Oct. 23, 1923. 1,472,009

J. B. KNIGHT

APPARATUS FOR CONSERVING GAS, OIL, AND OTHER FLUIDS

Filed Nov. 7, 1921 6 Sheets-Sheet 1

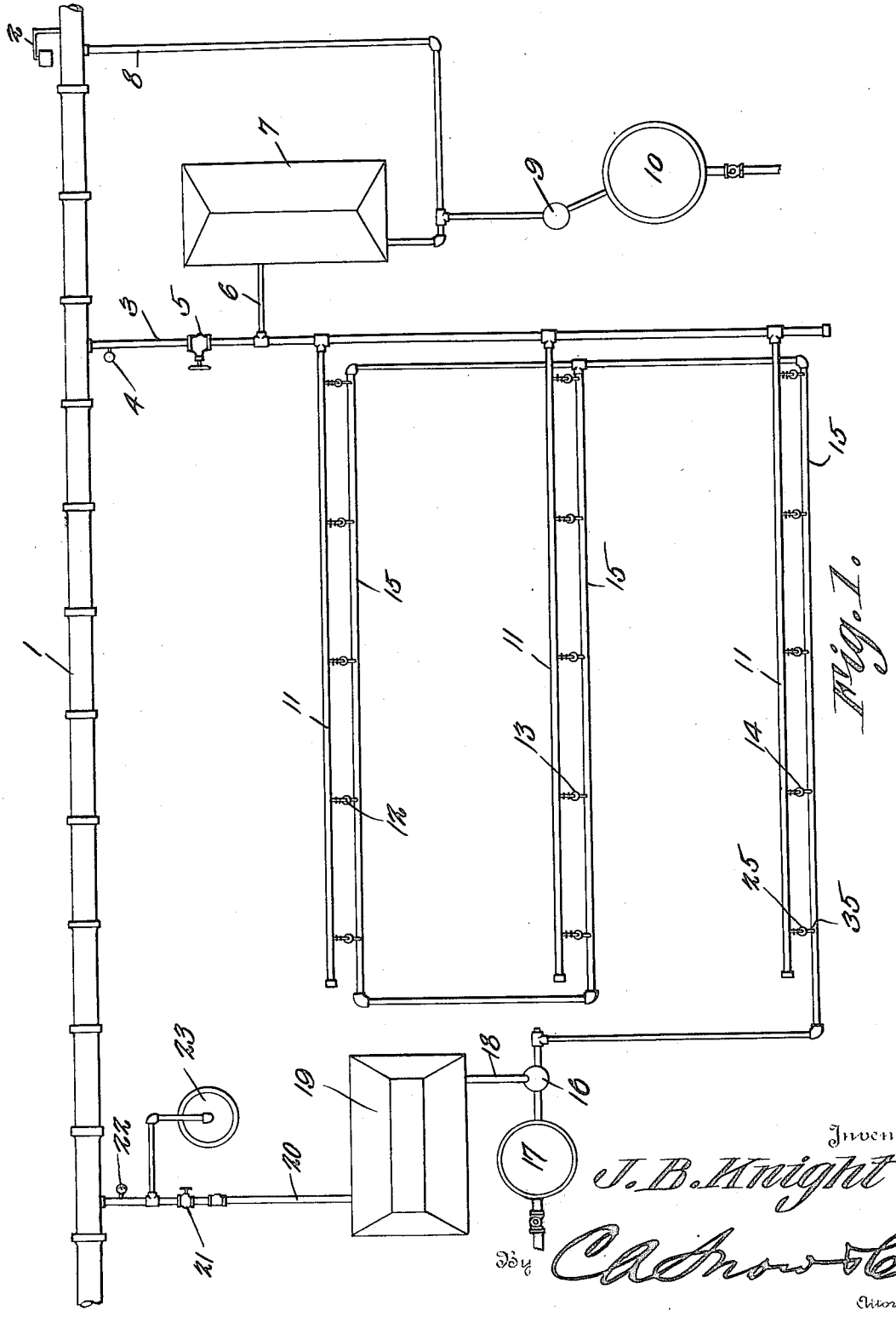


Fig. 1.

Inventor,
J. B. Knight
By C. A. Snow & Co.
Attorneys.

