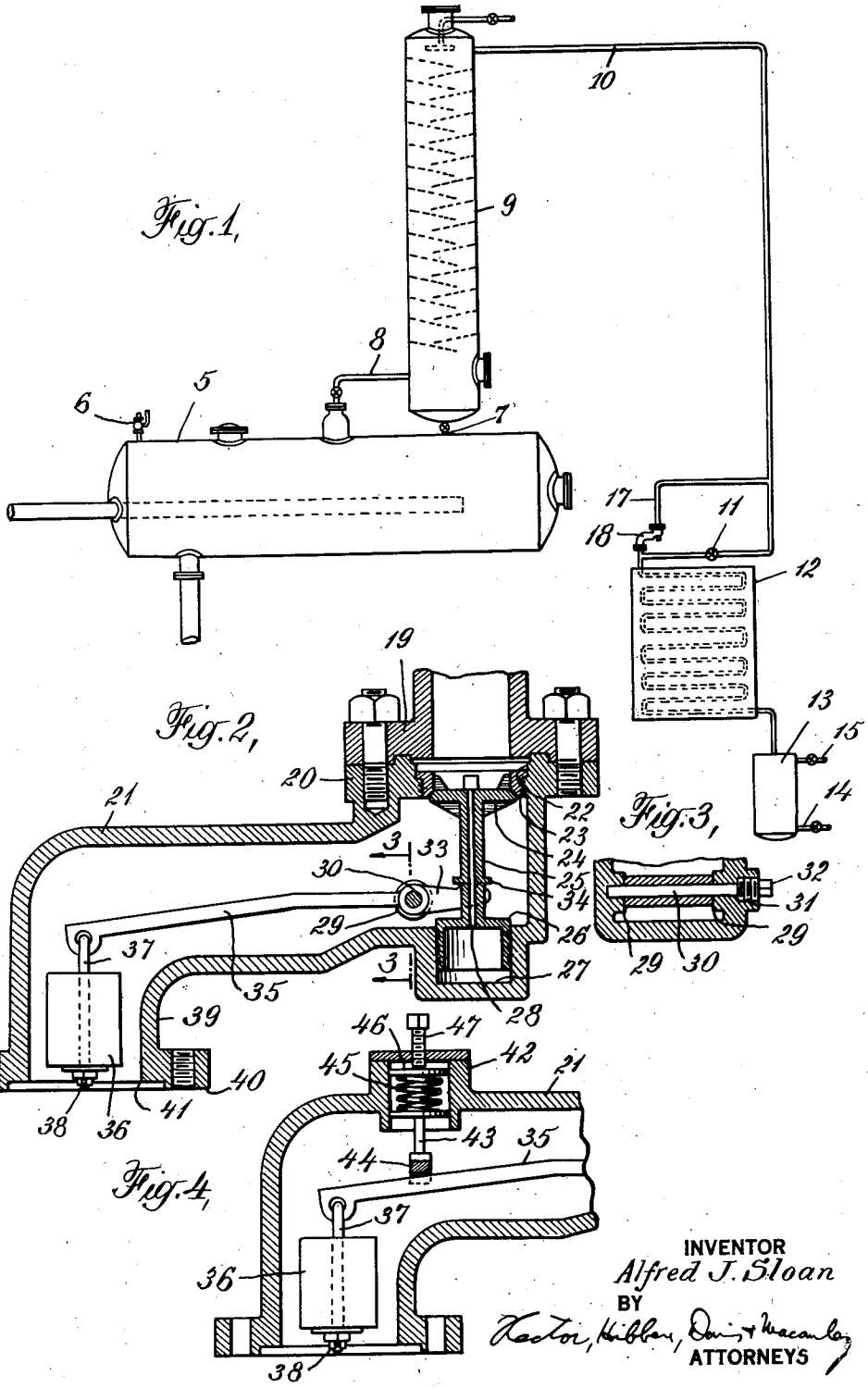
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PRESSURE STILL

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PRESSURE STILL.

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This invention relates to improvements in automatic relief valves particularly adapted for use in connection with pressure stills for cracking heavier hydrocarbons to produce lighter hydrocarbons, such as gasoline or pressure distillate therefrom. This application is a division of an application filed September 15, 1923, Serial No. 662,797.

