Sept. 29, 1953 J. J. SANTIAGO 2,653,474

APPARATUS FOR DETERMINING WELL PIPE PERFORATIONS

Original Filed July 1, 1946

2 Sheets-Sheet 1

Fig. 1.

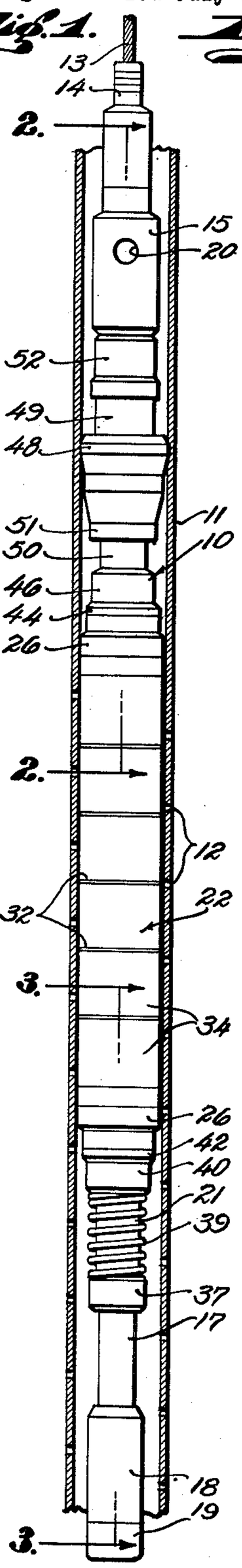


Fig. 2.

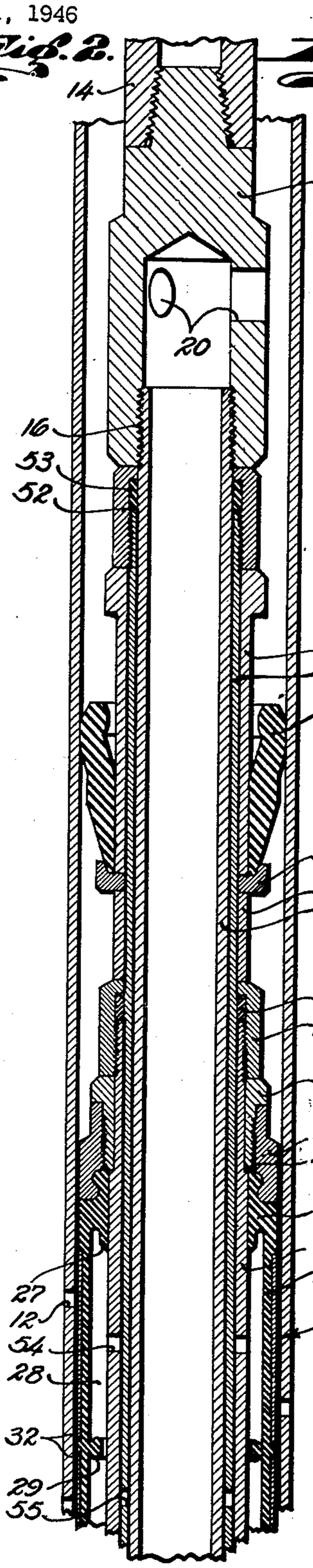
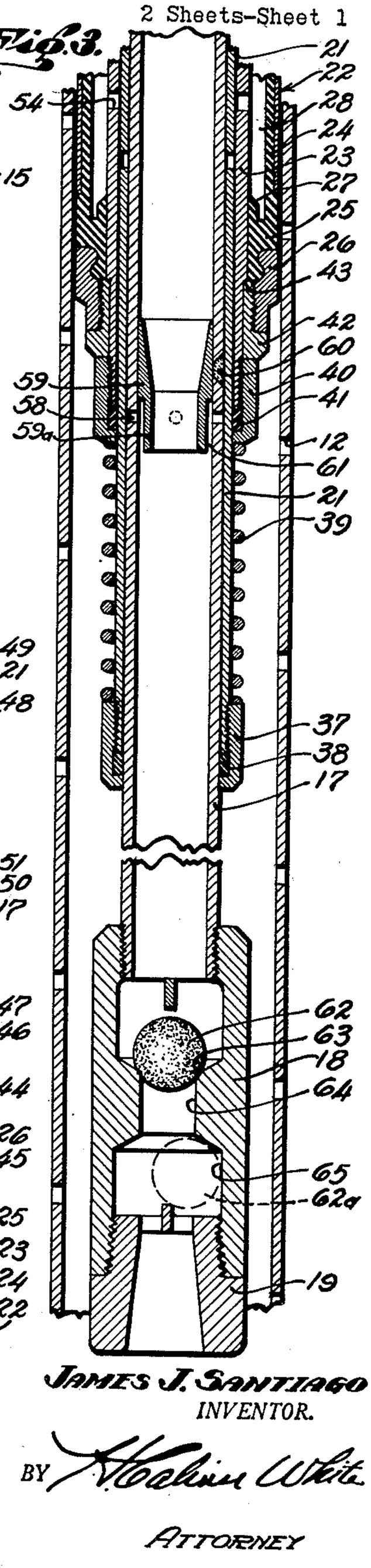


