Feb. 11, 1941. J. M. SHIMER 2,231,843

PORTABLE OIL FIELD BOILER

Filed Sept. 25, 1937 3 Sheets-Sheet 1

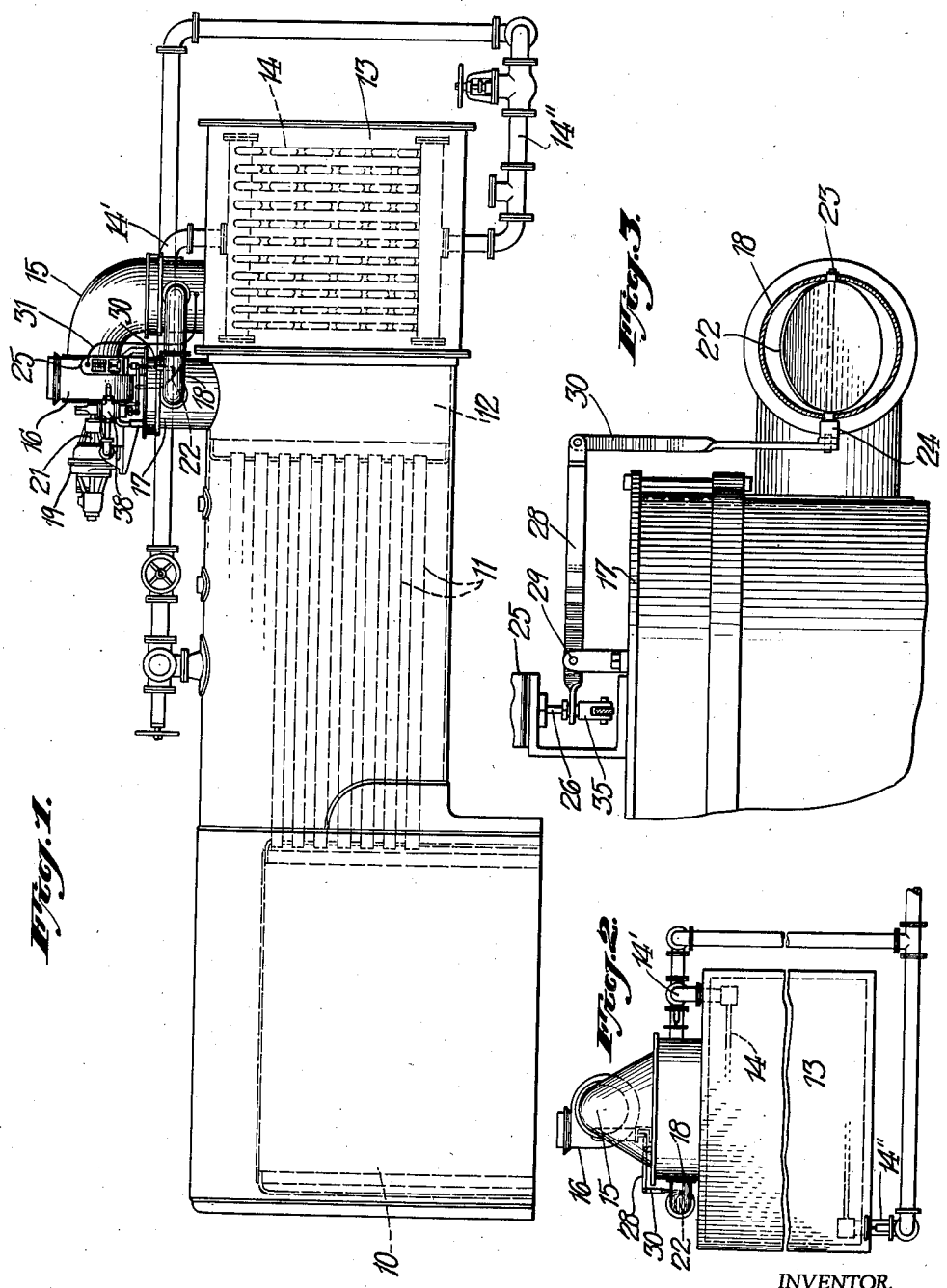


Fig. 1.

Fig. 3.

Fig. 2.

