March 28, 1944. W. ROSETT 2,345,073

APPARATUS FOR OPERATING THERAPEUTIC DEVICES

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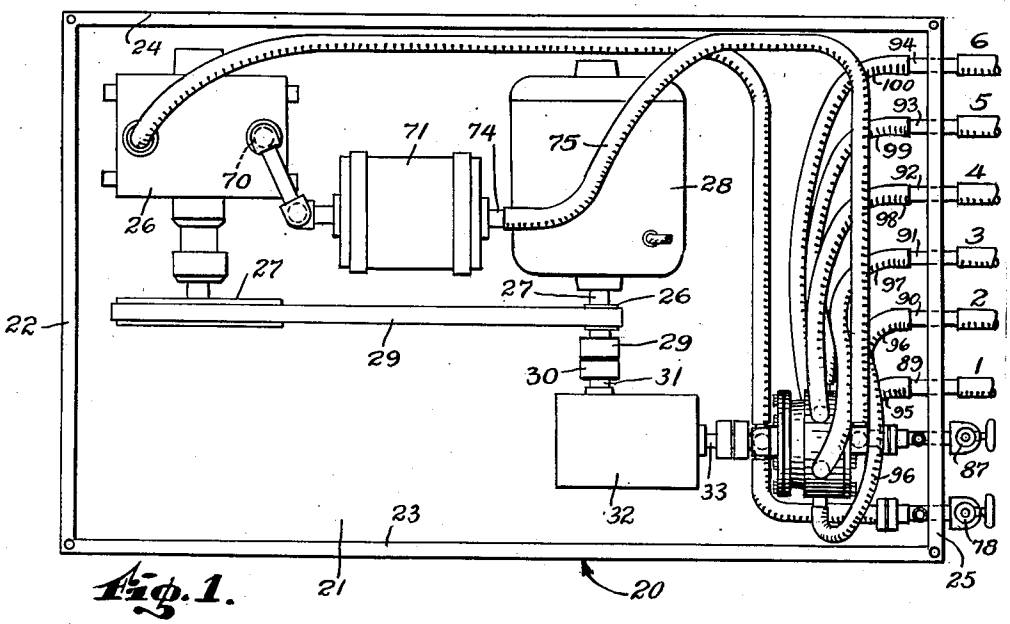

Fig. 1.

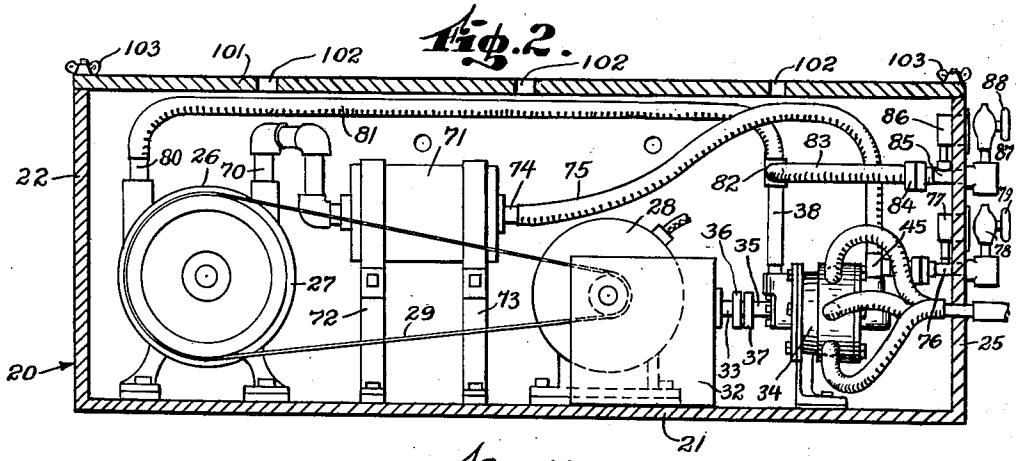

Fig. 2.