Fig. 3.



JAMES J. SANTIAGO
INVENTOR.

BY Hoskins White

ATTORNEY

Sept. 29, 1953 J. J. SANTIAGO 2,653,474

APPARATUS FOR DETERMINING WELL PIPE PERFORATIONS

Original Filed July 1, 1946 2 Sheets-Sheet 2

Fig. 4.

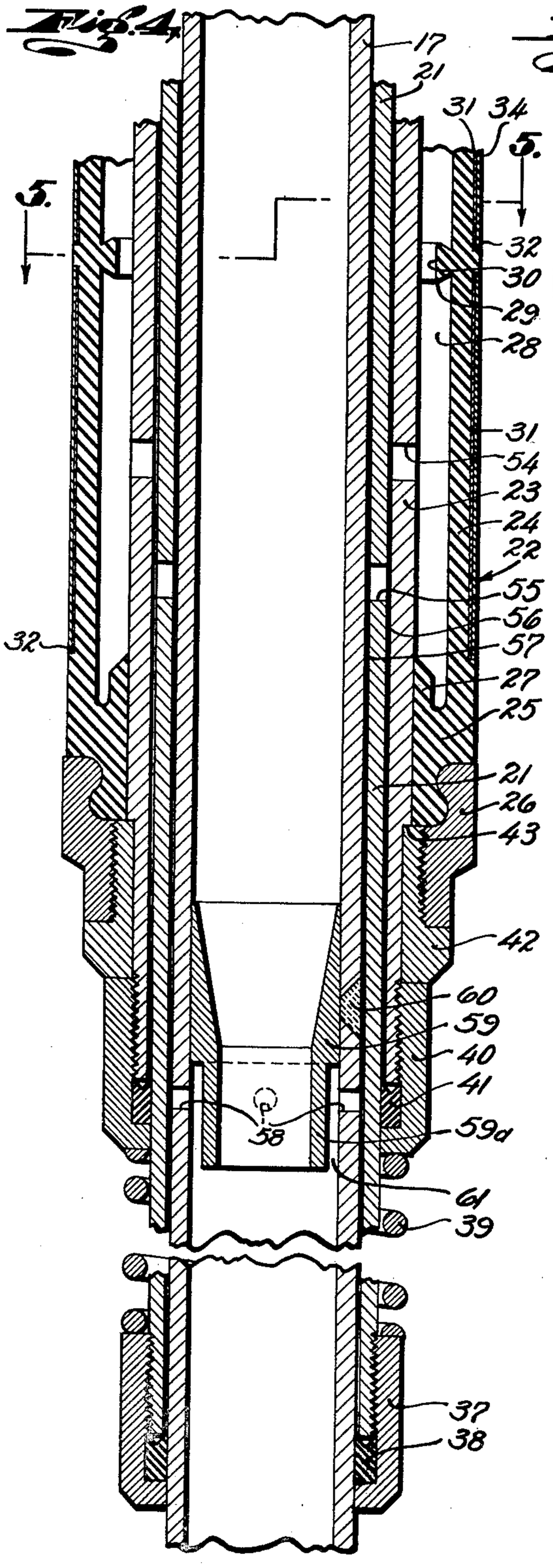


Fig. 5.