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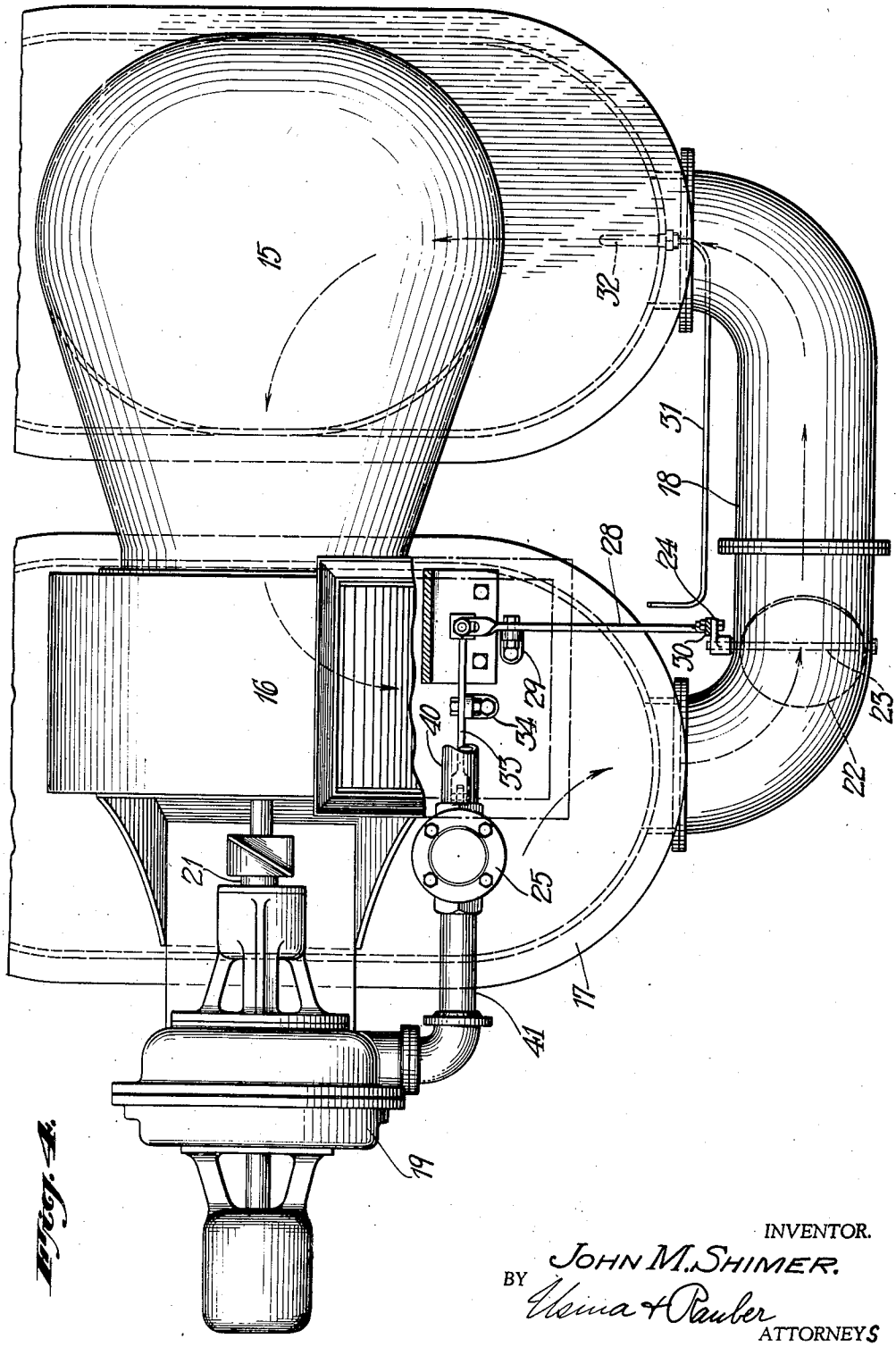


Fig. 4.

