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APPARATUS FOR APPLYING PRESSURE

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Fig. 1.

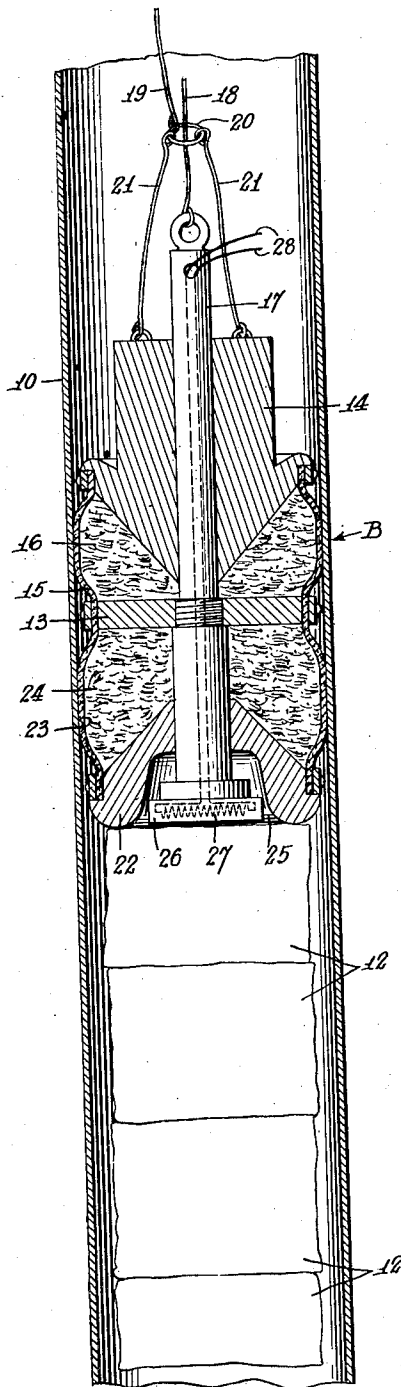
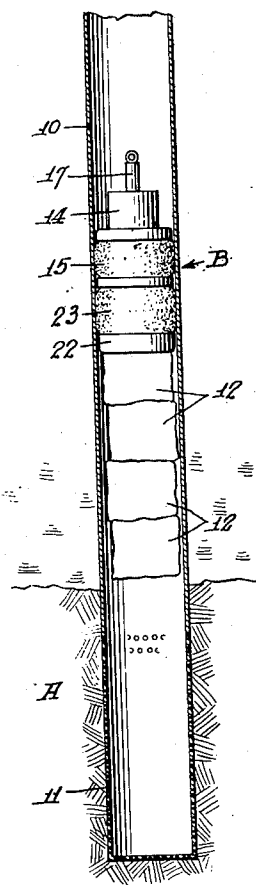


Fig. 2.



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APPARATUS FOR APPLYING PRESSURE

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My present invention is particularly applicable to the generation of pressure in locations that are more or less inaccessible and restraining it in all directions but those in which it is desired to have the pressure act to produce motion. This is accomplished by employing a solidified or liquefied gas that will gasify upon absorption of heat, at relatively low temperatures even when the pressure is fairly high, as for instance, frozen carbon dioxide. Such solidified or liquefied gas is placed adjacent the point where it is desired to exert the pressure and is then sealed as effectively or slightly as may be necessary to hold against the desired pressure, and a desired amount of heat is applied to cause more or less rapid evaporation to generate the desired pressure. The method of sealing off the solid or liquid gas varies under the conditions of the particular work which is to be done. The sealing may be by an expanding plug or, in certain cases, by a hydrostatic head of water or other liquid, and in some cases merely by the pressure of the air. The heat may be applied by an electric current or other suitable medium, or in some cases, merely by the heat existing in surrounding objects. The bottom of an oil well, which may be, say, 5,000 feet deep, is an illustration of a difficult location in which the pressure may be applied.

