Oct. 16, 1956 A. H. BRANDON 2,766,533

TUBING TESTER

Filed April 13, 1954 2 Sheets-Sheet 1

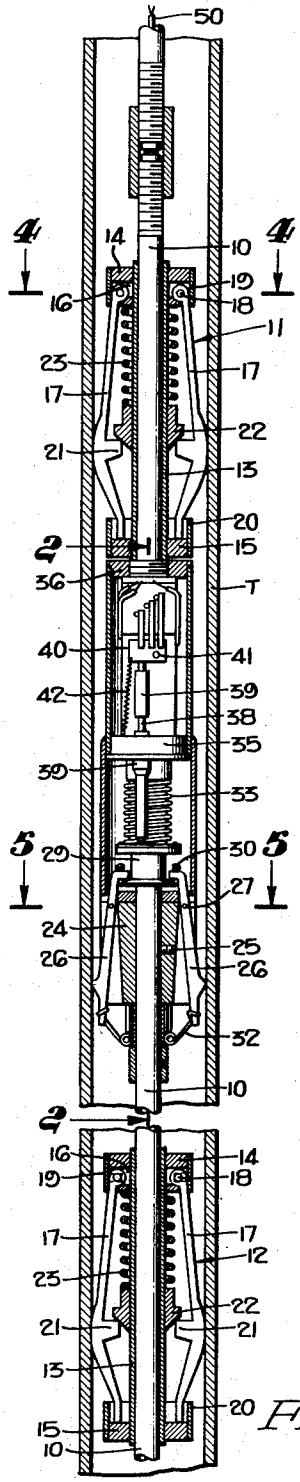


FIG. 1.

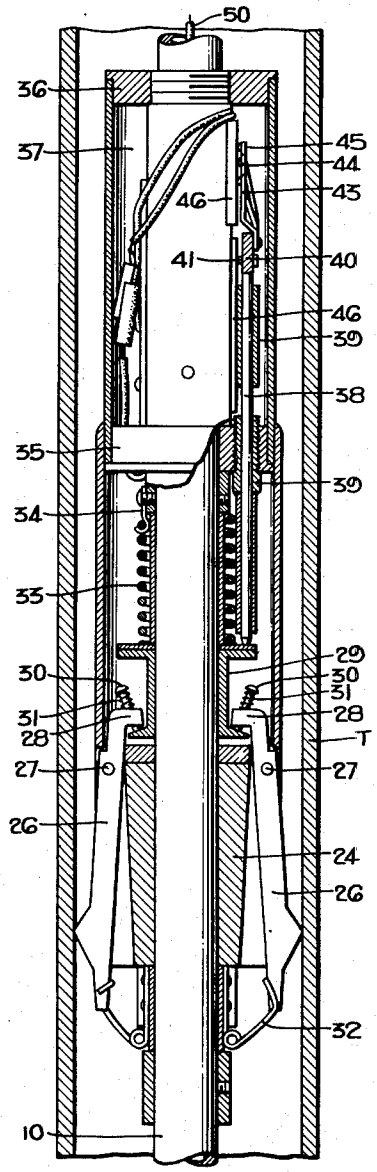


FIG. 2.

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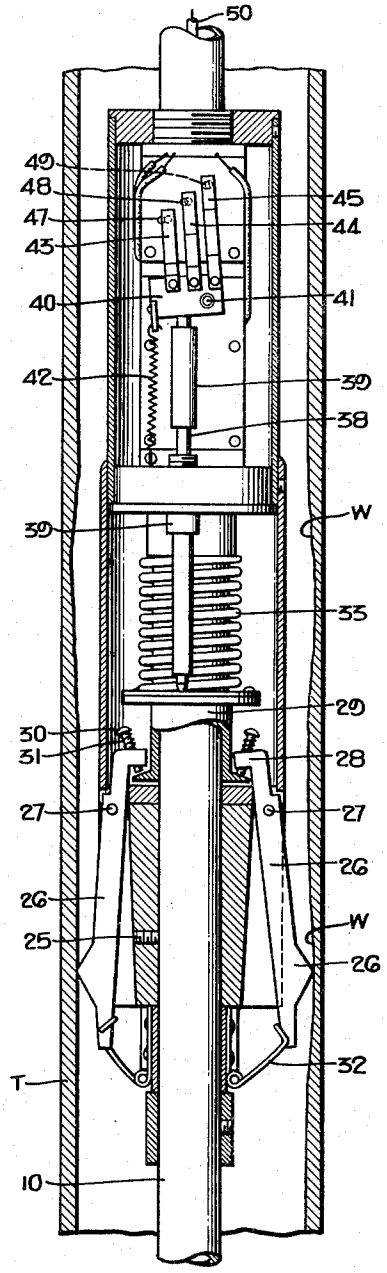


FIG. 3.