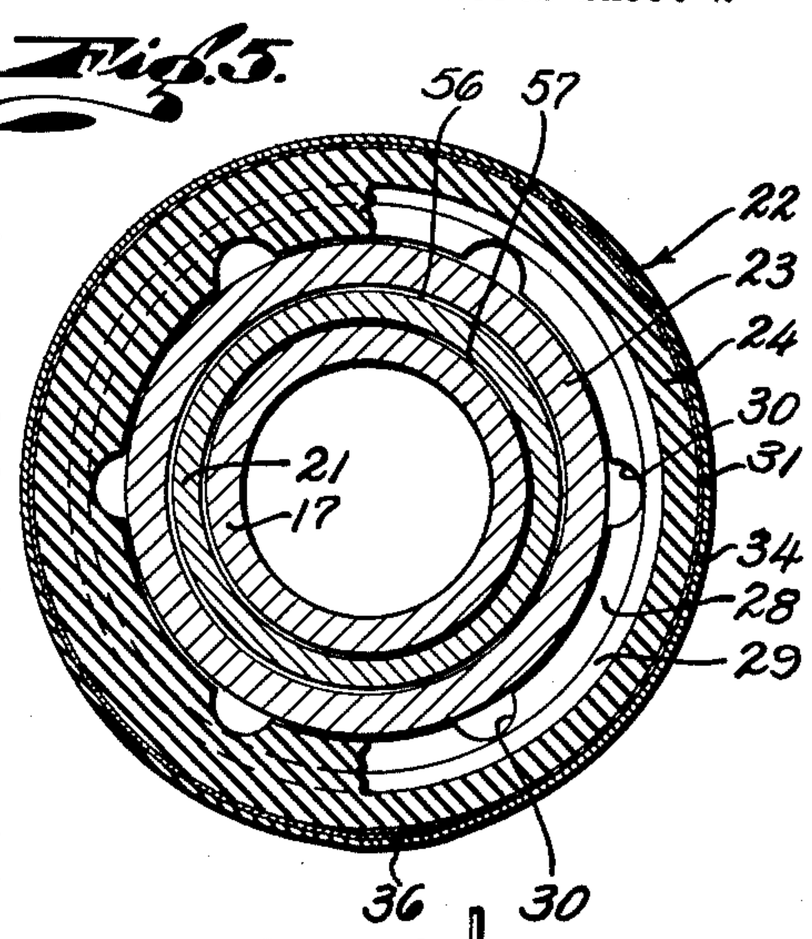
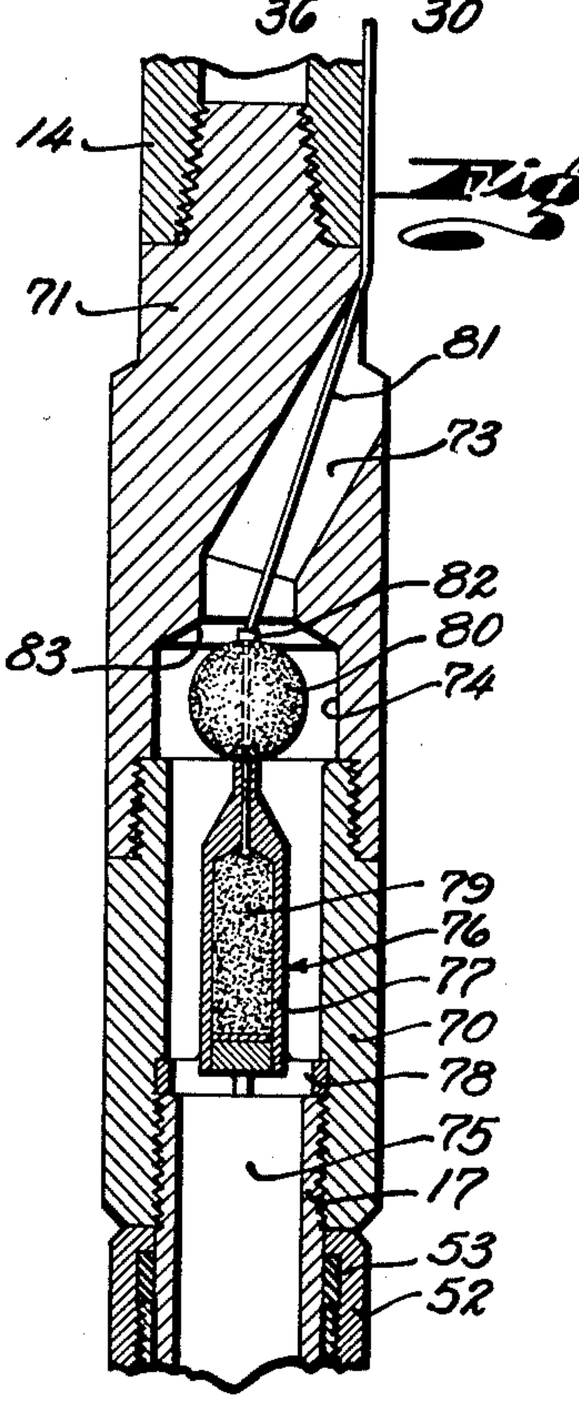