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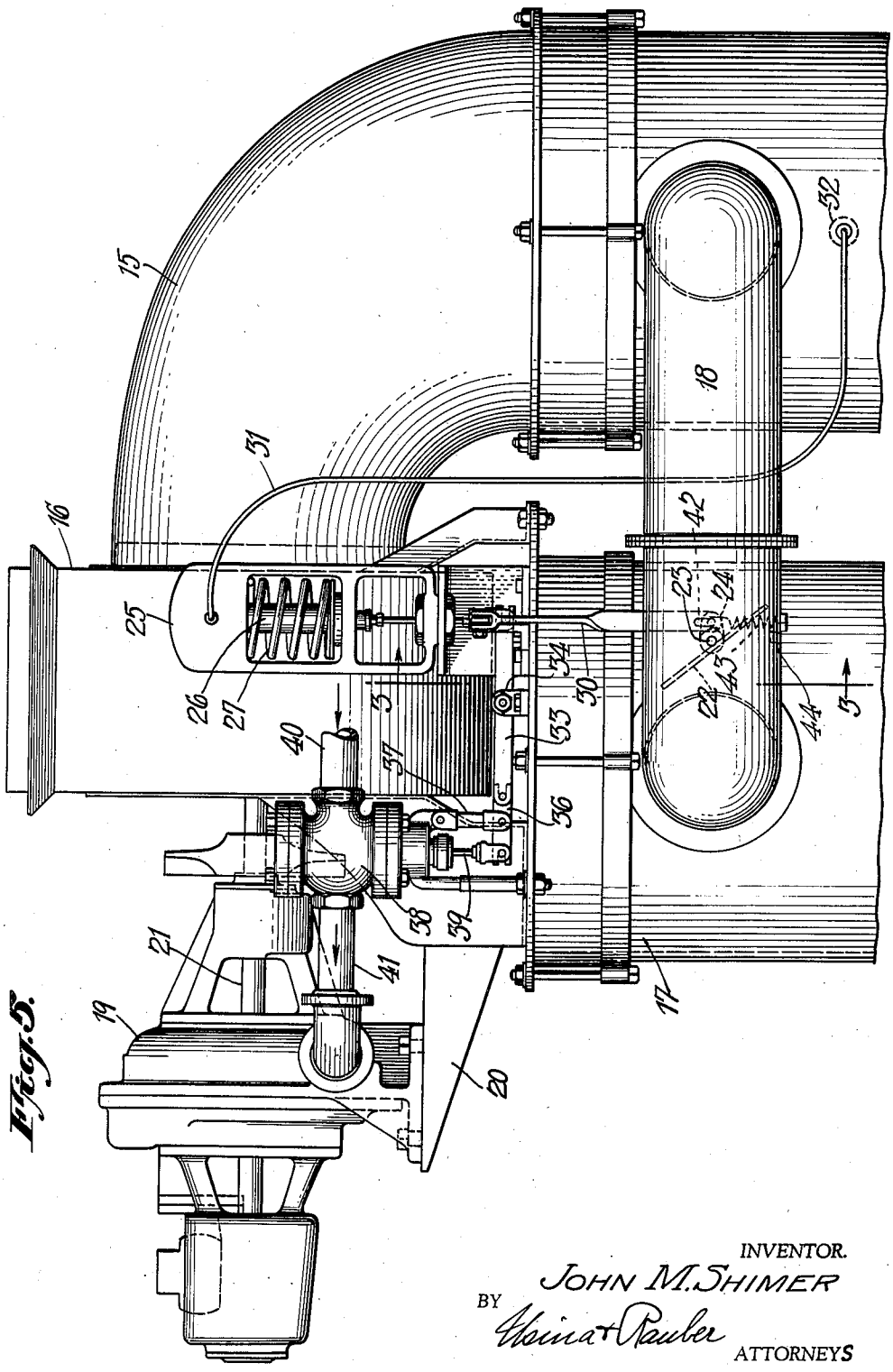


Fig. 5.

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PORTABLE OIL FIELD BOILER

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Application September 25, 1937, Serial No. 165,751

1 Claim. (Cl. 122—479)

My invention relates to a portable oil field boiler and more particularly to a boiler of the type shown in my co-pending application Ser. No. 111,149, November 16, 1936, in which a superheater is provided at the front of the smoke box through which products of combustion may be passed or by-passed on the way to a stack.

In a superheating apparatus such as mentioned above, the temperature of the steam from the superheater varies directly as the rate or amount of firing. Variation in the temperature of the superheated steam is, however, undesirable from many standpoints, particularly as it makes it difficult or impossible to regulate or control conditions for the use of the steam.

My invention overcomes this difficulty and provides apparatus whereby the temperature of the steam may be maintained at substantially constant or with a minimum of variation from a predetermined temperature.