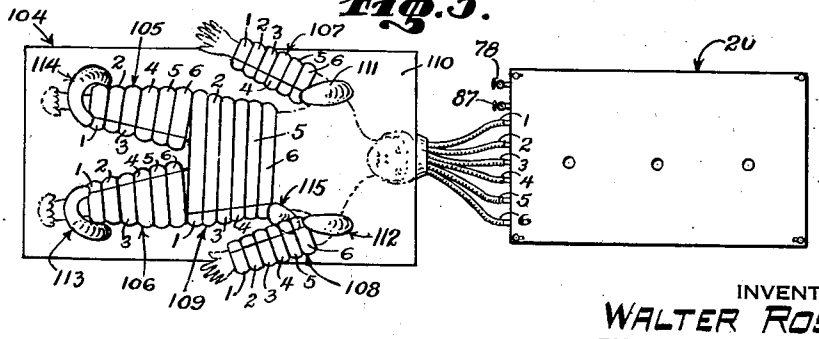

Fig. 3.

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Fig. 4.

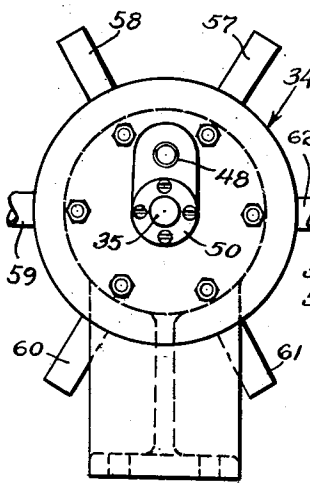


Fig. 5.

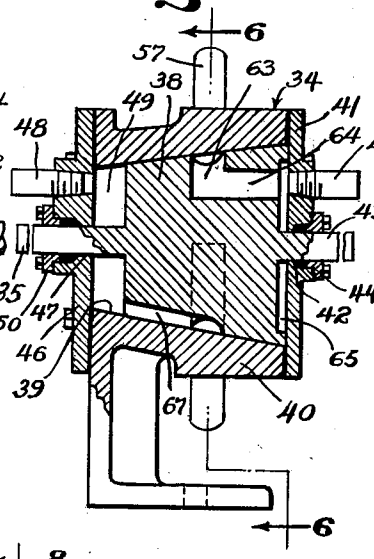


Fig. 6.

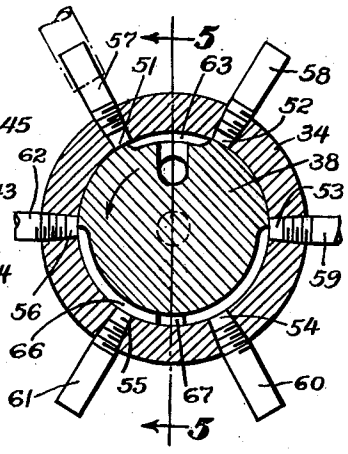


Fig. 8.

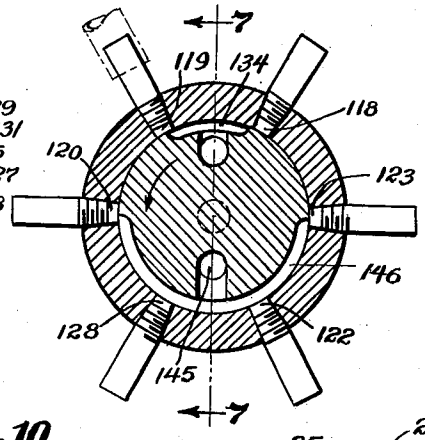


Fig. 7.

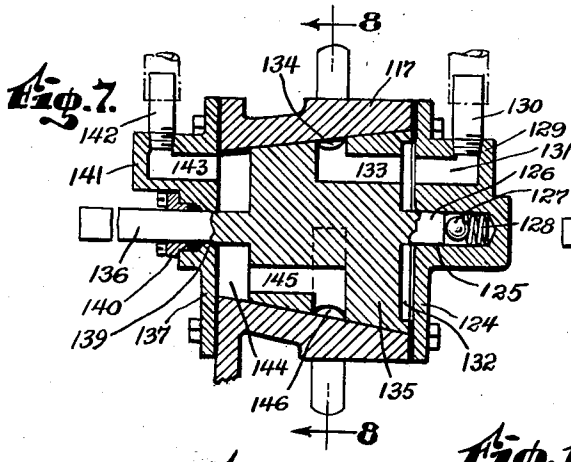


Fig. 9.

