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G. W. WILSON, JR
METHOD AND APPARATUS FOR CONTROLLING
FRACTIONATING COLUMNS

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2 Sheets-Sheet 1

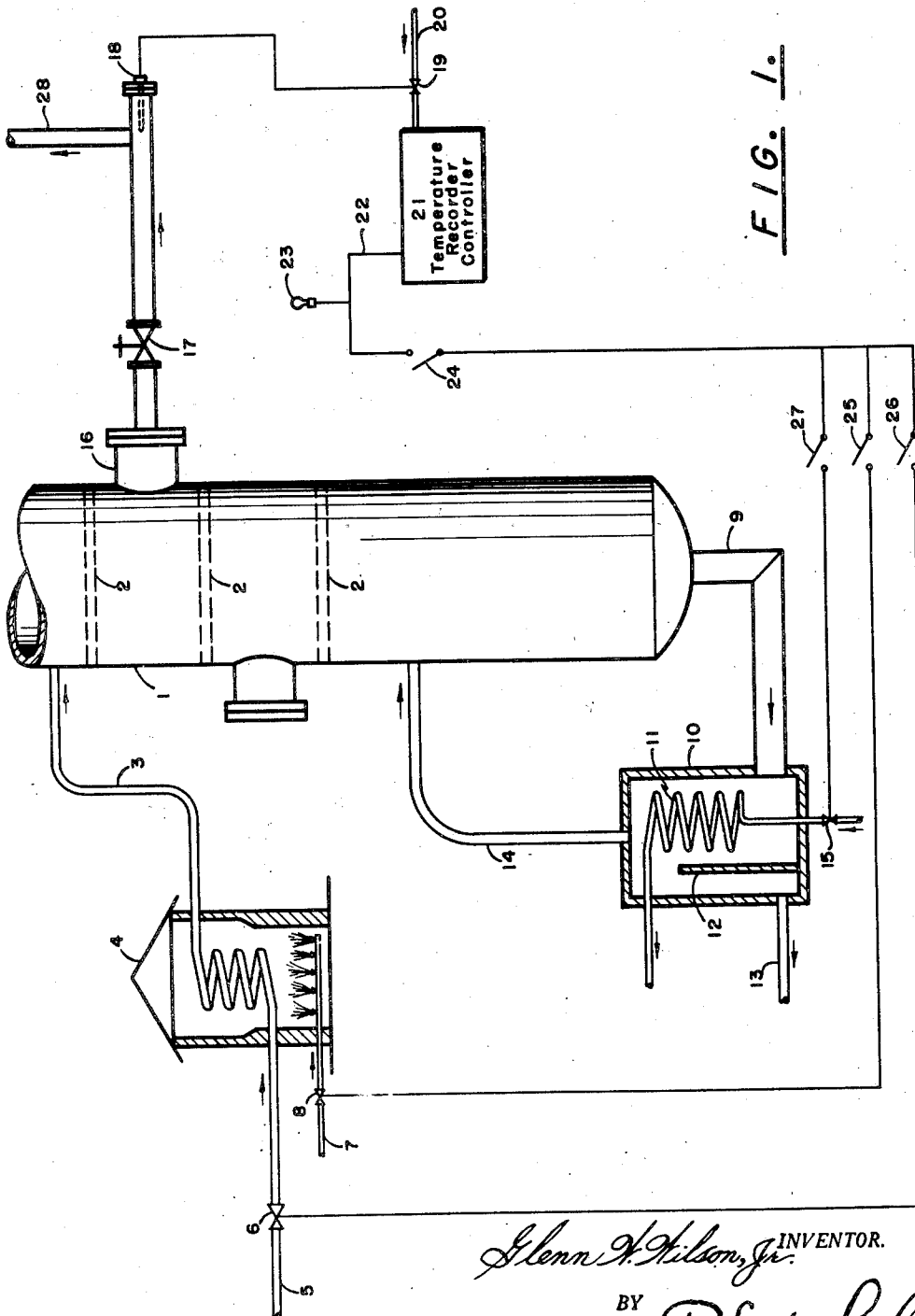


FIG. 1.

