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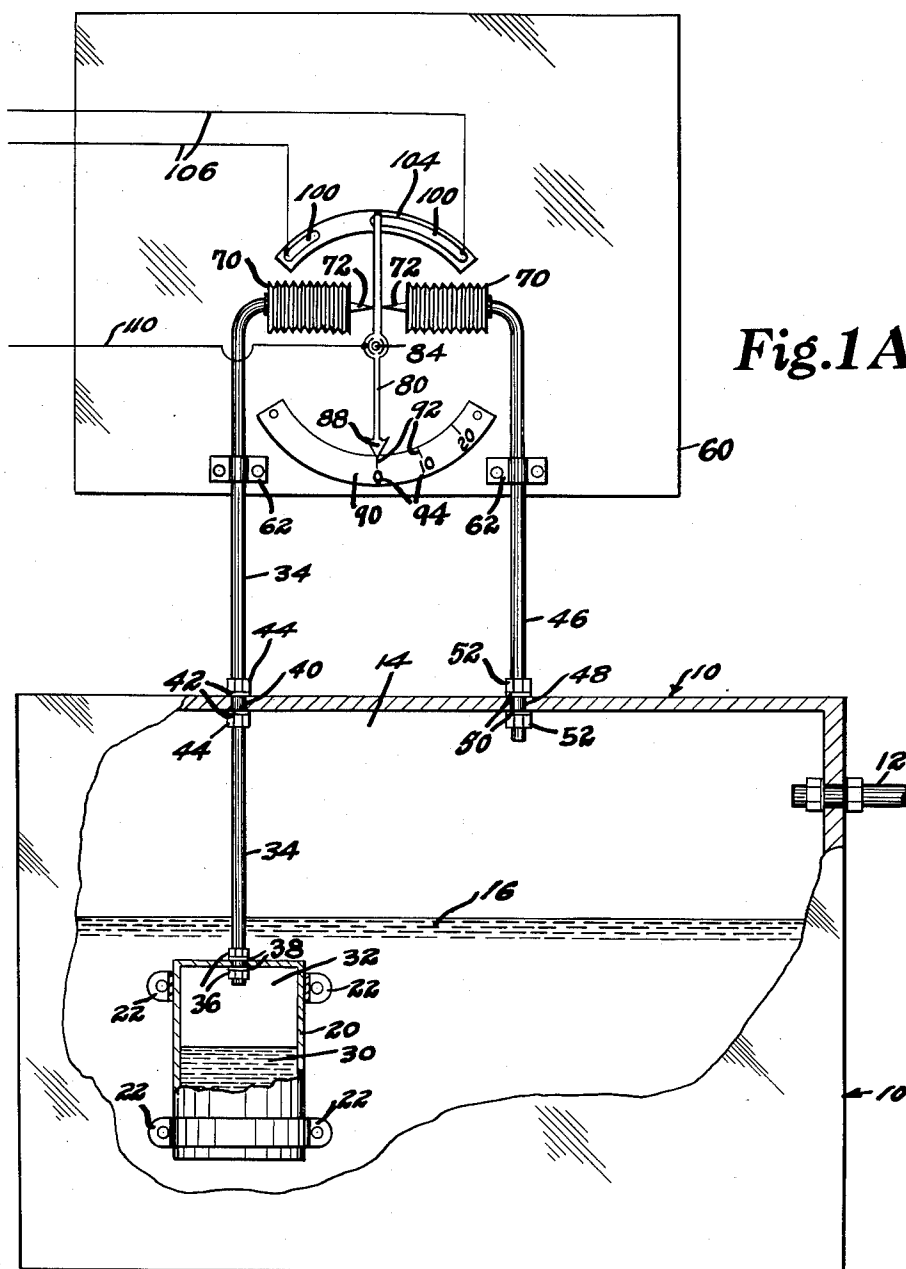
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FOREIGN GAS RESPONSIVE CONTROL APPARATUS

