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2,145,932

THERAPEUTICAL APPLIANCE

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FIG. 1

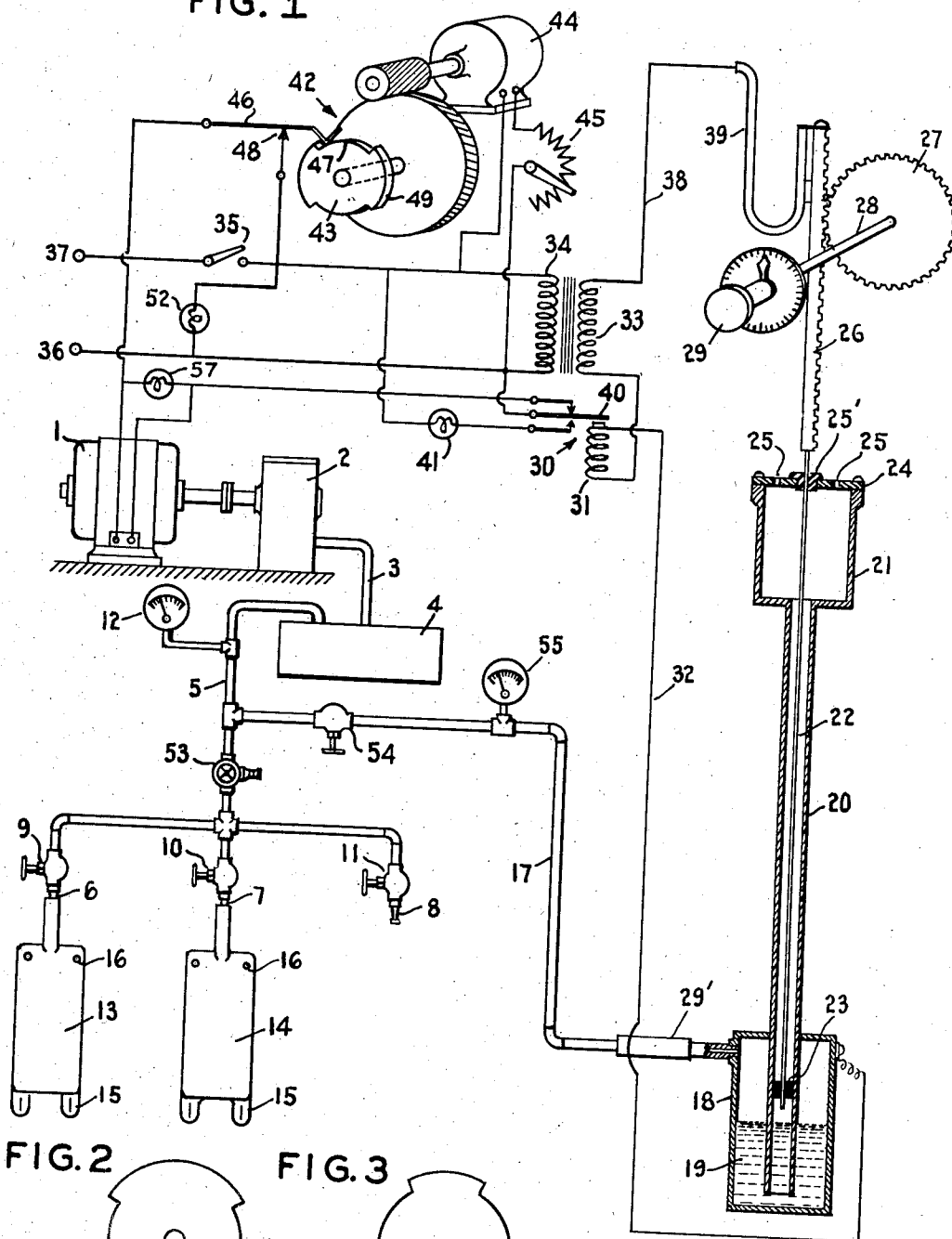
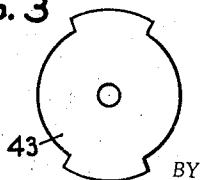
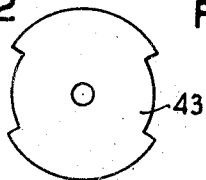


FIG. 2

FIG. 3



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THERAPEUTICAL APPLIANCE

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2 Claims. (Cl. 128—299)

This invention relates to therapeutical appliances and more specifically to apparatus for applying any desired variable pressure to parts of the human body intermittently over a period of time. Sufferers from ailments due to inadequate circulation of the blood, such as peripheral vascular diseases and gangrenous conditions are greatly relieved and in many cases permanently helped by such application of pressure to the circulatory system in definite rhythmic order.