Fig. 6.



JAMES J. SANTIAGO
INVENTOR.

BY Hoalwin White

ATTORNEY

Patented Sept. 29, 1953

2,653,474

UNITED STATES PATENT OFFICE

2,653,474

APPARATUS FOR DETERMINING WELL PIPE PERFORATIONS

James J. Santiago, Los Angeles, Calif., assignor to Grant Oil Tool Company, Los Angeles, Calif., a corporation of California

Substituted for abandoned application Serial No. 680,558, July 1, 1946. This application July 9, 1951, Serial No. 235,843

2 Claims. (Cl. 73—151)

1

This invention has to do with apparatus for determining the presence and location of perforations in well pipe, i. e. casing or liners, and relates particularly to improvements and different adaptations of the type of apparatus disclosed in my Patent No. 2,416,441, issued February 25, 1947, on "Determination of Well Pipe Perforations."

One of my major objects is to provide a perforation recording medium adapted to be run into the well on a wire line or cable, and actuated to take and retain a record showing the presence (or absence) of perforations in a selected area of the pipe, and the relative locations of the perforations. The preferred form of recording medium is the type disclosed in my earlier application, comprising a flexible member adapted to be pressed against the pipe, and capable of forming and retaining impressions of its perforations.

The invention contemplates controlling the expansion operation of the recording medium by way of the suspension line or cable, as by upward movement of the cable, or otherwise transmitting energy through the cable, as by the passage of electrical current.

Preferably, expansion of the recording medium is effected by fluid pressure, and specifically by application to the recording medium of pressure transmitted by way of well liquid. As will appear, space at the inside of an expansible recording medium may be accessible to well liquid, to which in turn pressure may be applied to press the medium against the perforated area of the pipe by virtue of movement of or transmission of energy through the suspension line. Development of the expansive pressure may be accomplished by utilizing the pressure or resistance of the liquid column standing in the well pipe above the apparatus, or by generating pressure locally within the apparatus as by burning of a combustible or explosive charge.

The invention has various additional features and objects, all of which will be understood to better advantage and without necessity for further preliminary discussion, from the following detailed description of certain typical embodiments of the invention shown by the accompanying drawings, in which:

Fig. 1 is a general view showing the recording apparatus lowered in a perforated well pipe;

Figs. 2 and 3 are vertically continuing views showing the apparatus in enlarged cross-section with the parts positioned preparatory to expanding the recording medium;

Fig. 4 is a fragmentary section showing at enlarged scale the communications between the inner section of the apparatus and the expansive capsule;

Fig. 5 is a cross-section on line 5—5 of Fig. 4; and

Fig. 6 is a fragmentary section illustrating a variational form of the invention.

2

Referring to Fig. 1, the apparatus generally indicated at 10, is shown to be lowered within the well pipe or casing 11 opposite the perforations 12 whose presence and location are to be recorded. The apparatus is lowered on a wire line or cable 13 having a socket connection 14 with coupling 15, see Fig. 2, which is attached at 16 to the upper end of the mandrel or inner tubular section 17 of the apparatus. As shown in Fig. 3, section 17 carries on its lower end a check valve body 18 and a shoe bushing 19. As the apparatus is lowered or raised in the well, fluid bypasses the later described packer, through the check valve body, tube 17 and openings 20 in the coupling 15.

