June 7, 1955

A. C. HAMILTON, JR

2,710,065

WELL BRIDGING DEVICE

Filed Aug. 31, 1951

3 Sheets-Sheet 1

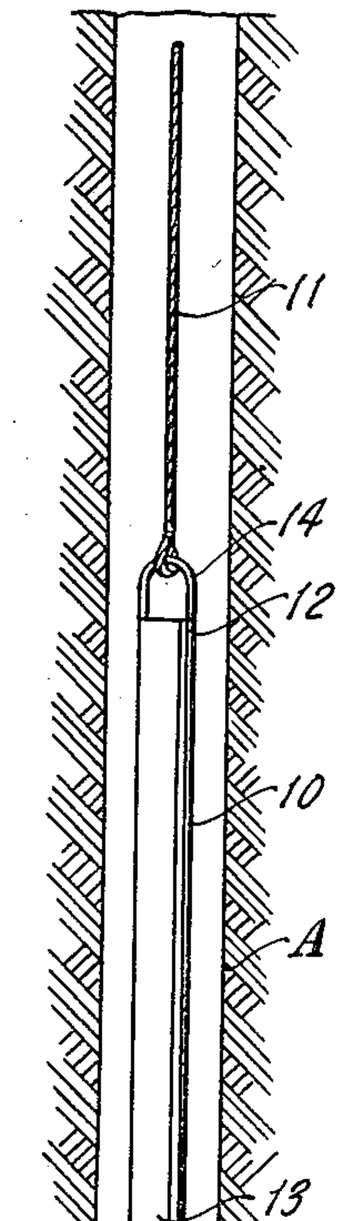


Fig. 1

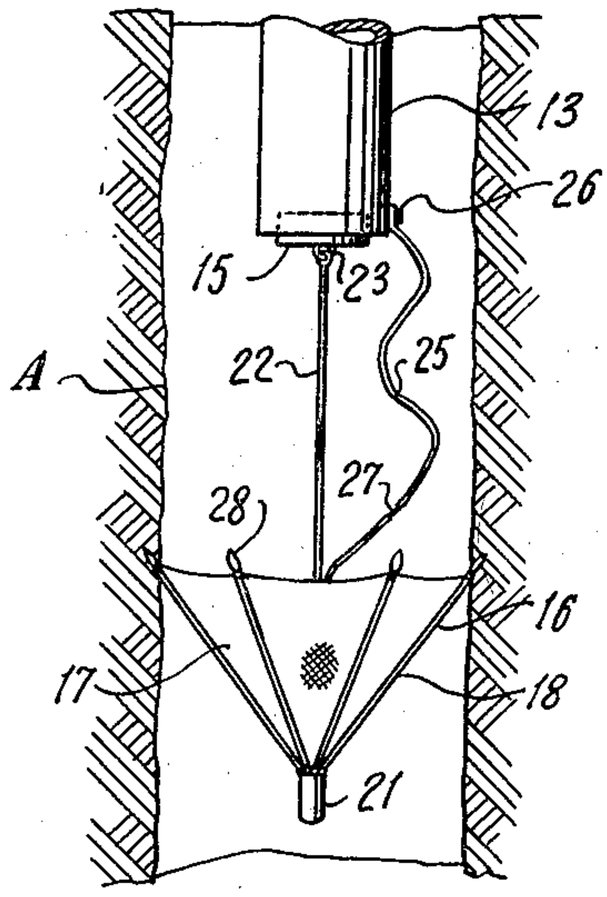
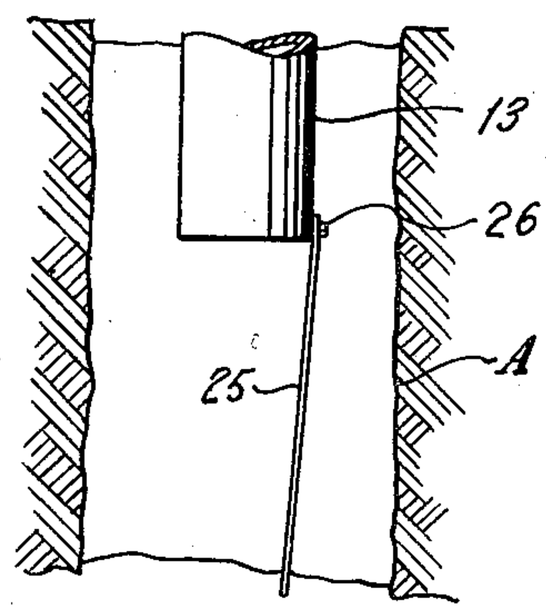