In many oil fields, the oil is in soft shale at a considerable distance below the surface and great difficulties are encountered in obtaining the oil because the soft, chalk-like shale clogs the strainer of the pipe which has been projected into the shale bed, and thus seals the pipe against the entry of oil thereto.

It is necessary to periodically clear the strainer in order to maintain the oil flow, but previous efforts to accomplish this have failed or have involved great difficulties, long delays or considerable expense.

The main object of my invention is to provide simple, quickly operating, inexpensive and efficient means for clearing the strainer and the lower end of the oil pipe. I accomplish this result by plugging the pipe at a point above the strainer and creating below

the plug a gas pressure which increases at such a rate and to such a point that the shale or other accumulation in the bottom of the pipe, in the strainer or in the holes of the latter, is forced out, but not with such violence as will rupture the parts or prevent subsequent removal of the plug. The gas used is an inert one so that there is no liability of forming an explosive mixture with the oil vapors or hydrocarbon gases and I prefer to apply it in solid form, preferably in blocks which may be placed in position before the pipe is plugged. The plug employed is such that it may be lowered to the point desired, expanded to make a gas tight seal, and after the gas has done its work, contracted and removed for future use. Thus the entire operation may be performed easily, quickly and at low cost, the solidified gas being the only material that is lost and this being relatively cheap.

In carrying out my invention, I preferably employ cakes of frozen carbon dioxide. This material gasifies slowly, yields over 500 cubic feet of gas per cubic foot of the solid, is now readily obtainable and costs but a few cents per pound. The plug may be provided with heating means to control the rate of gas formation and to raise the pressure by raising the temperature of the gas. The gas forces the obstructions out of the strainer and the lower end of the pipe and may pass out through the surrounding shale so that at the end of the operation the pressure in the pipe below the plug will not be materially higher than that due to the oil pressure and the plug may be removed to permit oil to again flow through the cleared strainer.

As a further important feature of my invention, I provide certain improvements in the plug whereby the latter may be readily secured in place to form a gas tight seal at any desired depth in the pipe and may be readily removed even while great gas pressure is being exerted against it from below.

The above and other features of my invention may be more fully understood from the following description in connection with the accompanying drawings, in which

Fig. 1 shows more or less diagrammatically

a central longitudinal section through the lower portion of an oil pipe lining for an oil well and also showing the sealing plug in section; and

Fig. 2 is a section similar to Fig. 1, but on a smaller scale, and showing the pipe in position as a lining of an oil well, with the strainer forming an extension at the lower end of the pipe, the plug being shown in side elevation.

In these drawings, the usual form of oil pipe 10 is shown as having been driven along, lowered through a drilled hole, or in any other suitable or customary manner brought in position with the lower end projecting into a bed A of oil bearing material, such as shale, as indicated in Fig. 2. It is customary to provide the lower end of such a pipe with some form of strainer 11, permitting the entry of oil to the lower end of the pipe and intended to exclude at least in part the entry of solid material. The difficulty arises due to the fact that a large amount of the very fine shale will enter the pipe through the strainer, or clog the holes of the strainer, and prevent further entry of oil.

In carrying out my invention I provide a plug B and means whereby gas may be generated in the lower end of the pipe, below said plug to force out the obstruction and clear the openings. To generate the gas I employ solid carbon dioxide which may be lowered or dropped to the bottom of the pipe in the form of cakes 12, the number and size of such cakes depending upon the amount of gas which it is desired to form or the amount of pressure which it is desired to create.

After inserting the cakes or blocks of solid carbon dioxide, the pipe is sealed gas tight at a point preferably directly above the upper cake.

For sealing or plugging the pipe, there is preferably employed the form of plug illustrated in the drawings, although so far as the broad method is concerned, any suitable type of gas tight, removable plug may be employed.