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3 Sheets-Sheet 1



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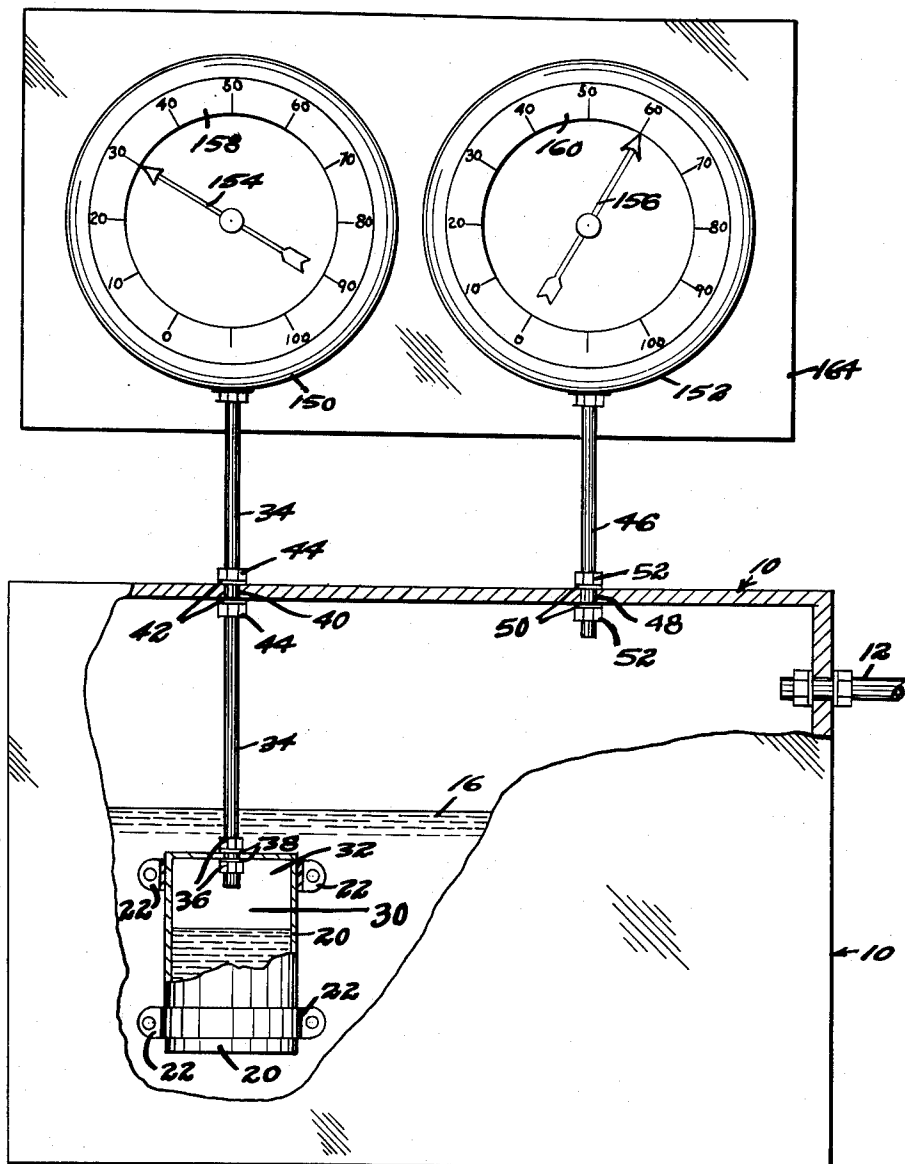
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Fig. 1B



