March 10, 1953 A. H. BRANDON 2,630,632

TUBING CALIPER WITH RELEASABLE LATCH

Filed Aug. 2, 1948 2 SHEETS—SHEET 1

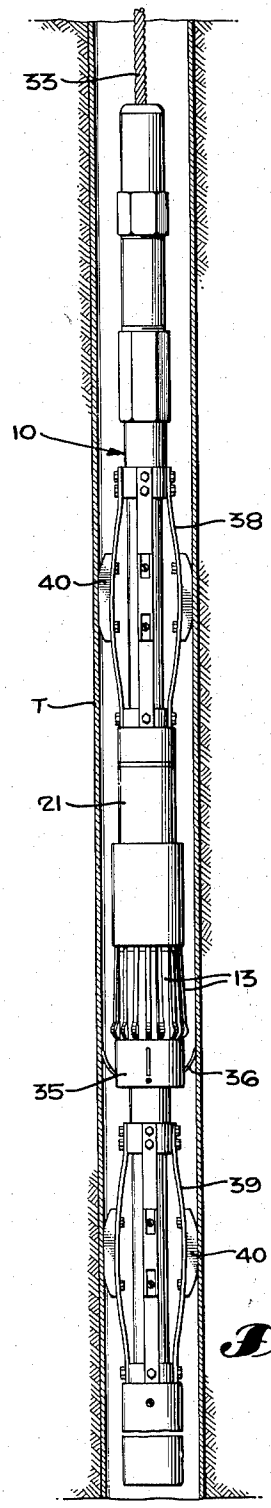


Fig. 1.

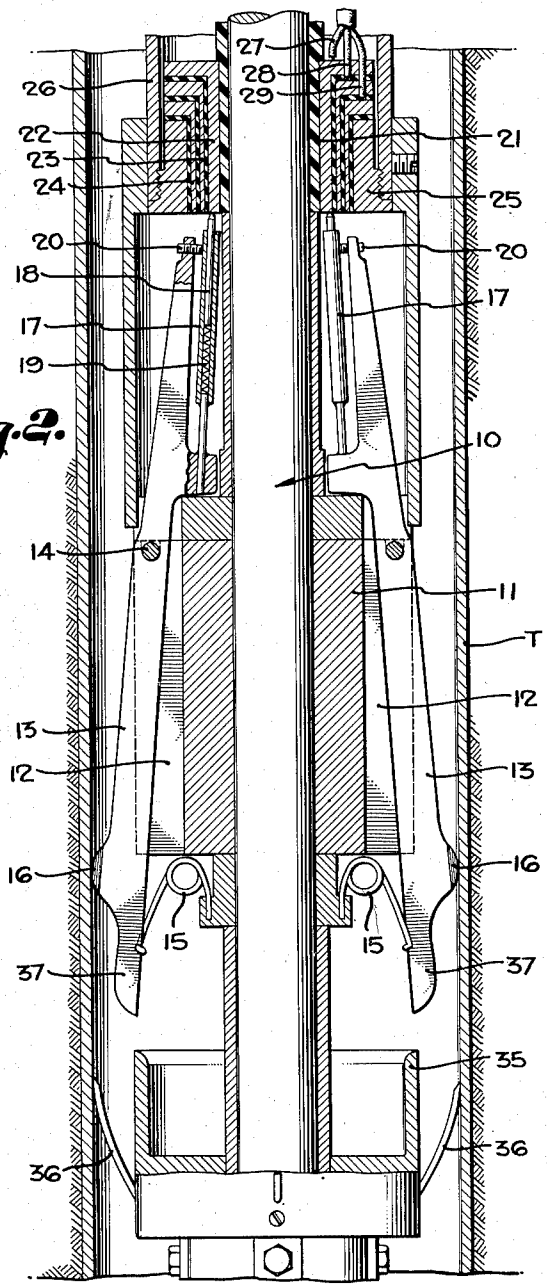


Fig. 2.

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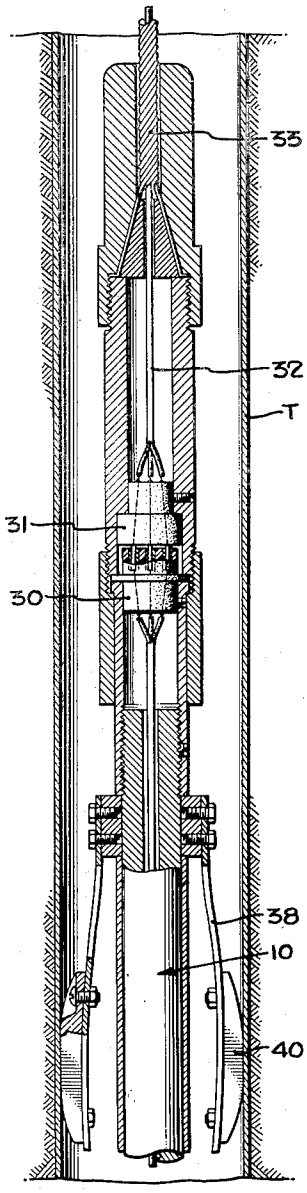


Fig. 3.

