drawn downwardly. This movement of the piston V will be transmitted through the oil to the control valve *e* which will be raised against the pressure of the spring *x* until communication is established between the interior of the control valve and the drain pipe *t*, whereupon a portion of the oil in the passageway *g* may be by-passed to the source of supply.

During the downward movement of the bell float R the pilot valve 9 will be moved into a position by the levers 5, 3 and the rod 4 to establish communication between the oil supply line 13 and the passage 14 to admit oil in the top of the cylinder 2. At the same time the pilot valve 9 will establish communication between the passage 15 and the drain pipe 17 so that the oil previously admitted beneath the piston *z* may be drained therefrom, and the oil admitted on top of the piston *z* will act to move the valve D in the direction of its seat, thus reducing the supply of steam to the motor.

It will be observed from the foregoing description that the device so far described is intended to maintain a substantially constant discharge volume in the discharge line of the blower. The regulator functions to compensate for any fluctuations in the discharge pressure. As will be readily understood, such uniformity of the discharge volume is of course only possible in the event that the pressure and temperature of the air flowing through the conduit E remain uniform. Due, however, to changes in atmospheric conditions, such as variations in the temperature or in the weight of the air flowing to the blower the discharge volume of the blower may vary considerably from the desired volume.

The present invention contemplates the provision of means adapted to compensate for such fluctuations. To this end the regulator is provided with a pair of elements which are responsive to and are actuated by the atmosphere. One of these elements is designated generally by 19 and the other element by 20. The element 20 comprises a corrugated diaphragm or metallic bellows 21 which is preferably disposed within the conduit E and seated with its outer head 22 on brackets 23 secured to the interior of the conduit E. The head 22 may be termed the fixed head, and to the opposite or movable head 24 of the diaphragm 21 is attached a rod 25 to reciprocate with the head 24. The diaphragm 21 may be filled with a suitable volatile liquid which may readily respond to any variations in the temperature of the intake air for contracting and expanding the diaphragm 21.

Secured to the opposite end of the rod 25 is a head 26 of a collapsible diaphragm 27 which is supported by a plate 28 and which plate may act as a fixed head for the diaphragm 27. Threaded to the plate 28 or otherwise suitably secured thereto is a connection such as a hose 29 which is threaded at its opposite end to a plate 30 shown as being integral with the cover *u*.

Upon the plate 30 is seated a collapsible diaphragm 31 for one end of which the plate may form a head and having at its opposite end a movable head 32. The connection 29 affords communication between the interiors of the diaphragms 27 and 31 and said diaphragms, as well as the connection 29, may be filled with a suitable liquid, such as oil, so that the expansive and contractile movement of one diaphragm will be transmitted from one diaphragm to the other.

The element 19 likewise comprises a closed oil circuit consisting of a collapsible diaphragm 33 which may be suitably secured at its lower end to the plate 30 and a conduit 34 affords communication between the diaphragm 33 and a similar diaphragm 35 secured at its lower end to a plate 36 whereby it is supported.

Secured to the movable head 37 of the diaphragm 35 is a rod 38 which is attached with its other end to the movable head 39 of a diaphragm 40 disposed in alignment with the diaphragm 35. The diaphragm 40 may be secured with its upper end to a plate 41 so that the said plate may form a fixed head for this end of the diaphragm 40.

The interior of the diaphragm 40 is under a vacuum so that the atmospheric pressure acting against the head 39 of said diaphragm will tend to collapse the diaphragm. In order to counterbalance the air pressure on the diaphragm 40 a spring 42 is interposed between the head 37 of the diaphragm 35 and a spring seat 43 which is located between the movable heads of the diaphragms 35 and 40. The spring 42 may be suitably calibrated to exert a force on the diaphragm 35 sufficient to counterbalance the normal pres-

sure of the air against the head 39 of the diaphragm 40.

As will be readily apparent, the diaphragms 21 and 40 are the actuating diaphragms of the elements 20 and 19 respectively. The arrangement of these elements is such that when the diaphragms 21 and 40 contract or expand the pressure of the oil in the diaphragms to which they are attached will be increased or decreased so that a thrust will be imparted to the diaphragms 31 and 33 or that said diaphragms 31 and 33 will be allowed to contract when the pressure of the oil therein decreases.