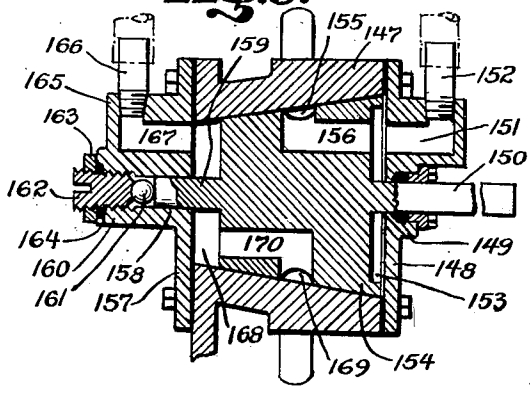
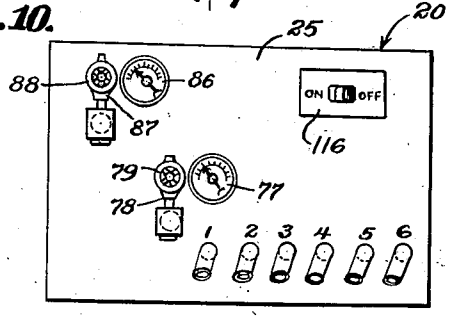


Fig. 10.



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2,345,073

UNITED STATES PATENT OFFICE

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APPARATUS FOR OPERATING THERAPEUTIC DEVICES

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Application April 10, 1942, Serial No. 438,380

3 Claims. (Cl. 251—104)

This invention relates to improvements in an apparatus for operating therapeutic devices and is directed more particularly to the operation and control of devices for assisting in the circulation of the blood or for massaging the human body.

A main object of the invention is the provision of a compressor, particularly of the rotary vane type, and novel means for utilizing the pressure and the vacuum therein for controlling the successive inflation and deflation of pneumatic bags embodied in therapeutic devices for propelling the venous blood of the body toward the heart, thereby providing a systematic kneading of the tissues of the body and consequent enhancement of circulation of the fluids in the lymphatic spaces.

A further object of the invention is the provision of a distributing valve adapted to serially apply pressure to said pneumatic bags embodied in the therapeutic device and to serially apply vacuum subsequent to the removal of said bags from the influence of said pressure.

Another object of the invention is the provision of a control unit comprised of a rotary compressor, means to drive the same, a reduction gear connected to said means, and a distributing valve driven by said reduction gear at a reduced rate of speed, connections between the discharge of said compressor and said distributing valve, another connection between said distributing valve and the intake of said compressor, and a control panel for said unit including a pressure gauge and a bleeder valve connected to said discharge, a second bleeder valve and a vacuum gauge connected to said intake, and a plurality of connections to said distributor valve which are serially and sequentially subjected to pressure and vacuum, said control panel being situated so that the operator may control every phase of the operation from the single position.

Yet another object of the invention is the provision of the distributor valve for pressure and vacuum including a tapered rotor which is seated in a corresponding tapered bore in said valve under the urge of said pressure at the large end thereof and under the urge of said vacuum at the small end thereof.

Another object of the invention is the provision in a distributor valve of settable means for regulating the degree of engagement of the tapered surface on the rotor with the corresponding tapered surface in the stator.

Other objects and advantages of the invention will be apparent to those skilled in the art upon the perusal of the following specification and the accompanying drawings wherein:

Figure 1 is a plan view of the complete control device with the top of the cabinet removed;

Figure 2 is an elevation partially in section of the device shown in Figure 1;

Figure 3 is a diagrammatic representation of the device connected to a therapeutic device to be controlled thereby;

Figure 4 is an elevation of one form of distributor valve embodied in said device;

Figure 5 is a sectional elevation of the distributor valve of Figure 4 as seen along the line 5—5 of Figure 6;

Figure 6 is a sectional elevation of the distributor valve as seen along the lines of 6—6 of Figure 5;

Figure 7 is a sectional elevation of a modified form of the control valve shown in Figure 5 as seen along the lines 7—7 of Figure 8;

Figure 8 is a sectional elevation as seen along the line 8—8 of Figure 7.