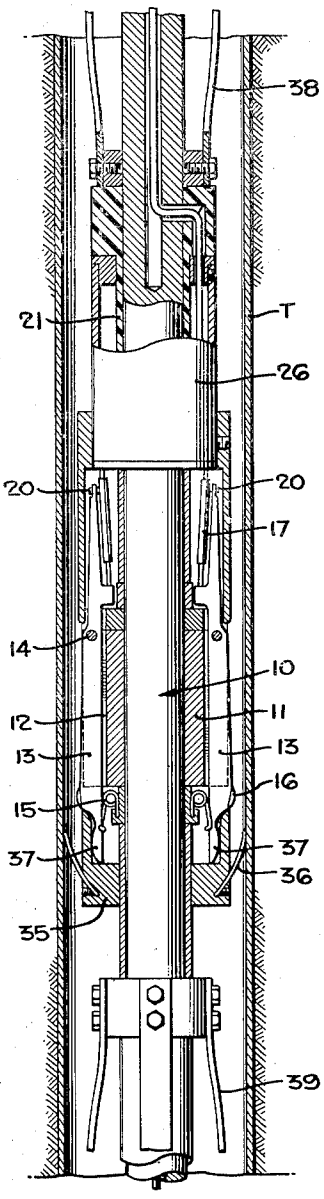


Fig. 4.

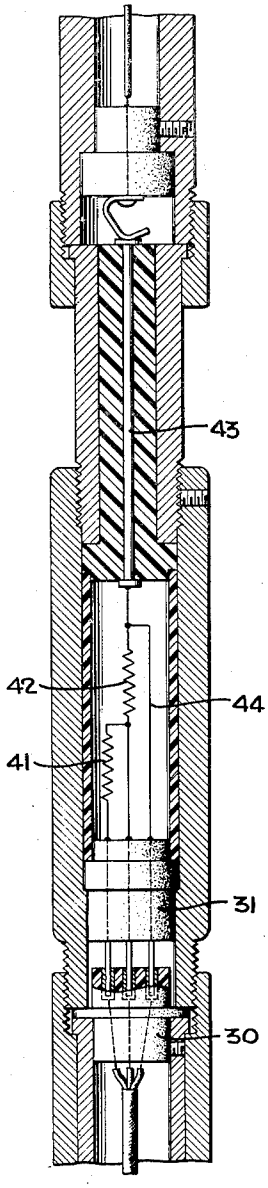


Fig. 5.

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TUBING CALIPER WITH RELEASABLE LATCH

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Application August 2, 1948, Serial No. 42,055

2 Claims. (Cl. 33—178)

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This invention relates to improvements in tubing testers used for testing tubing in wells or in racks after it has been withdrawn from the well, and for analogous purposes.

Heretofore testers of this general character have been devised consisting essentially of a body adapted to be introduced into the tubing to be tested and held centrally thereof by means of centering springs. On the body a plurality of fingers are mounted for radial swinging movement to engage the interior surface of the tubing. If the tubing has become worn or corroded so that its wall thickness has been weakened, the fingers are permitted thereby to expand. Such expansion of the fingers is indicated by contacts thereon engaging a contact on the body, completing an electric circuit, which operates an indicator.

It is desirable to indicate the extent to which the tubing has become worn or corroded for if the tubing is only slightly worn or corroded its use may be continued under less severe operating conditions. On the other hand, if the tubing has become badly worn or corroded, its use as tubing may be discontinued and it may be used for other purposes. Under the most extreme conditions where the tubing has become very badly worn or corroded, the tubing is usually junked.

Heretofore in tubing testers of this general character it has been customary to set the tubing tester to indicate one measurement of reduced wall thickness of the tube. Thus, if it is desired to determine what sections of the tubing have only been slightly worn or corroded the tool is set to make this indication. However, when the tubing tester traverses sections of the tubing that have become badly worn or corroded or of extremely reduced wall thickness the setting of the tool merely indicates that the tubing has been worn to some extent. Consequently when it is desired to distinguish between the three grades of wear or corrosion it has been necessary heretofore to make three separate and distinct runs with the tubing tester during each of which the tubing tester is given a different setting.

