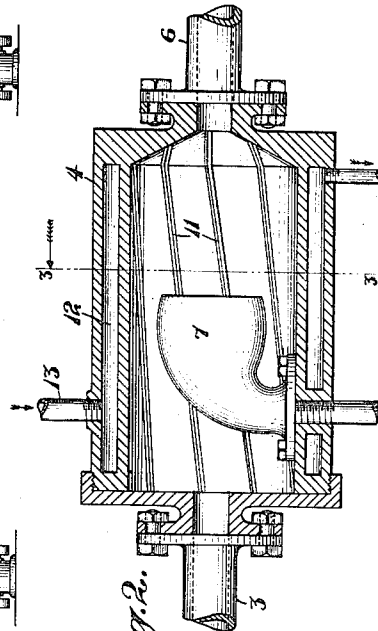
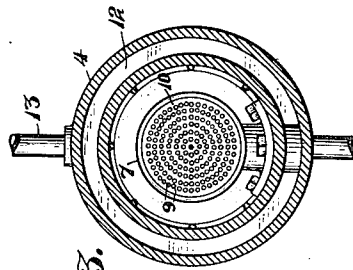
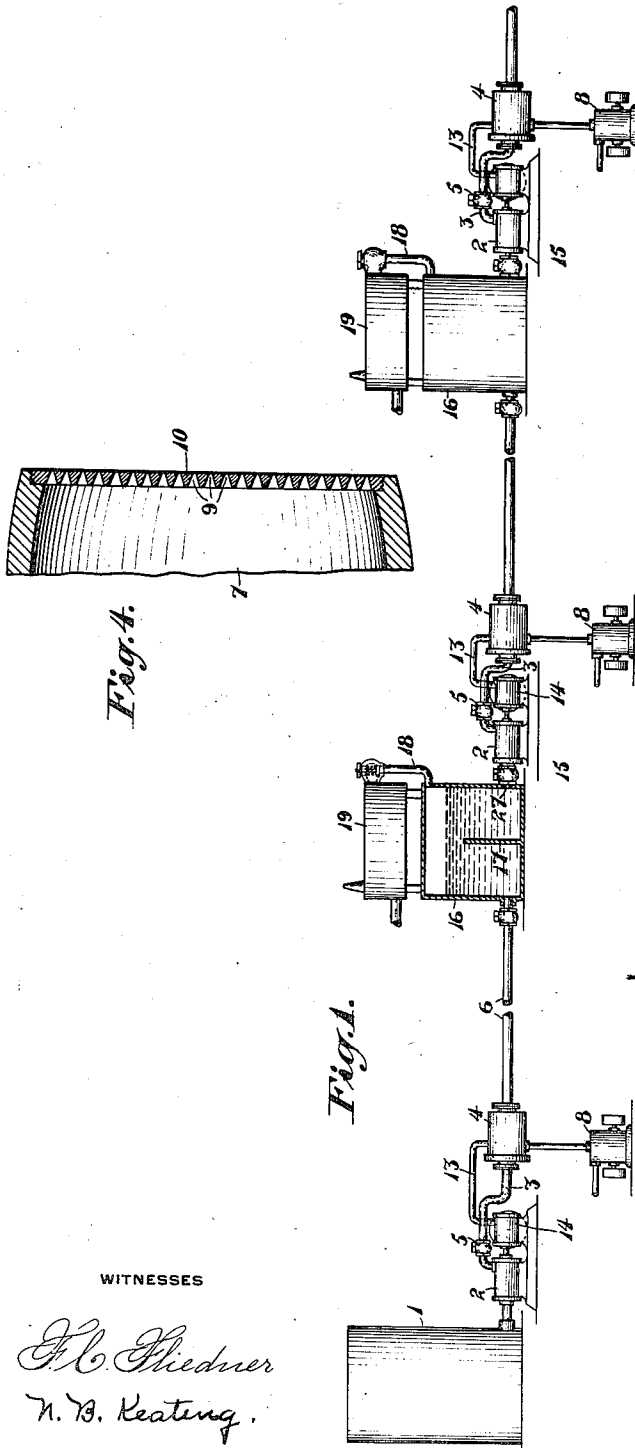


E. N. MILLS.
 APPARATUS FOR TRANSPORTING OIL.
 APPLICATION FILED MAR. 29, 1911.

1,008,980.

Patented Nov. 14, 1911.



WITNESSES

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APPARATUS FOR TRANSPORTING OIL.

1,008,980.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, EDWARD N. MILLS, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented new and useful Improvements in Apparatus for Transporting Oil, of which the following is a specification.

The object of the present invention is to provide an improved apparatus for transporting oil in pipe lines, which shall be economical in operation and in which the oil when so transported will rapidly become in condition for further use or treatment.

The present method generally adopted for transporting oil is by means of pipes, which, in the case of heavy oils, are rifled, water being mixed with the oil to cause it to flow more readily in said pipes. Upon the oil arriving at its destination, it has to be freed from the water by distillation and other methods, this process being expensive as well as slow.

The object of the present invention is to provide means to avoid these defects.

In the accompanying drawing, Figure 1 is a side view of my improved apparatus certain parts being shown in section; Fig. 2 is a longitudinal sectional view of a portion thereof; Fig. 3 is an enlarged transverse view on the line 3—3 of Fig. 2; Fig. 4 is an enlarged longitudinal section of the end of the nozzle.