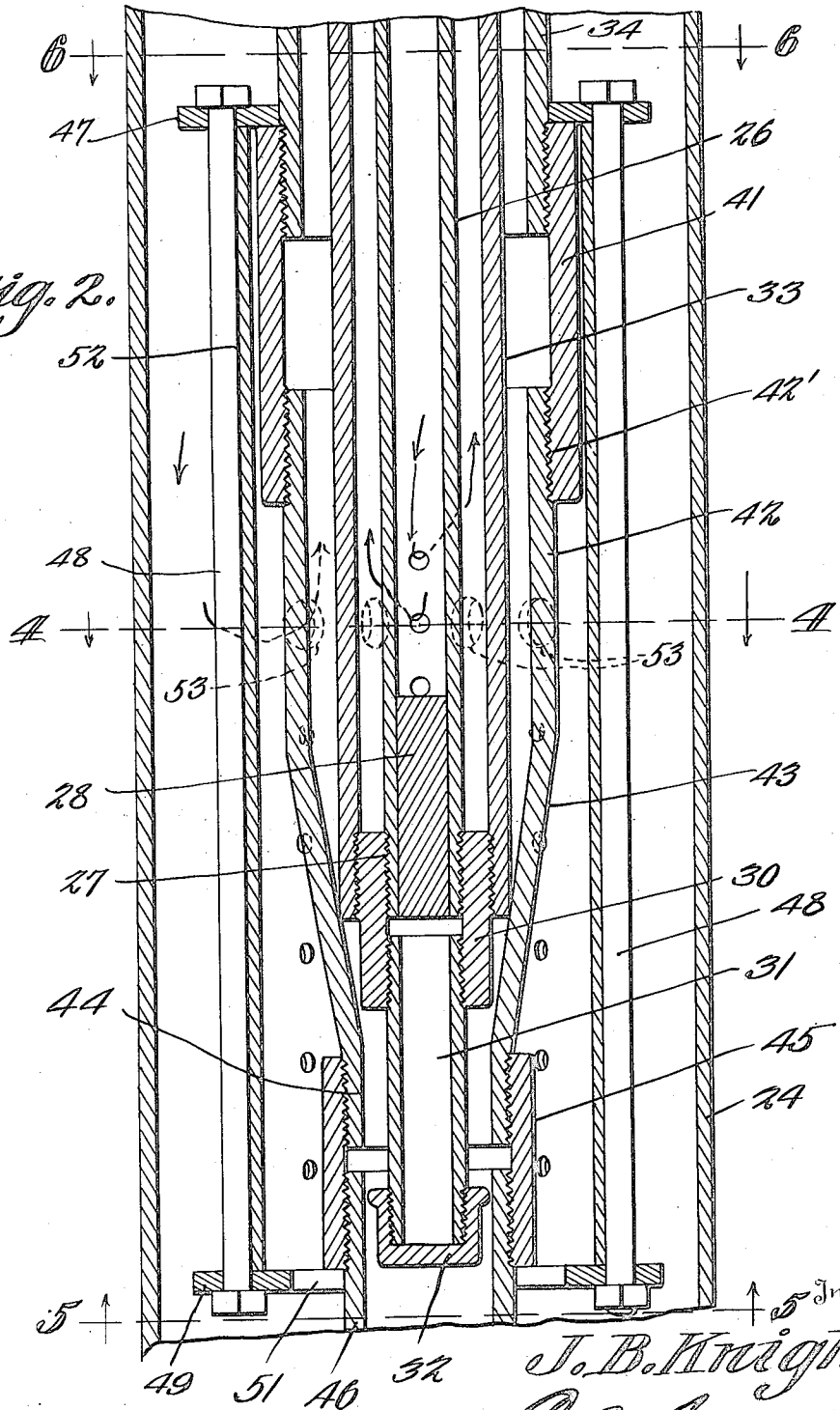
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J. B. KNIGHT

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Fig. 2.



Inventor
J. B. Knight
By C. A. Snow & Co.
Attorneys

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J. B. KNIGHT

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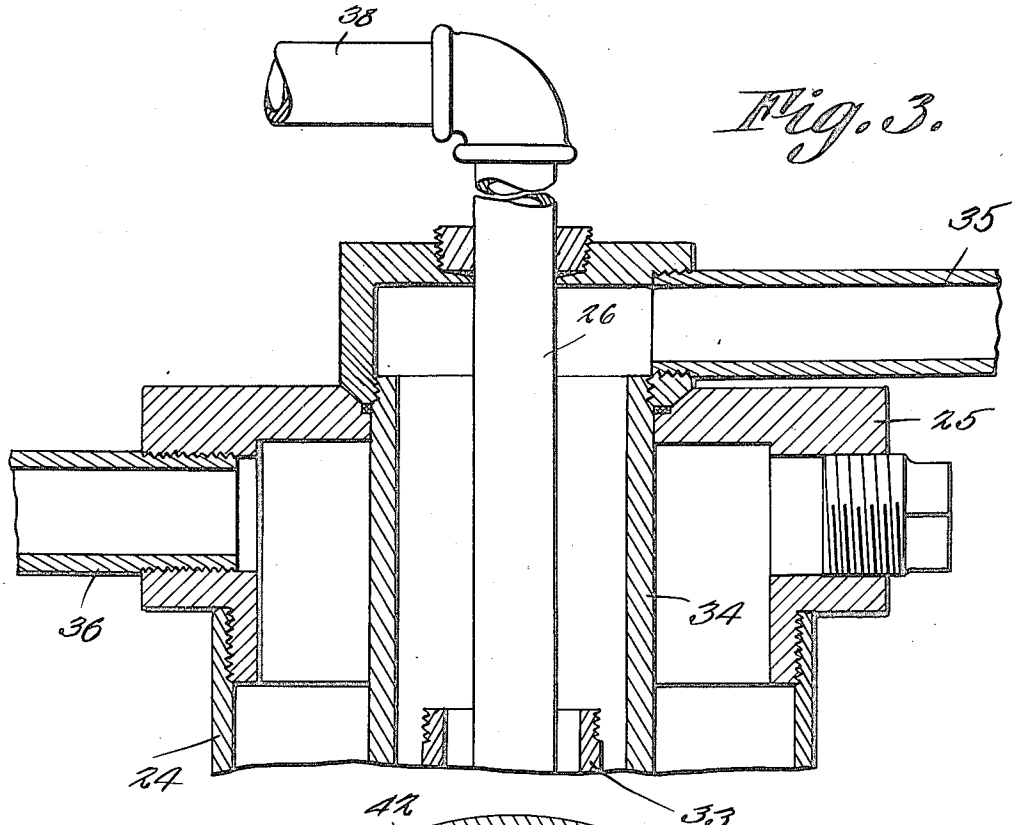