An object of the present invention is to provide an improved tubing tester of this character which is so designed that three different conditions of reduced wall thickness of the tubing can be indicated or recorded with but a single run of the tubing tester through the tubing. In accordance with the present invention the tubing tester has three contacts which are arranged concentrically with relation to the axis of the tubing tester and which are insulated from each other. In this manner, if the fingers are permitted to expand to only a slight degree only the first of these contacts will be engaged to make an appropriate indication or recording at the surface. On the other hand, if the wall thickness of the tubing is such as to allow the fingers to expand to a greater extent a second contact will be engaged to make such a recording and if the tubing is worn to such an extent that the fingers are allowed to expand to the extent that will indicate that the tubing should be junked the third contact will be engaged to make a different recording. While these contacts may be connected to the surface indicator or recorder by three conductors incorporated in the lowering or suspending cable, such three conductor cables are not only relatively expensive but are sometimes difficult to maintain in good operating condition.

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It is therefore another object of the invention to provide a tubing tester of this character wherein by the incorporation of suitable resistances the three contacts engaged by the fingers may be connected to the surface indicator or recorder by a single conductor in the lowering cable and make the desired record or indication that will indicate the extent of the wear on the tubing traversed by the tubing tester.

It is another object of the invention to provide a simple and advantageous means for holding the fingers that engage the tubing in contracted position until the tubing tester has been lowered to the bottom of the well and which will then release the fingers for engagement with the interior of the tubing. By thus holding the fingers out of engagement until the tester has reached the bottom of the tubing, wear on the fingers is greatly reduced and the life of the tool is materially prolonged.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention wherein:

Figure 1 is a sectional view through a tubing illustrating the tubing tester embodying the present invention as having been introduced therein and in a position wherein it is about to be lowered through the tubing;

Fig. 2 is a sectional view on an enlarged scale illustrating a portion of the tubing tester shown in Fig. 1 but illustrating the fingers as having been released for engagement with the interior of the tube;

Fig. 3 is a sectional view illustrating the tubing

tester as having been connected to a three-conductor lowering cable;

Fig. 4 is a sectional view illustrating the lower portion of the tubing tester illustrated in Fig. 3; and

Fig. 5 is a view of an alternative form of construction showing the tubing tester as constructed for connection to a cable having a single conductor.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, T indicates the tubing to be tested for internal wear or corrosion. The tubing tester embodying the present invention comprises a central rod generally indicated at 10 on which there is mounted a body 11. This body has a series of vertically extending radial grooves 12 formed on the exterior thereof each of which is designed to accommodate a radial finger 13 mounted for swinging movements in radial planes extending radially from the axis of the rod 10. To this end a ring 14 may serve to pivotally mount the fingers in their respective grooves 12 on the body 11. The lower ends of the fingers are urged outwardly by means of springs 15, and the engaging points 16, which are designed to engage the interior of the tubing T, are preferably hard-faced with a wear-resisting metal. The upper end of each finger carries a contact holder 17 within which there is a contact 18 that is urged upwardly by means of a compression spring 19. Adjustments of the contact holders with relation to their respective fingers is accomplished by means of an adjusting screw 20.

Above the contacts 18 on the fingers an insulating sleeve 21 is mounted on the rod 10 and around this sleeve there are positioned a series of flanged concentric contact sleeves indicated at 22, 23 and 24. These contact sleeves are insulated from each other and have their lower ends flush with each other and flush with an internal nut 25 which attaches the sleeves to an outer housing 26 so that the entire structure at the bottom of the housing presents a smooth flush surface capable of being readily traversed by the contacts 18. In the manufacture of these concentric sleeves which are insulated from each other I find it advantageous to apply insulating enamel to the sleeves in consecutive coats so as to build up the insulation between the sleeves until the sleeves with their applied insulation will just fit one within the other. Then, on applying a final coat of insulating enamel the sleeves are effectively cemented and bound together.

Each of the sleeves is electrically connected to its individual conductor, the conductors being indicated at 27, 28 and 29. These conductors, in turn, may be connected to a socket 30 adapted to receive a plug 31 which, in turn, is connected to three conductors generally indicated at 32 that are disposed within the lowering cable 33.

As a means for holding the fingers 13 in retracted positions while the tool is being lowered through the tubing a cup 35 is slidably mounted on the lower end of the rod 10 and has upwardly directed springs 36 mounted thereon. This cup, when in its uppermost position on the rod, is adapted to receive the extensions 37 on the lower ends of the fingers in a position somewhat as illustrated in Fig. 4. When the tool is lowered into the well the springs 36 merely rub against the interior of the tubing during the descent of the tool. However, when the tool is lifted by the cable 33 the springs 36 resist this upward movement holding the cup 35 stationary. Upward movement of the tool pulls the extensions 37 out of the cup allowing the fingers to be expanded under the effects of the springs 15. The ends of the springs 36 may become caught in the gap between adjacent tubing sections and when this occurs the spring steel prongs 36 are merely bent downwardly as their replacement cost is quite minor.