Fig. 2



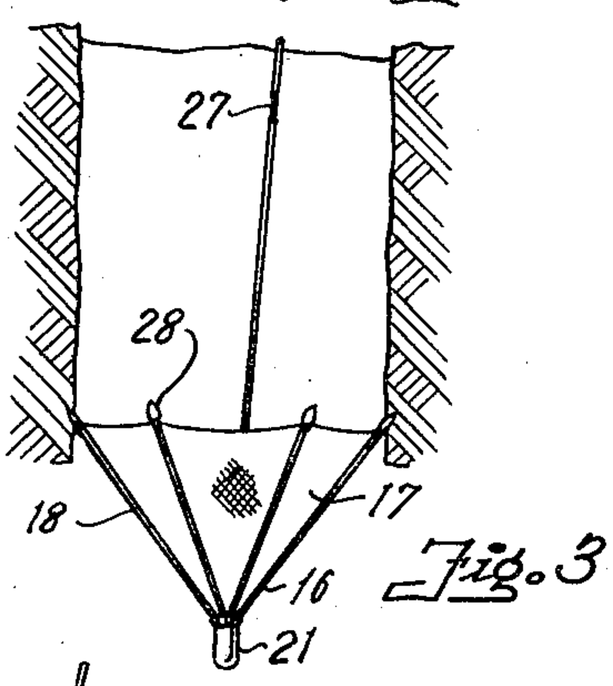


Fig. 3

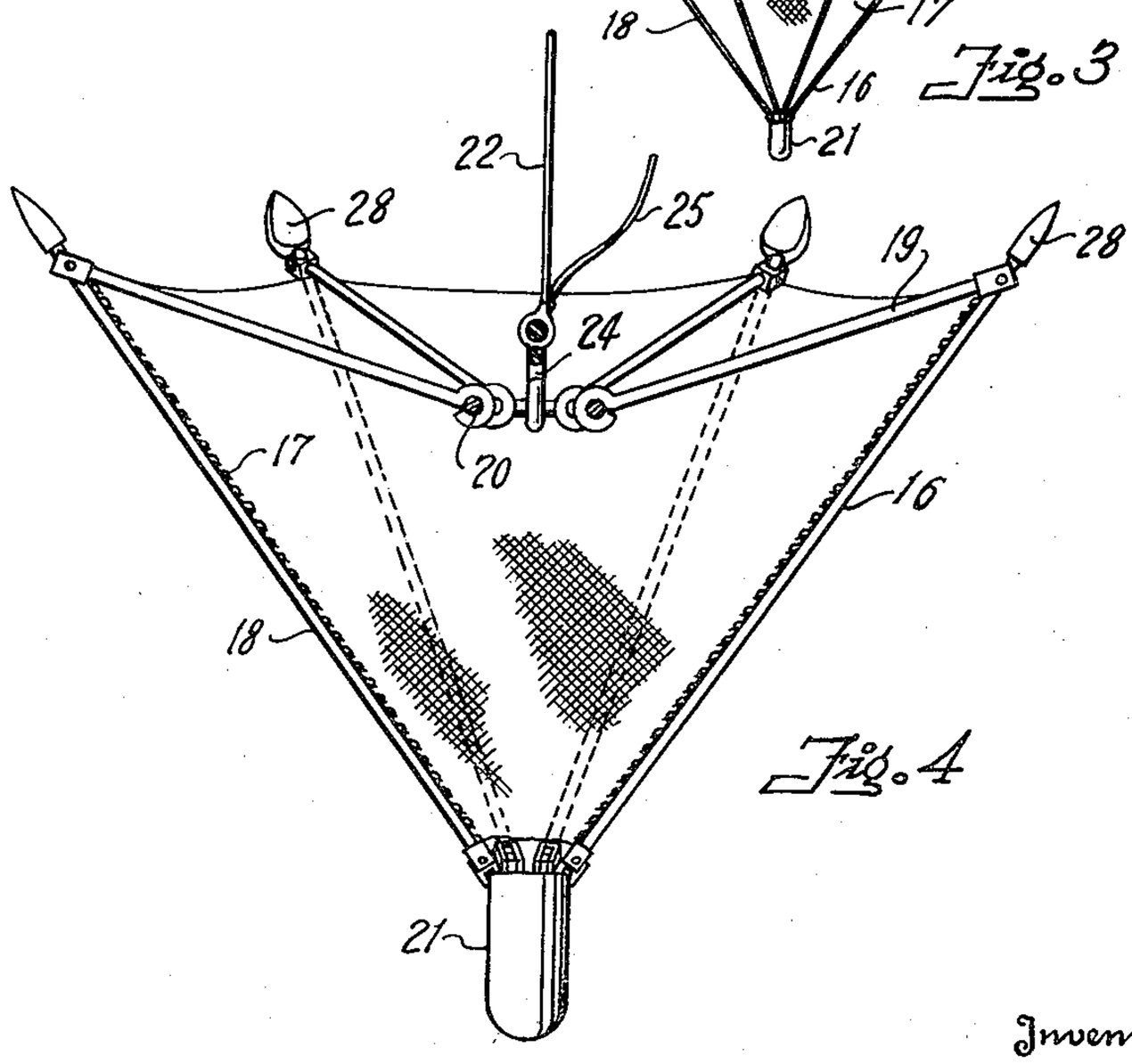


Fig. 4

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