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J. H. BULLARD.

DEVICE FOR AUTOMATICALLY REGULATING SUPPLY OF LIQUID FUEL TO BOILERS OF AUTOMOBILE VEHICLES.

(Application filed Feb. 3, 1899.)

(No Model.)

Fig. 1.

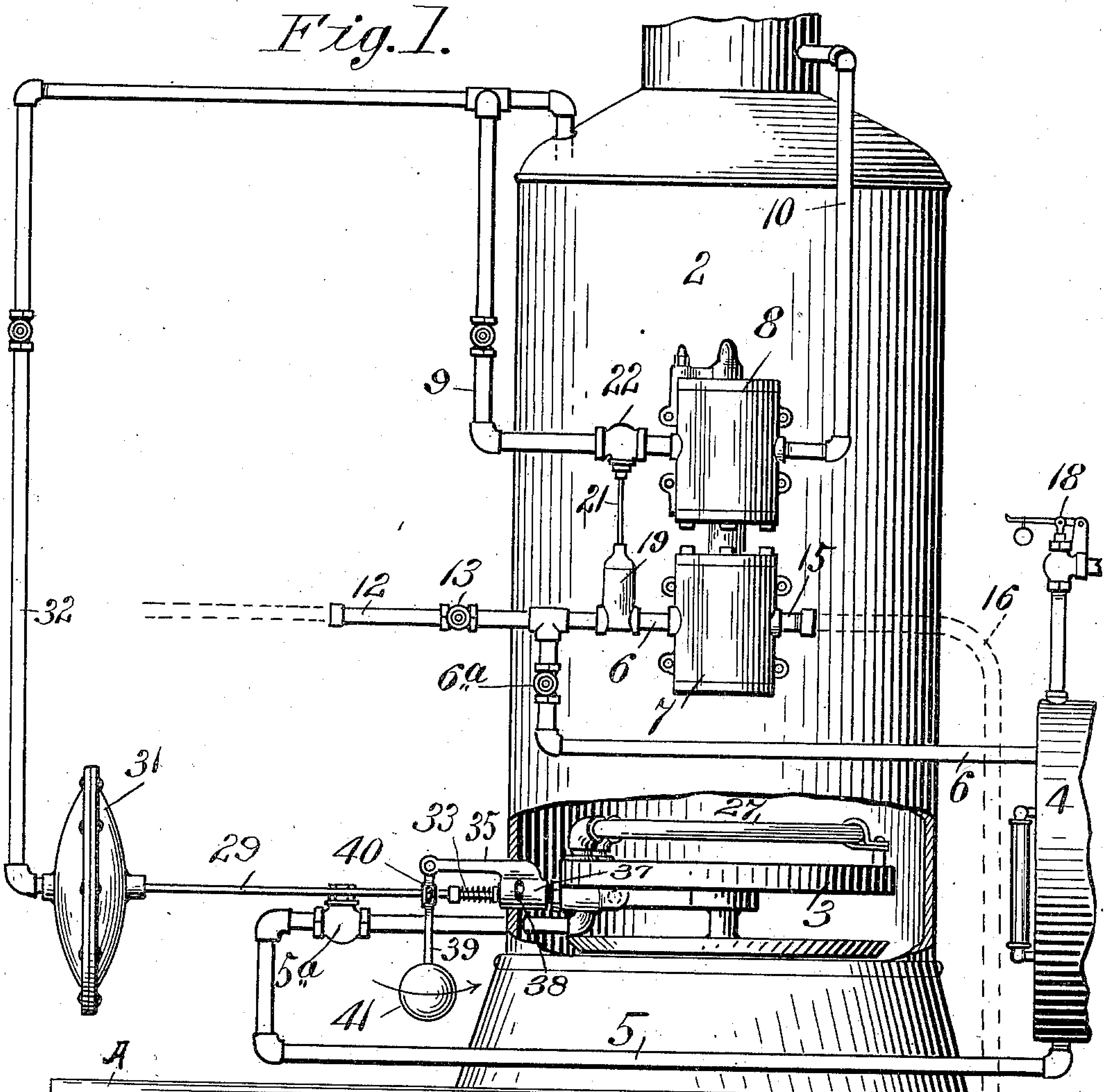


Fig. 2.