The tubing tester should, of course, be held centrally of the tubing T to be tested and to this end groups of centering springs 38 and 39 are mounted on the rod 10 above and below the fingers 13. These centering springs carry wear-resisting shoes 40 which engage the interior of the tubing. The centering springs merely serve to centralize the tool with relation to the tubing.

The operation of the above described construction is substantially as follows: The tubing tester is lowered into the tubing with the fingers in their contracted positions by virtue of the extensions 37 being confined within the cup 35. When the tool has reached the bottom of the string of tubing to be tested it is elevated by the cable 33 causing the extensions 37 to be withdrawn from the cup and allowing the fingers to expand into engagement with the tubing. If the tubing T is of normal wall thickness the contacts 18 will be held outwardly of the outermost sleeve 24. When a section of tubing of slightly reduced wall thickness is encountered this allows the engaging points 16 on the fingers to move outwardly a slight distance causing one or more contacts 18 on the fingers 13 to swing inwardly a sufficient distance to engage the sleeve 24. This closes an electric circuit which is connected through the conductor 29 and the corresponding conductor of the group 32 to a surface indicator or recorder. In a similar manner, if the tubing traversed by the tool is severely worn, one or more contacts 18 will engage the central sleeve 23 closing a circuit to indicate at the surface that the tubing is worn to a greater extent than that indicated when sleeve 24 was engaged. Similarly, if the tubing is very badly worn as is illustrated in Fig. 2, sleeve 22 will be engaged, closing the circuit to make an indication of this condition. Normally these indications are recorded on a pen recorder at the surface.

The use of a three-conductor line within the cable frequently proves quite expensive both as to initial cost and as to maintenance and to overcome this I have illustrated in Fig. 5 that the conductors from the three sleeves 22, 23 and 24 may be connected to a socket 30 adapted to receive a plug 31. The three conductors in this plug are, in turn, connected as illustrated in Fig. 5 wherein the outer sleeve 24 is connected through two resistances 41 and 42 to a single conductor 43. The central sleeve 23 is connected to the conductor 43 only through the resistance 42 and the innermost sleeve 22 is connected to the conductor 43 by means of a shunt 44. In this manner, when the outermost sleeve 24 is engaged by one or more contacts 18, the circuit will be closed but will be closed only through the maximum resistance provided by the sum of the resistances 41 and 42. Similarly, when the middle sleeve is contacted, the circuit is closed but only through the resistance 42. When the innermost sleeve is contacted as illustrated in Fig. 2, the circuit is closed through the shunt 44. In this manner the use of a single conductor cable whose conductor is electrically connected to the conductor 43 can be used in that when the outermost sleeve 24 is contacted the recorder will be actuated but only

to a slight extent, indicating relatively light wear on the tubing. If the tubing is more severely worn the pen recorder will be actuated to a great extent due to the smaller resistance at **42** and when the tubing has been most severely worn the recorder will be actuated to the greatest extent due to the shunting of the circuit at **44**. In this manner a single conductor cable may be employed and appropriate readings secured.

In both forms of constructions it will be appreciated that the tubing tester may be lowered into the tubing and with a single pass of the tester therethrough three different types of readings corresponding to the three different types of wear may be secured.

If the tester is apt to be used in wells wherein salt water may be encountered, a system such as that disclosed in my copending application entitled "Method of Testing Well Tubing" Serial No. 42,054, filed Aug. 2, 1948, now Patent No. 2,502,775, issued April 4, 1950, may be utilized in conjunction with the tester herein disclosed to counteract the short-circuiting effect of the salt water between the contacts.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. In a tubing tester, a body, a plurality of fingers mounted for swinging movement radially with respect to the body, contacts engageable by the fingers as the fingers swing outwardly with relation to the body, means slidable relatively to the body engageable with the fingers to hold the fingers in contracted positions, and means carried by said first named means engageable with the interior of the tubing for causing said first named means to slide relatively to the body to release the fingers and allow the fingers to expand.

2. A tubing tester comprising a body having an axis, a plurality of fingers pivotally mounted intermediate the ends thereof on the body for swinging movements radially with respect to said axis, means urging the lower ends of said fingers outwardly with respect to the body to engage the interior of a tubing, contact means engageable by the fingers adapted to be engaged by the upper ends of the fingers, an upwardly open cup slidably connected to the body adapted to receive the lower ends of the fingers to hold the lower ends in contracted position while the tubing tester is being lowered in a tubing, and upwardly directed springs on the cup engageable with the tubing for causing the cup to slide downwardly relatively to the body when the tubing tester is elevated with respect to the tubing to cause the cup to release the fingers to permit them to expand into engagement with the tubing.

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