The outer section of the body comprises a tube 21 within which the inner section 17 is vertically movable, and carrying the expansive recording medium generally indicated at 22. The latter is carried on an extended sleeve 23 movable vertically relative to the tube 21, as and for the purposes later explained. The recording means comprises an annular, fluid pressure expansible rubber capsule 24, the end portions 25 of which are received within retaining rings 26 and shaped to provide annular seal lips at 27 engageable against the sleeve 23 to prevent fluid leakage from the interior 28 of the capsule. On its inner surface, the capsule may carry one or more annular ribs 29 engageable against the sleeve 23 to internally support the capsule, the rib or ribs having circularly spaced recesses 30 assuring pressure equalization above and below the rib.

Capsule 24 carries the recording medium proper, preferably in the form of thin metallic or other sheet material capable of being deformed in accordance with the perforations 12 when expanded against the pipe, and capable also of retaining the deformation to provide a permanent record of the number and locations of the perforations. Typically the metallic recording medium is shown to be placed in thin sections 31 about the capsule and within recesses 32 in its surface. For protection against scoring or abrasion while being lowered into and out of the well, the annular recording sheet sections 31 may be given protective layers 34, preferably of thin rubber, suitably applied about the metallic sheets, either as separate thin rubber layers wrapped

thereabout or as a temporary integrated rubber coating to be stripped from the metal sheet after its recording deformation. It will be understood that the sheet material **31** and protective layer **34**, will be sufficiently thin and flexible as to be deformable and impressionable by internally applied fluid pressure expanding them against the perforated pipe, and causing the metallic layers to become permanently deformed (outwardly dimpled) at the perforation locations. As illustrated in Fig. 5, the sheet metal sections **31** may be made expansible in response to the applied fluid pressure by wrapping the sheet about the capsule with the edges of the sheet in slidable overlapping relation at **36**.

Nut **37** on the lower end of pipe **21** contains a packing ring **38** sealing against fluid leakage about the outside of pipe **17**. A coil spring **39** is confined between nut **37** and nut **40** containing packing ring **41** sealing against fluid leakage between pipe **21** and the sleeve **23**. Bushing **42** threaded into the capsule retaining ring **26**, is clamped by nut **40** against shoulder **43** on the sleeve **23**. The upper retaining ring **26** similarly receives a threaded bushing **44** clamped against shoulder **45** by nut **46** threaded on the upper end of sleeve **23** and containing packing ring **47** sealing against fluid leakage upwardly about the tube **21**.

A suitable packer **48** is positioned above the capsule assembly and in fixed relation thereto, by a mounting permitting relative vertical movement of the body sections **17** and **21**. As illustrative, the packer may be bonded to a sleeve **49** clamped between spacer **50** and retaining ring **51**, and nut **52** containing packing ring **53** and threaded on the upper end of tube **21**.

Referring to Fig. 4, the interior **28** of the capsule is communicable with the well fluid inside body section **17**, by way of openings **54** and **55** respectively in sleeve **23** and tube **21**, clearance spaces at **56** and **57** respectively between sleeve **23** and tube **21**, and between the latter and tube **17**, and openings **58** in the wall of tube **17**. For purposes that will later appear, tube **17** contains a Venturi tube **59**, held in position as by a spot weld at **60**, the lower portion **59***a* of the tube being annularly spaced at **61** from tube **17**, opposite the openings **58**. The valve body **18** contains a rubber ball check **62** engageable against the seat **63** and displaceable, during operation of the apparatus as described below, through bore **64** into the enlarged diameter bore **65**, wherein the valve assumes a position, as at **62***a*, permitting downward fluid by-pass through the body.

In considering its operation, assume the apparatus to be lowered in the casing **11** on line **13** (with weight added to the line if necessary) to the position of Fig. 1 bringing the recording medium **22** opposite a perforated section of the casing. Tubular body section **21** and the various parts carried by it, including recording medium **22**, are frictionally retained against falling downwardly from the position of Figs. 1 through 4 by engagement of packer **48** with the well pipe. Expansion of the capsule **24** to press the recording medium against the pipe and to deform the sheet **31** into impressions affording a record of the perforations, is effected simply by exerting an upward pull on the wire line **13**. The resulting upward movement of the inner body section **17** within and relative to section **21** and the parts carried thereby, causes fluid pressure to be communicated from within tube **17** (check valve **62** being seated) through openings **58**, **55**, **54**, and spaces **57** and **56**, into the capsule chamber **28**. The magnitude of the pressure thus communicated to the capsule may be increased in accordance with the suddenness of the upward displacement of tube **17**. Upon continued upward movement, the valve body **18** engages the lower end of nut **37**, with the result that the upward pull is transmitted through spring **39** and sleeve **23** to the packer **48**, whereupon further upward displacement of the inner body section is resisted by the entire fluid column in the casing. The consequent fluid pressure in section **17** first assumes a magnitude that will expand the capsule against the perforated section of the casing with sufficient tightness to press and deform the recording medium into the perforations. Upon further increase of the fluid pressure, the rubber ball check **62** is forced down through bore **64** into the enlarged space **65**, thus relieving the pressure and permitting contraction of the capsule by virtue of its resiliency.

