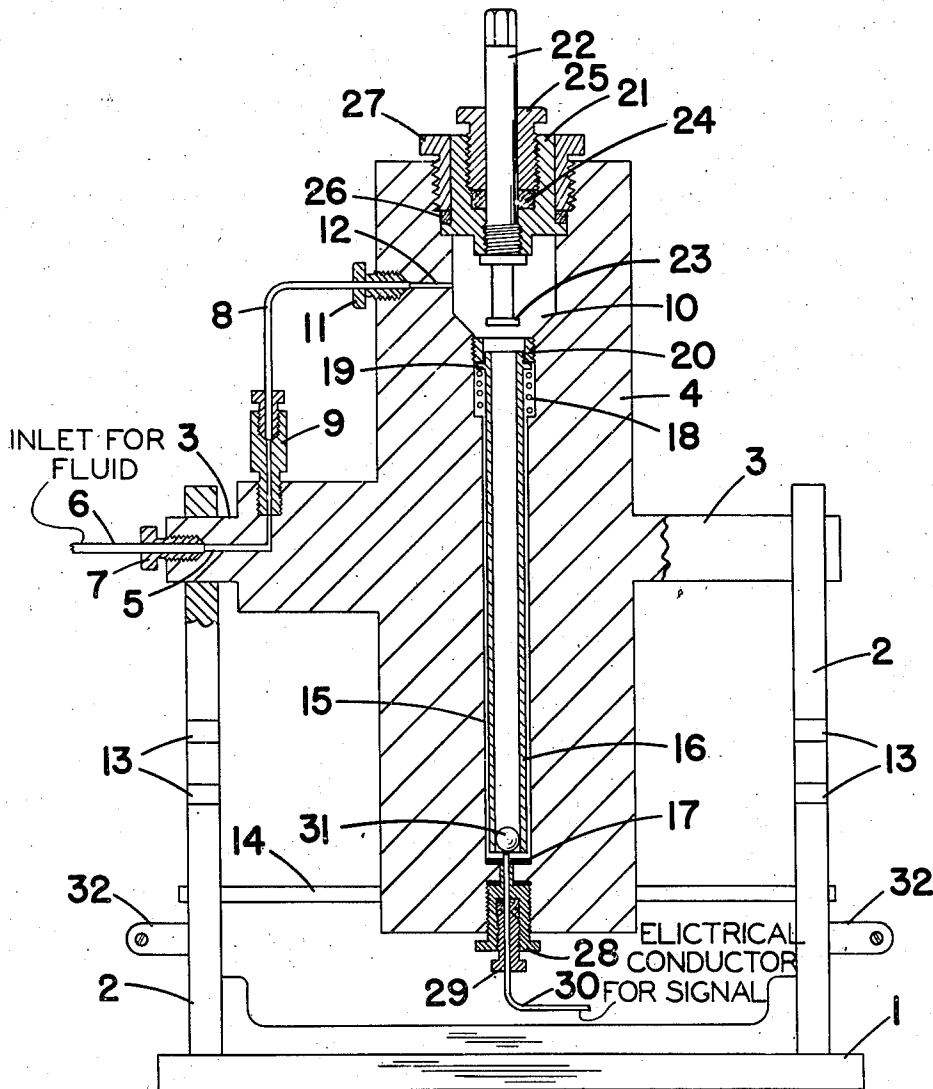


S. E. BUCKLEY

VISCOSIMETER

Filed March 24, 1941

2 Sheets-Sheet 1



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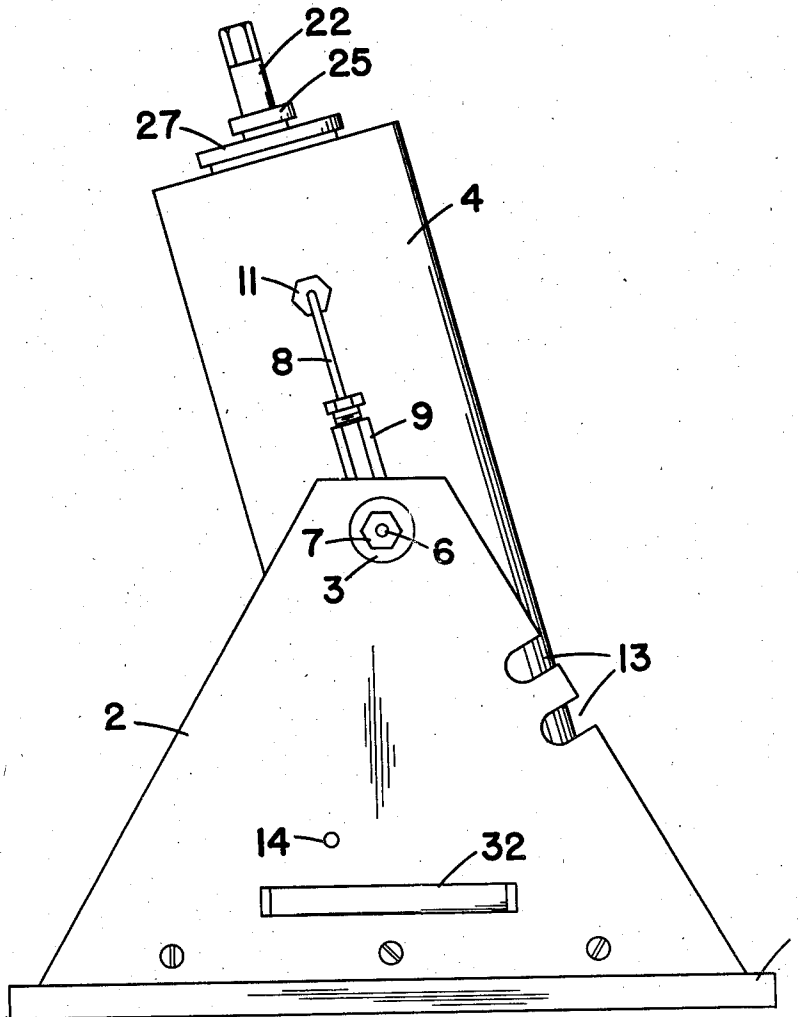