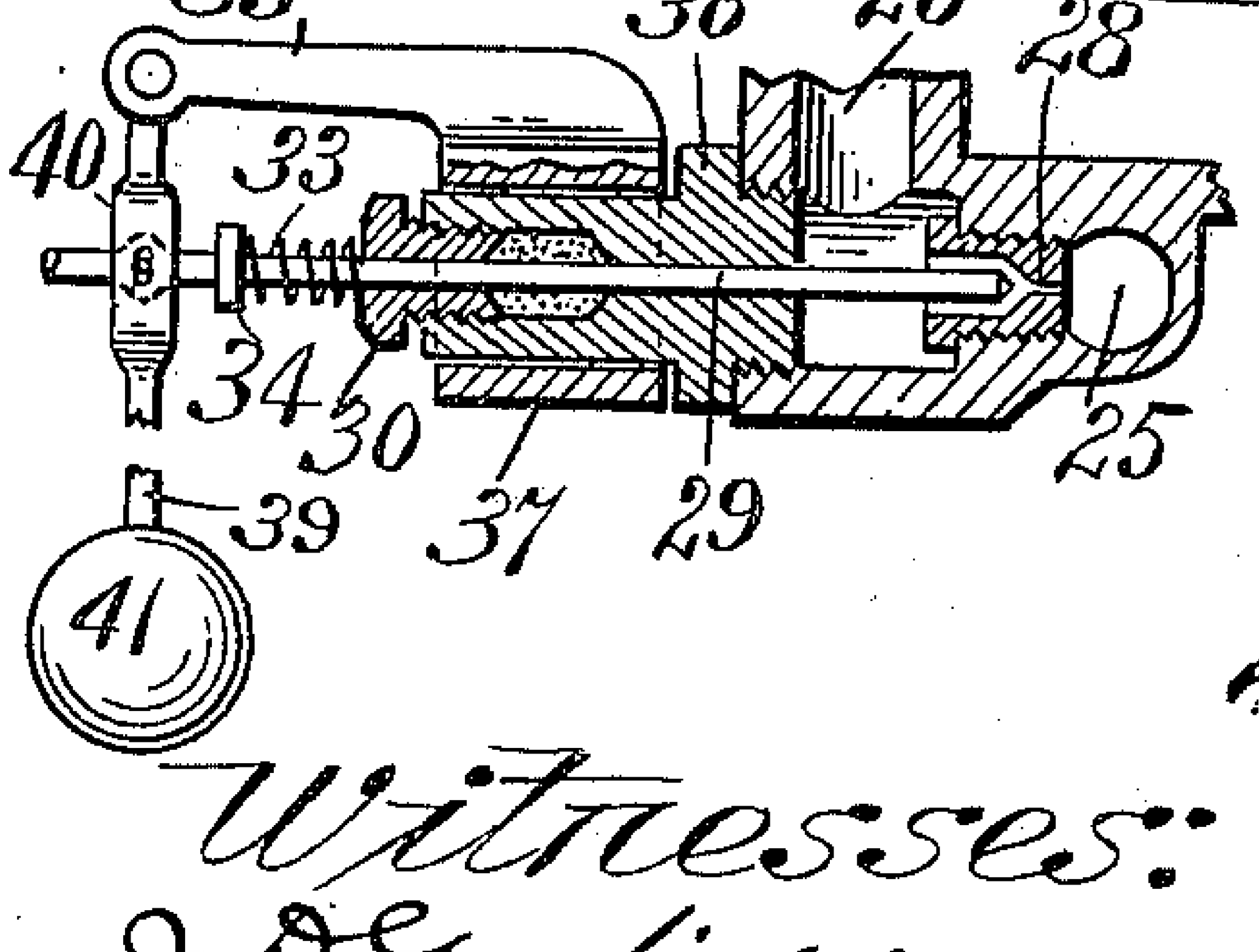