In pressure stills for cracking heavier hydrocarbons, the oil is heated in the still to a cracking temperature under a high pressure, and the vapors resulting from the cracking operation, either with or without refluxing, are withdrawn to a condenser. Such pressure stills are operated at high pressure, for example, at pressures around 90 to 125 lbs. per square inch, where gas oil is subjected to cracking, while much higher pressures may be used where lighter oils such as kerosene are subjected to cracking, pressures around 300 to 325 pounds being sometimes used, and even much higher pressures, around 600 to 700 pounds per square inch.

In order to protect such stills in case excessive pressure develops therein, a safety valve is usually provided which will discharge into the atmosphere in case of abnormal rise in pressure, thus relieving the pressure and reducing the danger of explosion and its attending hazards. The vapors contained in such pressure stills are heated to such a high temperature that they will take fire spontaneously if discharged directly into the air, and precautions are accordingly necessary to cool the vapors to prevent their spontaneous ignition in case relief of vapors through the saftey valve should take place.

Where the condensers for the pressure stills are maintained at atmospheric pressure, or at a predetermined pressure, between that of the pressure still and atmospheric, a pressure reducing and regulating valve is usually provided between the still and condenser, and this valve is operated to regulate the pressure in the still and to promote the withdrawal of the cracked vapors in regulated amount therefrom. Where the pressure still is provided with a reflux tower, this pressure regulating valve is commonly provided between the reflux tower and the condenser.

In the operation of the pressure stills such pressure regulating and reducing valves require more or less constant observation and attention on the part of the operator, who adjusts the valve to maintain a substantially constant pressure in the still and to release the vapors in regulated amount therefrom. In case of lack of attention on the part of the operator an abnormal pressure may be built up in the pressure still, and, in case this pressure becomes excessive release of vapors through the safety valve to the atmosphere will take place. The release of pressure in this way is not only wasteful, but it seriously interrupts the proper operation of the still, as it usually results in a diminution of pressure to a point considerably below that of normal operation, with the result that a larger amount of heavier hydrocarbon vapors than the vapor system of the still is designed to handle is immediately vaporized and a considerable amount may be lost to the atmosphere, and the still will then require to be again brought up to normal operating condition.

The present invention provides an improved automatic relief valve which arranged in a by pass around the usual pressure reducing or regulating valve will operate upon a predetermined increase in pressure above that at normal operation to relieve this excess pressure by discharge of vapors of the regulating valve to the low pressure side. This automatic pressure relief valve is advantageously enclosed entirely within a casing, so that there are no stuffing boxes or outside connections or adjustments through which leakage can take place. When such adjustments or outside connections are provided, they are arranged on the discharge side of the valve where a relatively low pressure will exist even during the operation of the valve. This improved automatic relief valve is especially designed and constructed so that when opened it will give quick release of the excess pressure but so that it will be quickly closed when the excess pressure has been relieved. The automatic relief valve moreover is so adjusted as to open before the safety valve on the still so that, except in the case of a most unusual increase of pressure, it will open and pass vapors to the condenser thus relieving the pressure in the still before the safety valve on the latter

can open, thus saving the loss of vapors and interruption of regular operation above mentioned.

Other features of the invention will appear from the accompanying drawing and from the following more detailed description thereof, it being intended and understood that the specific disclosure is for the purpose of exemplification, and that the scope of the invention is defined in the following claims in which I have endeavored to distinguish it from the prior art as known to me, it being my purpose to cover the novelty disclosed in the broadest possible scope.

In the drawings, Fig. 1 is a diagrammatic view of a still embodying the invention.

Fig. 2 is a vertical cross sectional view of the automatic release valve of the invention.

Fig. 3 is a cross section on the line 3—3 of Fig. 2.

Fig. 4 is a view similar to Fig. 2 of a modified form of construction.