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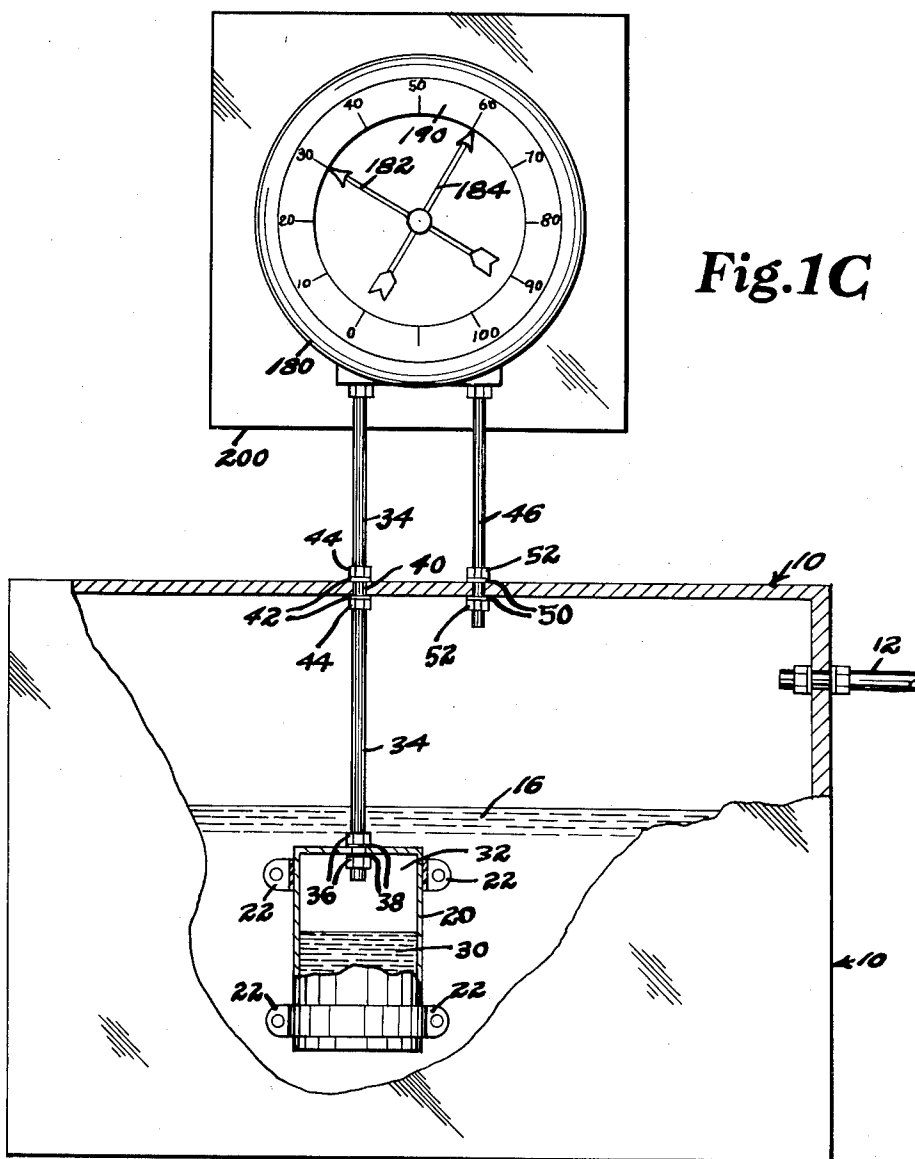
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FOREIGN GAS RESPONSIVE CONTROL APPARATUS

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1 Claim. (Cl. 73—23)

This invention relates to the condensing of gases and more particularly it is an object of the invention to provide a device for indicating the excess pressure required to condense a foul air contaminated gas beyond the relative condensing pressures and temperatures of the pure gas because of the foul air present in the gas.

In refrigeration, the power required to condense a gas to a liquid is in proportion to the physical properties of the gas and in proportion to the foul air present in the condensing container. This foul air, being practically non-condensable under the operating conditions, increases the power needed for condensing the gas in proportion to the volume of foul air present.

An object of this invention is, therefore, to provide a device for detecting, measuring and indicating the effect of the foul air in a condensable gas compression container.

A further object of this invention is to provide a device responsive to the sum of two pressures: an evaporation pressure of a liquid inherent in the physical properties of the liquid, and a foul air pressure, the foul air pressure sometimes being composed of the sum of the pressures of several foreign gases, the device being useful for indicating the pressure difference and for controlling other mechanisms, including switches and valves.

A more particular object of the invention is to indicate where power used for condensing a foul air contaminated gas can be economically saved by exhausting foul air from the gas before condensing.

Another object of the invention is to provide three modifications, a two separate gauge indicator, a double indicator single scale gauge indicator, and a bellows indicator, the latter, with additions, also being an automatic controlling device.

Another object of the invention is to provide a device for the purpose described which is sturdy and durable in construction, reliable and efficient in operation, and relatively simple and inexpensive to manufacture, assemble and utilize.

Other and still further objects and advantages of the invention will become apparent from the following detailed description of a preferred embodiment thereof.

In the drawings:

Figure 1A is a frontal elevation of the preferred form of foreign gas responsive control of this invention, shown as mounted on a tank partially filled with gas and foul air, and partially filled with liquid of a kind condensed from the gas, a front portion of the tank being broken away, and a front portion of a container of the control of this invention being broken away, showing liquid therein.

