May 25, 1943. S. E. BUCKLEY ET AL 2,320,219

VISCOSIMETER

Filed March 24, 1941 2 Sheets-Sheet 1

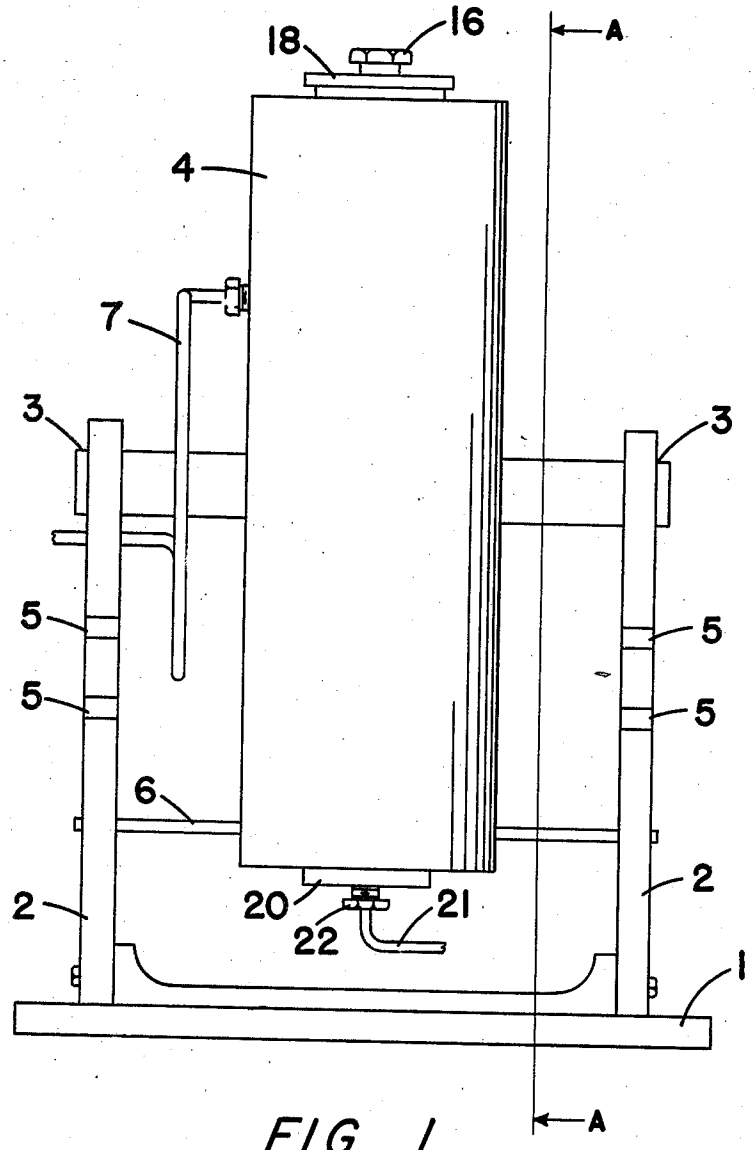


FIG. 1.

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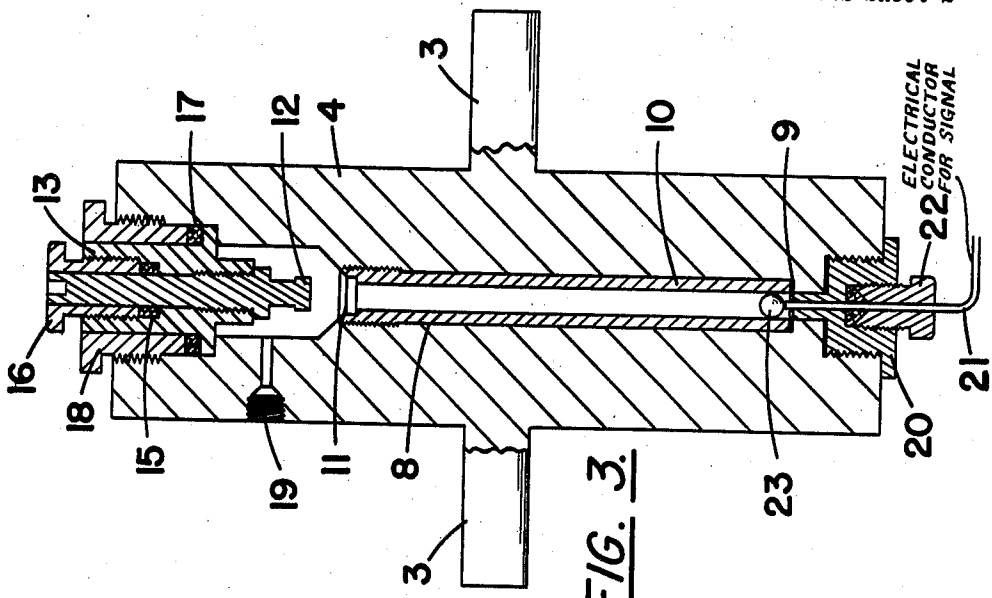