As the apparatus then is withdrawn from the well, fluid by-passes down through the body section **17** through openings **20**, the Venturi tube **59** and the valve body **18**. The fluid velocity increase resulting from the restriction within the venturi **59**, is utilized to produce a suction effect tending to pull the recording medium inwardly from the casing wall. Thus the Venturi created depression is communicated through opening **58**, and thence through the passages **56**, **57** and openings **54**, **55**.

Fig. 6 illustrates a variational embodiment of the invention, whereby the capsule expanding fluid pressure is developed independently of the well fluid column pressure, and specifically by ignition of a combustible or explosive charge within the apparatus. Below the inner section **17**, to the upper end of which the explosive charge-containing body **70** is attached, the apparatus may have the same construction as the first described form, the rubber ball check **62** initially being positioned above its seat **63**, as before. The body **70** connects with the wire line socket **14** through a coupling **71** containing an inclined passage **73** communicating through the counterbore **74** and body **70** with the passage **75** below. The explosive charge **76** may be of any suitable type having such burning characteristics as may be desired for most effective expansion of the capsule. Preferably the charge will have sustained burning characteristics, assuring the continuance of available pressure throughout the later described sequence of operations. Typically the charge **76** is shown to comprise a capsule **77** suitably supported in the body **70** as by means of spider ring **78**, and containing the explosive **79**. A valve is used in conjunction with the passage **73** to normally maintain the passage in open (by-passing) condition, and to temporarily close the passage during development of the explosive charge pressure to a degree required for expansion of the capsule **24**. Typically, such valve means may comprise a rubber ball check **80** through which passes the wire **81** running to the ground surface and through which electric current is supplied to detonate the charge. Normally the valve **80** is held in the illustrated open position by engagement with an enlargement **82** on the conductor wire.

Assuming the apparatus to be lowered to recording position, explosion of the charge **76** and

the resulting release of valve 80, causes the latter to seat against shoulder 83, and the explosion created pressure to develop in chamber 75, since its lower end initially is closed by the bottom rubber ball check 62. The resulting pressure communicated through opening 58 to the capsule 24 expands and deforms the recording medium in the manner previously explained. The rapid increase of pressure beyond that required for expansion of the capsule, causes the valves 62 and 80 to be expelled respectively through the openings 64 and 73, with the result that the pressure in chamber 75 is relieved and the by-pass therethrough opened to permit free removal of the apparatus.

I claim:

1. Apparatus comprising a body including relatively vertically movable tubular sections one within the other means carried at the outside of said outer section forming a chamber communicating with the interior of the inner section and having an outer wall radially expansible by pressure in the chamber, said wall including a record forming medium to be positioned opposite the perforated area of a well pipe and radially expansible by pressure in said chamber, a packer carried by said outer section above said medium,

and means for raising said inner section to communicate fluid pressure from within the inner section to said record-forming medium to expand it against the pipe, and a check valve carried by said inner section to close it against downward fluid flow therethrough during initial upward movement of the section, said valve thereafter being displaceable to open said inner section to downward fluid flow during further upward movement of the section.

2. Apparatus comprising a flexible and deformable metallic record-forming medium, a support for said medium adapted to be lowered in a well pipe to bring said medium opposite a perforated area thereof, a thin rubber layer applied to the outer surface of said medium, and means operable to expand said medium and layer to transform said medium into a record of the pipe perforations in said area.

JAMES J. SANTIAGO.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,416,441	Grant et al.	Feb. 25, 1947
2,626,884	Ewing	Jan. 27, 1953