Figure 1B is a frontal elevation of the modification of this invention which is adapted for indicating the difference in pressures in a gas and foul air area above a liquid and in a pure gas area above a similar liquid at a similar temperature; two gauges being employed mounted side by side; a forward portion of a tank being broken away showing liquid therein, and a forward portion of a liquid and pure gas container being broken away show-

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ing liquid therein, the tank and container being similar to those shown in the modification of Figure 1A.

Figure 1C is a modification of the invention, the lower portions of the figure being the same as shown in Figure 1B, a single gauge of a tank having dual indicating needles and a single calibrated scale being employed.

The foreign gas pressure responsive control device, or indicating device, or indicating and control device of this invention is for attachment to a tank 10 of a type adapted to withstand considerable pressure during the condensation under pressure of a gas which is caused to enter the tank 10 through a pipe 12 near the upper end of the tank.

In practice, it is found that in plants performing this operation, a certain amount of foul air enters the gaseous upper portion 14 of the tank 10 with the pure gas itself. This foul air can include one or more foreign gases, each having different physical characteristics than the gas being condensed.

It is found, in practice, that the amount of pressure which must be applied through the pipe 12 to the upper layer 14 in the tank 10 in order to condense the desired gas therein into a liquid state shown in the lower layer 16 of the tank, increases in proportion to the amount of foul air present in the layer 14. This is because the foul air is usually more difficult to condense than the pure gas. Usually the foul air is practically incondensable under the operating conditions chosen for the pure gas.

To condense the pure gas when considerable foul air is present requires great pressure and much power is wasted. On the other hand, to exhaust the foul air before condensing the gas is also an expensive operation.

It is desirable to know the exact amount of foul air present as reflected by the pressure of the foul air in order for plant operators to judiciously ascertain whether the quantity of foul air present will make it more desirable and economical to exhaust foul air or increase condensation pressure to condense the gas in spite of the foul air present.

The device of this invention includes a container 20 disposed beneath the surface of the liquid 16 and sealed therefrom. The container 20 may be mounted on a side wall of the tank 10 if desired, by means of suitable straps 22. A supply of liquid 30 is provided in the container 20, the liquid being of the same kind found in the layer 16, that is, the liquid is of the kind formed by the condensation of the pure gas. The upper portion of the container 20 is provided with a layer 32 of pure gas of the same type which it is desired to accumulate in the tank 10. A conduit 34 is provided and is disposed in sealed communication by means of the nuts 36 and gaskets 38 with the upper layer 32 of the container 20. The conduit 34 extends upwardly through an opening 40 in the tank 10, the remainder of the opening 40 being sealed by suitable gaskets 42 and nuts 44.

A second conduit 46 is provided and is disposed through an opening 48 in the upper end of the tank 10, the lower end of the conduit 46 being in communication with the gaseous layer. Suitable gaskets 50 and nuts 52 are employed for sealing the remainder of the opening 48. The conduits 34 and 46 extend from the tank 10 and are secured to a suitable frame or mounting board 60 by any suitable means such as brackets 62. At their upper ends, the conduits 34 and 46 are preferably in-turned toward each other, terminating with their ends disposed at a right angle with respect to the remainder thereof.

Each of the conduits is provided with a bellows 70, each bellows having a point 72 disposed on its outer end. The bellows 70 are so arranged that their points 72 are oppositely disposed on opposite sides of and in engagement with a movable member or indicating arrow or needle 80. The member 80 is movably secured to the

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frame or mounting member 60, preferably being pivotally secured on an axle 84. The axle 84 is disposed on one side of and spaced apart from the points 72. The arrow 80 is provided with indicating head 88 on the opposite end of the arrow 80 from the points 72 and a scale 90 is provided having calibrations 92 and numbers 94. The scale 90 is disposed at the indicating arrow end of the member 80.

The right-hand member 100 is disposed normally in contact with the arrow 80 and at times when the arrow 80 indicates a zero point on the scale 90. The members 100 are mounted upon an insulating member or arcuate bar 104 and each member 100 is secured by means of a wire 106 to any desired electrically controlled mechanism, not shown.

The latter may be a compressor for increasing the pressure on the layer 14 secured to one of the wires 106, and a foul air removing device secured to the other wire 106. A third wire 110 is provided and is secured to the arrow 80, the latter being electrically conductive and adapted to engage the members 100 each at different times. The third wire 110 can be connected to the compressor and device for completing the circuit of each at times when the arrow 80 engages one of the contact members 100.