Fig. 3.

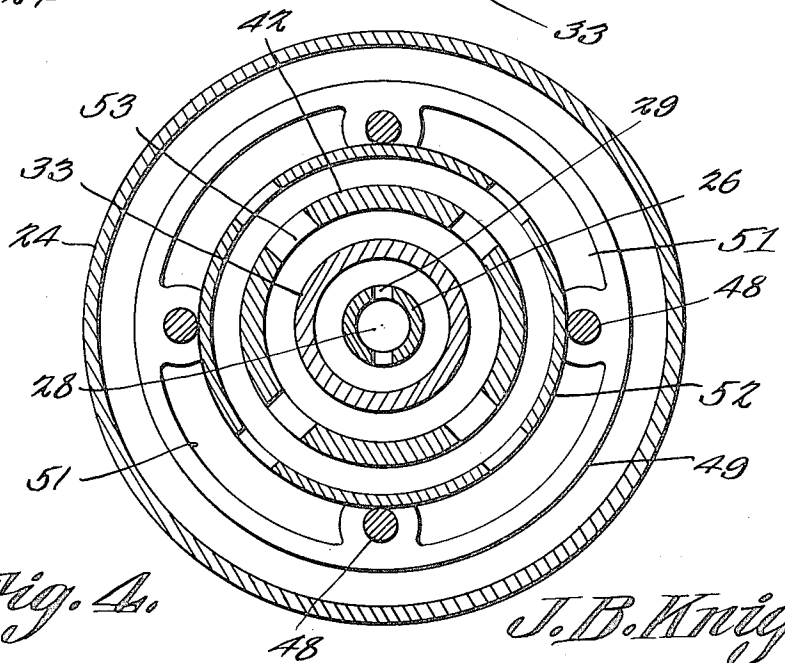


Fig. 4.

Inventor
J. B. Knight
By Crosby & Co.
Attorneys.

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J. B. KNIGHT

APPARATUS FOR CONSERVING GAS, OIL, AND OTHER FLUIDS

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Fig. 5.