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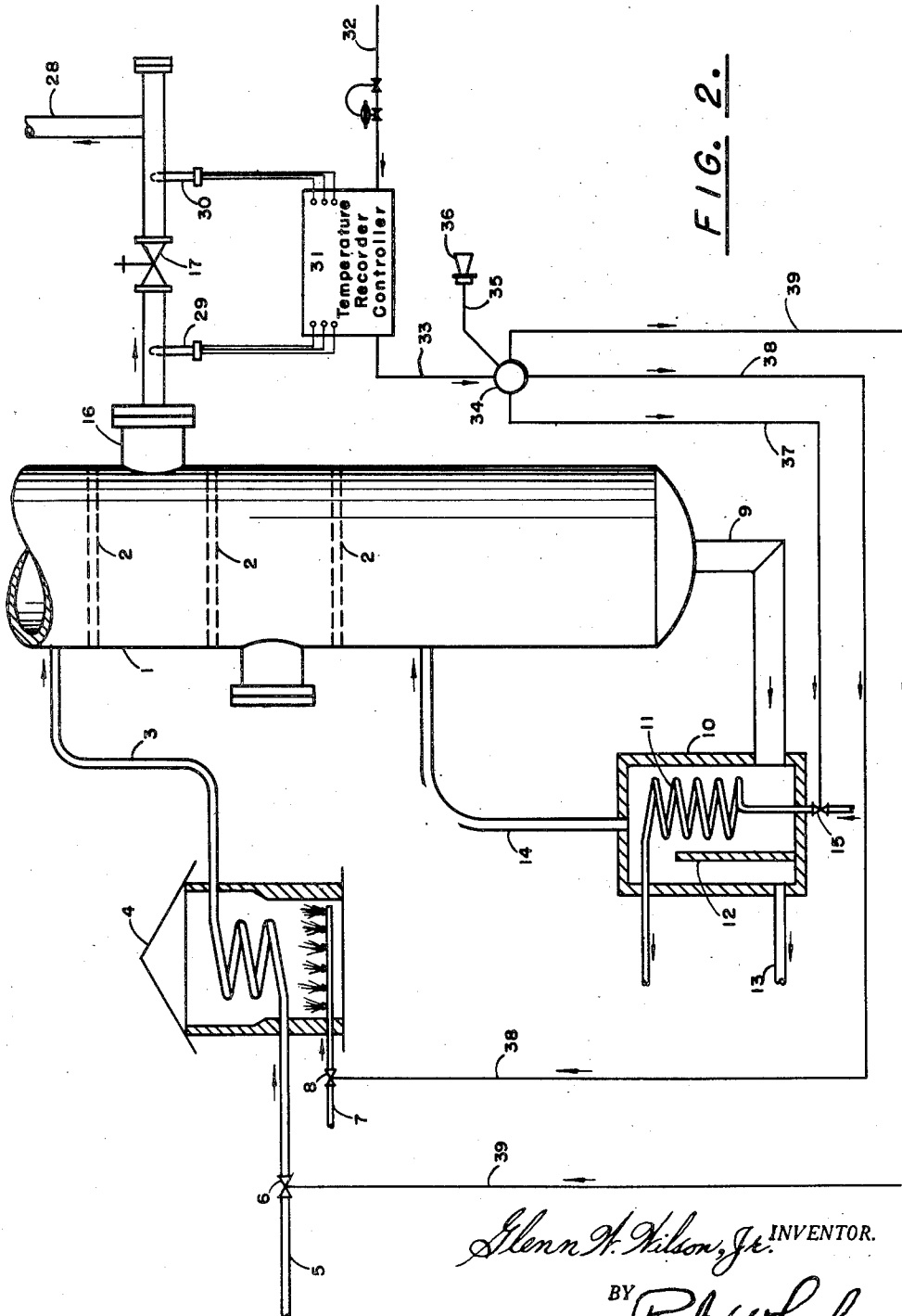
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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR CONTROLLING FRACTIONATING COLUMNS

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5 Claims. (Cl. 202-160)

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The present invention is directed to a method and apparatus for controlling the operation of a fractionating column.

