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DEVICE FOR AUTOMATIC REGULATION OF FLUID PRESSURE

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Fig. 1.

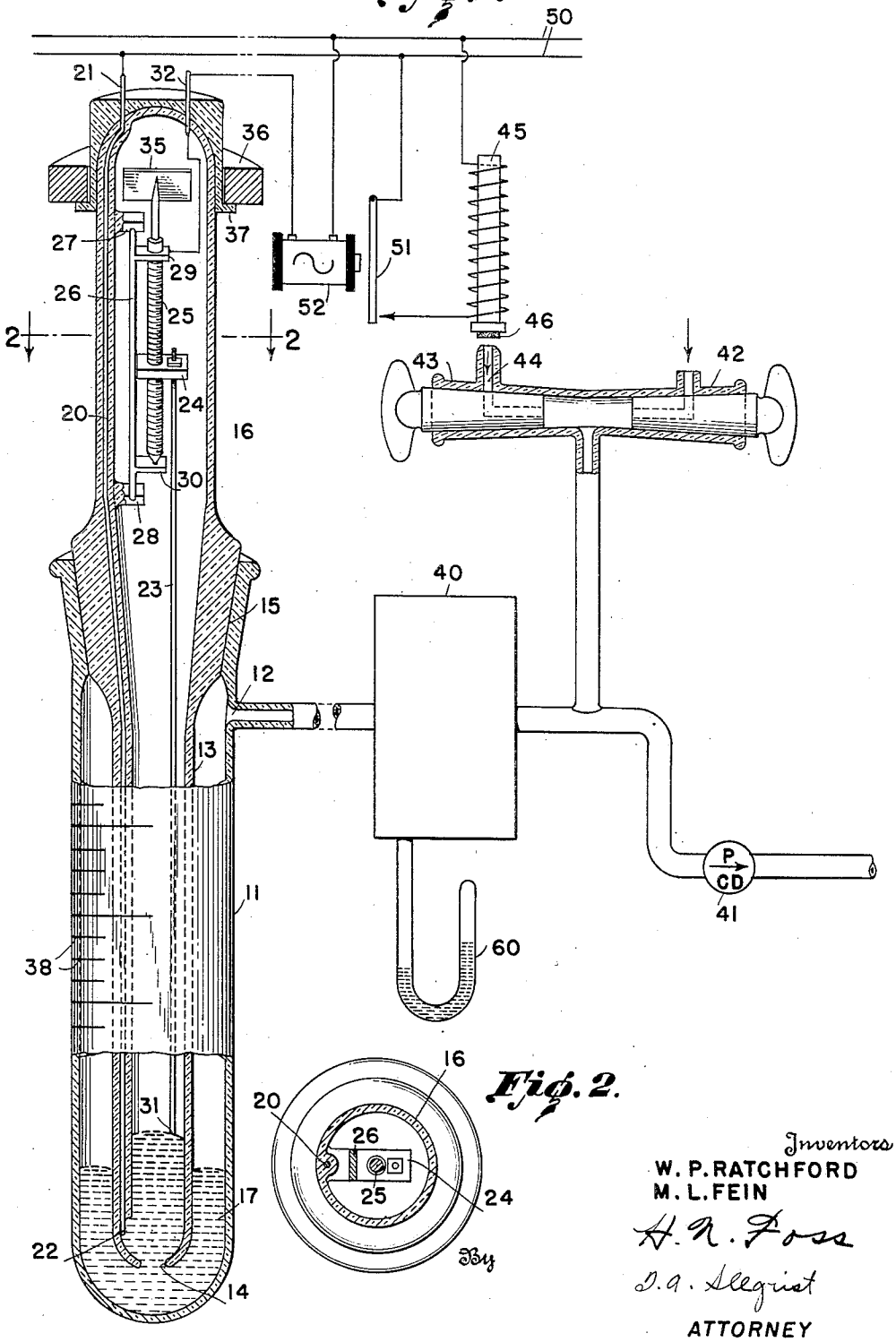


Fig. 2.

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DEVICE FOR AUTOMATIC REGULATION OF FLUID PRESSURE

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3 Claims. (Cl. 200—81.6)

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This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented in any country, may be manufactured and used by or for the Government of the United States of America for governmental purposes throughout the world without the payment to us of any royalty thereon.

This invention relates to a device for automatically regulating fluid pressure in apparatus such, for example, as a partially evacuated still, and has among its objects the provision of such a device which is simple in construction, will regulate the pressure closely to the desired value, which is easily adjusted to various pressures, and which may also be used as a manometer, and such other objects as will be apparent from the following description and claims.

In general, according to the invention, the regulating device has an outer hollow vertical tube provided with an aperture near its top for establishing communication with the pressure apparatus. An inner tube, hermetically sealed at its top and provided with an aperture at its bottom, is removably fitted in an opening in the outer tube and is hermetically sealed therein with its upper end projecting from the outer tube. The inner tube is smaller than the outer tube, thus to allow space between them and a conducting liquid, preferably mercury, is placed in the bottom of the outer tube and covers the aperture in the bottom of the inner tube. Thus pressure change in the apparatus communicated to the upper surface of the liquid in the outer tube results in varying of the liquid level in the inner tube. One electrical conductor with an external lead makes continuous contact with the conducting liquid. A second electrical conductor with an external lead is located in the inner tube for making and breaking contact with the upper surface of the conducting liquid therein as its height varies. The point of contact of this conductor with the liquid is vertically adjustable. The outer tube is preferably transparent and provided with calibrated graduations so that the height of the mercury column therein as indicated by the graduations may be used as the index for reading the pressure in the apparatus. In use, the external leads from the conductors are connected to electric control means which operates to regulate the pressure.