Referring to the drawing, 1 indicates a tank containing the oil to be transported. From said tank the oil is impelled by a pump 2 through a pipe 3 into a mixing chamber 4, a check valve 5 being interposed in said pipe between the pump 2 and the chamber 4. I employ my improved apparatus to mix the oil with infinitesimal particles or bubbles of air, so as to convert it into a froth or foam, and in this condition I conduct it by a pipe 6 to the distant point. For the purpose of producing this foamlike condition in the oil I provide a nozzle 7 connected with a compressed air pump 8, said nozzle being contained in the mixing chamber 4 between the pipes 3 and 6. Said nozzle is of an expanded form and the air issues therefrom through tapering holes 9 in a nozzle plate 10, there being a large number of such holes, and these holes being very minute. The number of such holes is so

large and they are so minute that they cannot be properly illustrated in the drawing, which is, in this respect, only diagrammatical. It is of the greatest importance that the air issuing from said nozzle should be divided into streams as fine as possible in order that the bubbles into which the air is divided may be as small as possible. The length of time during which the oil retains this foamlike condition increases with the smallness of these particles of air. The mixing chamber is formed on its inner wall with helical ribs or vanes 11, which impart to the oil passing therethrough a rotary motion. On account of this rotary motion, the oil cuts or divides the streams of air into infinitesimal particles. In this condition the oil is very easily conveyed through the pipe. By reason of the great reduction in pressure of the air on issuing through said nozzles, and the consequent expansion of the air, a refrigerating effect is produced, which is undesirable for the purpose for which my invention is designed. To counteract this refrigerating effect I provide around the mixing chamber a steam jacket 12, which is supplied by a pipe 13 with exhaust steam from the engine 14 which drives the pump.

In order to transport the oil a very long distance I provide stations 15, as shown in Fig. 1. At each station the same apparatus is provided as at the first station, but since the oil arrives at each station in a foamlike condition, part only of the air having escaped, it can therefore be easily propelled to the next station. At each station after the first there is provided a receiving tank 16 at one side of which the mixing oil and air enters by the pipe 6, escaping from the other side by the pipe 27. A transverse partition 17 in each receiving tank separates the oil inlet from the oil outlet. The air escaping from the mixture rises to the top and escapes by a pipe 18 into a supplementary air chamber 19 from which it can escape into the atmosphere, leaving, however, in said supplementary chamber any oil which may have been carried up with the air.

I am aware that it has been proposed to provide apparatus for transporting water in a pipe, which apparatus contains means for injecting jets of compressed air in the direction of the pipe. Such apparatus, which may be successfully used for transporting water in a pipe, is not practicable

for transporting oil, for the reason that, as compared with water, oil is a very sluggish, viscid, and tenacious liquid, traveling in a pipe like molasses. Ordinary apparatus for transporting water in a pipe are quite useless for transporting oil. This transportation can only be effected by reducing the oil into a foamlike condition, so that the dark brown oil becomes of a character like light brown soap suds. To bring it to this condition it is necessary that the bubbles of air introduced therein shall be extremely great in number and small in size, and that the jets of air should be forced through holes certainly not more than one-sixteenth of an inch in diameter and preferably much smaller than this, and also that when so forced, each jet should not be allowed to issue in a continuous stream of air but should be broken up into fine particles. I have found in experimental apparatus of this character that crude oil thus reduced to a foamlike condition remains apparently uncharged after traveling through a pipe $2\frac{1}{2}$ miles long, showing that its condition, necessary for rapid transportation in the pipe, would remain unchanged for much longer distances. It is also an important feature of my apparatus that it must contain means for employing some extraneous force to force the oil along the pipe in addition to the pressure of the air which is mixed with the oil. My experiments show that it is apparently not possible to force oil along the pipe by the mere pressure of the jets of compressed air. These can be used only to perform their function of reducing the oil to a foamlike condition, and pumping apparatus must still be employed to force the oil along the pipe.

I claim:—

1. An apparatus for transporting liquid comprising a conduit, a chamber connected to said conduit, a nozzle in said chamber formed with a large number of minute holes, means for supplying compressed air to said nozzle, and a pump for pumping the liquid along the conduit, substantially as described.

2. An apparatus for transporting liquid comprising a conduit, a chamber connected to said conduit, a nozzle in said chamber formed with a large number of minute holes

opening in the direction of the conduit, means for supplying compressed air to said nozzle, and a pump for pumping the liquid along the conduit, substantially as described.

3. An apparatus for transporting liquid comprising a conduit, a chamber connected to said conduit, a nozzle in said chamber formed with a large number of minute holes opening in the direction of the conduit, means for supplying compressed air to said nozzle, means for causing the liquid to break up into minute bubbles the several streams of air from said holes in the nozzle, and a pump for pumping the liquid along the conduit, substantially as described.

4. An apparatus for transporting liquid comprising a conduit, a chamber connected to said conduit, a nozzle in said chamber formed with a large number of minute holes, means for supplying compressed air to said nozzle, oblique vanes for imparting a rotary motion to the liquid, and a pump for pumping the liquid along the conduit, substantially as described.

5. An apparatus for transporting liquid comprising a conduit, a chamber connected to said conduit, a steam jacket around said chamber, a nozzle in said chamber formed with a large number of minute holes, means for supplying compressed air to said nozzle, and a pump for pumping the liquid along the conduit, substantially as described.

6. An apparatus for transporting oil comprising a series of receptacles for the oil, a pipe leading from each receptacle to the next of the series, an apparatus for forcing oil along each pipe comprising a pump, and means for reducing said oil to a foamlike condition by admixture thereof with air, each of said receptacles to which said oil is conducted being provided with means for permanently separating from the oil the air which has escaped from admixture therewith, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD N. MILLS.

Witnesses:

FRANCIS M. WRIGHT,
D. B. RICHARDS.