March 26, 1957 D. L. LUSK 2,786,276

TUBE CALIPER

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FIG-1

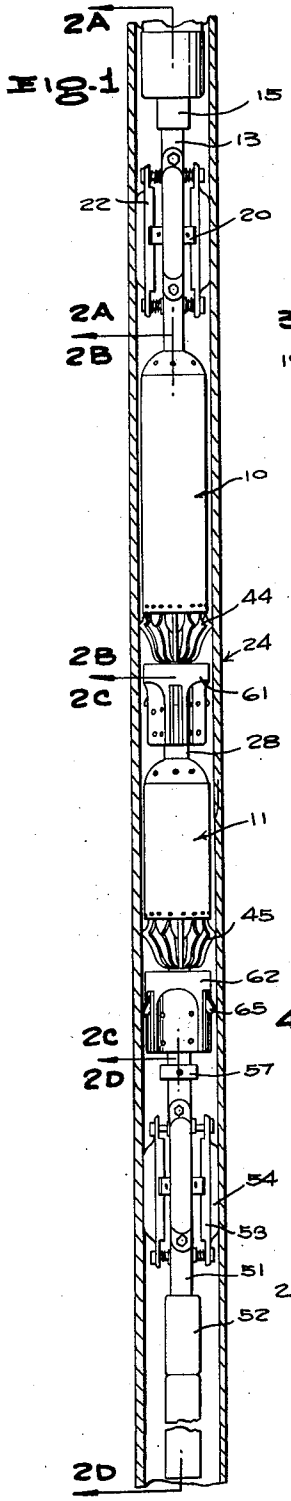


FIG-2A

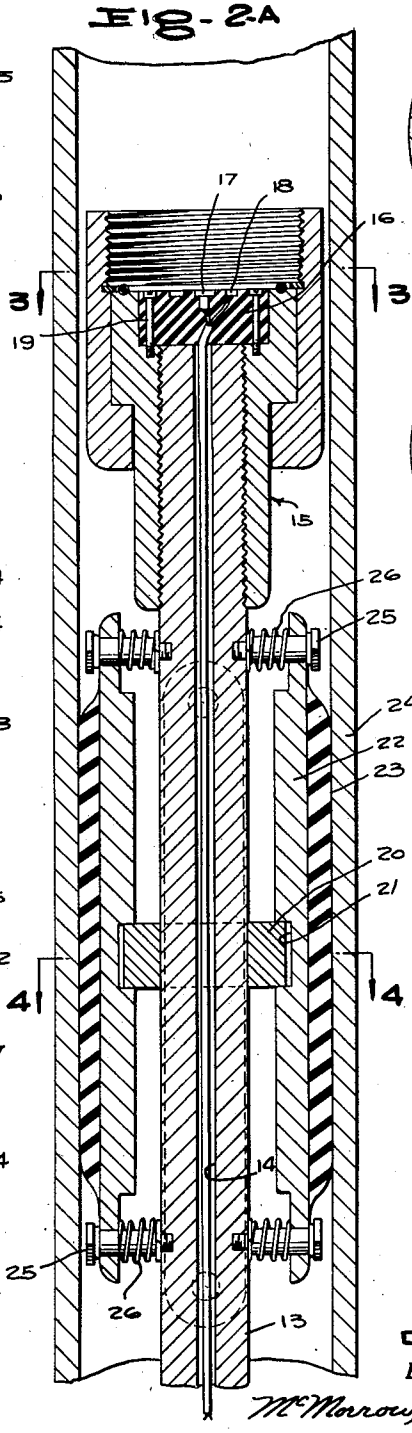
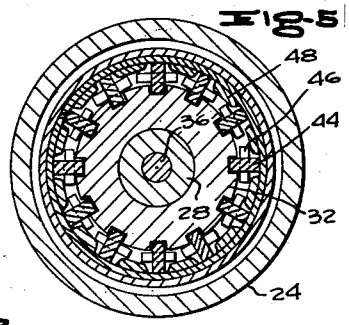