In order to obtain the maximum degree of fractionation in a given fractionating column, it is necessary to operate the column at the maximum allowable vapor rate, limited only by the tendency of some particular section of the tower to flood. With the conventional methods of control a designated vapor rate is set as the maximum to which the tower is controlled. However, spilling rates will change from time to time, depending on variations in feed stock composition, operating conditions and the degree of tower fouling. It is desirable that the approach to flooding rates be carefully controlled, as a short period of upset operation may nullify the gains attributable to a marginal increase in vapor rate.

According to the present invention vapor rate is controlled by utilizing the increase in liquid level on a selected plate, as flooding begins, either to operate a signal to warn the operator or to actuate control valves governing the feed rates of liquid feed stock and/or vapors from the reboiler and/or steam to the reboiler and/or fuel fed to the preheater for the feed stock. Briefly, the present invention is based on the difference between temperature drop due to the expansion of vapors passing through an orifice on the one hand and the temperature drop resulting from the partial vaporization of a liquid at its bubble point when the pressure is reduced on the other hand.

In the practice of the present invention test work is conducted on a given fractionating column to locate the plate in the column on which flooding occurs first. A vapor line is connected into the vapor space above the designated plate, and this line is equipped with a throttle valve to provide an adjustable orifice. Downstream from the throttle valve is a temperature-responsive element of the type commonly employed to control other devices such as a recording device, a signal device, or a valve. In the normal operation of the tower vapor will pass through the throttle valve and the temperature measured on the downstream side will be within a few degrees of the temperature inside the tower. If, however, the vapor rate is increased to the point where flooding occurs, liquid will pass through the throttle valve and the temperature measured on the downstream side will be appreciably lower than the temperature inside the tower. By suitable adjustment of the throttle valve the difference between the temperature downstream there-

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of when liquid is passing through the valve and that when only vapor is passing therethrough can be made sufficiently large to permit the use of temperature-responsive actuating devices to control or manipulate almost any kind of a desired device for correcting the condition.

The method of the present invention is practiced with conventional equipment. For example, the temperature-responsive device employed may be of any conventional type such as those shown at pages 1688 and 1689 of the 1934 edition of "Chemical Engineers' Handbook," by John H. Perry, published by McGraw-Hill Company, Inc. These temperature-responsive control members can be used to operate valves directly or may be used to control a compressed air supply, which in turn may be connected to suitable recorders and valve controls in the conventional manner.

The nature of the present invention may be better understood from the following detailed description of the accompanying drawing, in which

Fig. 1 is a front elevation partly in section and partly in diagrammatic form of one type of apparatus according to the present invention; and

Fig. 2 is a similar view of a type which differs in the control means.

Referring to Fig. 1 of the drawing in detail, numeral 1 designates a fractionating column having plates 2. The liquid to be fractionated is introduced into the column through line 3 after passage through a preheater 4, into which the feed stock is introduced by way of line 5, provided with a control valve 6. The fuel for the preheater is fed in by way of line 7, provided with a control valve 8.

The column 1 is provided with a bottom draw-off line 9, connected to a reboiler 10, in which is a steam coil 11 and an overflow weir 12 for conducting overflow to the discharge line 13. The upper part of the reboiler is provided with a vapor line 14 for returning vapors to the column above the level of the bottoms. The feed line to the steam coil is provided with a control valve 15.