The cakes of frozen carbon dioxide can be made from snow compressed to any desired density up to, say, twice the density of petroleum so that they will tend to sink in any liquid that may be in the bottom of the well. While dense cakes will yield proportionally greater volumes of gas, lighter cakes that will tend to float may be desirable, because this facilitates locating them in the pipe 10, a desired distance above the strainer 11, as diagrammatically indicated in Fig. 2. In this way the freezing effect of gasification may be localized in a body of the liquid as high as desired above the strainer. In such case, the pressure of the gas will be transmitted downward, the more or less congealed upper portion acting as a piston upon the column of warmer more fluid petroleum, lower down.

In practice of the invention under varying conditions, the amount of the frozen carbon dioxide to be employed to yield a given gas pressure can be calculated closely enough so that a safe margin of excess pressure will be assured. In practice it is usually desirable to use an excess charge, such as will extend a substantial distance up into the pipe above the strainer. Obviously the greater the charge, the more blocks there will be absorbing heat from the metal pipe lining and the soil surrounding the same, and the more rapid will be the rise of pressure within the sealed space below the plug. Furthermore, the higher the stack extends, the greater will be the space filled with compressed gas and the more sustained will be the follow up expansion pressure, when the clogging layer around the strainer is once broken through.

While I have shown the cakes as considerably smaller than the diameter of the pipe 10, it will be understood that so long as a safe, easy sliding fit is assured, minimum clearance is desirable, in order to minimize the empty space in which the gas must build up pressure. One-half inch clearance in an eight inch pipe is usually sufficient.

In the construction shown, the plug includes a plate 13 and a weight 14, the lower portion of the weight being of conical form. The plate and weight are of such size that they may freely slide within the pipe 10 and their peripheries are connected by an annular flexible wall 15, preferably of leather, rubber or similar sheet material. Between the plate and the weight and encircled by the flexible wall 15, is a filling 16 of such material that it will be forced outwardly to press the flexible wall 15 tightly against the surface of the pipe when the conical end of the weight exerts compression or radial thrust on this material. Merely as an example of a suitable material, I may mention sponge rubber, although various other materials might be employed.

The plate 13 is threaded on or otherwise rigidly secured to a central rod 17 which extends loosely through a central bore in the weight 14 so that the weight is slidable thereon. The rod 17 is connected to a suspension wire or cable 18 and the weight 14 is provided with an independent suspension wire or cable 19.

To facilitate symmetrical suspension and free sliding of the weight on the rod, the lower end of the wire 19 may be connected to a ring 20 which latter may be connected to the weight through a plurality of wires 21 that are of equal length and have symmetrically located points of attachment to said weight 14.

A second sealing surface may be provided by extending the rod 17 below the plate 13 and mounting on this lower extension a second weight 22 having an upwardly facing

conical end. The periphery of this weight is connected to the periphery of the plate 13 by a flexible wall 23 which may be integral with and merely form an extension of the flexible wall 15. A filler 24 similar to filler 16 is used between the plate 13 and the weight 22. The weight 22 is preferably provided with an annular recess 25 in its lower face, adapted to receive a head 26 on the lower end of the rod and permit the lower surface of the weight to extend below the lower surface of said head, for purposes described below.

In lowering the plug into position, the weight of the entire plug is sustained by the wire 19. The weight 22 will be suspended from the plate 13 by the wall 23 and the plate will be suspended from the upper weight by the wall 15. Thus the three parts will tend to separate to the maximum extent, the flexible wall will be drawn in radially free of the wall of the pipe, and the conical surfaces of the weights 14 and 22 will be withdrawn from radially expansive pressure on the fillers 16, 24.

When the weight has been lowered to the limiting position, the weight 22 will strike the upper cake of solid carbon dioxide and the further movement of the plate 13 and the weight 14, due to the action of gravity or to the momentum of the descent will force the packing material outwardly and bring the flexible walls into gas tight engagement with the pipe.

If it is desired to place the plug at any desired point above the gas forming material, the center rod 17 may be stopped at the desired point by the supporting wire 18 and the weight 14 will force the packing material 16 outwardly by the further movement of such weight in respect to the rod and the plate 13 carried thereby.