FIG-5



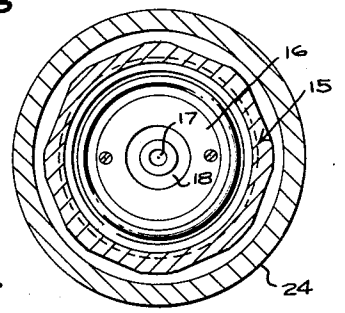
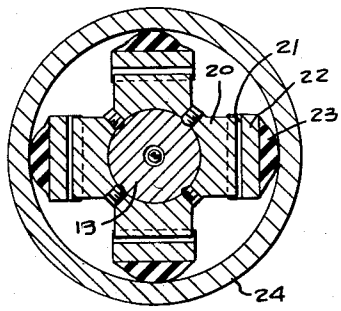


FIG-3

FIG-4



INVENTOR.
DEWEY L. LUSK
BY
McMorrow, Berman + Davidson
ATTORNEYS

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Fig. 2B

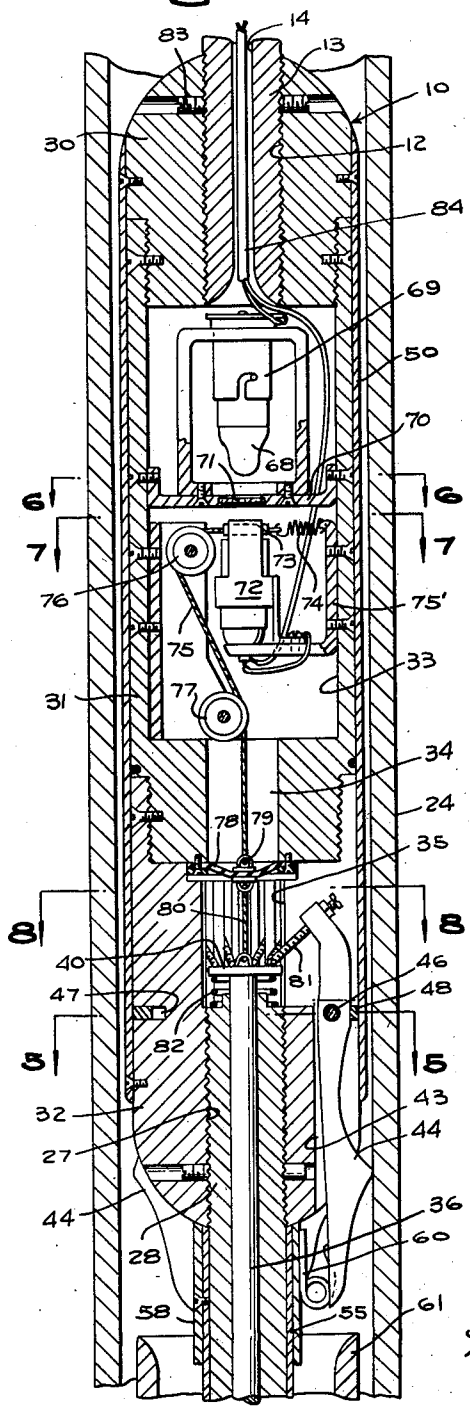
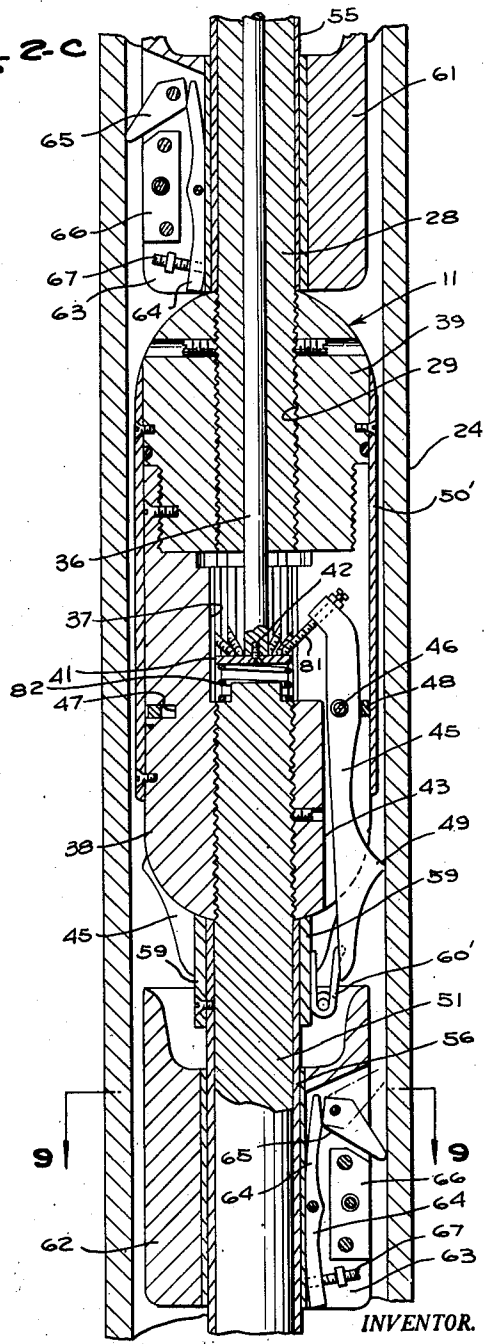