FIG. 2.

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VISCOSIMETER

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6 Claims. (Cl. 265—11)

The present invention is directed to a viscosimeter and particularly to a device for measuring the viscosity of fluid containing gas at high pressure.

The principal object of the present invention is the provision of a viscosimeter which makes possible the measurement of the viscosity of a fluid containing gas at elevated pressures and temperatures.

An additional object of the present invention is the provision of a viscosimeter which is so constructed as to enable the operator to reproduce conditions existing in subsurface formations and to determine the viscosity of fluids obtained from said formations under the reservoir conditions. An additional object of the present invention is the provision of a device of the character described so constructed as to eliminate inaccuracies in readings due to vapor locking.

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

Fig. 1 is a front elevation, partly in section, of a device according to the present invention; and

Fig. 2 is a side elevation of the device.

Referring to the drawings in detail, numeral 1 designates a base to which is secured a pair of spaced parallel vertical walls 2. In each of these walls at its upper end is journaled a trunnion 3 which is rigidly connected to a cylinder 4. This cylinder is a thick walled metal cylinder capable of withstanding extremely high pressures. One of the trunnions has an L-shaped bore 5, to the axial end of which is connected a tube 6 through a nipple 7, and to the radial end of which is connected a tube 8 through a nipple 9. The other end of tube 6 is connected to a pump, and the other end of tube 8 is connected to an enlarged chamber 10 in the upper end of cylinder 4 through a nipple 11 and a lateral passage 12 in the wall of the cylinder.

The front edges of the walls 2 are provided with notches 13 adapted to receive a bar which serves as a stop for the cylinder so that it can be brought to rest at different angles to the vertical. A similar stop 14 in the form of a bar is carried between the walls 2. It will be understood that as many notches 13 as desired may be provided so as to enable viscosity measurements to be made at as many angular positions of the cylinder 4 as desired.

The cylinder 4 is provided with a central nar-

row bore hole 15 extending for a substantial portion of its length. Arranged in this bore is a tube 16 of such diameter as to leave an annular space between the tube and the bore. At the lower end of the bore 15 is a packing disk 17 on which tube 16 can seat. The tube is normally held off this seat by a spring 18 arranged at the upper end of the bore 15. The upper end of the tube 16 is provided at its outer surface with a flange 19 which is adapted to abut against a stop 20 which limits the upward movement of the tube. The upper end of the chamber 10 is provided with a plug 21 which has a central opening to receive a plunger 22 which extends into the enlarged chamber 10 and is provided with a head 23 adapted to seal off the upper end of tube 16. Between the outer end of the plunger and the plug 21 is an annular space filled with packing 24 which may be compressed by a screw threaded collar 25. Similarly, between the outer surface of the plug 21 and the wall of cylinder 4 is an annular space filled with packing 26 which may be compressed by a threaded collar 27.

The lower end of the cylinder 4 carries a threaded plug 28 which has a central opening in which is arranged an adapter 29 carrying an electrode 30 which extends through the packing disk 17 in a position to contact the metal ball 31 which is of such diameter as to roll in the tube 16 with its surface contacting the inner surface of the tube. The electrode is connected to an electric circuit containing a signaling device such as a buzzer or a light. The walls 2 are provided with handles 32.

In the use of this device a mixture of fluid and gas, such as oil containing gas obtained from a subsurface formation, is pumped through the tube 6 into the enlarged chamber 10. The pressure in this chamber is adjusted to be somewhat in excess of that of the formation from which the fluid was obtained so as to insure that the fluid will be at least as saturated with the gas as it was in the formation. The formation temperature may be reproduced by immersing the entire device in a bath of fluid maintained at the formation temperature. When the device is charged, the cylinder 4 is oscillated on its trunnions so as to insure a thorough mixing of the liquid and gas. In this connection, when the cylinder is turned upside down bringing the ball to the plunger end and then righted, the ball travelling downwardly forces fluid up through the annular space between the tube 16 and the bore 15, thus elim-

inating any possibility of a gas pocket at the lower end of the bore which would make the readings erroneous.