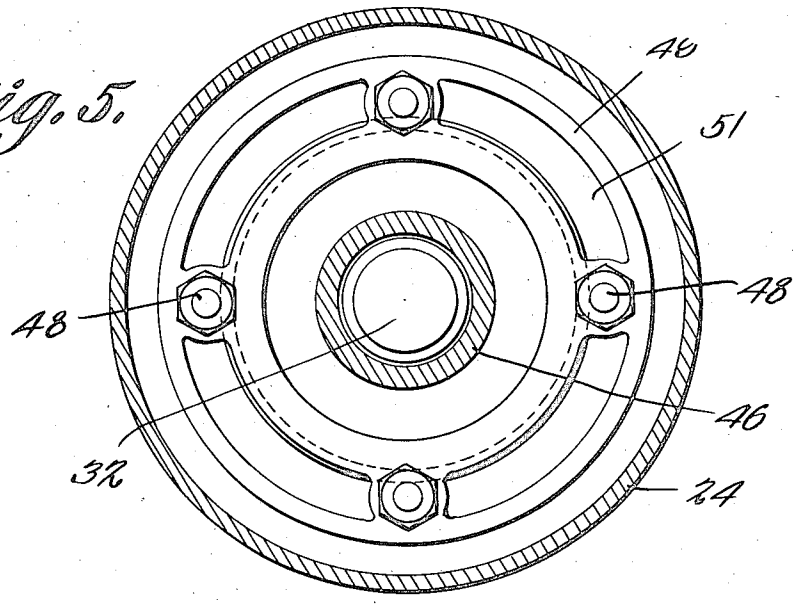
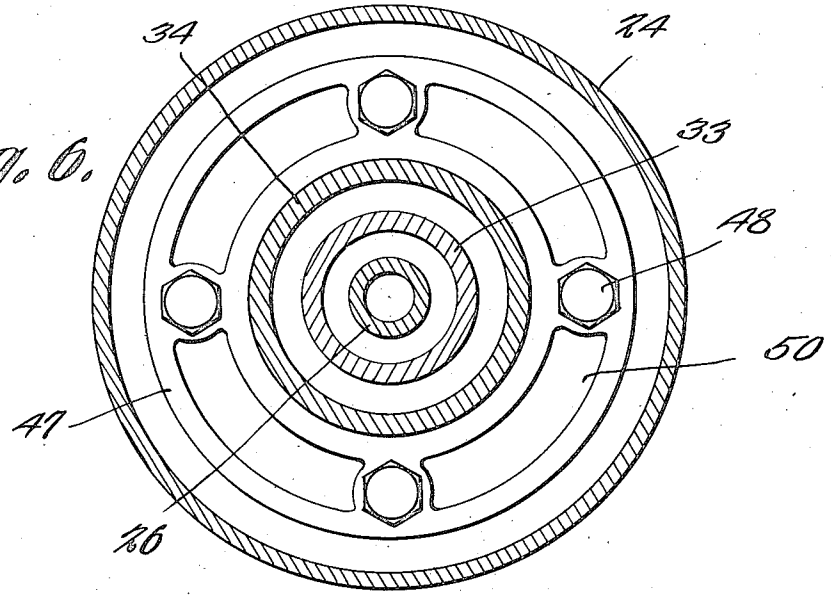


Fig. 6.



Inventor
J. B. Knight
By Crosby & Co.
Attorneys.

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J. B. KNIGHT

APPARATUS FOR CONSERVING GAS, OIL, AND OTHER FLUIDS

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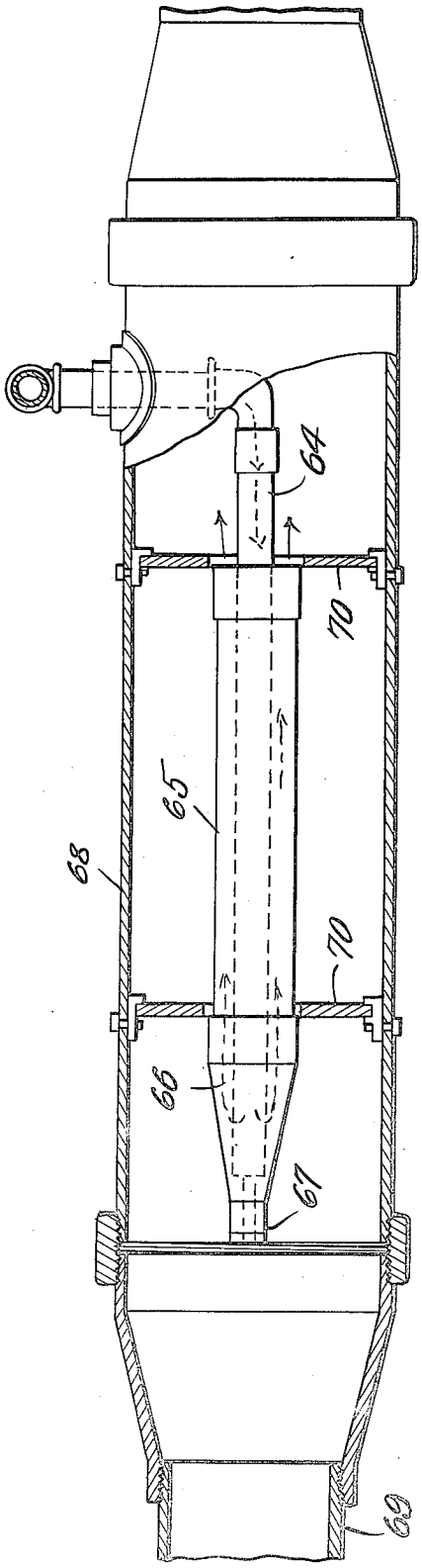


Fig. 9.