FIG. 3.

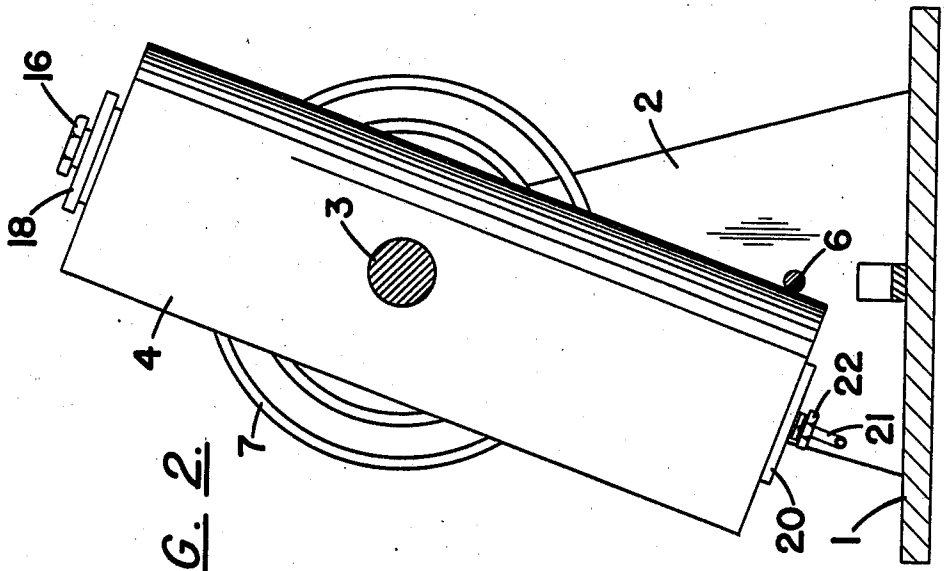


FIG. 2.

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VISCOSIMETER

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Application March 24, 1941, Serial No. 384,872

2 Claims. (Cl. 265—11)

The present invention is directed to a viscosimeter and particularly to a device for measuring the viscosity.

In evaluating the potential recovery of oil from a reservoir and in seeking to determine the most efficient method for producing the oil, it is desirable to have information concerning the viscosity of the oil in place in the reservoir. When it is borne in mind that the oil in place is at an elevated temperature and is in contact with high pressure gas whereby it is ordinarily at its saturation point for gas, it will be understood that ordinary methods for measuring viscosity are not applicable for obtaining the desired information.

The principal object of the present invention is the provision of a device of the character described wherein the viscosity of oil containing gas at elevated pressures may be determined.

It is an additional object of the present invention to provide a device of the character described by means of which it is possible to determine the viscosity of oil at elevated pressure in varying degrees of saturation with gas.

Other objects and advantages of the present invention will appear from the following description of the accompanying drawings in which—

Fig. 1 is a front elevation of an apparatus according to the present invention;

Fig. 2 is a section along the line A—A of Fig. 1; and

Fig. 3 is a vertical section of the barrel.

Referring to the drawing in detail, numeral 1 designates a base having vertically arranged spaced walls 2. Journalled in each wall is a trunnion 3 rigidly connected to a bomb 4 of cylindrical form. This cylinder is a thick walled metal cylinder capable of withstanding extremely high pressures. The front edges of the walls 2 carry notches 5 in which may be placed a bar forming a stop for the cylinder 4 so that the latter may be caused to come to rest at different degrees to the vertical. Similarly, a bar 6 forms a stop which, in the embodiment shown, is so arranged as to cause the cylinder to assume an angle of 75° to the vertical.