In my invention I provide an offtake from the superheater and a fan to induce a draft. I also provide a by-pass from the smoke box of the boiler directly to the offtake and a damper in this by-pass to control the amount of gases passing through it and thus to apportion the products of combustion between the by-pass and the superheater. By closing the by-pass damper and increasing the draft induced by the fan the draft through the superheater is increased with a consequent increase in temperature; conversely, when the by-pass damper is opened a larger proportion of the hot gases will be by-passed directly from the smoke box to the offtake pipe with a consequent decrease in the draft through the superheater and a lowering of the temperature of the steam. The fan in the offtake pipe may also be slowed to decrease the draft. The by-pass damper and the fan may be independently and automatically controlled by the temperature of the exhaust gases of combustion inasmuch as the temperature of the superheated steam will have a relation thereto. This may be accomplished by placing the bulb of a temperature control regulator in the exhaust gas stack.

The various features of the invention are illustrated by way of example in the accompanying drawings in which Fig. 1 is a side elevation of a portable oil field boiler embodying a preferred form of the invention. Fig. 2 is a front elevation of the boiler shown in Fig. 1. Fig. 3 is a vertical section through the damper taken on line 3—3 of Fig. 5. Fig. 4 is a plan view of the offtake or exhaust flue of the boiler, and Fig. 5 is a side elevation of the elements shown in Fig. 4.

As shown in the accompanying drawings, the invention is illustrated as applied to a portable boiler having a fire box 10 connected by means of a number of fire tubes 11 to a smoke box 12. Immediately in front of the smoke box 12 and communicating therewith through an opening in the lower front wall of the smoke box is a superheater chamber 13 containing a number of superheating steam pipes 14, supplied from the boiler by piping 14' and supplying an offtake steam pipe 14''. Hot products of combustion passing from the fire box 10 through the fire tubes 11 into the smoke box 12 may, therefore, pass into the lower part of the superheater chamber 13 and thence upwardly into an offtake flue 15 and into a stack 16.

The smoke box 12 has an upper extension 17 into which gases may also flow and thence through a by-pass 18 into the offtake pipe 15 joining with the gases coming from the superheater chamber 13. The stack 16 is mounted on the closed top of the extension 17.

The lower part of the stack 16 into which the offtake pipe 15 enters comprises a fan driven by a turbine 19 mounted on a bracket 20 secured to the stack 16 on the top of extension 17. The turbine 19 through a shaft 21 drives a fan, not shown, within the stack 16 to draw gases from the offtake pipe 15 including those from the by-pass 18 into the stack 16 and thence into the atmosphere.

The flow of gases through the by-pass 18 is controlled by a damper 22, Fig. 5, mounted on a shaft 23 extending through the by-pass 18 and provided with a crank arm 24. The damper 22 is tilted toward open or closed position by means of a fluid pressure cylinder 25 through a piston 26 acting through the spring 27. The movement of the piston 26 is transmitted through a lever 28, Fig. 3, pivoted on a bracket 29 on the top of extension 17 and connected by a link 30 with the crank arm 24, Fig. 5.

Pressure fluid is supplied to or withdrawn from the cylinder 25 through a tube 31 from a thermostatic bulb 32 in the offtake pipe 15 below the by-pass 18 as shown in Fig. 5.

It will be apparent that as the temperature of the gases leaving the superheater increase, the fluid in the bulb 32 will expand and passing into the cylinder 25 will drive the piston 26 downwardly against the action of the spring 27. This will tilt the lever 28 counterclockwise when viewed in the position of Fig. 3, lifting the link 30 and swinging the crank arm 24, Fig. 5, counterclockwise opening the by-pass damper 22. More of the hot gases will, therefore, pass through the by-pass 18 and less through the superheater so that less superheating will take place and the temperature of the steam from the superheater and of the hot gases passing through the offtake 15 will fall until a predetermined temperature is reached. Conversely, when the temperature in the offtake 15 falls below a predetermined limit the fluid in the bulb 32 will contract and the

flow out of the cylinder 25 will permit the spring 27 to force the piston 26 upwardly. This causes the lever 28, Fig. 3, to swing clockwise as also the crank 24, Fig. 5, moving the damper 22 toward closed position. This will cut down the amount of gases passing through the by-pass and cause them to pass through the superheater increasing the temperature of the superheated steam and of the gases about the bulb 32 until the latter reaches a predetermined temperature.