Fig. 2C



INVENTOR.

DEWEY L. LUSK

BY

McMorrow, Berman + Davidson

ATTORNEYS

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TUBE CALIPER

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Fig. 2D

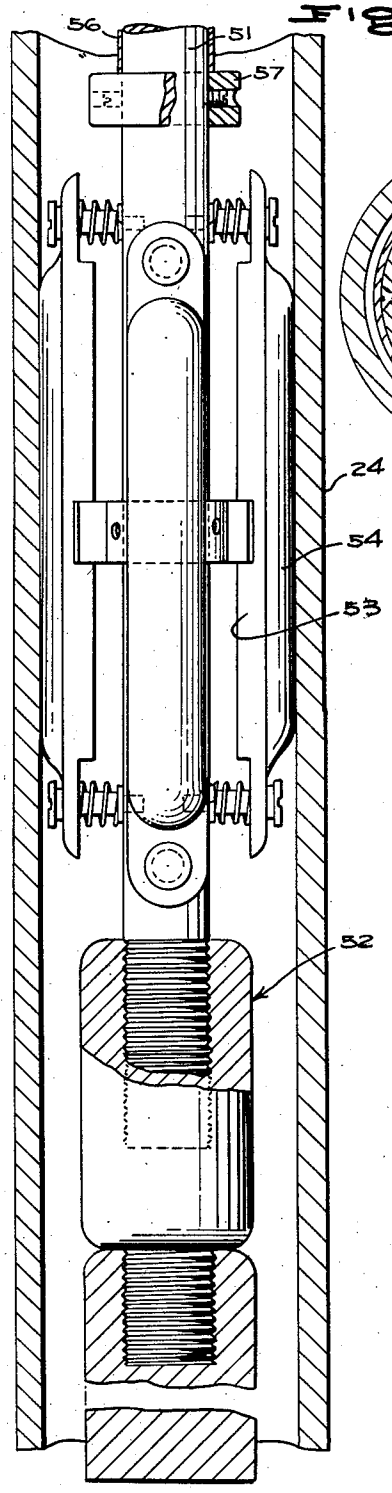


Fig. 6

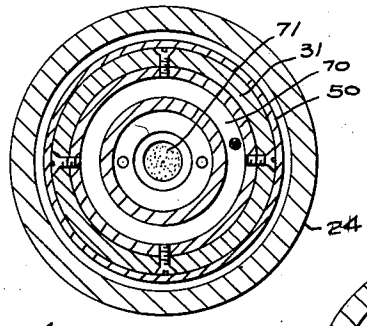


Fig. 7

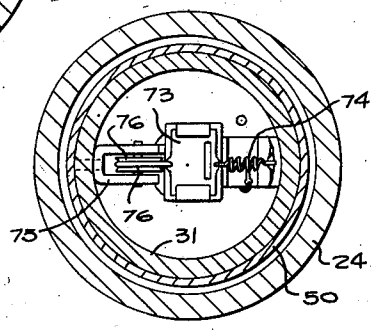


Fig. 8

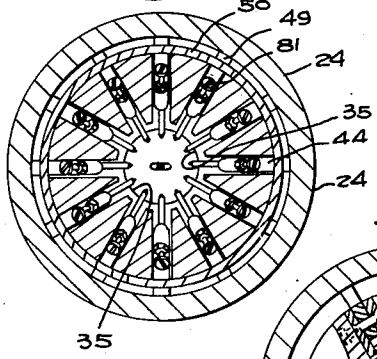
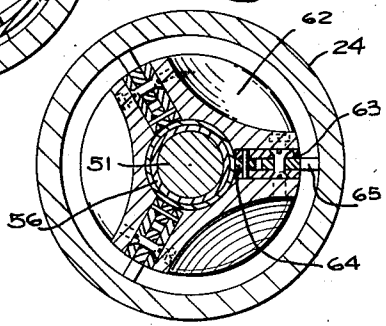


Fig. 9



INVENTOR.