Referring to the drawings, the still proper is indicated at 5 and may be of any suitable type of construction, such as a shell still or a tube still, heated either directly or by circulating the oil through heating tubes. The drum illustrated is of the general type disclosed in U. S. Letters Patent No. 1,285,200, granted to the Sinclair Refining Company upon an application of Edward W. Isom, and oil is heated by circulation from the drum 5 through heating tubes (not shown) and back to the drum 5. The drum is shown as provided with a safety valve 6 which may be of the usual construction.

The pressure still is provided with a reflux tower 9 connected with the vapor drum of the still through a vapor line 8 and having a return pipe 7 for the return of reflux to the still. The reflux tower 9 is shown as a baffle tower with a feed line for fresh feed entering the top of the tower. The vapors from the top of the tower escape from the vapor line 10 having the pressure reducing and regulating valve 11 therein, to the condenser shown conventionally at 12, and the pressure distillate is collected in the receiver 13 and drawn off through the pipe 14, while the permanent gas and any uncondensed vapors are drawn off through the pipe 15. Valves in the pipes 14 and 15 permit the maintenance of a pressure greater than atmospheric on the condenser and receiver, although this pressure may be substantially atmospheric.

A by-pass 17 is provided around the pressure reducing and regulating valve, and this by-pass contains an automatic relief valve of a special construction described below. This by-pass leads from the high pressure side of the pressure regulating valve to the line connecting the discharge side of the valve with the condenser. Normally this by-pass valve will be closed, but upon a predetermined rise in pressure above normal this valve is designed to open sufficiently to permit the release of the excess pressure while closing before the pressure falls to any considerable extent below normal.

Referring to the construction of the improved automatic relief valve shown in Fig. 2 it will be noted that the casing 21 which encloses the relief valve terminates in two flanges by which the casing can be directly connected to a similar flange 19 on the by-pass pipe 17, and to a similar pipe on the outlet end. It will also be noted that except for these two openings the casing 21 is entirely closed and that no moving parts extend outwardly therethrough.

The upper flange 20 of the casing is provided with an opening 22 in which is threaded a bushing 23 serving as a seat for a valve head 24. This valve head has formed integrally a stem 25 which terminates at its lower end in a piston 26 which fits in a chamber 27 formed in the bottom wall of the casing 21. A passage 28 of restricted size extends through the stem of the valve and serves to place the chamber 27 in communication with the space above the valve. The piston 26 may be provided with the usual piston rings. The diameter of the piston is also slightly less than the diameter of the valve head, the difference in area being the effective area upon which the execess pressure operates. That is, the high pressure in the pipe 17 above the automatic relief valve also acts upon the piston 26 through the restricted opening in the valve stem and the pressure acting upwardly upon the piston partly counterbalances the pressure acting downwardly upon the valve head.

Mounted in suitable bosses 29 of the casing is a pintle 30 having a threaded portion 31 by means of which it is secured in place and having a square end 32 extending beyond the casing by which it may be tightly screwed in the casing with suitable packing to insure a tighter fit if necessary.

Pivotally mounted on this pintle within the casing is a lever having a short arm 33 which bears against a collar 34 formed on the valve stem 25, and having a long arm 35 extending in the opposite direction. To the end of this long arm 35 a weight 36 is secured by a supporting rod 37 and nut 38. The casing is so formed and the long arm 35 is so arranged therein that the weight is free to move up and down in the offset portion 39 of the casing, which terminates in a flange 40, and an outlet opening 41, this flange being bolted to a similar flange on the vapor line.

The action of the weight will be to counteract or offset the pressure upon the valve head during the normal operation of the pressure still. The slight difference in area between the piston and the valve head con-

stitutes the effective operating area of the valve upon which the high pressure of the still operates, and this pressure is normally counter-balanced by the weight so as to keep the valve closed. However, upon the occurrence of a predetermined excess pressure in the pressure still, this excess pressure will act upon the valve and force it from its seat and permit the release of vapors therethrough to the low pressure side of the pressure control valve 11.

The construction of the piston 26 is not only such as to partly counter-balance the valve 10 but it is also such as to give a dashpot effect upon sudden increases in pressure. The restricted opening through the valve stem 25 will require an appreciable time for the pressure above the valve to be communicated to the under side of the piston, and with sudden increase in pressure above the valve, this valve will open quickly, and since the valve head is relatively large, an annular opening of appreciable size will be provided for the escape of vapors therethrough. The pressure below the piston 26 will, however, serve to retard the opening of the valve and will help close the valve when the pressure falls below the predetermined pressure.