Figure 9 is a sectional elevation of a further modification of the distributor valve; and,

Figure 10 is an elevation of the right end of the device, Figure 1, showing the control panel.

Referring to Figures 1 and 2, a casing generally designated by the numeral 20 houses the compressor, the motor, the distributor valve and allied devices. This casing has a base 21, an end wall 22, side walls 23 and 24, and an end wall 25 which forms a control panel for the device as will hereinafter be described. The compressor 26 carries a fly wheel pulley 27 which is connected to a pulley 26 carried on the shaft 27 of the motor 28 by means of a belt 29.

The motor shaft 27 also carries a member 29 which engages a cooperative member 30 carried on the shaft 31 of a gear reduction unit 32, to form a Cardan joint or flexible drive between the shaft 27 and the shaft 31. The gear reduction unit 32 has a shaft 33 which is driven at reduced speed due to the gearing therein. A distributor valve 34, details of which will presently be described, has a shaft 35 extending therefrom in alignment with the shaft 33, and a member 36 on the shaft 33 and a cooperative member 37 on the shaft 35 form a flexible driving joint therebetween.

One form of distributor valve 34 is shown in Figures 4, 5, and 6 and consists of a rotor 38 which is preferably tapered. This rotor forms a working fit with the tapered bore 39 formed in the body casting 40. An end plate 41 secured to one end of the body carries a bearing 42 for the

shaft extension 43 and a suitable stuffing box 44. By means of a pipe fitting 45, air under pressure is led into the distributor valve and the stuffing box 44 will prevent the air from leaking around the shaft extension 43.

A similar end plate 46 is secured to the opposite end of the body 40 and carries a bearing 47 for the shaft extension 35. By means of a pipe fitting 48, the space 49 between the end of the rotor 38 and the end plate 46 is subjected to sub-atmospheric pressures, as for example, by connecting this fitting to the inlet side of a pump. A suitable stuffing box 50 is provided for preventing the ingress of air around the shaft extension 35.

Equally spaced about the bore 39 in the body 40 are ports 51, 52, 53, 54, 55, and 56, each of said ports being provided with pipe threads to accommodate suitable fittings such as 57, 58, 59, 60, 61 and 62.

A port opening 63 is formed in the rotor 38, the length of which is preferably equal to the distance between any two adjacent ports plus approximately half of the width of a port. A cross hole 64 extends from the port opening 63 to a chamber 65 formed in the large end of the rotor, which chamber is in communication with the source of air under pressure via the fitting 45 so that as the rotor is moved, for example, in the direction of the arrow as shown in Figure 6, air under pressure is successively furnished to the ports 51, 56, 55, 54 and 52, therefore the air bags connected to these ports, as will presently be described in connection with Figure 3, are successively inflated.

The rotor 38 also has formed therein a circular port 66 which preferably extends a distance substantially equal to the arcuate distance from one port to the third port in advance thereof. In other words this arcuate port is always in communication with at least three of the ports and is in communication with four of the ports just at the time one end is leaving a port and the other is coming into communication with a port. A passage 67 formed in the rotor 38 communicates with the chamber 49 and therefore the ports spanned by the circular port 66 are subjected to sub-atmospheric pressures to facilitate the removal of air from air bags which have previously been inflated as will also be presently described in connection with Figure 3.

A pipe 70 is connected to the discharge of the pump and carries fittings connecting the discharge of the compressor to a filter 71 which is supported on the base 21 by means of brackets 72, 73.

Extending from the filter 71 is a nipple 74 to which is connected one end of a hose or tube 75. The other end of the tube is connected to the nipple 45 on the distributor valve 34, and thereby compressed air is delivered to the chamber 65 therein. This air, via the passages 64 and the port 63, is successively delivered to the ports 51, 56, 55, 54 and 52.