Means are provided to transmit the movement of the diaphragms 31 and 33 and to utilize such movement of the diaphragms for automatically controlling the pressure within the chamber v to increase the tension of the spring x. To this end the movable heads of the diaphragms 31 and 33 are pivotally connected to the opposite ends of a bar 44 and intermediate the ends of the bar 44 is pivoted, as at 45, a rod 46.

The rod 46 extends upwardly and terminates in substantially the same plane as the corresponding end of a rod 47 which is attached to the plunger w and is guided by the cover u. The upper end of the rod 46 is pivoted to the corresponding ends of a pair of parallel levers 48 and said levers 48 may extend across the top of the cover u, although at a point some distance from the end of the cover, and may be connected to each other at their free ends and held in spaced relation with respect to each other by a pin 49.

Adjacent the diaphragms 31 and 33 is a valve chest 50 which may be supported by the plate 30 or may form an integral portion thereof as shown.

The valve chest 50 contains a bushing 51 which is bored to form a valve chamber 52 for the accommodation of a reciprocable pilot valve 53. A stem 54 on the pilot valve 53 is pivotally connected to the levers 48 and preferably at a point closely adjacent the point of connection between the rod 46 and the levers 48. The pilot valve 53 has upper and lower end heads 55 and 56 respectively and an intermediate head 57.

Encircling the bushing 51 are a series of annular grooves 58, 59 and 60. The groove 58 may be termed the uppermost groove and communicating therewith is a drain pipe 61 which may lead to an oil reservoir or sump (not shown). The groove 59 is located intermediate the grooves 58 and 60 and is in communication with the chamber v through a pipe 62, while the groove 60 is in communication with the source of oil under pressure through an inlet pipe 63.

Formed in the bushing 51 and adjacent the grooves 58, 59 and 60 are ports 64, 65 and 67 respectively to afford communication between the valve chamber 52 and the groove.

Preferably the heads 55, 56 and 57 are all of the same diameter so that the position of the pilot valve 53 will not be disturbed by the pressure of the oil acting thereagainst. Movement of the pilot valve 53 will only be effected by action of the elements 19 and 20.

Means are provided to enable an initial pressure to be manually applied to the control valve e for maintaining said control valve in substantially the correct position to assure approximately a predetermined discharge volume of the blower. The means illustrated include a lever 68 which is pivoted at one end on the pin 49 and is pivotally connected to the rod 47. The lever 68 is preferably disposed between the levers 48 and in the portion 69 of the lever 68 which lies between the rod 47 and the point at which the pilot valve 53 is connected to the levers 48 is a slot 70 to act as a guideway for a pin 71 carried by a spacer 72.

The spacer 72 is preferably disposed perpendicularly to the lever 68 and is provided at its other end with a pin 73 to bear against a cam surface 74 formed by an inclined slot 75 in a plate 76. The plate 76 may be suitably supported by a bracket 77 on the cover u and the valve chest 52.

The spacer 72 is held in substantially the desired position with respect to the lever 68 by a nut 78 having a guideway 79 through which the spacer 72 may freely slide. The nut 78 may be suitably threaded for cooperation with a hand screw 80 journalled in the bracket 77 and the hand screw 80 may be provided with a hand wheel 81 to enable the screw 80 to be conveniently rotated for actuating the nut 78 and therefore the spacer 72 longitudinally of the screw 80.

In order to conveniently indicate the position which the spacer 72 should occupy for applying the required pressure on the plunger w so that an approximately constant predetermined output volume of the turbo blower will be assured, the spacer 72 is provided with a pointer 82 to cooperate with calibrations 83 on the plate 76. The calibrations may be suitably marked to indicate different discharge volumes in cubic feet under standard conditions of the inflowing air.