WELL BRIDGING DEVICE

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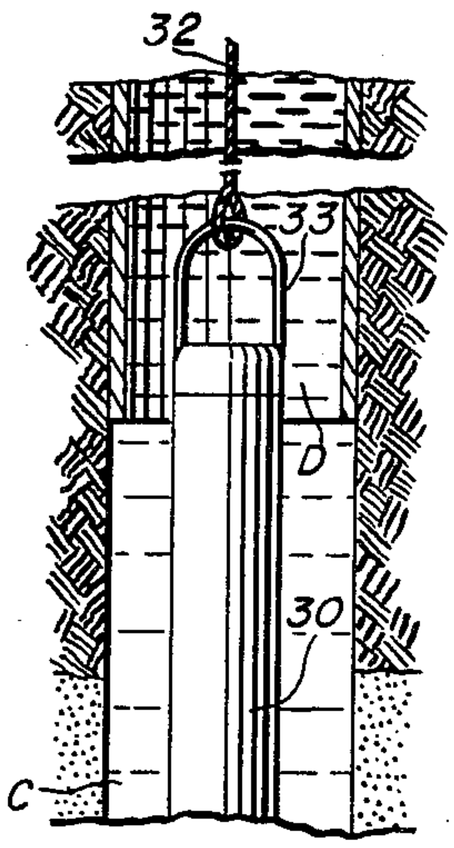