With a valve having a valve head of two inches diameter, the piston may have an effective diameter of $1\frac{15}{16}$ inches. With a pressure of 251 lbs. on the valve head there will be a pressure of about 236 lbs. on the piston, or a differential pressure of about 15 lbs., which the weight will be required to counter-balance. A valve so constructed is sufficiently sensitive so that it will open upon a pre-determined small increase in pressure of a few pounds and serve to release the excess pressure without permitting the pressure to drop to an objectionably low point below that desired in the pressure still.

Additional means may be provided for preventing or reducing the chattering of the relief valve. A modified construction showing such added means is shown in Fig. 4. In this figure the casing 21 is shown as provided with a hollow boss 42 in which is located a plunger rod 43 carrying a plunger at its upper end and terminating in a forked arm 44 at its lower end bearing against the long arm 35 of the lever. Located above the plunger 43 is a coil spring 45 bearing against a plate 46 which is held in adjusted position by a threaded pulley 47 extending through a threaded aperture in a cover plate 48 suitably secured to the boss. The action of the spring-held plunger is to damp the vibrations of the lever arm 35 and reduce or prevent objectionable chattering.

In the operation of the automatic relief valve it will be evident that it functions so as to relieve the vapors from the inlet or pressure side of the pressure-regulating valve to the outlet or low pressure side thereof. The valve will normally be held against its seat, being accurately guided by the projections or guides and by the equalizing piston. When the pressure on the inlet side increases to a pre-determined degree above normal, it reacts on the valve and equalizing piston and serves to open the valve. When the pressure in the inlet pipe again becomes normal, the weight will function and over-balance the pressure in the inlet pipe, thereby re-seating the valve in the valve seat and closing off the release of vapors.

In the normal operation of the pressure still, the pressure will be regulated by manipulation of the hand-operated pressure control valve 11 and the still pressure will be held at an approximately constant working pressure, for example, of 95 lbs. The vapors will be released through the pressure regulating and reducing valve 11 to the condenser and receiver which may be maintained at atmospheric pressure or at a predetermined pressure above atmospheric, for example, a working pressure of 25 lbs. If the pressure regulating valve 11 does not function the pressure in the still will build up above the normal working pressure of 95 lbs., causing the automatic relief valve to open and to discharge the vapors through the by-pass line to the condenser, for example, when a pressure of 105 lbs. is attained.

It will be noted that the construction of the automatic relief valve has no outside connection of stuffing boxes, etc., on the high pressure side of the valve, and, in the preferred construction of Fig. 2, there are no such connections on the low pressure side of the valve, except for the opening through which the pintle 30 enters the casing. In Fig. 4 the adjusting screw 47 extends through a threaded opening, but this can be made sufficiently tight to prevent leakage, and there will be less danger of leakage because of the low pressure maintained on the outlet side of the valve. All the working parts of the valve and adjustments are enclosed in one continuous casing and there are no adjustments which can be accidentally changed to prevent the automatic relief valve from operating. All of the operating parts of the relief valve are enclosed in a single casing so that positive and relief operation is obtained.

I claim:

1. An automatic relief valve comprising a casing having inlet and outlet openings, a valve seat in the casing adjacent the inlet opening, a valve head fitting the seat to close the inlet opening, a hollow stem attached to the head, a piston on the stem movable in a chamber communicating with the inlet through the stem and operable by the pressure on the inlet side of the head to force the latter toward the seat, and a weighted

arm pivoted within the casing and having one end engaging the stem to force the head toward the seat.

2. An automatic relief valve comprising a casing having inlet and outlet openings, a valve seat in the casing, a valve head fitting the seat to close the inlet opening, a hollow stem attached to the head, a piston on the stem movable in a chamber communicating with the inlet through the stem and operable by the pressure on the inlet side of the head to force the latter toward the seat, and a weighted arm acting through the stem to force the valve head toward the seat.

In testimony whereof I affix my signature.

ALFRED JAMES SLOAN.