It is an object of this invention to provide apparatus for this purpose that is readily adjusted to any desired pressure and to any desired frequency of pressure application and removal.

Another object is to provide for cyclic applications of pressure, alternating with periods of repose to suit the treatment to the condition of the patient.

Another object is to provide a pressure control that is accurately and quickly adjustable to the pressure determined by the physician giving the treatment.

Another object is to provide a compact control board having accessible switches, valves and control knobs and visible signal devices that indicate the exact condition of the apparatus at all stages.

Other objects will appear in the following description, reference being had to the drawing, in which:

Fig. 1 is a diagrammatic illustration of the electrical circuits and pressure apparatus.

Figs. 2 and 3 illustrate differently shaped cams for controlling the period of opening of the motor circuit.

Referring to the drawing, 1 is an electric motor of any desired type connected to a pump 2 which may be of any of the various kinds, but I prefer a piston operated pump on account of its quietness of operation. This pump is connected by suitable pipe 3 to a storage tank 4 which is quite small but of sufficient size to minimize the pressure pulses due to the pump. The tank is connected by a pipe line 5 to three outlets, 6, 7, 8, having control valves 9, 10, 11, to shut off the pressure or turn it on, as desired. The pressure device 12 indicates the pressure in the line.

Any number of pressure outlets may be provided and I have illustrated three by way of example. To the pressure outlets are connected the pressure bladders 13 and 14, no bladder being shown connected to the outlet 8, but of course it is intended that one be connected at this point when desired.

The bladders are of standard construction such

as doctors use particularly in determining blood pressure. They are made of elastic material such as rubber and have tabs 15 that are buttoned or snapped to fasteners 16 in any desired way. When bladders have to be fastened around various portions of the body the fasteners need to provide for considerable adjustment but this forms no part of this invention and the fasteners have been merely indicated somewhat generally.

Continued application of steady pressure is of no benefit for relief of the ailments previously referred to herein. It is alternating pressure that forces the blood through the blood vessels the desired amount. To provide for this cyclic application of pressure a control device is necessary. The pipe 5 is connected through pipe 17 to a chamber 18 containing a supply of mercury 19. A tube 20 of material that is not attacked by mercury, such as iron, has one end dipping into the mercury, as shown, and the other connected to a safety reservoir 21 though this latter may be omitted when desired. This tube makes an air-tight joint with the chamber 18. Inside of the tube 20 is a conducting rod 22 having a spacer 23 of insulation to prevent contact with the tube.

The reservoir 21 is closed by a lid 24 having a number of perforations 25 to equalize the pressure with the outside atmosphere and a central opening through which slides the rod 22. To prevent electrical contact at this point an insulation bushing 25' is used. The upper end of the rod is either integral with, or is fastened to, a rack 26 meshing with a gear 27. The gear 27 is secured to a shaft 28 on the end of which is control knob 29 for adjusting the position of the conducting rod 22 in respect to the mercury supply 19. The reservoir 18 may be made of iron and it may be suitably insulated from the other parts of the apparatus where necessary. The entire pipe 17 or a section thereof as at 29' may consist of a rubber tube to prevent electrical connection between the pressure apparatus and the mercury chamber.

A relay generally indicated at 30 opens and closes the circuit of the motor 1 under control of the pressure switch. This relay has an operating coil 31 preferably with an iron core, as indicated. One end of this coil is connected by wire 32 to the mercury chamber 18. The other end of the wire is connected to one end of the secondary 33 of a transformer, the primary 34 of which is connected by the main switch 35 with the supply mains 36, 37. The opposite end of the coil 33 is connected by conductor 38 and flexible cable 39 to the rack 26.