When it is desired to remove the plug, the operator may pull up on the wire 19, the first effect of this will be to lift the weight 14 and contract the upper flexible wall 15. When this wall is drawn inwardly to cylindrical form, further upward pulling action will be transmitted to the plate 13 as this will then be suspended by the wall 15. The upward movement of the plate 13 draws inwardly the flexible wall 15 and this is permitted due to the fact that the lower weight 22 will temporarily remain at rest. It will thus be apparent that both sealing surfaces are automatically released by the pull on the wire 19, and the plug may be removed. The sealing of the plug at any point along the pipe and the release of the plug is thus accomplished solely by the manipulation of the two suspending members 18 and 19.

The lower end of the plug and preferably the head 26 of the center rod is provided with means to facilitate or control the formation of gas from the solid carbon dioxide. Such means may be an electric heating coil 27

which may be connected to feed wires 28 projecting through the center rod, but sealed gas tight therein.

It will be noted that in the construction illustrated any gas which might leak between the lower weight 22 and the lower extension of the rod 17 cannot escape past the plug as the partition 13 is sealed gas tight to both the rod and the flexible wall.

In carrying out my invention, the desired gas pressure is produced below the plug without the need for any gas pipe leading downwardly through the pipe 10 to a point below the plug. Furthermore, by controlling the electric heater 27, the rapidity of gas formation and therefore the pressure, may be controlled at will.

In this connection, it is to be noted while a gas forming material or mixture of materials might conceivably be used in place of frozen carbon dioxide, the latter has certain peculiar advantages, some of which have been referred to above. It has the further advantage that it sublimates from solid to gaseous condition without any intermediate liquid state, at pressures up to 75 pounds per square inch. Consequently, during the initial building up of pressure, the source of the pressure, the solid carbon dioxide cannot escape from within the clogged strainer, except in gas form.

Various other means for plugging the well may be employed, as, for instance, filling the pipe with oil to a depth of one thousand feet or more would afford, say, 500 pounds pressure at the bottom of the well. In such case the frozen carbon dioxide would first melt to liquid and then when warmed up to near 30° F. would become a gas and further warming would cause further gaseous expansion and increase of pressure, provided, of course, the obstructions withstood the lower pressures. Such oil pressure could be used alone or could be superposed on a primary plug and it is obvious such plug could be similar to or different from that shown at B.

It will be obvious also that this method of generating pressures may be applied for removing obstructions from tubes or cavities other than oil wells, and even in an oil well the method may be applied for generating gaseous pressures for any purpose. For instance, where two or more wells are adjacent, gaseous pressure may be generated in one of them by my method and the resulting expansion through the bottom of the well into the surrounding strata may be utilized to force oil upward in the other well.

I claim:

1. An apparatus for clearing obstructions from the end of an oil pipe which includes a plug having a transverse wall, a weight provided with a conical end facing toward said wall, a flexible wall connected to the peripheries of said weight and said first

mentioned wall, a filler, and means for effecting relative movement of said weight and first mentioned wall to press said filler and force said peripheral wall outwardly into sealing engagement with the pipe.

2. A plug for sealing a pipe which includes a pair of coaxial relatively movable members, one having a conical surface projecting toward the other, a flexible wall connecting the peripheries of said members, and a filling material within said flexible wall and surrounding said surface.

3. A pipe sealing plug including a pair of relatively movable members, a central rod projecting from the lower member through the upper member, a flexible wall connecting the peripheries of said members, and independent flexible suspending means for the upper member and said rod.

4. A pipe sealing plug including a pair of weights having opposed conical portions, a flexible cylindrical wall connecting the peripheries of said members, a rod projecting through said members and having a head below the lower member, and separate suspending means for the upper member and for said rod.

Signed at New York in the county of New York, and State of New York this 22nd day of May, A. D. 1928.

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