Also connected to the nipple 45 is a branch pipe 76 which is connected to a gauge 77 and to a bleeder valve 78 which is controlled by a handle 79. The gauge and the bleeder valve are mounted on the end 25 of the cabinet, which constitutes a control panel.

The inlet or suction of the pump 26 has connected thereto a nipple 80, to one end of which a pipe or hose 81 is connected. In the arrangement shown in Figures 1 and 2, the nipple 48 on the distributor valve 34 extends upwardly and has connected thereto a T fitting 82 which carries a vertical nipple (not shown), to which the other end of the hose 81 is connected. A pipe 83 has one end connected to the T 82 and the other end connected to a union 84.

Extending from the union 84 is a pipe 85 which connects to a gauge 86 and a bleeder valve 87 carrying an adjusting handle 88. The gauge 86 is also mounted on the control panel 25 and is capable of indicating sub-atmospheric temperatures.

The control panel carries nipples 89, 90, 91, 92, 93, and 94 which are respectively connected to the nipples 61, 62, 57, 58, 59 and 60 of the distributor valve 34 by means of tubes 95, 96, 97, 98, 99 and 100.

The cabinet 20 is provided with a suitable cover 101 having ventilating holes 102 formed therein and is secured to the cabinet by means of wing nuts 103.

As an example of the use of the device and the method of operating a therapeutic device thereby, reference is made to Figure 3 wherein a therapeutic device generally designated by the numeral 104 carries a leg-embracing member 105, a leg-embracing member 106, arm-embracing members 107 and 108, and a torso-embracing member 109. These embracing members include a series of rubber bags, and the object is to selectively and sequentially inflate and deflate said bags in groups, in order to accelerate the circulation of the blood in the veins of the human body toward the heart.

The rubber tube 1, for instance, is connected to all of their air bags in the embracing members designated by the numeral 1, and is also connected, as may be seen in Figure 1, to the nipple 89, which is in turn connected to the port 55 associated with the nipple 61 in Figure 6.

The hose 2 is likewise connected to all of the bags designated by the numeral 2, and this hose is also connected to the nipple 90, which is in turn connected to the nipple 60 on the distributor valve, Figure 6, communicating with the port 54.

The other bags are connected in the order to 3, 4, 5 and 6, as indicated in Figure 3. The embracing members are preferably attached to a mattress 110 and the rubber tubes 1 to 6 are concealed within the body of the mattress and exit to the embracing members via the casings of 111, 112, 113, 114, and 115.

To operate the device, the switch 116 which controls the flow of current to the motor 28, is thrown to the "on" position, thereby starting the motor in operation. This drives the compressor or pump 26 and air is delivered via the strainer 71 to the pressure end of the distributor valve 34 via the nipple 45. Since the distributor valve is rotated at a slower speed by the gear reduction box 32, the valve rotates slowly, for example in the direction indicated by the arrow in Figure 6.

The suction side of the pump is connected to the suction end of the distributor valve via the pipe 48 for removing air from any bags previously inflated. By means of the valve 78, the pressure reading on the gauge 77 may be set by the operator; likewise by means of the valve 87, the desired vacuum setting may be made and read off on the vacuum gauge 86.

As the rotor 38 of the distributor valve 34 rotates, the ports are supplied with air under pressure via the chamber 65, the passage 64 and the port 63 to the ports circumferentially disposed about the body of the valve 34, for example in

the following order: To the ports 51, 56, 55, 54, 53 and 52. In Figure 6, it will be seen that the port 63 is in communication with the port 51 and has just been cut off from the port 52. As the rotor advances in the direction of the arrows, the port 63 next will communicate with the port 56 and will be cut off from the port 51.

At the same time the suction side of the compressor is, via the chamber 49 and the passage 67, connected to the port 66, which is at all times in communication with at least three of the ports which have been previously supplied with pressure. Some of the time the port 66 is in communication with four of the ports, one such instance being when the rotor is in the position shown in Figure 6. The port 66 at that time communicates with the ports 56, 55, 54 and 53.