In operation, it will be seen that the pressure in the conduit 34 is the pressure of a pure gas above the liquid 30 and that the pressure in the layer 14 and the conduit 46 is greater normally, being the sum of the pressures of the pure gas in the layer 14 and of the foul air in the layer 14 in accordance with Dalton's law for vapor.

The bellows 70 on the conduit 46 will thus exert a greater pressure than the bellows 70 on the conduit 34, causing the arrow 80 to swing to the right side of the scale 90 in proportion to the pressure of the foul air, and thus in proportion to the amount of foul air present, indicating to an operator the amount of foul air present.

The upper end of the arrow 80 will, at the same time, engage the left-hand contact member 100, if the foul air pressure is great enough. The compressor or other device for exhausting foul air will then be placed in operation. Conversely, if the amount of foul air present is insufficient to warrant exhaustion, the arrow 80 will engage the right-hand contact member 100, completing a circuit useful for lighting a warning light, bell or other device.

The modification shown in Figure 1B is composed of similar lower parts bearing similar numbers. However, the conduits 34 and 46 in Figure 1B, are directly connected each to a separate gauge 150 and 152. The gauges 150 and 152 are each provided with an indicating arrow 154 and 156 respectively, for indicating positions on calibrated dials 158 and 160. The gauges 150 and 152 are preferably mounted upon the same frame or mounting panel 164 in side-by-side positions facing the same direction for simultaneous reading.

In the operation of the device in Figure 1B, the difference in pressure is indicated by mentally subtracting the reading of the gauge 150 from the reading of the gauge 152 for determining the relative amount of foul air present.

The modification shown in Figure 1C is similar to the modification of Figure 1B, with the exception that a single gauge housing 180 is employed. The housing 180 is provided with two indicating needles 182 and 184 connected by their concentric axles to the respective conduits 34 and 46 in a conventional manner. The arrow 182 and 184 form individual gauges combined for co-operation. The needles 182 and 184 share the same calibrated scale 190. The housing 180 can be mounted upon any suitable frame or gauge panel 200.

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In the operation of the gauge shown in Figure 1C, the function is the same as that previously described for Figure 1B, with the exception that the difference in readings of the indicators 182 and 184 is more easily seen, since they both share the same calibrated scale.

The temperature of the respective gases at the gauges must be higher than the temperature of the liquids in the respective tank 10, and container 20, or condensation will take place, causing incorrect reading, unless drainage back into the respective tank 10 and container 20 is supplied.

This invention has provided a foreign gas pressure responsive device which can be used for indicating the presence of foul air mixed with a pure gas to be condensed and which can be combined with automatic pressure responsive means of the invention for automatically actuating the foul air expelling means or gas compression means at different desired times.

From the foregoing description it is thought to be obvious that a foreign gas responsive control constructed in accordance with my invention is particularly well adapted for use by reason of the convenience and facility with which it may be assembled and operated, and it will also be obvious that my invention is susceptible of some change and modification without departing from the principles and spirit thereof, and for this reason I do not wish to be understood as limiting myself to the precise arrangement and formation of the several parts herein shown in carrying out my invention in practice except as claimed.

I claim:

In a device for detecting foreign gas in refrigerant gases, the combination which comprises a pressure tank having a gas in the upper part and a liquid in the lower part, the said liquid being condensed from a gas of the type present in the upper part of the tank, a container also having a gas in the upper part and a liquid in the lower part positioned in the liquid in the said tank, the liquid of the container being of the same type as that of the liquid in the tank and the gas in the container being of the same type as that of the gas in the tank without having foreign gas therein, a panel, a needle pivotally mounted on the panel, a bellows having a point on one end mounted on the panel and positioned with the point thereof in engagement with one side of the needle, a tube connecting the opposite end of the bellows to the upper part of the said container where the gas is positioned, a complementary bellows also having a point on one end and also positioned on the panel and with the point thereof in engagement with the opposite side of the needle, said bellows and points being in alignment, a tube connecting the opposite end of the said complementary bellows to the upper part of the tank where the gas is positioned, a scale mounted on the panel and positioned to coact with the pointer to indicate the amount of foreign gas in the gas of the tank, and a segment having contacts thereon positioned to be engaged by the pointer for completing a warning circuit and also a circuit for actuating means for removing the foreign gas from the upper part of the tank.

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