DEWEY L. LUSK

BY

McMorrow, Berman + Davidson

ATTORNEYS

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2,786,276

TUBE CALIPER

Dewey L. Lusk, Caruthersville, Mo.

Application December 16, 1955, Serial No. 553,550

5 Claims. (Cl. 33—178)

The present invention relates to a caliper for measuring the internal diameter of a tube, such as a well casing, for determining the thickness of the tube as a means of detecting portions of the tube which may be worn thin or corroded.

An object of the present invention is to provide a tube caliper which has means for generating a signal varying in proportion to the tube wall thickness.

Another object of the present invention is to provide a tube caliper which has means for engaging the inner surface of the tube at two levels simultaneously, with the engaging means on one level intermediate the engaging means on the other level so that the entire inner surface of the tube is engaged.

A further object of the present invention is to provide a tube caliper which is sturdy in construction, one simple in structure and of few parts, and one in which the means for generating a signal as an indication of the tube thickness is accurate and efficient and easily adjusted for tubes of varying wall thicknesses.

These and other objects and advantages of the present invention will be fully apparent from the following description when taken in connection with the annexed drawings, in which:

Figure 1 is a sectional view of the tube caliper of the present invention installed within a tube to be calipered,

Figure 2A is a sectional view, on an enlarged scale, taken on the line 2A—2A of Figure 1,

Figure 2B is a sectional view, on an enlarged scale, taken on the line 2B—2B of Figure 1,

Figure 2C is a sectional view, on an enlarged scale, taken on the line 2C—2C of Figure 1,

Figure 2D is a sectional view, on an enlarged scale, taken on the line 2D—2D of Figure 1,

Figure 3 is a sectional view taken on the line 3—3 of Figure 2A,

Figure 4 is a sectional view taken on the line 4—4 of Figure 2A,

Figure 5 is a sectional view taken on the line 5—5 of Figure 2B,

Figure 6 is a sectional view taken on the line 6—6 of Figure 2B,

Figure 7 is a sectional view taken on the line 7—7 of Figure 2B,

Figure 8 is a sectional view taken on the line 8—8 of Figure 2B, and

Figure 9 is a sectional view taken on the line 9—9 of Figure 2C.

Referring in greater detail to the drawings in which like numerals indicate like parts throughout the several views, the tube caliper of the present invention comprises a pair of support members 10 and 11 arranged in axially spaced relation as seen in Figure 1. The upper one of the support members, support member 10, has an axially-arranged threaded bore 12 in its upper end (Figure 2B) into which is threaded the lower end of a round stem 13 having a hole 14 extending therethrough. The stem 13,

Figure 2A, has a coupling 15 on its upper end for attachment to a lifting device, such as a well drill rod or another coupling on the end of a cable, neither of which is shown. The coupling 15 contains an insulating box 16 having circular contacts 17 and 18, as seen in Figures 2A and 3. Screws 19 secure the box 16 in the coupling 15.

Intermediate the ends of the stem 13 is fixedly secured a collar 20 having four projecting portions the ends of which each engage a slot 21 in the under face of a guide block 22 for positioning the latter relative to the stem 13. Resilient shoes 23 on the outer faces of each of the guide blocks 22 slidingly engage the inner surface of a tube 24 when the tube caliper of the present invention is inserted within the tube 24 for the purpose of calibrating the thickness of the tube 24. The guide blocks 22 are further supported on the stem 13 by means of a bolt 25 at each end threaded into a tapped hole in the stem 13. A spring 26 surrounding each bolt 25 between the stem 13 and the guide block 22 biases the latter outwardly to the position in which the shoes 23 lightly engage the inner surface of the tube 24 and thereby position the stem 13 coaxially of the tube 24.