The vacuum or suction deflates the rubber bags that have been previously inflated, so that a sharper and snappier effect is obtained when the bags are inflated.

The bags, when the device is operating, are inflated in the order, 1, 2, 3, 4, 5, 6, respectively, and produce in the arms, legs and torso of the body a series of "squeezes" progressively moving upwardly toward the general direction of the heart, and thereby the blood in the veins is accelerated toward the heart.

A therapeutic device of the type illustrated diagrammatically in Figure 3 is shown and described in great detail in co-pending application Serial Number 438,381, filed April 10, 1932.

Figures 7 and 8 show a further modification of the distributor valve. The valve body 117 has preferably a tapered bore therein and carries ports 118, 119, 120, 121, 122 and 123. An end plate 124 carries a bearing 125 for the shaft end 126.

Within the bearing 125 is a hardened ball 127 which is urged into contact with the end of the shaft 126 by means of a spring 128. A boss 129 on the end plate 124 is tapped to receive a nipple 130 which would be connected to the discharge of a compressor.

A passage 131 within the end plate 124 communicates with the chamber 132 which in turn communicates with a passage 133 and a distributor port 134.

A rotor 135 in addition to the shaft extension 126 carries a shaft 136. The passage 133 and the distributor port 134 are formed in this rotor.

The end plate 137 is secured to the body 117 and carries a bearing 139 supporting the shaft 136. A stuffing box 140 is provided to prevent leakage into or out of the valve from the atmosphere. A boss 141 carries a nipple 142 communicating with a passage 143 and the chamber 144.

When the pipe 142 is connected to the suction of a compressor, the vacuum is compressed on the interiors of the passage 143 and the chamber 144. The passage 145 communicates with the chamber 144 and with the port 146. The operation of this valve is substantially the same as that described above. However, the pressure of the steel ball 127 against the end of the shaft 126 tends to urge the rotor shaft toward the left, as seen in Figure 7, and thereby tends to minimize the leakage of air between the tapered surfaces in contact with each other.

In the modification shown in Figure 9, the valve body 147 is provided with a tapered bore and carries an end plate 148 with a bearing 149 therein for supporting the shaft 150. The end plate has a passage 151 formed therein in communication with the pipe 152 and the chamber 153 formed in the end of the rotor 154. A port 155 formed in the rotor communicates with the chamber 153 via a passage 156 so that compressed air via the pipe 152 passes via the passages 151, 156, to the port 155.

The other end plate 157 carries a bearing 158 for the shaft extension 159. The boss 160, in which the bearing is formed, also carries a steel ball 161 which bears against the end of the shaft 159 and against the nose of a set screw 162. The set screw 162 carries a nut 163 and may be sealed against leakage by means of a gasket 164.

Where the angle of the taper of the rotor falls within such limits that the pressure and vacuum tend to force the tapered surfaces together with undue friction, the arrangement shown in Figure 9 is advantageous because the device shown in Figure 9 can be set to a point where the leakage between the surfaces is at a minimum and thereby the device can be operated with a minimum of friction and the consequent heating.

The lock nut 163 may be loosened and the set screw 162 moved. Since this set screw bears against the steel ball 162, and the ball in turn bears against the end of the shaft, it is obvious that the set screw may be used to effect any desired setting, and after the setting is obtained the set screw may be locked in the set position by means of the lock nut 163.

A boss 165 on the end plate 157 carries a pipe 166 which may be connected to the suction side of a compressor. A passage 167 therein communicates with the chamber 168 formed at the small end of the rotor, and this chamber communicates with the port 169 via the passage 170.

The arrangement of the nipples 89 to 94, inclusive, in the control panel 25, and the provision of gauges 77 and 86 thereon and having associated therewith respectively bleeder valves 78 and 87, greatly facilitate the operator's work in connection with the use of the apparatus in connection with a therapeutic device as herein described, because from a single position the operator has knowledge of the conditions in various portions of the system and has at his finger-tips the means of effecting even the most minute control over the pressures and the distributing of the positive and negative pressures of impulses to the therapeutic device.