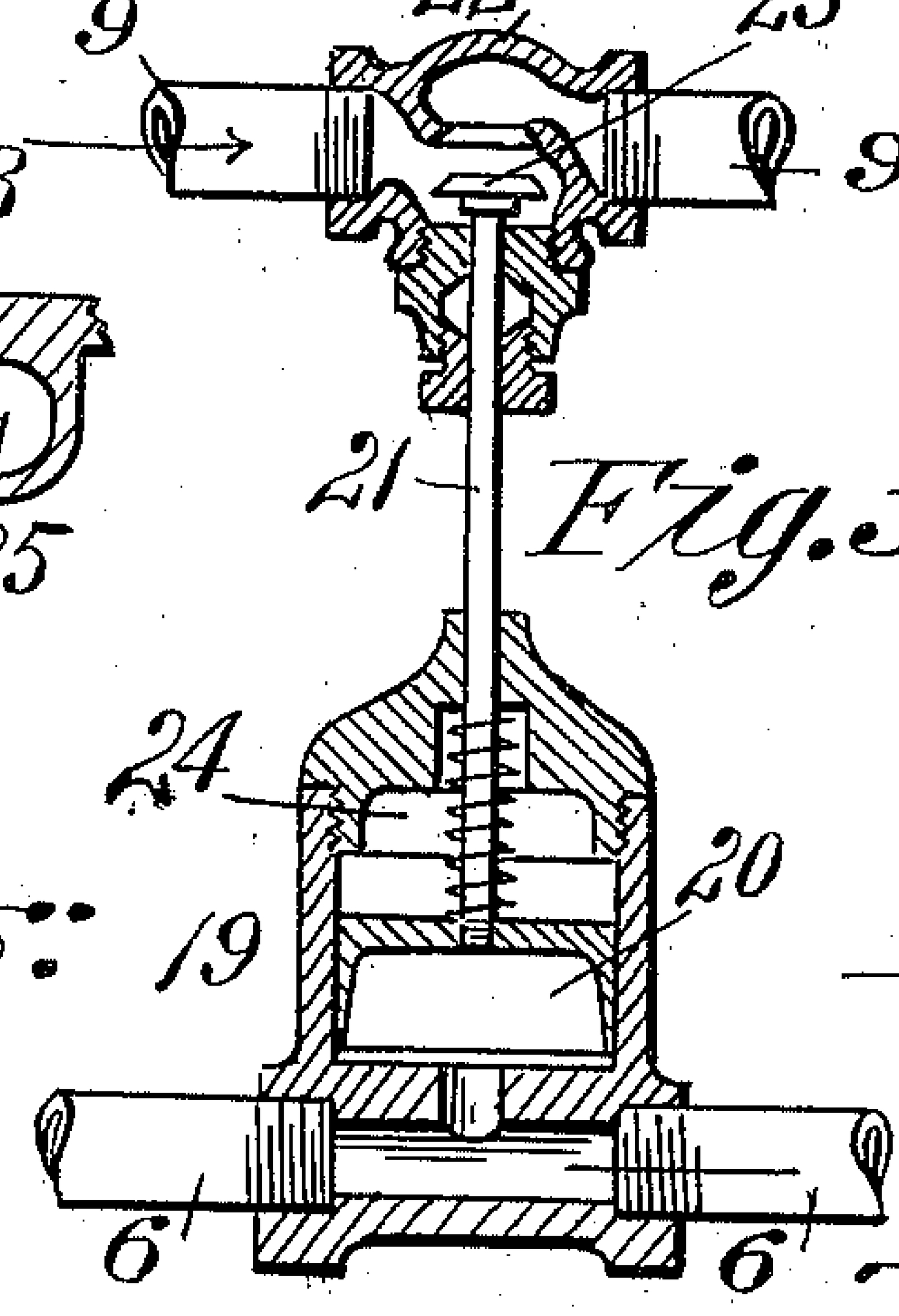