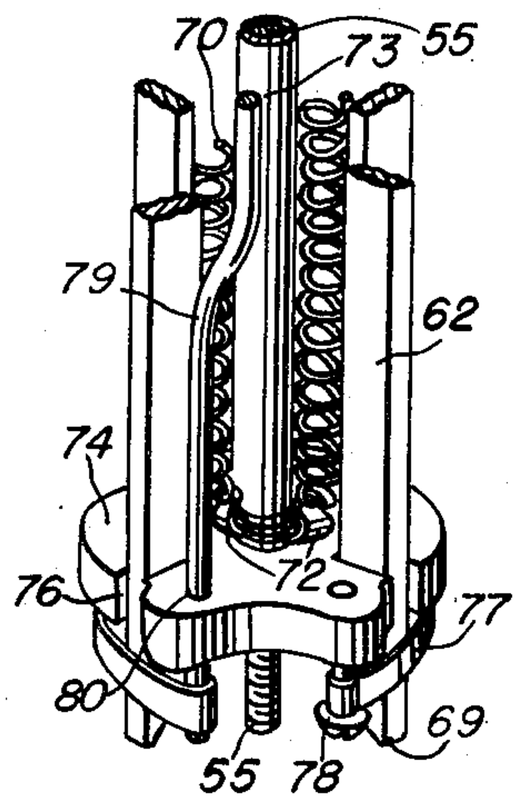

Fig. 9

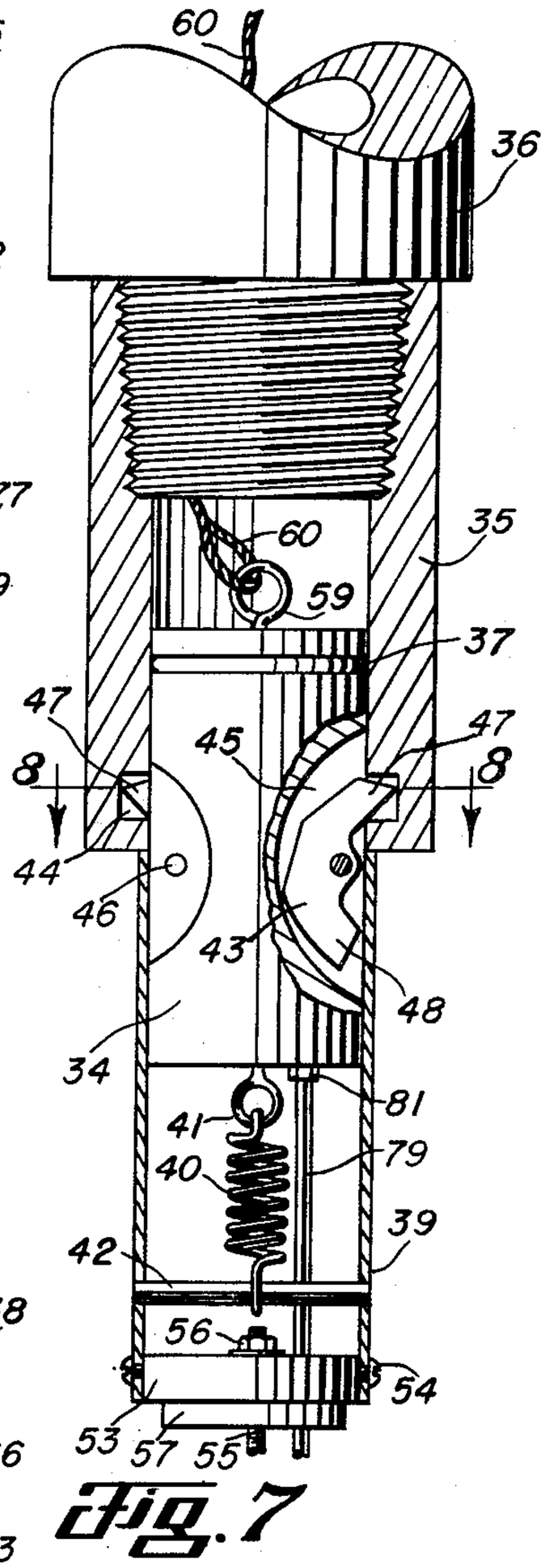

Fig. 7

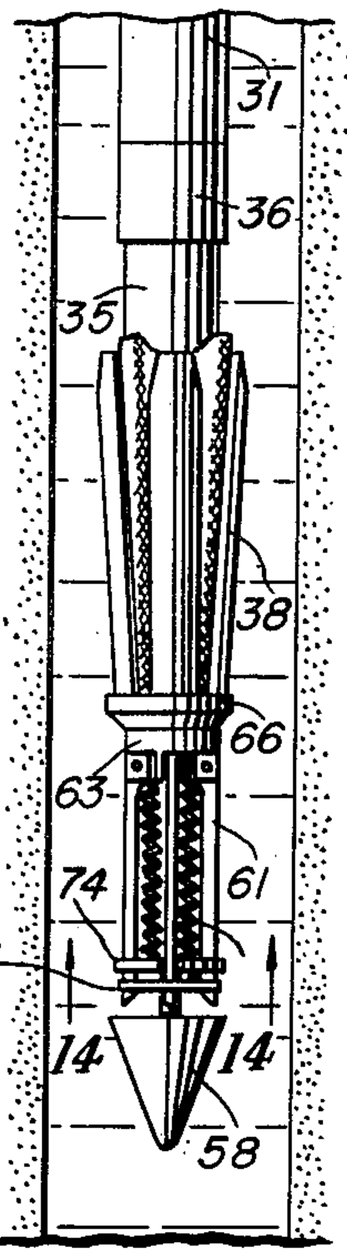

Fig. 5

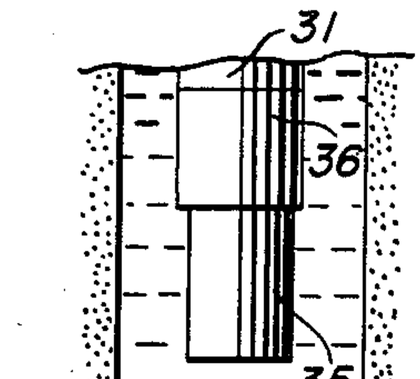

Fig. 6