The lower end of the support member 10 is also provided with a threaded bore 27, arranged axially thereof, into which is threadedly secured a hollow auxiliary stem 28. The auxiliary stem 28 has its upper end secured in the support member 10 and has its lower end threadedly secured in a threaded bore 29 in the upper end of the support member 11, as seen in Figures 2B and 2C. The support member 10 consists in three parts, an upper part 30, an intermediate part 31 which is threaded on the lower end of the upper part 30, and a lower part 32 which is threaded on the lower end of the intermediate part 31. The intermediate part 31 of the support member 10 is provided with a bore 33 extending inwardly from its upper end and providing an instrument chamber. A well 34 in the lower end of the intermediate part 31 connects the bore 33 constituting an instrument chamber with a well 35 formed in the upper end of the lower part 32. The upper end of the auxiliary stem 28 extends into the well 35 provided in the lower part 32 of the support member 10. A rod 36 is slidably movable in the lower end of the support member 10 and in the upper end of the support member 11. The rod 36 is positioned so that it extends through the hollow auxiliary stem 28 and has its upper end in the well 35 and has its lower end in a well 37 provided in the lower part 38 of the support member 11. The lower part 38 and the upper part 39 of the support member 11 are similar to the lower part 32 and the upper part 30 of the support member 10.

A circular plate 40, embodying a flat contact surface, is secured to the upper end of the rod 36 and a second circular plate 41, also constituting a flat contact surface is secured, as by means of a screw 42, to the lower end of the rod 36. The lower parts 32 and 38 of the support members 10 and 11, respectively, are each provided with radially-arranged slots 43 arranged in spaced relation about the respective support member and extending upwardly from the lower ends thereof and having their upper ends connected in communication with the wells 35 and 37, respectively.

A first group of vertically-disposed fingers are arranged one within each slot 43 in the lower part 32 of the support member 10 and a second group of vertically-disposed fingers are arranged one within each slot 43 in the lower part 38 of the support member 11. The fingers associated with the support member 10 are designated by the reference numeral 44 and the fingers associated with the support member 11 are designated by the reference numeral 45. The fingers 45 of the second group are so arranged that a finger thereof is intermediate adjacent fingers 44 of the first group. Each finger 44 and 45

is connected intermediate its ends to the respective one of the support members 10 or 11 for rocking movement about a horizontal axis, the connecting means including a transversely-disposed pivot pin 46 secured intermediate its ends to each finger 44 and 45. The pins 46 are supported in an annular groove 47 formed in the outer surface of each of the lower support member parts 32 and 38, a split washer 48 being seated in the groove 47 and bearing against the outer face of each finger 44 and 45 adjacent the pin 46.

Each finger 44 and 45 is provided with a knuckle 49, preferably fabricated of carbide steel or other wear-resistant metal, intermediate its connection axis, the pivot pin 46, and the lower end thereof and is normally adapted to engage the inner surface of the tube 24 when the tube caliper of the present invention is suspended within the tube 24. Each finger 44 and 45 has its upper end in bearing engagement with the respective one of the circular plates 40 and 41.

A sleeve 50 extends over all but the lower ends of the slots 43 in the lower support member part 32 and another sleeve 50' extends over all but the lower ends of the slots 43 in the lower support member 38. Referring to Figures 2C and 2D, a second stem 51 has its upper end threaded into the lower part 38 of the support member 11 and has its lower end threadedly connected into a socket provided in one section of a series of sectional weights designated generally by the reference numeral 52. Guide blocks 53 and shoes 54, in an assembly identical with the guide blocks 22 and shoes 23 as previously described, are similarly secured to the stem 51 between the lower end of the support member 11 and the weights 52. An antifriction sleeve 55 surrounds the auxiliary stem 28 between the lower end of the support member 10 and the upper end of the support member 11. Another sleeve 56 surrounds the stem 51 between the lower end of the support member 11 and a collar 57 which is fixedly secured to the stem 51. A short sleeve 58 is secured around the upper end portion of the sleeve 55 and another short sleeve 59 is secured about the upper end portion of the sleeve 56.