Fig. 3.



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UNITED STATES PATENT OFFICE.

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DEVICE FOR AUTOMATICALLY REGULATING SUPPLY OF LIQUID FUEL TO BOILERS OF AUTOMOBILE VEHICLES.

SPECIFICATION forming part of Letters Patent No. 638,495, dated December 5, 1899.

Application filed February 3, 1899. Serial No. 704,395. (No model.)

To all whom it may concern:

Be it known that I, JAMES H. BULLARD, a citizen of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented new and useful Improvements in Devices for Automatically Regulating the Supply of Liquid Fuel to Boilers of Automobile Vehicles, of which the following is a specification.

This invention relates to devices for automatically regulating the amount of liquid fuel to be supplied to a burner for the generation of steam or other elastic fluid for power purposes in the boiler of an automobile vehicle; and the object of the invention is to produce a construction which will regulate under normal conditions the said supply of fuel by means of the maximum pressure which it is desired said steam shall attain and under abnormal conditions shall by other means automatically increase or diminish said supply in proportion to the requirements of the moment.

The invention consists in the construction of the devices hereinafter described, and pointed out in the claims.

In the drawings forming part of this specification, Figure 1 is a steam-boiler fitted with a liquid-fuel burner and showing the adaptation of this invention thereto. Fig. 2 is an enlarged sectional view of the mechanism whereby the supply of fuel for said burner is regulated under abnormal conditions. Fig. 3 is an enlarged sectional view of a regulating device actuated by the maximum air-pressure required for forcing fuel to said burner and adapted to stop or check the air-pump when said maximum pressure is reached.

The devices herein shown and described are particularly applicable to self-propelled steam fire-engines, and the term "normal conditions" used above is intended to designate conditions of running existing on ordinarily level surfaces, and "abnormal conditions" refer to conditions existing in ascending or descending a grade. These devices are shown mounted upon a platform which may be considered as forming part of a suitable vehicle, (represented in Fig. 1 of the drawings by A.)

Referring to the drawings, 2 represents a suitable steam-boiler or analogous pressure-generator adapted to be heated by liquid fuel from the burner 3. Said fuel is contained in any convenient tank 4 and is supplied in proper quantity to said burner by a pipe 5 between the latter and said tank. A suitable valve 5^a is located in said pipe, and the delivery of fuel therefrom to said burner is regulated by other devices automatic in their operations, which will be fully described farther on. Said fuel is forced to said burner under air-pressure supplied to the upper part of said tank 4 through a pipe 6, leading therefrom to the delivery-port of the air-pumping cylinder 7 of an air-compressor. A valve 6^a is located in said pipe 6. Said air-compressor is of the common type, comprising a steam-cylinder 8 for operating said pumping-cylinder 7. Steam is supplied to said cylinder 8 through the pipe 9, and 10 is the exhaust-pipe thereof. Connected with said pipe 6 is a horizontal extension 12 of said pipe 6, having a valve 13 therein, the function of which branch will be described farther on. At a point substantially opposite the entrance of the pipe 6 into said air-pumping cylinder 7 is the suction-port of the said cylinder, and a short branch pipe 15 is screwed into said port and provided on the end thereof with a coupling, whereby a piece of flexible or other pipe 16 (shown in dotted lines only) may be attached thereto. The object of this connection with the suction-port of said air-pumping cylinder 7 is to provide means whereby liquid fuel may be drawn from a barrel or other reservoir 17 (indicated in dotted lines) and forced through the pipe 6 into the tank 4 for replenishing the supply of fuel therein, using said air-cylinder as a liquid-pumping cylinder, to which it is equally well adapted. Said tank 4 is provided with a safety-valve 18 to provide against an accidental overcharging of the tank with air through the failure of the proper operation of the governing devices connected with the pump to shut off the latter when the maximum pressure of air in said tank has been attained. Said governing devices consist in the mechanism illustrated in detail in Fig. 3 and comprise a cylinder 19 in communication with the pipe 6 and having a piston 20 therein, whose piston-rod 21 extends

upward into a valve 22 in the steam-pipe 9, the valve-disk 23 of which is connected to the end of said piston-rod. On the latter, between the piston-head and the end of the cylinder 19, is a spring 24, the resistance of which to compression is equal to the maximum pressure of air it is desired to carry in the tank 4, and hence when said air-pressure exceeds this resistance the piston 20 will be forced upward and, compressing said spring, will cause said valve-disk 23 to seat and shut off the ingress of steam into said cylinder. As pressure in said tank is reduced by the withdrawal of fuel the spring 24 will force said piston 20 down again and cause the valve-disk to move away from its seat, allowing the pump to resume its functions.