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June 7, 1955 A. C. HAMILTON, JR 2,710,065

WELL BRIDGING DEVICE

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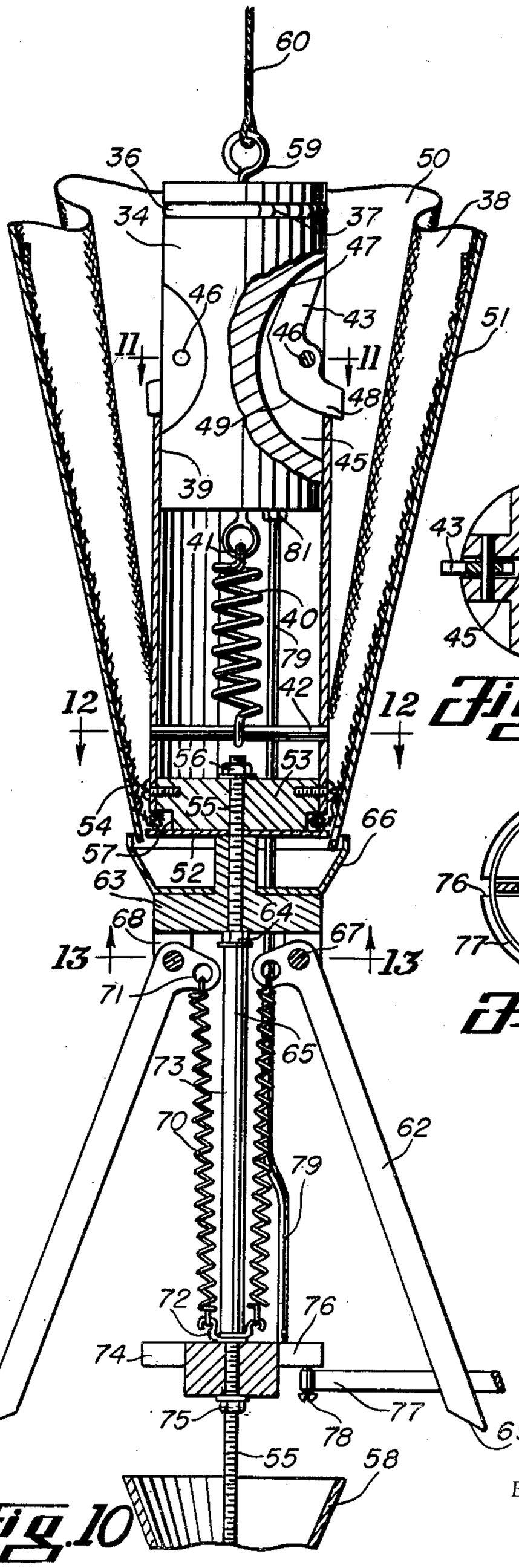