It will be seen that an electrical circuit is closed through the relay coil 31 whenever the mercury is forced into electrical contact with the rod 22 by the air pressure from the pipe 17. To provide for various pressures the control knob may move the rod 22 up and down through the rack and gear arrangement. Suitable friction will be provided in the mechanism so that the rod will stay in any position that it is adjusted.

The relay coil 31 previously described acts on a spring biased armature 40 to open and close the circuit of the motor 1 and substantially simultaneously close or open the circuit of the indicating lamp 41. Thus, when the lamp is lighted it indicates to the physician that the motor relay is open and the pressure is dying down.

While periodic application of pressure for relief of various ailments is highly beneficial it is found to be more beneficial, and particularly more satisfactory to the patient under treatment, if this periodic application of pressure is discontinued for definite short periods. This not only gives the patient relief from the pressure, if it should happen to be annoying, but it also permits the circulatory system to get in its work unaided for short periods, thus inducing the natural functioning of the system.

To provide for periodic interruption of the pressure applications, various devices may be used, but I have illustrated a switch generally indicated at 42, operated by cam 43 connected through reducing gearing to an electric motor 44, whose speed is controlled by any means, a rheostat 45 being shown by way of example, for this purpose. When the cam lets the arm 46 drop into the depression 47 contact is closed at 48 and the circuit of motor 1 is made, but operation still depends upon the operation of the relay 30. When the arm 46 is on the raised portion 49 of the cam the contact at 48 is broken so that the circuit of motor 1 is opened and the pressure application is interrupted no matter what may be the stage of operations through the relay 30.

The indicating lamp 52 is lighted continuously while the apparatus is being used by closure of the main switch 35.

When the pressure is off through the closing of the contact between the rod 22 and the mercury 19, means must be provided to release the pressure. This takes place through the adjustable bleeder valve 53 which is continuously open, which means that air is being by-passed while the motor is operating, as well as while the motor circuit is opened by the mercury switch, but this is no disadvantage and it provides a very simple pressure release. The amount of air in the entire system is small and the air is quickly released.

In order to make a steady flow of pressure to the mercury switch, I find it very desirable to employ a valve 54 which is not fully opened. This prevents the pulsations of the pump, not smoothed out by the tank, from causing the mercury switch to flutter.

A pressure gauge 55 is connected to the pipe 17 to indicate the pressure in the line connected to the pressure switch. This pressure generally will be somewhat different from that in the line 5.

A light 57 is connected across the terminals of motor 1 and remains lighted only while the motor is running. This is another signal device to keep the attending physician advised as to the operations.

The operation of the system will now be described. Let it be supposed that the bladder 13 is connected around a portion of the body of a

patient receiving treatment and that the valve 9 is open while the valves 10 and 11 are closed, one patient only being treated. The physician will close the main switch 35 and lamp 52 will be lighted up. The circuit to the motor 1 is closed at the point 40 and the motor immediately starts and operates the pump 2 to put the air pressure in the line, which pressure will be indicated by the gauge 12. This will apply pressure to the bladder 13. Valve 54 will not be fully opened and any remaining pulsations of the pump will not be transmitted into the pipe 17. The physician will have adjusted the pulsation rate by manipulating bleeder valve 53 on the front of the panel. He also will manipulate knob 29 to raise the rod 22 to such height as to energize the relay when the desired pressure is reached. The mercury 19 rises as the pressure increases and finally contacts with the rod 22. This closes the circuit through the relay 31 which opens the motor 1 switch at the contact 40. The motor 1 therefore stops. There is considerable lag in the various operations so that the pressure reaches and overruns the pressure set by the control 29 and the bleeder 53 causes the pressure to quickly drop to a pressure considerably below that set by the control 29 before the motor can bring it back up again. The difference between the high and low pressure is determined by the adjustment of the bleeder valve. It can be made small or great, depending upon the amount that it is opened.