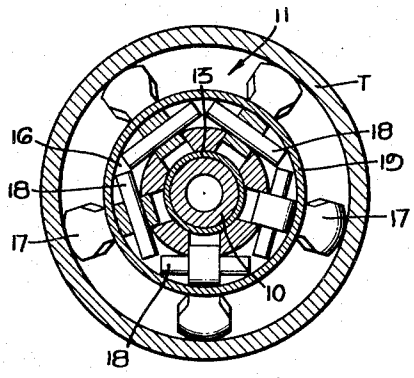


FIG. 4.

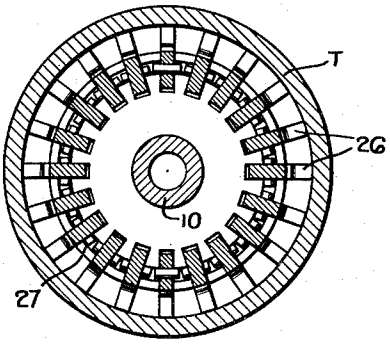


FIG. 5.

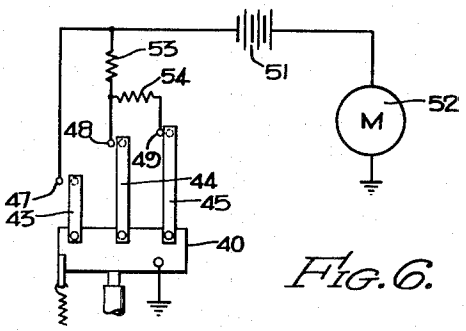


FIG. 6.

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2,766,533

TUBING TESTER

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Application April 13, 1954, Serial No. 422,770

3 Claims. (Cl. 33—178)

This invention relates to a tubing tester or tubing caliper.

A primary object of the invention is to provide a device which may be introduced into a pipe or tubing and which will indicate electrically at a remote point the degree to which a tubing may have become internally worn or the extent to which the wall thickness of the tubing has become reduced on the interior thereof.

Heretofore, devices of this general character have been provided which would indicate whether or not a tubing had been worn or had its wall thickness reduced on the interior thereof beyond a certain extent. If it was then desired to ascertain to what extent the tubing had been worn beyond this limitation a separate tool or the same tool which was differently adjusted to measure the next increment of wear was introduced into the tubing and readings again obtained. This involved making several consecutive runs of the same or different tools through the tubing in order to ascertain the extent to which the tubing had been worn or its wall thickness reduced.

Another object of the present invention is to provide an improved tool which will enable the degree to which the tubing has been worn to be ascertained in a single run of the tool.

More specifically, an object of the invention is to provide a tubing tester or tubing caliper wherein there are a plurality of radially expansible fingers engageable with the interior of the tubing and which are urged outwardly, and to provide a novel means for indicating whether one or more of these fingers have been allowed to move outwardly by the worn tubing and the extent to which it has moved.

With the foregoing and other objects in view, which will be 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 view in vertical section of the improved tubing tester illustrating the same within a tubing that is to be tested;

Fig. 2 is a vertical section taken substantially upon the line 2—2 upon Fig. 1 in the direction indicated;

Fig. 3 is a view similar to Fig. 2, but illustrating the tool in the position assumed thereby when a worn section of tubing is encountered by the tool;

Fig. 4 is a horizontal section taken substantially upon the line 4—4 upon Fig. 1 in the direction indicated;

Fig. 5 is a horizontal section taken substantially upon the line 5—5 upon Fig. 1 in the direction indicated; and

Fig. 6 is a wiring diagram.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the improved tool consists of a hollow central mandrel 10 near the top and bottom of which there are centering devices, generally indicated at 11 and 12 which hold the mandrel centrally of the tubing T that is to be

tested. Each of these centering devices consists of a sleeve 13 telescopically arranged over the mandrel and having secured thereto upper and lower collars 14 and 15. The upper collar is peripherally grooved as indicated at 16 and the radially expansible arms or fingers 17 which surround the sleeve have their upper ends pivotally mounted within the groove by means of pivot pins 18, see Fig. 4. A skirt 19 on the upper collar retains these pivot pins in the groove so that the arms or fingers 17 are pivotally mounted on the upper collar. The lower ends of these arms are radially movable above the lower collar 15 between the sleeve 13 and an upwardly extending skirt 20. On the inner sides of the arms 17 there are bosses 21 which are engageable with a conical cam 22 that is urged downwardly by a compression spring 23. The conical cam 22 thus is caused to bear on all of the bosses 21 with substantially equal effort so that all of the arms 17 will be urged outwardly with substantially the same force, causing the mandrel 10 to be held substantially centrally of the tubing T.