The bulb 32 and cylinder 25 and piston 26 may also control the speed of the turbine 19 and thereby of the exhaust fan. For this purpose a lever 33 is mounted on a bracket 34 on the top of the extension 17, one end of which is connected to the lower part of the piston stem 26 by a connector 35, and the other end of which is connected to a second lever 36 mounted in a bracket 37 depending from a steam control valve 38. The end of the lever 36 opposite its connection with the lever 33 is connected to a valve stem 39 of the valve 38. The construction and arrangement of the levers is such that when the piston 26 is forced downwardly by the expansion of fluid in the bulb 32 it rotates the lever 33 clockwise and the lever 36 anticlockwise about their respective fulcrums 34 and 37. Thereupon the valve stem 39 is moved downwardly or toward open position. The flow of steam from a supply pipe 40 into a pipe 41 leading to the turbine 19 is thus increased, increasing the speed of the turbine and thus increasing the draft. When the fluid of the bulb 32 contracts the piston 26 and the levers 33 and 36 associated therewith and the valve stem 39 move toward closed position.

Both the damper 22 and the steam control valve 38 for the turbine 19 are controlled from the thermostatic bulb 32 through the cylinder 25. The turbine control and damper function separately and independently of each other so that, for example, upon increase in temperature about the bulb 32 the steam control valve 38 is opened increasing the speed of the turbine and the draft induced by it. A further increase in the temperature of the bulb 32 then serves to move the damper 22 toward open position bypassing some of the hot gases from the smoke box directly to the offtake 16. For the purpose of providing this lag a slot 42 is provided in the link 30. Accordingly, an increase in the temperature of the bulb 32 which will force the piston 26 downwardly will first serve to open the steam control valve 38 and increase the draft, an increased draft being required for an increase in the firing of the boiler. As the temperature about the thermostatic bulb 32 increases the play in the slot 42 is taken up and the crank arm 24 is actuated to move the damper 22 toward open position, thereby by-passing some of the gases around the superheater. For example, the length of the slot 42 may be such as to permit a rise in temperature of 100 degrees F. with an increase in draft and then to open the by-pass damper 22 progressively to full open position in case of a tendency of an additional increase of 50 degrees F.

In the practice of my invention, the fire in the fire-box 10 is controlled by the usual draft. Under normal firing, the temperature in the superheater chamber may be below 500° F., or the temperature at which superheated steam may be produced.

However, in anticipation of a demand upon the boiler for superheated steam which may require a temperature in the superheater chamber of in the neighborhood of 600° F., the operator increases the fire, thereby increasing the temperature in the superheater in proportion.

For the purpose of quickly attaining and maintaining said superheat constant, my improved device assumes control of the boiler as follows. The fan is set to cut in at a temperature of 500° F. in the superheater through the bulb 32 and its associated mechanism, and the fan 16 will increase in speed through the increased steam supplied to its turbine 19 with an increase of temperature above 500° F. in the superheater chamber.

Under the present illustration, the control for the fan may be set for maximum speed at some upper temperature limit, say 750° F., at the bulb 32. If the cooling effect of the withdrawal of steam is less than the available increase in superheat, the superheater temperature rises with an increase in fan speed to maximum.

However, the control for damper 22 is preferably set to open said damper before said maximum temperature is reached, say at about 675° F., and thereby acts as a check upon the upward surge of the superheat by by-passing a portion of the available products of combustion directly to the fan and stack, thereby cooling the superheater and reducing the speed of the fan. In this manner, the fan and its check coact to control the superheat within the selected limits by the temperature in the superheater chamber. By such an arrangement, it is impossible to burn out the superheater under the conditions stated.

Conversely, when the steam withdrawal is greatest, the controls permit of the utilization of all the available heat from the fire, and assuming the demand not to be beyond the boiler capacity, the boiler will be entirely adequate and will supply as nearly uniform superheat as is possible.

What I claim is:

In a boiler of the character described, the combination with a smoke box, of a superheater chamber in communication therewith, a stack, means for maintaining a substantially constant superheat above a predetermined temperature including an off-take pipe connecting the superheater chamber and stack, an exhaust fan in the stack, variable speed means for driving the fan, a by-pass connecting the smoke box and off-take, a damper normally closing said by-pass, means for actuating said damper, thermal sensitive means responsive to the temperature in the superheater chamber for controlling the fan driving means and damper actuating means, said thermal sensitive means being responsive above a predetermined temperature in the superheater chamber for starting the fan driving means and for increasing the speed thereof with a subsequent increase in said temperature, said damper actuating means being operable to open said damper upon said increased temperature attaining a selected amount, thereby diverting a portion of the products of combustion directly to the stack, the fan and damper being automatically regulated by said thermal sensitive means to control the temperature in the superheater chamber above said predetermined temperature.

JOHN M. SHIMER.