During the operation just described the motor 44 was also in operation because it was connected directly across the lines leading from the switch 35 but it does not affect the operation of the system because the arm 46 is in the notch 47 and the switch 48 is closed. When the pressure drops sufficiently to deenergize the relay 31 the circuit of motor 1 is again closed at the switch 40 and pressure is built up in line 5 again to repeat the cycle, but as stated, the pressure drops considerably below the amount called for by the adjustment of knob 29, due to lag in the system. In this way the pressure is applied to the patient with a frequency of pressure change that depends upon the adjustment of the pulsation rate through bleeder control 53.

After a number of cycles of pressure have been completed, the time of which may be regulated, as hereinafter described, the arm 46 rides out of the notch 47 on to cam surface 49 and the circuit of motor 1 is interrupted at point 48. This stops the operation of the motor and the pump no matter what part of the cycle happens to be taking place at the time. The motor will remain inoperative until the arm 46 rides off of the cam down into the notch 47 when the circuit will again be closed at the switch 48 to start the motor.

Various means may be used for controlling the length of time that the switch 48 is opened but I have shown, by way of example, the rheostat arm 45 for controlling the speed of the motor 44, but of course many other means could be used. When switch 35 is closed, the circuit energizing motor 1 may be traced as follows: Terminal 37 to switch 35, through contacts 40 and 46 to the left terminal of motor 1, and power input terminal 36 connects to the right terminal of motor 1 through a path including lead 36', armature 40 and lead 40'. The bulb 57 is energized when the said circuit is closed. Simultaneously, motor 44 is energized through the path traced from terminal 36 through lead 36'; then to lead 34' and adjustable tap element 45 to resistor 45;

through the terminals of motor 44, lead 44', switch 35 and to terminal 37.

The mercury 19 contacting with conductive rod 22 establishes the following circuit to energize relay coil 31: The upper side of secondary 33 connects to rod 22 through a path including lead 38, element 39 and rack 26; the lower side of transformer 33 connects to mercury 19 through a path including coil 31, lead 32 and container 18. When switch 35 is closed, voltage is induced in secondary 33 by the current flow through primary 34. When the circuit through coil 31 is closed by contact between rod 22 and mercury 19, the armature 40 is pulled into contact with its lower contact element. This results in a breaking of the energizing circuit of motor 1. The latter is deenergized, as well, when switch arm 46 is forced away from contact 48. The indicator light 41 is energized when armature 40 is pulled towards coil 31, since its energizing circuit includes switch 35 and return lead 36'.

To change the relation of the "off" period to the "on" period in the cam switch a series of cam plates may be used, as shown, in Figures 2 and 3, and an appropriate one selected for attaching to the shaft of the driven mechanism.

The various pilot lights, gauges and valves will be placed on the front of the apparatus such as a panel board and the lights may be differently colored to more readily portray the stages of the operation, or this may be told by the position of the lamps on the control board.

The over-flow container 21 previously referred to merely acts as a storage reservoir in case that something goes wrong with the apparatus and the mercury should flow entirely up through the tube 20. It is merely a precaution and usually may be omitted.

Various modifications may be made in the invention and the claims are not to be limited to any specific form.

Having described my invention, what I claim is:

1. In therapeutic devices, a pressure bladder, a pump for applying pressure to said bladder, an electric motor for operating said pump, an electrical circuit for energizing the motor, a normally open relay circuit having a switch for opening and closing the energizing circuit to the motor and including an element biased to a position to close the energizing circuit, means operable by the pressure from said pump to close the relay circuit to open the biased switch, and means connected to the pressure line of the pump to reduce the pressure materially below the pressure required to operate the first mentioned means before the pump again causes the pressure to rise, and said first means including a mercury contact switch.

2. In therapeutic devices, a pressure bladder, a pump for applying pressure to said bladder, an electric motor for operating said pump, an electrical circuit for energizing the motor, a normally open relay circuit having a switch for opening and closing the energizing circuit to the motor and including an element biased to a position to close the energizing circuit, a pressure operated switch for closing said relay circuit to open the biased switch to deenergize said motor, a bleeder valve connected to the pressure line of the pump to reduce the pressure materially below the pressure required to operate the second mentioned switch before the pump again causes the pressure to rise, and said relay circuit including a mercury switch comprising a receptacle of mercury and a manually adjustable contact rod.

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