Between the upper and lower centering devices 11 and 12 there is a collar 24 that is retained on the mandrel by means of a set screw 25. This collar has a plurality of radial slots formed on the exterior thereof, each one of which receives a radially swingable finger 26. These fingers are pivotally mounted upon the collar by means of pivot pins 27 and have their upper ends bent inwardly as at 28 so as to overlie the lower flange on an axially slidable collar 29. The lower flange on the collar slopes downwardly and outwardly. Set screws 30 are mounted on these inwardly bent portions and engage the lower flange of the collar 29. These set screws are held in adjusted positions by means of compression springs 31 disposed thereabouts. The fingers 26 are independently urged outwardly by means of torsion springs 32 that are mounted on the lower end of the collar 24 so that each finger is independently urged outwardly into engagement with the tubing T. The collar 29 is urged upwardly relatively to the mandrel by means of a tension spring 33, the lower end of which is secured to the collar 29 and the upper end of which is secured to a spring retainer 34 on a collar 35 that is mounted on the mandrel 10. This collar, together with an upper collar 36, defines a chamber 37 about the mandrel into which slidably extends a push rod 38 that is slidable within bearings 39 and which is engageable at its lower end with the upper flange of the collar 29. The upper end of the push rod is engageable with a contactor 40 that is pivotally mounted on the side of the mandrel as at 41 and which is urged downwardly into engagement with the push rod by a tension spring 42. On the contactor there are three contacts 43, 44, and 45 although the number of contacts may be increased or decreased.

On a block of insulating material 46 which is mounted on the side of the mandrel there are three stationary contacts 47, 48, and 49. These contacts are arranged to be sequentially engaged by the contacts 45, 44, and 43, whenever the collar 29 is caused to descend relatively to the mandrel 10 by the expansion of one of the fingers 26. That is, whenever one or more of the fingers 26 expands into a worn location in the tubing T as illustrated in Fig. 3, its set screw 30 will engage the bottom flange of the collar 29 depressing the collar 29 and allowing the tension spring to swing the contactor 40 and to depress the push rod 38. When the contactor 40 swings about its pivot 41, contact 45 will first engage contact 49 and as the swinging movement continues contact 44 will then engage contact 48. Ultimately, if the swinging of the contactor 40 is great enough the contact 43 will ultimately engage the contact 47. The contacts 47, 48, and 49 are all in circuit with the conductor of a lowering

cable 50 and with a source of electric current indicated at 51.

In the circuit there is a recording meter 52 such as a brush recorder. In series with the contact 47 there may be little or no resistance but in series with the contact 48 there is a resistor 53. A resistor 54 is connected between contact 49 and the conductor connecting contact 48 and the resistor 53. Consequently, if contact 45 merely engages contact 49 with contacts 44 or 43 engaging their contacts 48 or 47, the amount of current flowing through the recording meter 52 is governed by the combined resistances 53 and 54. However, if contact 44 also engages contact 48, one path of the circuit is required to pass merely through the resistor 53. This enables a greater amount of current to pass through the circuit. If contact 47 is engaged by contact 43 a direct shunt is placed in the circuit, permitting a maximum amount of current to pass through the circuit. These various amounts of current are recorded on a paper strip or ribbon in the recording meter 52.

The operation of the device is substantially as follows:

The tool may be lowered into the tubing T while the tubing is still in a well, and when the tubing tester is drawn past a worn spot W in the tubing, one or more of the fingers 26 will be urged outwardly by their springs 32. When these fingers move outwardly they cause their set screws 30 to depress the collar 29 overcoming the tension of tension spring 33. This enables the tension spring 42 to swing the contactor 40 by an amount commensurate with the depth of the worn spot W. If the worn spot W is relatively shallow the finger 26 will not swing outwardly to any great extent. Consequently the collar 29 will be depressed only to a minor extent. This allows the push rod 38 to descend only so far as to permit the contactor 40 to swing its contact 45 into engagement with the contact 49 and due to the fact that the circuit will then include both resistances 54 and 53, the pen on the recording meter will swing or be actuated only a minimum amount. If the worn spot W is deeper, contact 44 may engage contact 48 and due to the fact that there is only resistance 53 in circuit with this contact the pen on the recording meter 52 will be actuated to a greater extent. It is only when the worn spot W is extremely deep or the fingers 26 are allowed to expand into a tubing collar that the contact 43 engages contact 47 and the pen on the recording meter is actuated to the maximum extent.