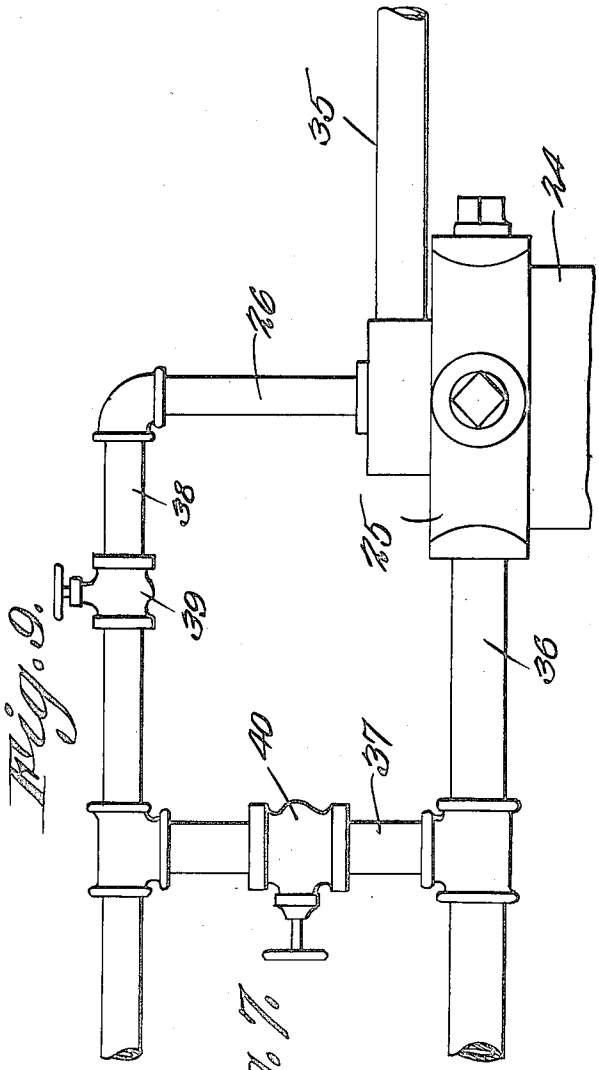


Fig. 7.

Inventor
J. B. Knight
By C. A. Snow & Co.
Attorneys

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J. B. KNIGHT

APPARATUS FOR CONSERVING GAS, OIL, AND OTHER FLUIDS

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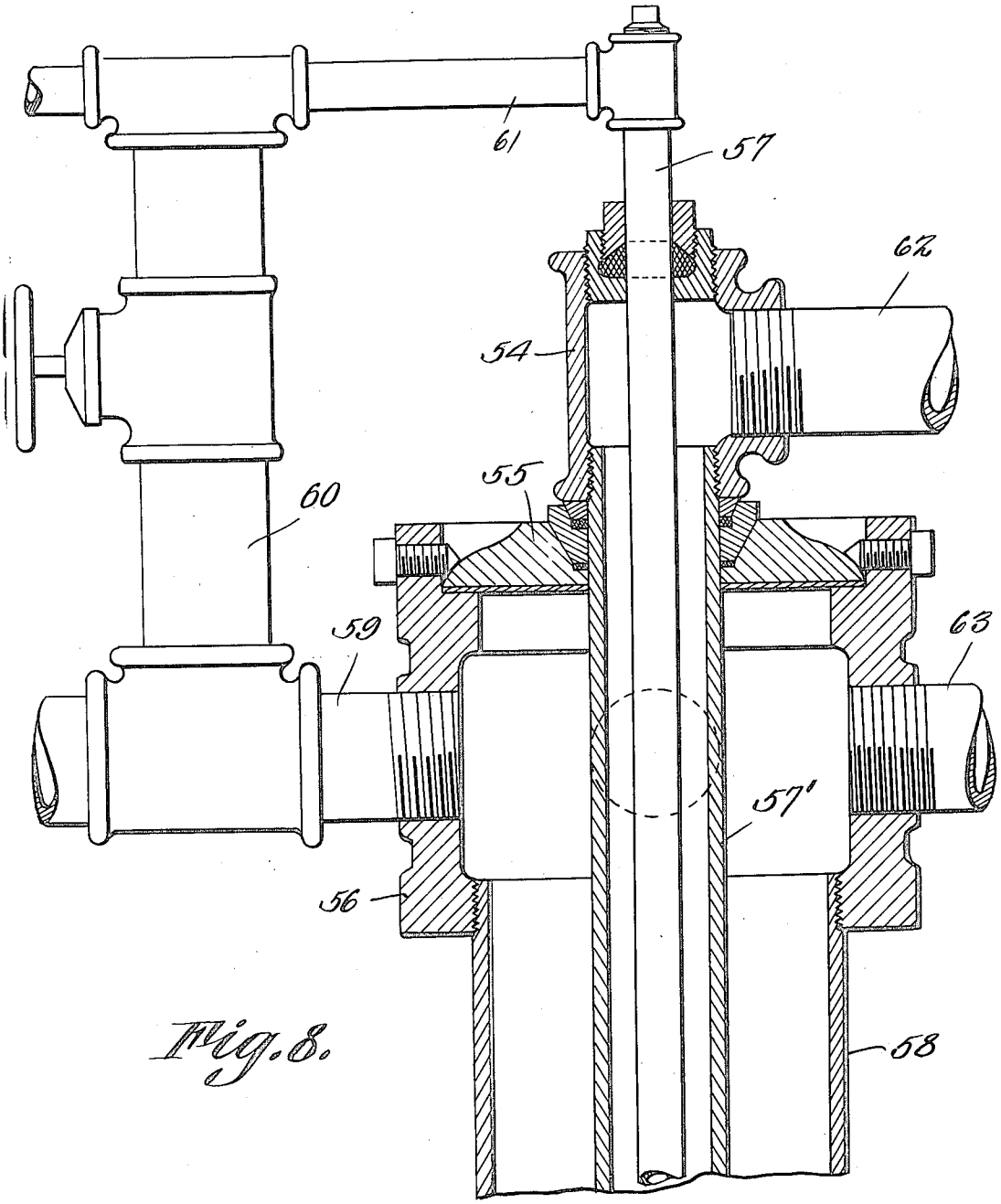