For a detail description of the invention, reference is made to the accompanying drawing, in which—

Figure 1 structurally shows the device at the

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left-hand side of the figure with parts broken away for purpose of illustration, its association with the pressure apparatus being illustrated diagrammatically at the right, and

Figure 2 is a cross section on the line 2—2 of Figure 1.

In the drawing, an outer hollow, vertical, transparent glass tube 11 is provided with an opening 12 near its top for establishing communication with the pressure apparatus. An inner glass tube 13, hermetically sealed at its top, is provided with an aperture 14 at its bottom and is removably fitted in an opening in the outer tube as by a hermetically sealed joint 15, with its upper end 16 projecting from the outer tube, tube 13 being smaller than tube 11 so as to allow space between them. A sufficient quantity of mercury 17 is provided in the bottom of the outer tube to cover aperture 14 for all variations of height of mercury in the tube encountered in normal use of the device.

Conductor 20 having an external lead 21 is sealed in the inner tube in such manner as to be in continuous contact with the mercury at 22. Conductor 23 is secured at its upper end to a non-rotatable, traveling, conducting nut 24 threaded on a rotatable conducting screw 25. This screw is supported inside the upper end 16 of the inner tube by means of a conducting bracket 26 held between tabs 27 and 28 integral with the tube. The screw is rotatably held by horizontal conducting tabs 29 and 30 fixed to the bracket in the manner illustrated. The lower end 31 of conductor 23 makes and breaks contact with the mercury. External lead 32 is connected to tab 29 so that the circuit from contact 31 is provided through the conductor, traveling nut, screw and the tab.

For adjusting the height of contact 31, a magnetic vane 35 is fixed to the upper end of screw 25. A manually rotatable ring magnet 36 is supported externally of the tube on a ledge 37 so as to be in magnetic polar position relative to the vane. Rotation of the magnet causes rotation of the vane and consequent rotation of the screw, thus to propel the traveling nut 24 vertically.

Graduations 38 on the outer tube provide for pressure readings.

A manner of using the device is further illustrated in Figure 1, in which 40 represents a pressure apparatus, as for example, a partially evacuated still, in which it is desired to maintain a close pressure control. The still is connected in the usual manner to a constant delivery vacuum pump 41. This pump is of capacity to

draw a higher vacuum than that desired. A manually controlled valve 42 is provided to admit air to the pressure apparatus in such manner that the pump very slowly reduces the pressure beyond the desired level. A second manually controlled valve 43 is also provided to admit air. This valve is similar to valve 42 except that its inlet 44 is provided with a valve seat which is closed by a solenoid operated valve rod 45 provided with a rubber valve ring 46 to engage the seat, the weight of the valve rod closing the ring on the valve seat. In operation, the valve 43 is so set that when inlet 44 is open, the air admitted will result in a gradual rise in pressure in the still. The solenoid operating rod 45 is connected to a power supply line 50 through the switch 51 of a conventional relay 52, connected to leads 21 and 32 through the line.

If the pressure in apparatus 40 is lower than that desired, the mercury in tube 11 will rise and that in tube 13 fall, thus breaking the contact at 31. This disconnects the circuit through the relay and closes switch 51, so that the valve rod 45 is raised by the solenoid admitting air through inlet 44. This causes a rise of pressure in apparatus 40 so that the mercury in tube 11 falls and that in tube 13 rises, re-establishing the contact at 31. This connects the circuit through the relay, thus opening switch 51 and allowing valve rod 45 to drop by gravity cutting off the flow of air through the inlet. This results in a drop of pressure in the apparatus and the cycle repeats. With proper adjustment of valves 42 and 43, the cyclic changes occur rapidly so that valve rod 45 essentially flutters, thus controlling the pressure in the apparatus 40 very closely to the average.

The average pressure in the apparatus is adjusted by manipulation of screw 25, lowering contact 31, resulting in lowering of pressure.

A conventional calibrated manometer 60, such as a U-tube type, may be connected to the apparatus if desired as a check and for calibration of the graduated scale 38.

It will be apparent to those skilled in the art that when regulation is desired at subatmospheric pressures, the inner tube 13 may be evacuated more or less completely, depending on the desired operating range. It will be further apparent that when regulation is desired at superatmospheric pressures, the pressure within inner tube 13 may be made superatmospheric to a degree dependent on the desired operating range.

By making simple changes in the valve system and switch 51, and reversing the direction of pumping, it is evident that regulation may be attained at superatmospheric pressures.

In addition to pressure regulation, the invention, with modifications, may be employed as a regulating flowmeter, or in general, may be used to regulate any system in which a deviation from a desired operating point may be made to vary the liquid level of the conducting liquid.

Having thus described the invention, what is claimed is:

1. A device for automatically regulating fluid pressure in a pressure apparatus, comprising an outer hollow vertical tube provided with an an opening near its top for establishing communication with the pressure apparatus, an inner tube hermetically sealed at its top and provided with an aperture at its bottom, said inner tube being removably fitted in an opening in the outer tube and hermetically sealed therein with its upper end projecting from the outer tube, said inner tube being smaller than the outer tube so as to allow space between them, conducting liquid in the bottom of the outer tube covering the aperture at the bottom of the inner tube, an electrical conductor with an external lead making continuous contact with the conducting liquid, and a second electrical conductor with an external lead in the inner tube for making and breaking contact with the upper surface of the conducting liquid in the inner tube as its height varies, the point of contact of the second conductor being vertically adjustable.

2. The device of claim 1 in which the conducting liquid is mercury.

3. The device of claim 1 in which the outer tube is transparent and provided with graduations matching the upper surface of the conducting liquid therein for reading the pressure in the apparatus.

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