Above a selected plate, which has been determined to be the plate on which flooding begins, or at least a plate above that on which flooding begins and adjacent thereto, is a draw-off line 16 provided with a throttle valve 17. Downstream from the throttle valve is a temperature-responsive element 18 of any conventional type, as hereinbefore mentioned, which is arranged to actuate a valve 19 in a compressed air line 20. The compressed air in this line is used to actuate a temperature recorder 21, which may be a conven-

tional Foxboro rotary chart recorder. This compressed air in this type of device also closes a circuit which supplies power to line 22. This power may be utilized to operate a light 23 or an audible signal, or by closing switch 24 and switch 25 may be used to control an electrically operated valve 8 in the fuel feed line 7. Likewise, with switch 24 and switch 26 closed, the electric power may be used to actuate an electrically operated valve 6 in feed line 5. In like manner, by closing switches 24 and 27 the electric power may be used to control electrically operated valve 15 in the feed line to heating coil 11.

The vapors, after passing through throttle valve 17, may be led off by way of line 28 to a fuel burner. In the event a particular downstream pressure is desired rather than some convenient pressure, such as atmospheric or the pressure in a fuel system or the like, it will be desirable to provide an additional throttle valve in line 28. Adjustment of the two throttle valves will permit operation at any flow rate and pressure differential desired. For example, a drop in pressure from 115 to 45 pounds per square inch gauge in a column for separating isobutane from butane will result in a 40° F. spread between downstream temperatures in branch line 16 for liquid and vapor, while a drop from 110 pounds per square inch gauge to atmospheric pressure will increase the spread to 95° F.

In Fig. 2 the parts corresponding to the same parts in Fig. 1 bear the same numerals. In this case a resistance thermometer 29 is placed ahead of the throttle valve 17 and a similar thermometer 30 is placed behind the throttle valve. These thermometers are connected in a known way to a differential temperature recorder controller 31 which may conveniently be the type of instrument marketed by Leeds & Northrup. This instrument has a compressed air supply line 32 and a compressed air control line 33. In the latter line is a valve 34 which may be a two, three or four way valve. A line 35 connected with the valve supplies air for a horn 36. A second line 37 supplies air for an air operated valve 15 in steam line 11. A third line 38 supplies compressed air for operation of air control valve 8 in fuel line 7. A fourth line 39 connected with valve 34 supplies compressed air to air control valve 6 in oil line 5. Thus it will be seen that this embodiment differs from the embodiment shown in Fig. 1 by the employment of air controlled valves instead of electrically controlled valves. It may be mentioned that control valves of both types are well known on the market and in common use in various industries. For this reason details of the construction of such valves are deemed unnecessary for this description.

The nature and objects of the present inven-

tion having been fully described, what I wish to claim as new and useful and to secure by Letters Patent is:

1. In the operation of a fractionating column to prevent flooding thereof the steps of withdrawing from said column at a point above the location of the plate at which flooding begins, a sidestream of fluid whereby in the normal operation of said tower vapor will flow in said sidestream while when flooding sets in liquid will flow in said sidestream, passing the fluid flowing in said sidestream through an orifice and utilizing the difference in temperature on the downstream side of said orifice between that prevailing when vapor flows in said sidestream and that prevailing when liquid flows in said sidestream for setting into operation a corrective measure for at least one of the factors which contributes to flooding.

2. In a fractionating column having fractionating plates, in combination, an outlet line arranged between plates of said column above a plate at which flooding begins, means in said outlet for restricting the cross sectional area of the stream of fluid flowing therethrough, temperature responsive means on the downstream side of said restricting means and means actuated by said temperature responsive means for setting into operation at least one corrective measure for flooding in said fractionating column.

3. An apparatus according to claim 2 in which the means actuated by the temperature responsive means is a signal for warning the operator that flooding has begun.

4. An apparatus according to claim 2 in which the fractionating column is provided with a reboiler including a line for conducting heating medium for said reboiler and the means set in operation by the temperature responsive element controls the flow of heating medium in said line.

5. An apparatus according to claim 2, in which the means set in operation by the temperature responsive element controls the temperature of the material to be fractionated and fed to said fractionating column.

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