Fig. 10

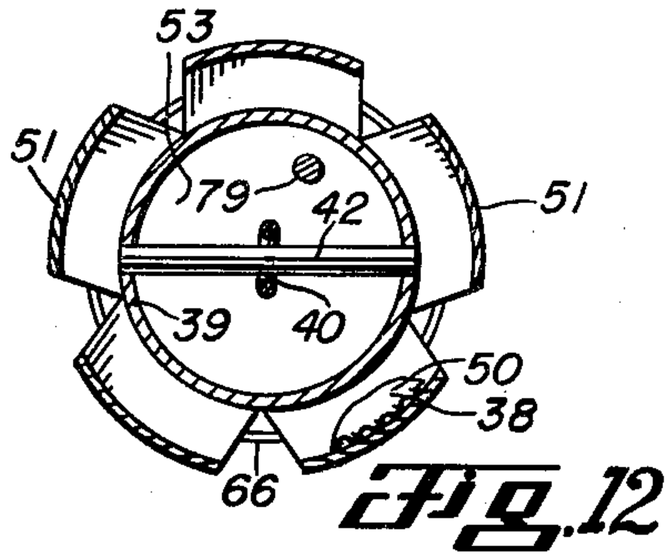

Fig. 12

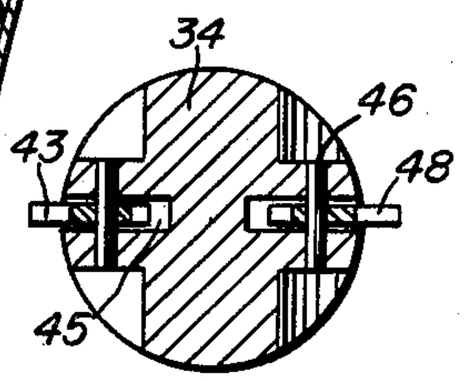

Fig. 11

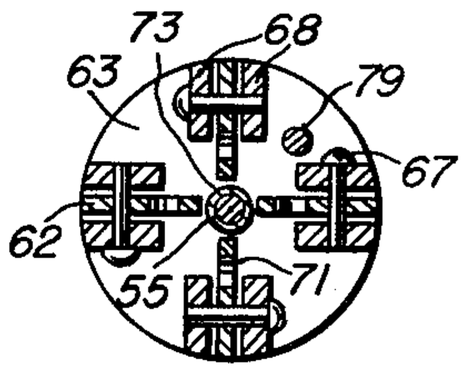

Fig. 13

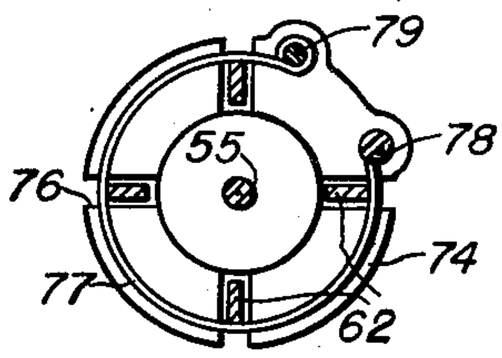

Fig. 14

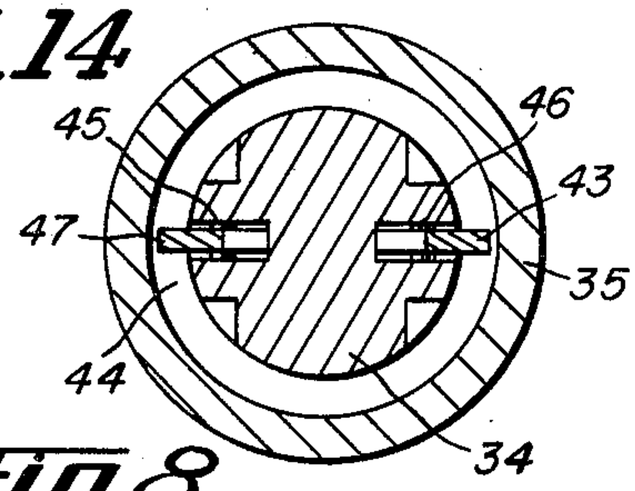

Fig. 8

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United States Patent Office

2,710,065

Patented June 7, 1955

2,710,065

WELL BRIDGING DEVICE

Andrew C. Hamilton, Jr., Dallas, Tex.

Application August 31, 1951, Serial No. 244,657

11 Claims. (Cl. 166—192)

This invention relates to new and useful improvements in well bridging devices.

One object of the invention is to provide an improved well bridging device of such construction that a well may be readily bridged at any desired point with minimum effort in a relatively short period of time.

An important object of the invention is to provide an improved well bridging device having a container for receiving and lowering a bridging material into a well hole together with means for supporting the material unloaded or discharged from the container so as to bridge the well hole at a predetermined point.

Another object of the invention is to provide an improved well bridging device which includes an umbrella suspended from a dump bailer and arranged to dump or unload the bailer upon being set whereby the bridging material discharged from said bailer is supported by the umbrella.

A particular object of the invention is to provide an improved well bridging device which includes a dump bailer having a closure in its lower end and means having connection with the closure for supporting the bridging material discharged from the bailer, the supporting means resisting upward movement through the fluid so as to be expanded and set by a predetermined upward pull of said bailer to open said closure and permit the discharge of said bridging material whereby accidental or premature opening of the closure is substantially eliminated.

Still another object of the invention is to provide an improved dump bailer having a removable plug closing its lower end and a member having connection with the plug and resistant to upward movement through the fluid in a well hole whereby upon a predetermined upward pull of the bailer, the resistance of the member is sufficient to remove said plug and dump the contents of said bailer.