Spring means is provided operatively connected to each of the fingers 44 of the first group of fingers and to the fingers 45 of the second group of fingers for biasing the knuckles 49 of the fingers 44 and 45 into the tube-engaging position. Specifically, this means consists in a short length of coil spring 60 having one end bearing against the sleeve 58 and having its other end bearing against the lower end of the finger 44. A similar short length of coil spring 60' is associated with each of the fingers 45 and has one leg bearing against the sleeve 59 and the other end bearing against the lower end of the finger 45.

Means is provided exteriorly of and adjacent the lower ends of each of the support members 10 and 11 and is engageable with the lower ends of the fingers 44 and 45 of the first and second groups of fingers for releasing the knuckles 49 from their tube-engaging positions. Specifically, this means consists in an upwardly open cup 61 slidably mounted on the sleeve 55 and another upwardly open cup 62 slidably mounted on the sleeve 56. The cups 61 and 62 are identical and will be described with reference to the cup 62.

Referring to Figures 2C and 9, the cup 62 will be seen to have three inwardly-directed slots 63 in each of which is pivotally supported a vertically-extending spring member 64 having its upper end bearing against the flat face on the rear end of a dog 65. The dog 65 is pivotally supported for swinging movement from the downwardly-sloping position shown in full lines in the lower portion of the Figure 2C to the dotted line position in the same figure. A stop 66 is positioned within each of the slot 63 limits the downwardly-swinging movement of the dog 65 and an adjusting screw 67 anchored intermediate its ends in the slot 63 has its inner end bearing against the lower end of the spring member 64 to vary the effective

pressure of the upper end of the latter against the flat faces of the dogs 65. The cups 61 and 62 are normally in positions in which the lower ends of the fingers 44 and 45 are received therein, compressing the springs 60 and 60', and drawing the knuckles 49 out of the tube-engaging position. With the cups 61 and 62 in this position, the tube caliper of the present invention may be lowered into a tube 24, the dog 65 swinging to the dotted line position and slidably engaging the inner surface of the tube 24. Upon upward movement of the tube caliper the projecting ends of the dogs 65 will engage in any depression in the inner surface of the tube 24 or will engage in the space between adjacent sections of the tube 24 within the coupling provided between sections. This engagement of the dog 65 with the tube 24 causes the cup 61 or 62 to move downwardly with respect to the associated one of the support members, freeing the lower ends of the fingers so that the knuckles 49 engage the tube 24 inner surface. Should it be necessary to again lower the tube caliper, the dogs 65, having been swung from their dotted line position to their full line position by their engagement with the tube 24 will again engage the same depression or the end of the section of the tube 24 within the coupling provided and will cause the cup 61 or 62 to move upwardly reengaging the fingers 44 or 45 and drawing the knuckles 49 inwardly.

Signal means is provided operatively connected to the upper end of the rod 36 and is actuable in response to the sliding movement of the rod 36 in the downward direction. Specifically, this signal means embodies a bulb 68 seated in a socket 69 fixedly secured in the chamber formed by the bore 33 in the intermediate part 31 of the support member 10. A ring 70 positioned below the bulb 68 supports a ground glass lens 71. A light sensitive signal means embodying a photoelectric cell is positioned below the lens 71 so that it is adjacent to and spaced from and in axial alignment with the bulb 68, the photoelectric cell being mounted in a housing designated by the reference numeral 72. A shutter 73 is interposed between the photo-electric cell and the bulb 68 and is supported in the intermediate part 31 of the support member 10 for back and forth movement. The spring 74 has one end mounted upon a bracket 75' which supports the housing 72 and has its other end connected to one end of the shutter 73. The other end of the shutter 73 is connected to one end of the flexible cable 75 which travels over a pulley 76 and another pulley 77 and enters the well 34. A flexible diaphragm 78 closes the lower end of the well 34 and is secured to the lower end of the intermediate part 31 of the support member 10. A double-eye formation in the center of the diaphragm 78 provides a connection for the cable 75 as designated by the reference numeral 79. Another section or cable 80 has its lower end fixedly secured to the plate 40 and its upper end secured to the double-eye formation 79 and completes the connection of the cable 75 with the plate 40.

All of the fingers 44 and 45 are provided on their upper ends with adjusting screws 81 by means of which the fingers are adjusted for tubes of different internal diameters within a short range of diameters. The sensitivity of the fingers is also made adjustable by the screws 81. Springs 82 interposed between the upper ends of the auxiliary stem 28 and the stem 51 and the adjacent ones of the plates 40 and 41 bias the plates 40 and 41 upwardly.