Reference has been made to means for automatically regulating the supply of liquid fuel to the burner 3 under normal and abnormal conditions. Said means consist of the devices illustrated in Fig. 2, and 25 indicates a passage in the burner into which the liquid fuel in the pipe 5 enters on its way to the burner, and 26 indicates the passage by which said fuel reaches the vaporizing-chamber 27, which consists of a coil of pipe exposed to the flame from the burner below it and wherein the fuel may be vaporized by heat before it issues from said burner to be consumed. Said chamber 27 has one end thereof in communication with the said passage 26 and its other end communicates with the interior of the burner 3, from which it issues through suitable apertures. The details of the construction of this burner are not shown, as its construction forms no part of this invention. Between said passages 26 and 25 lies the smaller passage 28, one end of which is controlled by the point of an endwise-movable regulator-rod 29, which extends through a suitable stuffing-box 30, and the outer end thereof is connected with a distensible diaphragm which is inclosed in a suitable case 31. The said diaphragm is of metal, and with its inclosing case 31 forms a well-known construction and requires no detailed description or illustration. The diaphragm may be concentrically corrugated, if desired, to increase the range of its distention. Said diaphragm divides said case 31 into two parts, the rod 29 passing through one of said parts for connection with said diaphragm, as stated, and the other of said parts is made steam-tight in any suitable manner and placed in communication with said boiler through the pipe 32. The regulator-rod 29 is provided with a spring 33 thereon near said burner, one end of which spring bears on a part of the latter and the opposite end against a collar 34, adjustable to and fro on said rod, whereby the tension of said spring may be varied. When the maximum pressure is reached by the steam in the boiler, the resistance of said diaphragm and said spring on the said regulator-rod will be overcome, and the distention of said diaphragm will move said regulator-rod toward the burner, and the point of said rod will obstruct more or less the open passage 28 and reduce the quantity of liquid fuel passing therethrough to the vaporizing-chamber of the burner, thus reducing temporarily the steam-generating capacity of the boiler until such time as the withdrawal of steam from said boiler shall have operated to reduce the pressure thereof to a point which will permit the retraction of said diaphragm, aided by the said spring 33, thus moving the point of the regulator-rod 29 away from the orifice of said passage 28, when the quantity of fuel moving through said passage will again increase the steam-generating capacity of said boiler.

The above method of regulation is sufficient for all requirements of the apparatus under normal conditions.

Under abnormal conditions—viz., when a steep gradient is to be surmounted and extra power is required for that purpose—it becomes necessary to add instantly to the power of resistance of the diaphragm to distention, whereby a pressure of steam in the boiler may be accumulated in excess of the normal maximum, which under normal conditions is sufficient to distend said diaphragm and reduce the supply of fuel passing to the burner. To that end the following devices are provided, which not only perform the above-described functions, but, further, may be so adjusted as to temporarily distend the diaphragm in the direction opposite to that in which it is distended by the boiler-pressure and whereby a supply of fuel above the normal amount may temporarily be allowed to pass into the vaporizing-chamber of the burner.

Referring to Fig. 2, (in which said devices are shown in detail,) 35 is an arm supported on a stud 36, screwed into the body of the burner 3, a portion of which only is shown in said figure. Referring to Fig. 1, the hub 37 of the arm 35 fits freely on said stud 36 and is revoluble thereon within the limits of a slot 38 in said hub, through which a pin passes and enters said stud. A rod 39 is pivotally supported in the end of said arm 35 for a swinging movement in the plane of the regulator-rod 29, the latter passing through an opening in an enlarged part 40 of said rod 39, thus permitting said swinging movement of the latter, and by the pin-and-slot connection of the two rods providing means for mechanically moving the regulator-rod endwise by the movement in the same vertical plane of said rod 39. On the lower extremity of said rod 39 is fixed a weight 41.