The manner in which the atmospheric pressure and temperature elements 19 and 20 operate to compensate for fluctuations in the pressure and temperature of the air flowing to the blower A is as follows: Ordinarily, the bell float R, together with the piston V and the elements connecting these parts with the valve D serve to assure approximately a constant predetermined discharge volume for the blower A. As is well understood however, the temperature of the intake air and the pressure thereof may vary from that prevailing at the time the control valve e is set for a certain discharge volume, so that a greater

or lesser amount of air may pass to the blower and, in consequence of which, the discharge volume of the blower may subsequently vary to a considerable extent unless the speed of the blower is also varied to compensate for such fluctuations in the air conditions.

With the foregoing facts in mind, let it be assumed that after the spacer 72 has been set to indicate a certain discharge volume, and that the control valve *e* is therefore subjected to the necessary pressure to assure this volume. If then atmospheric conditions change so that the temperature of the air flowing through the conduit E is increased, the inflowing air will, by contacting with the diaphragm 21, cause the volatile liquid therein to expand and cause the head 24 of the diaphragm 21 to be actuated in the direction of the diaphragm 27.

Inasmuch that the head 26 of the diaphragm 27 is fixedly secured to the rod 25 the diaphragm 27 will be collapsed and a pressure is accordingly imparted to the oil therein. The pressure within the diaphragm 27 is communicated to the diaphragm 31 through the conduit 29 and the head 32 of the diaphragm 31 is raised somewhat, as are also the rod 46 and the levers 48 to which the rod 46 is attached.

Movement of the levers 48 in an upwardly direction will cause the pilot valve 53 to be raised. Oil under pressure will then flow from the annular groove 60 through the valve chamber 52 and through the pipe 62 into the chamber *v* to act against the plunger *w*.

The pressure thus acting against the plunger *w* will be communicated to the control valve *e* by the spring *x* so that the valve *e* will be moved into a position in which the area of communication between the ports *k* and the annular passage *q* will be increased. In this way the pressure within the passageway *g* will be increased and the piston V will therefore be moved in an upwardly direction.

The movement of the piston V is transmitted through the levers 5 and 3 and the rod 4 to the pilot valve 9 so that the pilot valve 9 will be moved downwardly into a position where free communication will be afforded between the intake pipe 13 and the passage 15 leading to the bottom of the cylinder 2. Oil will then flow into the cylinder 2 and act against the piston to raise said piston and open the valve D to wider limits.

By raising the valve D the supply of steam to the motor which drives the blower A will be increased and the speed of the motor and therefore of the turbo blower A will be accelerated. In this way the discharge volume of the blower may be maintained substantially constant, notwithstanding the increased volume of the air.

If, during the same period of operation, the temperature of the air flowing through the conduit E should decrease, the liquid within the diaphragm will contract and permit partial collapse of the said diaphragm. The pressure upon the oil in the diaphragms 27 and 31 will then be diminished so that the diaphragm 31 may again contract. The movement of the diaphragm 31 will be transmitted to the pilot valve 53 through the linkage connecting these elements, thus drawing the pilot valve 53 downwardly to cut off communication between the intake pipe 63 and the pipe 62.

As the temperature of the air in the conduit continues to decrease so that the diaphragm 31 is further collapsed the pilot valve 53 will be drawn downwardly to open communication between the chamber *v* and the drain pipe 61, whereupon the oil under pressure may escape from the chamber *v*.

In like manner, when the weight of the air acting against the diaphragm 40 of the element 19 reaches a value below that of the pressure exerted by the spring 42 the diaphragm 35 will be compressed by the spring. This will create a pressure on the oil in the diaphragms 35 and 33 so that the bar 44 will be raised by the diaphragm 33. The movement of the bar 44 will be communicated to the pilot valve 53 by the rod 46 and the levers 48 to move the pilot valve into a position for opening communication between the supply pipe 63 and the pipe 62. In such case oil will also be admitted into the chamber *v* to act against the plunger *w* and increase the pressure thereon to establish a larger area of communication between the ports *k* and the interior of the valve *e*.

With the valve *e* thus depressed the pressure within the passageway *g* will be increased and such pressure acting against the piston V will move the piston V upwardly. In consequence, the pilot valve 9 will be shifted into a position for admitting oil beneath the piston *z* to open the valve D to wider limits, thus resulting in an increased supply of steam to the motor, a consequent speeding up of the motor and therefore an increase in the discharge volume of the blower.