Set screws, one of them being shown in Figure 2B and designated by the numeral 83, secure the support members 10 and 11 to the stems 13 and 51 and to the auxiliary stem 28 in a conventional manner.

A cable 84 extends through the hole 14 in the stem 13 and contains wires which have their upper ends connected to the contacts 17 and 18. A mating coupling, not here illustrated, for the coupling 15 and having suitable brush contacts is provided on the end of the hoisting cable or drill rod and completes the circuit to the bulb 68 and

the signal means within the housing 72. A recorder such as a chart and electrically-driven pen may be used to record the signal impulses as an indication of the tube wall thickness.

In operation, the tube caliper of the present invention is attached to a drill rod or cable and is lowered into the sections of the tube or well casing. Upon reaching the bottom of the casing or tube, and upon upward movement of the tube caliper, the dogs 65 will engage the tube in any depression such as that between adjacent sections of the tube and will cause the cups 61 and 62 to release the lower ends of the fingers 44 and 45, respectively. Upon further upward movement of the tube caliper, the fingers will detect grooves or depressions due to corrosion or wear on the inner surface of the tube and by the movement of the knuckles outwardly the upper ends of the fingers will depress the associated plate and cause the rod 36 to move downwardly. The downward movement of the rod 36 moves the shutter across the face of the photoelectric cell. The shutter may be of the graduated-opacity type so as to produce a signal of varying intensity or amplitude. Should it be necessary to again lower the tube caliper before it has reached the ground surface, the dogs 65, having been reversed by the upward movement of the support members 10 and 11, will again engage a depression in the tube and will cause the cups 61 and 62 to move upwardly to again receive the lower ends of the fingers 44 and 45, respectively.

What is claimed is:

1. A tube caliper comprising a pair of support members arranged in axially spaced relation, a rod extending between said support members and slidably movable in the lower end of the upper one of said support members and in the upper end of the lower one of said support members and having the upper end within the upper one of said support members and the lower end within the lower one of said support members, a flat contact surface on each of the upper and lower ends of said rod, a first group of vertically-disposed fingers arranged in spaced relation about said upper one of said support members and each connected intermediate its ends to said upper one of said support members for rocking movement about a horizontal axis, each of said fingers of said first group being provided with a knuckle intermediate its connection axis and the lower end normally adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the upper end of said rod, a second group of vertically-disposed fingers arranged in spaced relation about said lower one of said support members and each connected intermediate its ends to said lower one of said support members for rocking movement about a horizontal axis, the fingers of said second group being arranged with respect to the fingers of said first group so that a finger of said second group is intermediate adjacent fingers of said first group, each of said fingers of said second group being provided with a knuckle intermediate its connection axis and the lower end adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the lower end of said rod, and signal means operatively connected to the upper end of said rod and actuable in response to the sliding movement of said rod in one direction.

2. A tube caliper comprising a pair of support members arranged in axially spaced relation, a rod slidably movable in the lower end of the upper one of said support members and in the upper end of the lower one of said support members and having the upper end within the upper one of said support members and the lower end within the lower one of said support members, a flat contact surface on each of the upper and lower ends of said rod, a first group of vertically-disposed fingers arranged in spaced relation about the said upper one of said support members and each connected intermediate its ends to the upper one of said support members for rocking movement about a horizontal axis, each of said fingers of said first group being provided with a knuckle intermediate its connection axis and the lower end normally adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the upper end of said rod, a second group of vertically-disposed fingers arranged in spaced relation about said lower one of said support members and each connected intermediate its ends to said lower one of said support members for rocking movement about a horizontal axis, the fingers of said second group being arranged with respect to the fingers of said first group so that a finger of said second group is intermediate adjacent fingers of said first group, each of said fingers of said second group being provided with a knuckle intermediate its connection axis and the lower end adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the lower end of said rod, signal means operatively connected to the upper end of said rod and actuable in response to the sliding movement of said rod in one direction, and spring means operatively connected to each of said fingers of said first and second groups for biasing the knuckles of said fingers into the tube-engaging positions.