While I have herein shown and described one device for operating therapeutic devices, and have shown modifications thereof, it is obvious that many changes may be made in the arrangement herein shown and described without departing from the spirit of the invention as set forth in the following claims.

What is claimed is:

1. In a distributing valve, a body having a tapered bore formed therein, a plurality of ports circumferentially disposed in said body and communicating with said bore, all said ports lying in a plane at right angles to the axis of said bore, a rotor for said body forming a working fit in said bore and having a distributing port whose circumferential length is equal to the circumferential distance from the center of one of said ports to the adjacent edge of the next adjacent port, means connecting said distributing port to a source of pressure, a second distributing port lying in the plane of said first distributing port and having its extremities circumferentially spaced apart from said first distributing port distances substantially equal to the length of said first distributing port, means connecting said sec-

ond distributing port to a source of sub-atmospheric pressure, means to rotate said rotor whereby the pressure delivered to one of said ports is cut off after a succeeding port begins receiving pressure, an end plate secured to one end of said body and having a drive shaft for said rotor passing therethrough, a stuffing box engaging said drive shaft, a second end plate secured to the other end of said body and having a stub shaft extension of said rotor journaled therein, a threaded passage communicating with the end of said stub shaft, a set screw in said threaded hole and adapted to engage said stub shaft to regulate the depth of engagement of said rotor in said tapered bore, sealing means engaging said end plate and said set screw, and a lock nut for locking said set screw in an adjusted position and at the same time sealing said set screw against the leakage of fluid pressure.

2. In a distributing valve, a body having a tapered bore therein, a plurality of ports circumferentially disposed in said body and communicating with said bore, said ports being adapted to receive fittings radially disposed in said body, a tapered rotor in said body having a distributing port adapted to coincide with said first ports and communicating with one end of said rotor, a second port in said rotor also adapted to coincide with said first ports and communicating with the other end of said rotor, an end plate secured in fluid-tight relation to one end of said body, a boss on said end plate having a passage formed therein in communication with said first end of said rotor, a shaft extending from said rotor through said end plate and adapted to be operatively connected to a prime mover a stuffing box on said end plate engaging said shaft to prevent the leakage of fluid therefrom, a second end plate secured in fluid-tight relation to the opposite end of said body, a boss formed on said second end plate and having a passage formed therein communicating with said second end of said rotor, a second shaft extending from said second end of said rotor and journaled in said second end plate, a set screw axially threaded in said second end plate and adapted to engage said second shaft to regulate the depth of said rotor in its tapered bore, and means for both locking said set screw in a set position and at the same time preventing the leakage of fluid past said set screw, each of said passages in said bosses being adapted to be connected to a fluid medium of a different pressure.

3. In a distributing valve, a body having a tapered bore therein, a plurality of ports circumferentially disposed in said body and communicating with said bore, said ports being adapted to receive fittings radially disposed in said body, a tapered rotor in said body having a distributing port adapted to traverse said first ports and communicating with one end of said rotor, a second port in said rotor also adapted to traverse said first ports and communicating with the other end of said rotor, an end plate secured in fluid-tight relation to one end of said body and spaced apart from said rotor to form a chamber, a boss on said end plate having a passage formed therein in communication with said chamber, a shaft extending from said rotor through said end plate and adapted to be operatively connected to a prime mover, a stuffing box on said end plate engaging said shaft to prevent the leakage of fluid therefrom, a second end plate secured in fluid-tight relation to the opposite end of said body and spaced apart from the other end of said rotor to form a second chamber, a boss formed on said second end plate and having a passage formed therein communicating with said second chamber, a second shaft extending from said second end of said rotor and journaled in said second end plate, a set screw axially threaded in said second end plate and adapted to engage said second shaft to regulate the depth of said rotor in its tapered bore, means for locking said set screw in a set position, and sealing means associated with said means for locking and adapted to prevent the leakage of fluid past said set screw, each of said passages in the bosses adapted to be connected to a fluid medium of a different pressure.

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