Fig. 8.

Inventor
J. B. Knight
By C. A. Snow & Co.
Attorneys

Patented Oct. 23, 1923. 1,472,009

UNITED STATES PATENT OFFICE.

JAMES BRUCE KNIGHT, OF EL PASO, TEXAS.

APPARATUS FOR CONSERVING GAS, OIL, AND OTHER FLUIDS.

Application filed November 7, 1921. Serial No. 513,576.

To all whom it may concern:

Be it known that I, JAMES B. KNIGHT, a citizen of the United States, residing at El Paso, in the county of El Paso and State of Texas, have invented a new and useful Apparatus for Conserving Gas, Oil, and Other Fluids, of which the following is a specification.

This invention relates to an apparatus designed primarily for use in connection with gas and oil wells and may properly be termed a "compound open circuit" system whereby wild flows of natural gas from large gas wells can be diverted to oil wells of contiguous properties which can thus be operated under natural pressure of the gas that would otherwise be wasted.

A further object is to provide a novel arrangement of pipe lines by means of which an interchange of gas can be effected between any two or more contiguous wells so that the operator can apply any excessive gas from any one well to the operation of bringing oil from those wells in which the gas has been depleted to such an extent that the use of a pump would otherwise be necessary.

A still further object is to provide apparatus of this character which leaves the wells open and unobstructed at all times, there being no moving parts or valves to impede the passage of the fluid either from natural flow or from gas or air forced into the well.

A still further object is to provide apparatus which not only permits the use of natural gas pressure distributed to one or more wells but also allows the use of a compressor whereby air may be utilized as the expelling medium should there be insufficient gas pressure at hand to produce the desired lifting action.

A further object is to provide apparatus which will recover casing-head-gas from the natural gas used to bring the oil to the surface, a gas separator being provided from which dry gas can be forced back into the original pressure line to be again used, it being designed to indicate by the use of meters any loss of gas due to leakage.

A still further object is to provide an apparatus which can be cleaned readily.

Another object is to provide apparatus all parts of which with but two or three exceptions, are made of standard equipment such as usually carried by a well supply house.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that, within the scope of what is claimed, changes in the precise embodiment of the invention shown can be made without departing from the spirit of the invention.

In the accompanying drawings the preferred forms of the invention have been shown.

In said drawings

Figure 1 is a plan view showing the complete apparatus, said view being somewhat in diagram.

Figure 2 is a central vertical section through the lower portion of the shell, casing, and adjacent parts in one well of the system.

Figure 3 is a central vertical section through the casing head and those parts combined therewith.

Figure 4 is a section on line 4—4, Figure 2.

Figure 5 is a section on line 5—5, Figure 2.

Figure 6 is a section on line 6—6, Figure 2.

Figure 7 is a view of a portion of the casing head and parts adjacent thereto and showing the by-pass.

Figure 8 is a central vertical section through another form of casing head and adjacent parts, showing the by-pass arrangement.

Figure 9 is a view partly in longitudinal section and partly in elevation of a modified arrangement for forcing fluid in an inclined or horizontal casing.

Referring to the figures by characters of reference 1 designates a main or supply line for conducting gas pressure from a well or a gas line, the same being provided with a gas regulator indicated in diagram at 2. Extending from this main line is a manifold 3 provided near its point of connection with the main line with a gas meter 4. A valve 5 may be arranged in the manifold between the meter and a branch pipe 6 extending from an air compressor station located generally at 7. A branch pipe 8 may be extended from the main line 1 to the air compressor station and can, in turn, be connected to a gas purifier agitator indi-

cated at 9, through which gas can be delivered to a storage tank 10 where it can be retained for commercial or domestic purposes.

Extending from the manifold 3 are distributing lines 11 each of which is extended close to one series of wells. In the present instance three such series have been indicated at 12, 13 and 14 respectively and, therefore, three distributing lines are illustrated. Arranged adjacent each series of wells is a fluid discharge line 15, these discharge lines all communicating with each other and with a gas separator 16 through which gas may be delivered to a tank 17 and used for commercial or domestic purposes. The separator is also in communication through a pipe 18 with a plant 19 for the recovery of casing-head gasoline and from this plant extends a pipe line 20 which opens into the main line 1 and has a valve 21 and a gas meter 22. A gas purifier agitator 23 can be connected to the pipe line 20 between valve 21 and meter 22.