3. A tube caliper comprising a pair of support members arranged in axially spaced relation, a rod extending between said support members and slidably movable in the lower end of the upper one of said support members and in the upper end of the lower one of said support members and having the upper end within the upper one of said support members and the lower end within the lower one of said support members, a flat contact surface on each of the upper and lower ends of said rod, a first group of vertically-disposed fingers arranged in spaced relation about said upper one of said support members and each connected intermediate its ends to said upper one of said support members for rocking movement about a horizontal axis, each of said fingers of said first group being provided with a knuckle intermediate its connection axis and the lower end normally adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the upper end of said rod, a second group of vertically-disposed fingers arranged in spaced relation about said lower one of said support members and each connected intermediate its ends to said lower one of said support members for rocking movement about a horizontal axis, the fingers of said second group being arranged with respect to the fingers of said first group so that a finger of said second group is intermediate adjacent fingers of said first group, each of said fingers of said second group being provided with a knuckle intermediate its connection axis and the lower end adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the lower end of said rod, signal means operatively connected to the upper end of said rod and actuable in response to the sliding movement of said rod in one direction, and means exteriorly of and adjacent the lower end of each of said support members and engageable with the lower ends of the fingers of said first and second groups for releasing the knuckles from their tube-engaging positions.

4. A tube caliper comprising a pair of support members arranged in axially spaced relation, a rod extending between said support members and slidably movable in the lower end of the upper one of said support members and in the upper end of the lower one of said support members and having the upper end within the upper one of said support members and the lower end within the lower one of said support members, a flat contact surface on each of the upper and lower ends of said rod, a first group of vertically-disposed fingers arranged in spaced relation about said upper one of said support

members and each connected intermediate its ends to said upper one of said support members for rocking movement about a horizontal axis, each of said fingers of said first group being provided with a knuckle intermediate its connection axis and the lower end normally adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the upper end of said rod, a second group of vertically-disposed fingers arranged in spaced relation about said lower one of said support members and each connected intermediate its ends to the said lower one of said support members for rocking movement about a horizontal axis, the fingers of said second group being arranged with respect to the fingers of said first group so that a finger of said second group is intermediate adjacent fingers of said first group, each of said fingers of said second group being provided with a knuckle intermediate its connection axis and the lower end adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the lower end of said rod, a light source means carried by said upper support member, a light sensitive signal means positioned adjacent to and in spaced axial alignment with respect to said light source means, a shutter interposed between said light source means and said signal means and supported on said upper support member for back and forth movement, and a flexible cable having one end connected to the upper end of said rod and having the other end connected to said shutter for effecting the movement of the latter in response to movement of said rod in one direction.

5. A tube caliper comprising a pair of support members arranged in axially spaced relation, a rod extending between said support members and slidably movable in the lower end of the upper one of said support members and in the upper end of the lower one of said support members and having the upper end within the upper one of said support members and the lower end within the lower one of said support members, a flat contact surface on each of the upper and lower ends of said rod, a first group of vertically-disposed fingers arranged in spaced relation

about said upper one of said support members and each connected intermediate its ends to said upper one of said support members for rocking movement about a horizontal axis, each of said fingers of said first group being provided with a knuckle intermediate its connection axis and the lower end normally adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the upper end of said rod, a second group of vertically-disposed fingers arranged in spaced relation about said lower one of said support members and each connected intermediate its ends to said lower one of said support members for rocking movement about a horizontal axis, the fingers of said second group being arranged with respect to the fingers of said first group so that a finger of said second group is intermediate adjacent fingers of said first group, each of said fingers of said second group being provided with a knuckle intermediate its connection axis and the lower end adapted to engage the inner surface of a tube and having the upper end in bearing engagement with the contact surface on the lower end of said rod, spring means operatively connected to each of said fingers of said first and second groups for biasing the knuckles of said fingers into the tube-engaging positions, means exteriorly of and adjacent the lower end of each of said support members and engageable with the lower ends of the fingers of said first and second groups for releasing the knuckles from their tube-engaging positions, a light source means carried by said upper support member, a light sensitive signal means positioned adjacent to and in spaced axial alignment with respect to said light source means, a shutter interposed between said light source means and said signal means and supported on said upper support member for back and forth movement, and a flexible cable having one end connected to the upper end of said rod and having the other end connected to said shutter for effecting the movement of the latter in response to movement of said rod in one direction.

No references cited.