Arranged parallel to the longitudinal axis of the cylinder is a spiral of tubing 7 having its inner end clipped to the adjacent wall 2 and connected with a suitable pump for feeding in the oil and gas. In practice a mercury pump is employed. The outer end of the spiral is connected to the cylinder near its upper end. Referring to Fig. 3, it will be noted that the cylinder has a narrow bore 8, at the bottom of which is a packing ring 9, against which is pressed a tube 10 which has a screw-threaded connection with the upper end of the narrow bore, and is provided with a seat 11 for plunger 12 threaded into a bushing 13 at the upper end of the cylinder 4 and extending beyond the bushing to the exterior of the cylinder. There is an annular space between the bushing and the outer end of the plunger which is filled with packing 15 which may be compressed by a collar 16 carried by the outer end of the plunger. Similarly, there is an annular space 17 between the outer surface of the bushing and the inner surface of the cylinder which is filled with packing which may be compressed by a collar 18. The space between the bushing and the upper end of the narrow bore 8 constitutes an enlarged chamber with which the tube 7 is connected through passage 19.

The lower end of the cylinder carries a threaded plug 20 which has a central passage adapted to receive an electrode 21 which is carried by an adapter 22. This electrode may be connected to any suitable electrical signaling device, the other end of which is grounded. A buzzer is a suitable signal, although a light may be used.

A metal ball 23 is arranged to roll in the tube 10 with its surface in contact with the inner surface of the tube.

In one practical use of this device it is employed to determine the viscosity of oil saturated with hydrocarbon gas at selected pressures and temperatures. In this operation a borehole sample of oil is obtained and brought to the surface in a closed chamber which retains all the gas which was in the oil in place in the reservoir. This mixture is pumped into the interior of cylinder 4 and the pressure increased to a point above the pressure of the formation from which the oil is obtained, thereby insuring that the gas redissolves in the oil. Generally, at this pressure a viscosity determination may be made at the temperature of the formation. This temperature is achieved in the viscometer by immersing the whole instrument in a bath of fluid maintained at the desired temperature.

When the device is charged and the operating conditions are fixed, the plunger 12 is seated on the top of the tube 11, thereby sealing this tube full of oil. The cylinder is then inverted and held in this position until the ball rests on the inner end of the plunger. Then the cylinder is flipped to assume any desired angle to the vertical and the time elapsing between the flipping of the cyl-

inder and the response of the electrical signal is noted. This time is then used in a formula for the calculation of the viscosity of the fluid in a manner well known. To facilitate the use of the instrument a graph is prepared from which viscosity may be read on the basis of the time measured, this graph being prepared by measuring times with fluids of known viscosity.

Usually a number of determinations of the viscosity at different angles of the cylinder are made. These various runs are made for checking purposes.

After the viscosity under one set of conditions and at one degree of oil saturation is determined, the plunger is retracted and the pressure on the mixture is reduced to any desired pressure to give a lesser degree of saturation, and the viscosity again determined in the manner described. Thus, it will be seen that information with respect to viscosity of the oil at various temperatures and pressures and with various degrees of saturation with hydrocarbon gas may be obtained expeditiously.

The enlarged chamber in the upper part of the cylinder is a vital element in the viscometer. The provision of this chamber makes possible the charging of enough liquid to insure ample quantity of liquid after the shrinkage of oil due to the liberation of gas. This chamber also affords space in which the oil and gas may be well mixed to insure the establishment of equilibrium conditions prior to the determination of the viscosity at the desired pressure.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. A viscosimeter for the measurement of viscosity at high pressures comprising an elongated cylinder provided with a narrow bore extending for a substantial portion of the length thereof and an enlarged chamber at the open end of said bore, means hermetically closing said enlarged chamber including manipulatable means for sealing off said bore from said chamber, said cylinder being further provided with an inlet for the introduction of fluid under pressure into said chamber, and a ball in said bore adapted to slide therealong.

2. A viscosimeter for the measurement of the viscosity of fluids containing gas at high pressure, comprising a chamber adapted to receive said fluid including an elongated column of uniform cross section, the volume of said column constituting only part of the total volume of said chamber, means for supporting said chamber pivotally so that it may be oscillated with respect to said supporting means to agitate said fluid in said chamber to establish equilibrium between said fluid and the gas, means for segregating the fluid in the column from the remainder of the fluid, and a ball adapted to slide in said column so that the viscosity may be measured by measuring the travel time of said ball from one end of said column to the other.

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