Each connection between a distributing line 11 and the adjacent discharge line 15 is extended into a well, the specific apparatus constituting such connection being illustrated in detail in Figures 2 to 7 inclusive. Each well is provided with the usual casing 24 on which is mounted a head 25. Through this head is extended an injector line 26 which extends downwardly within the casing so as to form a tubular thimble shaft the lower end of which is exteriorly screw threaded as at 27 and is closed by a metal plug 28. Openings 29 are formed within this tubular shaft close to and above the plug. A coupling sleeve 30 engages the threaded lower end of the tubular shaft 26 and supports a nipple 31 formed of pipe the lower end of which is closed by a screw cap 32. The upper portion of the coupling 30 is exteriorly screw threaded and projects into and engages the lower end of a tubular shell 33 spaced from and concentric with the tubular shaft 26 and extending upwardly to a point adjacent the top of the casing 24 and close to or below the bottom of the head 25. The well tubing 34 surrounds and is spaced from the shell 33, the upper end of the tubing being seated in the top of the casing head 25 where it communicates with a fluid outlet pipe 35 which opens into the adjacent fluid discharge line 15. Opening into the casing head 25 so as to flow into the space surrounding the tubing 34 is a pipe 36 for drawing off surplus gas for any purpose and also for opening communication to the interior of the casing 24 from a by-pass 37 which is in communication through a pipe 38 with the injector line or thimble shaft 26. A valve 39 is arranged within this pipe 38 and another valve 40 is arranged in the by-pass. Pipe 38 communicates with the distributing line 11.

The lower portion of the tubing 34 is engaged by a sleeve 41 the lower portion of which is interiorly screw threaded to engage the upper end of a nipple 42 the intermediate portion of which is tapered as at 43 and merges into an exteriorly screw threaded end portion 44 engaged by a coupling 45 attached to a tube 46 surrounding the cap 32.

Mounted on the sleeve 41 is a ring 47 provided with spaced slots and extending through this ring are tie bolts or rods 48 the lower ends of which are mounted within another ring 49 arranged below the coupling 45 and also having spaced slots. The slots in the upper ring have been indicated at 50 while the slots in the lower ring have been indicated at 51. The rods or bolts 48 extend along the outer surface of a cylindrical screen 52 preferably formed of sheet metal having a plurality of openings. Openings 53 are formed in the upper portion of the nipple 42 so that fluid passing through the screen can enter the nipple and thus flow upwardly around the shell 33 and within the tubing 34. As shown in Figure 2 the tapered portion 43 of the nipple 42 constitutes a seat for the lower end of the shell 33.

Assuming that the wells comprising the series 12, 13 and 14 do not have sufficient gas pressure to bring the oil to the surface, gas piped from a large contiguous well or gas from a pressure-main can be directed into the main line 1 and can be diverted to the manifold 3 and thence to the casing heads of those wells to be operated. The gas is directed through the by-pass 37 and thence through pipes 36 into the space between the casing 24 and the tubing 34. The pressure on the liquid thus produced will force the liquid through the screen 52 and thence through openings 53 upwardly into the tubing 34 and around the shell 33. To augment this action a supplemental amount of gas is delivered to the injector line or thimble shaft 26 which, escaping through the openings 29 into the lower portion of the shell, will flow upwardly between the shaft 26 and the shell 33. The gas thus delivered mixes thoroughly with the fluid in the shell and is so thoroughly mixed with the fluid that the pressure of the gas will be distributed evenly therethrough and the mixture of oil and gas will pass outwardly through the pipe 35 to the discharge line. The mixture of fluid and gas thus elevated will be separated at 16 and the gas will be directed back into the main line 1 while the fluid will be treated in the plant 19.

Should there be a surplus amount of gas

in one or more of the wells in the series, such surplus can be drawn off through the pipe 36, the by-pass being closed so that pressure will be admitted solely to the injector line or thimble shaft 26.

Instead of providing a casing head such as has been illustrated in Figure 3 a structure such as shown in Figure 8 may be used. In this arrangement a T 54 is supported in a suitable manner by a sand plate 55 secured on the casing head 56 and the injected line or thimble shaft 57 is extended downwardly through the T while the tubing 57 is fastened in the T and extends through the sand plate. The casing 58 is attached to the head 56 and said head is connected by a pipe 59 to a by-pass 60 communicating with the pressure pipe 61, these parts being all arranged as in the form heretofore described. The fluid discharge line communicating with the interior of the tubing has been indicated at 62. An outlet pipe 63 for use when cleaning the well, extends from the casing head.