Now it is apparent that under normal conditions the steam-pressure in the boiler will, through the diaphragm-operated regulator-rod 29, operate to regulate the flow of fuel to the burner 3 in the manner substantially as described without imparting more than very slight oscillations to the weighted rod 39; but as soon as the platform on which this apparatus is assembled assumes an inclined position, as in the ascent of a grade, the weight

41 will be thrown against the diaphragm in the case 31 through the connection of the rods 39 and 29 and the connection of the latter with said diaphragm, and it is further apparent that the steeper the incline to be surmounted by said apparatus the more strongly will the said weight bear against the said diaphragm. Thus an increase of steam-pressure beyond that necessary to close, through the means described, the passage 28 may be accumulated, which can be utilized to carry said apparatus up said grade. If a descending grade is encountered, the weight 41 will swing forward, and by as much of its weight as is applied to the regulator-rod 29 to push it toward the passage 28 it will to that extent reduce the resistance of the said diaphragm and spring 33 to operation by the boiler-pressure, and thus insure the closing of the passage 28 under a lower boiler-pressure than would be necessary on a level.

To provide for the proper functioning of the swinging rod 39 should the platform on which the apparatus is mounted be inclined transversely and longitudinally at the same moment, the hub 37 is made revoluble on the stud 36, as described, and said arm 35 and its said hub will by said weight 41 be rotated slightly on its support, thus permitting said weight-bearing rod 39 to maintain a relatively perpendicular position at all times, and thus operate without a binding of the parts.

The object of the extension 12 of the pipe 6 and the valve 13 therein is to provide means for inflating pneumatic tires of the wheels with which the platform on which this apparatus is assembled may be provided. By closing the valve 6^a, leading to the fuel-tank 4, the air-pumping cylinder 7 may be employed for this purpose by coupling a flexible pipe to said extension 12 and opening the valve 13.

It is to be noted that when fuel is forced into the fuel-tank 4 by means of the pump, as described, this operation may take place while normal pressure of air is carried in said tank and that as the fuel enters said tank and thereby increases said air-pressure that pressure in excess of the maximum which said tank is designed to carry will escape from said tank through the safety-valve 18.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination with a boiler, a liquid-fuel burner therefor, and a movable platform on which said boiler is supported, of a gravity-actuated device for temporarily increasing the supply of fuel passing to said burner, when said platform assumes a position upwardly inclined relative to the direction of its movement, substantially as described.

2. The combination with the boiler of an automobile vehicle, and a liquid-fuel burner therefor, of a regulator controlled by the pressure in said boiler for regulating the supply of fuel to said burner, and automatic means for temporarily increasing or decreasing said fuel-supply independent of the action of said regulator, when said boiler assumes an inclined position, substantially as described.

3. The combination with a boiler, a liquid-fuel burner therefor, a movable platform on which said boiler is supported, a fuel-receptacle, and a pipe connection between said burner and receptacle; of a gravity-actuated device for regulating the supply of fuel to said burner, whereby, when said platform assumes a position inclined from the horizontal in the direction of its movement, said gravity-actuated device will operate to increase or diminish the supply of fuel to the burner, substantially as described.

4. In combination, a boiler, a liquid-fuel burner therefor, a suitable platform on which said boiler is supported, a regulator controlled by the pressure in said boiler for regulating the supply of fuel to said burner, and automatic means for temporarily adding to the resistance of said regulator devices, when said platform is upwardly inclined from the horizontal in the direction of its movement, whereby a pressure above the normal may be generated in said boiler, substantially as described.

5. The combination with devices for the combustion of fluid hydrocarbons, of a movable platform on which said devices are supported, and gravity-actuated mechanism for temporarily increasing or diminishing the supply of hydrocarbon to said combustion devices, when said platform assumes a position other than horizontal, relative to the direction of its forward movement, substantially as described.

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