In the event that the pressure of the atmosphere acting against the head 39 of the diaphragm 40 increases to a degree in excess of the pressure exerted by the spring 42 upon the diaphragm 35, the diaphragm 40 will contract so that the pressure on the oil in the diaphragms 35 and 33 will be relieved. The diaphragm 33 will then contract and, through the linkage connecting it with the pilot valve 53, will again retract the said pilot valve 53 to establish communication between the pipes 62 and 61 for exhausting the oil from the chamber *v*.

In the foregoing description of the operation the action of each element 19 and 20 and the sequence of events resulting from the action of these elements have been dealt with

separately. It is, however, readily apparent that atmospheric conditions may exist in which both the diaphragms 21 and 40 may act to exert pressures on the connected diaphragms, and in consequence of which an upward thrust will be imparted to the bar 44 by both the diaphragms 31 and 33.

Inasmuch that the action of the diaphragms 40 and 21 in the direction necessary to obtain this upward thrust of the diaphragms 31 and 33 will only occur in the event that atmospheric conditions are such that there will be a diminished volume of air flowing through the conduit E, the simultaneous action of the diaphragms 31 and 33 will merely result in actuating the pilot valve 53 into the open position. In other words, to move the pilot valve so that it will allow a greater degree of communication between the supply of oil under pressure and the point at which it is applied, namely, the end of the plunger *w*.

By calibrating the plate 76 in terms of fluid volumes the pointer 82 may be set to coincide with that calibration 83 on the plate 76 which corresponds to the discharge volume which it may be desired to have the turbo blower supply. When the spacer 72 is thus set the bell float R together with the piston V may suffice to assure the indicated output volume of the blower under ideal conditions. If, however, the temperature and the pressure of the air flowing through the conduit E should vary the elements 19 and 20 will act automatically to compensate for such atmospheric fluctuations and as a result a constant discharge volume may be obtained from the blower irrespective of any variations in the condition of the air supplied to the blower.

I claim:

1. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by pressure fluid acting counter to the force of the air, pressure control means for controlling the supply of pressure fluid to the first said means, means responsive to the temperature of the air flowing through the conduit, and means actuated by the temperature responsive means for controlling the said pressure control means to vary the speed of the motor in accordance with the variations in the temperature of the air flowing through the conduit, thus assuring a constant discharge volume of the blower.

2. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the power delivered to the motor and being actuated in one direction by the air passing through the conduit, said means being subjected to fluid under pressure for counterbalancing the force of the air thereon, pressure actuated means for controlling the supply of pressure fluid to the first said means, and temperature responsive means actuated by the temperature of the air flowing through the conduit and connected to vary the pressure on the pressure actuated means, thereby varying the speed of the motor and thus assuring a constant discharge volume irrespective of fluctuations in the temperature of the air flowing through the intake conduit.

3. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit for the blower, means actuated by the air passing through the conduit for controlling the power delivered to the motor, a pressure actuated piston associated with said means to oppose the force of the air on said means, a pressure actuated control valve for controlling the supply of pressure fluid to the piston, temperature responsive means in the intake conduit and exposed to the air flowing through the conduit, and means actuated by the temperature responsive means for varying the pressure on the control valve, thereby controlling the movement of the first said means to vary the speed of the motor and thus assure a constant discharge volume irrespective of the fluctuations in temperature of the air flowing through the intake conduit.

4. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the power delivered to the motor and being actuated in one direction by the air passing through the conduit, a pressure actuated piston associated with said means to oppose the force of the air on said means, a pressure actuated control valve to control the supply of pressure fluid to the piston, a pilot valve to control the supply of pressure fluid to the control valve, temperature responsive means actuated by the temperature of the air flowing through the conduit, and means for transmitting the movement of the temperature responsive means to the pilot valve to vary the pressure on the control valve, thereby varying the speed of the motor and thus assure a constant discharge volume irrespective of fluctuations in the temperature of the air flowing through the intake conduit.

5. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by pressure fluid acting counter to the force of the air, pressure control means for controlling the supply of pressure fluid to the first said means, a temperature responsive element exposed to the air flowing to the blower, an atmospheric pressure actuated element, and means connected to be actuated by both elements for controlling the said

pressure control means to vary the speed of the motor in accordance with atmospheric pressure and temperature variations of the intake supply, thus assuring a constant discharge volume of the blower.

6. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by pressure fluid acting counter to the force of the air, a pressure control valve for controlling the supply of pressure fluid to the said means, a pilot valve to control the supply of pressure fluid to the control valve, a temperature responsive element exposed to the intake air and actuated by the temperature thereof, an atmospheric pressure actuated element, and means for transmitting the movement of both elements to the pilot valve to vary the pressure on the control valve, thereby causing the speed of the motor to be varied in accordance with atmospheric pressure and temperature variations of the intake supply to assure a constant discharge volume of the blower.

7. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by fluid under pressure acting counter to the force of such air, a pressure control valve for controlling the supply of pressure fluid to the said means, a pilot valve to control the supply of pressure fluid to the control valve for actuating said control valve, a rod, a lever pivotally connected to the rod and pilot valve, a temperature responsive element actuated by the temperature of the air flowing through the conduit, an atmospheric pressure actuated element, and a bar pivotally connected to both elements and the rod to transmit the movement of either element to the pilot valve, thereby causing the speed of the motor to be varied in accordance with atmospheric pressure and temperature variations of the intake supply to assure a constant discharge volume of the blower.

8. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by fluid under pressure acting counter to the force of such air, a pressure control valve for controlling the supply of pressure fluid to the said means, a pilot valve to control the supply of pressure fluid to the control valve for actuating the said control valve, a rod, a lever pivoted to the pilot valve and the rod, a temperature responsive element actuated by the temperature of the air flowing through the conduit, an atmospheric pressure actuated element, means connected to the rod and the elements for transmitting the movement of the elements to the pilot valve to vary the speed of the motor in accordance with atmospheric pressure and temperature variations, thus assuring a constant discharge volume of the blower, and manually operable means for applying an initial pressure to the control valve.

9. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by fluid under pressure acting counter to the force of such air, a pressure control valve for controlling the supply of pressure fluid to the said means, a pilot valve to control the supply of pressure fluid to the control valve for actuating the said control valve, a rod, a lever pivoted to the pilot valve and the rod, a temperature responsive element actuated by the temperature of the air flowing through the conduit, an atmospheric pressure actuated element, means connected to the rod and the elements for transmitting the movement of the elements to the pilot valve to vary the speed of the motor in accordance with atmospheric pressure and temperature variations, thus assuring a constant discharge volume of the blower, a second lever pivotally connected to the first said lever and the control valve, a plate having an inclined cam, a spacer slidably engaging the cam and the second said lever, and manually operable means for actuating the spacer to apply an initial pressure to the control valve.

10. A constant volume regulator for motor driven turbo blowers, comprising an air intake conduit, means for controlling the delivery of power to the motor and being actuated by the air flowing through the conduit and by fluid under pressure acting counter to the force of such air, a pressure control valve for controlling the supply of pressure fluid to the said means, a pilot valve to control the supply of pressure fluid to the control valve for actuating the said control valve, a rod, a lever pivoted to the pilot valve and the rod, a temperature responsive element actuated by the temperature of the air flowing through the conduit, an atmospheric pressure actuated element, means connected to the rod and the elements for transmitting the movement of the elements to the pilot valve to vary the speed of the motor in accordance with atmospheric pressure and temperature variations, thus assuring a constant discharge volume of the blower, a second lever pivotally connected to the first said lever and the control valve, a plate having an inclined cam and being calibrated in terms of fluid volumes, a spacer slidably engaging the cam and the second said lever, a nut forming a bearing for the spacer, a screw thread-

edly engaging the nut to actuate the spacer longitudinally of the second said lever for manually applying a pressure to the control valve, and a pointer associated with the spacer and cooperating with the calibrations to indicate fluid volumes on the plate.

In testimony whereof I have signed this specification.

LESLIE R. HUFF.