It might be stated at this time that when it is desired to clean the well steam or other suitable cleaning medium is directed through the pipe 62 and will flow downwardly within the well, escaping therefrom through the pipe 63.

The parts 26, 28, 30 and 33 constitute what is termed a thimble and the tapered portion 43 of the nipple 42 constitutes a seat or rest for the thimble. This thimble can be adjusted to handle the different grades of oil with regard to their respective specific gravities and viscosities. In order to avoid the necessity of providing a thimble of a different size for each different grade of oil or other fluid it has been found that the same apparatus can be used by varying the length thereof to adapt it to liquids of different viscosities. Tests have shown that the same volume of fluid of one specific gravity can be forced through a channel or pipe of a certain length and under a stated pressure in the same length of time that a similar volume of fluid of another specific gravity can be forced through a channel or pipe under the same pressure and in the same length of time provided the channel or pipe is lengthened or shortened to a degree sufficient to meet the conditions. Thus in the present case the thimble made up of the parts herein referred to can be lengthened or shortened within the well to adapt it to the specific gravity of the fluid to be elevated and it thus becomes unnecessary to provide thimbles of different proportions or to change the sizes of the orifices.

By providing a screen such as has been described the hardest service can be withstood and, as there are no valves in the well the openings in the screen can be large enough to allow a large quantity of sand to be carried out with the oil without settling around the ports and otherwise interfering with the action of the apparatus.

The principles herein described can be utilized in horizontal work such as transferring oil in pipe lines, and the like. An arrangement of parts for this purpose has been illustrated in Figure 9 wherein the injector line or thimble shaft has been indicated at 64 and forms part of a thimble made up of a shell 65, a tapered nipple 66 and an extension 67. These are supported within an enlarged casing 68 of the line 69 by means of rings 70. The action of this apparatus is the same as that already described, the pressure applied to the contents of the line from the large end of the thimble serving to facilitate or boost the flow as will be apparent.

Although gas from a contiguous well can be directed into the apparatus for the purposes hereinbefore described, natural pressure being used, it is to be understood that if necessary gas can be forced into the system under pressure or air under pressure can be utilized for getting the desired lifting action.

By providing the two meters at 4 and 22 the operator can determine the amount of gas taken from the main line and the amount returned thereto, thus readily determining the amount of waste or leakage that has occurred in the operation of the wells.

What is claimed is:—

1. In apparatus of the class described the combination with a casing and tubing therein, of a casing head having an orifice for receiving gas under pressure to direct it between the casing and tubing to elevate liquid within the tubing, a screen through which liquid is forced when flowing from the casing to the tubing, a tapered nipple supported by the tubing and within the screen, and a thimble seated within the nipple and including a tubular shell, a tubular shaft within and spaced from the shell, said shaft being closed at its lower end, means for closing the space between the lower ends of the shell and shaft, said shaft having a gas port adjacent its closed end opening into the shell, and means for directing gas under pressure into the shaft, said tube terminating at its upper end below the upper end of the tubing.

2. In apparatus of the class described the combination with a casing and a head thereon, of tubing supported within the casing and having a fluid outlet, a tapered nipple supported from the lower end of the tubing and having openings therein, a shell supported by the nipple and within and spaced from the tubing, the upper end of the shell being located below the upper end of the tubing, a tubular shaft within and spaced from the shell and communicating therewith adjacent its lower end, said shell and shaft

being closed at their lower ends, a pressure line, and means for directing pressure from said line into either or both the casing and the tubular shaft, said means including an outlet for surplus gas pressure in the casing.

3. In apparatus of the class described a casing, a head thereon, a tubing supported within the casing and communicating therewith solely at its lower end, a fluid outlet communicating with the tubing at the upper end thereof, a tapered nipple suspended from the lower end of the tubing and having apertures, a sand screen suspended from the tubing and surrounding the nipple, a shell seated on the nipple and supported within and spaced from the tubing, said shell terminating at its upper end below the fluid outlet, a hollow shaft closed at its lower end and supported within the shell, said shaft having an outlet adjacent its lower end for directing gas into the shell, said shell being closed at its lower end, a pressure line opening into the upper end of the tubular shaft, and a valved by-pass extending from the pressure line and opening into the space between the casing and tubing, said by-pass including a valved outlet for surplus gas pressure.

4. In apparatus of the class described the combination with a casing head, of tubing suspended therefrom and having a fluid outlet, a tapered nipple below the tubing, a sleeve coupling the nipple to the tubing, a thimble supported by the nipple within the tubing and including a shell and a tubular shaft closed at their lower ends and communicating adjacent said ends, a ring mounted on the sleeve, a second ring below the nipple, said rings having arcuate slots, an apertured cylindrical member mounted between the rings and constituting a sand screen and bolts outside of the screen and engaging the rings to bind them upon the screen.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

JAMES BRUCE KNIGHT.

Witnesses:
CHAS. G. WILFONG,
H. S. HARRIS.