When the operator is satisfied that the two phases in the chamber are in equilibrium, he screws down the plunger 22 to seat the tube 16 on the packing disk 17 and to seal the upper end of the tube. Then the cylinder is inverted to permit the ball to come to rest on the plunger. Then the cylinder is flipped to any desired position with respect to the vertical, determined by the notch in which the stop bar is arranged, or if the notches are not used, by stop bar 14. When the ball reaches the bottom of the tube it comes in contact with the electrode and gives a signal. The time elapsing between the flipping of the tube and the signal is then used to calculate the viscosity of the fluid. This determination can be made at various angles of the cylinder with the vertical so as to check the correctness of the determination. Then, if desired, the pressure on the interior of the cylinder can be reduced to increase the degree of saturation of the fluid with gas and the operation is repeated. Thus, determinations of viscosity of a fluid saturated to various degrees with gas at elevated pressures can be ascertained.

It will be noted that the connection between the tube 6 and the chamber 10 is such that no bending stress is introduced into the fluid-conducting tubes. In this connection, it will be understood that there is a swivel connection between tube 6 and nipple 7.

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 determination of the viscosity of a fluid at elevated pressure comprising a cylinder provided with a relatively small diameter axial bore having an enlarged chamber at its upper end and a fluid sealing seat at its lower end, the bore and chamber normally being in open fluid communication, means for introducing fluid to be tested into said enlarged chamber, a tube arranged in said bore adapted to seat on said fluid sealing seat, said tube being of such diameter as to leave an annular space between its outer surface and the wall of the bore, means for normally urging said tube off its seat to thereby establish fluid communication between said annular space, and said enlarged chamber and said tube, means for pressing said tube on its seat and sealing its upper end, and a ball adapted to traverse said tube.

2. A viscosimeter for the determination of the viscosity of a fluid at elevated pressure comprising a cylinder provided with a relatively small diameter axial bore having an enlarged chamber at its upper end and a fluid sealing seat at its lower end, the bore and chamber normally being in open fluid communication, means for supporting said cylinder intermediate its ends for oscillation about an axis intermediate its ends, means for introducing fluid to be tested into said enlarged chamber, a tube arranged in said bore adapted to seat on said fluid sealing seat, said tube being of such diameter as to leave an annular space between its outer surface and the wall of said bore, means for normally urging said tube off its seat to thereby establish fluid communication between said annular space, and said enlarged chamber and said tube, means for pressing

said tube on its seat and sealing its upper end, and a ball adapted to traverse said tube.

3. A viscosimeter according to claim 2 in which stops are provided for limiting the oscillation of said cylinder in a predetermined manner.

4. A viscosimeter for the determination of the viscosity of a fluid at elevated pressure comprising a cylinder provided with a relatively small diameter axial bore having an enlarged chamber at its upper end and a fluid sealing seat at its lower end, the bore and chamber normally being in open fluid communication, an electrical contact arranged at the lower end of said bore, means for introducing fluid to be tested into said enlarged chamber, a tube arranged in said bore adapted to seat on said fluid sealing seat, said tube being of such diameter as to leave an annular space between its outer surface and the wall of the bore, means for normally urging said tube off its seat to thereby establish fluid communication between said annular space, and said enlarged chamber, and said tube, means for pressing said tube on its seat and sealing its upper end, and a ball adapted to traverse said tube and contact said electrical contact when it is in the lower end of said tube.

5. A viscosimeter for determining the viscosity of fluid at elevated pressure, comprising a cylinder provided with a relatively small diameter axial bore having an enlarged chamber at its upper end and a fluid sealing seat at its lower end, the bore and chamber normally being in open fluid communication, means for supporting said cylinder intermediate its ends for oscillation about an axis intermediate its ends, an electrical contact arranged at the lower end of said bore, means for introducing fluid to be tested into said enlarged chamber, a tube arranged in said bore adapted to seat on said fluid sealing seat, said tube being of such diameter as to leave an annular space between its outer surface and the wall of the bore, means for normally urging said tube off its seat to thereby establish fluid communication between said annular space, and said enlarged chamber and said tube, a plunger arranged in said enlarged chamber and adapted to be manipulated for forcing said tube onto its seat and sealing its upper end, and a ball adapted to traverse said tube and to contact said electrical contact when it is in the lower end of said tube.

6. A viscosimeter for the determination of the viscosity of a fluid containing gas at elevated pressure comprising a chamber for receiving a quantity of said fluid containing gas, said chamber including an elongated column of uniform cross section having both of its ends normally in open fluid communication with the remainder of said chamber, thereby permitting circulation of fluid from said chamber through said column and back to said chamber, the volume of said column constituting only part of the total volume of said chamber, means for mounting said chamber which admit of agitation of said fluid after its admission to said chamber for establishing equilibrium between the gas and the fluid, means for segregating the fluid in said column from the remainder of the fluid, and a ball adapted to traverse said column so that viscosities can be measured by measuring the travel time of said ball from one end of the column to the other.

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