In conformity with general practice, the paper or tape is fed through the recording meter 52 in a manner commensurate with the rate at which the conductor cable 50 is either paid out or reeled in. As the fingers 26 will expand into each tubing collar as the tubing tester progresses through the tubing there will be one maximum indication made on the tape by the recording meter 52 for each tubing colar. These maximum indications on the tape can be co-related to the tubing collars on the tubing so that a section of the tubing which has become so severely worn that it should be replaced can be readily identified when the tubing is withdrawn from the well.

It will be observed from an inspection of Fig. 5 that there are spaces between adjacent fingers 26. These spaces may be as wide or wider than the thickness of the fingers. In order that a survey may be made as to all worn spots in the tubing, the tubing tester as depicted in Fig. 1 may be duplicated. That is, a second set of fingers 26, a second collar 29, a second contactor 40 and its associated contacts 47, 48, and 49 may be interposed between the above-mentioned apparatus shown and the lower centralizer 12. This second tubing tester may be oriented from the tubing tester shown so that its fingers 26 will traverse those portions of the tubing wall that are between the fingers 26 illustrated. In this way, all worn spots in the tubing can be detected. The contacts 47, 48, and 49 of the lower tester may also be connected to the same conductor cable 50.

From the above-described construction it will be appreciated that an improved tubing tester is provided which will enable the degree of wear in the tubing to be detected at the surface. Although the actual outward movement of the fingers 26 may be relatively small and the movement of the collar 29 may be relatively small, the arrangement is such as to multiply this movement in the swing of the contactor 40. The contacts 47, 48, and 49 may be adequately insulated from each other, and in addition thereto the chamber 37 may be filled with oil to maintain the insulation and to equalize pressures inside and out of the tool. Such equalization may take place through suitable apertures formed in the mandrel and as the movement of the push rod 38 into and out of the chamber is relatively small there is little danger of ingress of mud or egress of oil taking place.

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. A tubing tester or the like comprising a plurality of fingers, holding means for holding the fingers centrally of a tubing to be tested and pivotally mounting the fingers for independent outward swinging movement, spring means urging each finger outwardly independently of the others, a collar movable axially relative to said fingers on said holding means, an adjustable means on each finger engageable with the collar whereby when any finger is permitted to move outwardly the collar would be moved axially, a contactor pivoted upon said holding means having a plurality of contacts, contacts on the holding means adapted to be progressively engaged by the contacts on the contactor as the contactor swings, and means connecting the contactor to the collar whereby when any finger is allowed to swing outwardly, the contactor will be caused to swing a commensurate amount.

2. A tubing tester or the like comprising a plurality of fingers radially arranged, holding means pivotally mounting the fingers for radially swinging movement and holding them centrally of a tubing to be tested, spring means independently urging each of the fingers to swing outwardly, a collar axially movable upon the holding means presenting an outwardly extending sloping flange, adjustable means on each of the fingers engageable with the flange on the collar so as to cause axial movement of the collar when any finger is allowed to swing outwardly, spring means urging the collar axially into engagement with the adjustable means on the fingers, a contactor pivotally mounted upon the holding means carrying a plurality of contacts, a plurality of stationary contacts on the holding means arranged to be progressively engaged by the contacts on the contactor when the contactor swings, and means connecting the collar to the contactor to swing the contactor when any finger is allowed to swing outwardly.

3. A tubing tester or the like comprising a plurality of fingers radially arranged, holding means pivotally mounting the fingers for radial swinging movement and holding them centrally of a tubing to be tested, spring means independently urging each of the fingers to swing outwardly, a collar axially movable on the holding means presenting an outwardly extending sloping flange, the fingers having their upper ends extending inwardly over the sloping flange, adjustable means on each of the fingers engageable with the flange on the collar, spring means urging the collar axially into engagement with said adjustable means on the fingers so that when any finger is allowed to swing outwardly the collar will be moved axially in opposition to said spring means, a contactor pivotally mounted upon the holding means carrying a plurality of contacts, a push rod between the collar and the contactor so that movements of the collar may be transmitted thereby to cause swinging movement

of the contactor, spring means urging the contactor into engagement with the push rod, and a plurality of stationary contacts on the holding means arranged to be progressively engaged by the contacts on the contactor when the contactor swings in response to outward swinging movement of any finger.

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