A further object of the invention is to provide an improved bridging device, of the character described, wherein the umbrella is adapted to be suspended in close proximity to the dump bailer during dumping of said bailer which is movable away from said umbrella whereby a quick-setting material may be employed to bridge the well hole without any danger of the bailer becoming stuck.

A construction designed to carry out the invention will be hereinafter described together with the other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings wherein examples of the invention are shown, and wherein:

Fig. 1 is an elevational view of a well bridging device, constructed in accordance with the invention, shown being lowered into a well hole,

Fig. 2 is an elevational view of the lower portion of the device, showing the umbrella expanded and the connection between said umbrella and the bailer closure,

Fig. 3 is a view, similar to Fig. 2, showing the bailer

with the plug removed and the connection between the umbrella and bailer,

Fig. 4 is a transverse, vertical, sectional view of the umbrella in its expanded position,

Fig. 5 is an elevational view of a modified form of well bridging device in a well bore,

Fig. 6 is an elevational view of the lower portion of the modified device, showing the umbrella and its supporting means expanded and set and the closure or plug removed from the dump bailer,

Fig. 7 is a transverse, vertical, sectional view, showing the connection of the plug to the bailer,

Fig. 8 is a horizontal, cross-sectional view, taken on the line **8—8** of Fig. 7,

Fig. 9 is a perspective view of the lower portion of the supporting means, showing the latch for holding its legs retracted,

Fig. 10 is an enlarged, transverse, vertical, sectional view of the umbrella and its supporting means expanded,

Fig. 11 is a horizontal, cross-sectional view, taken on the line **11—11** of Fig. 10,

Fig. 12 is a horizontal, cross-sectional view, taken on the line **12—12** of Fig. 10,

Fig. 13 is a horizontal, cross-sectional view, taken on the line **13—13** of Fig. 10, and

Fig. 14 is an enlarged, horizontal, cross-sectional view, taken on the line **14—14** of Fig. 5.

This application is filed as a continuation-in-part of my copending application, Serial No. 51,919, filed September 30, 1948, now abandoned.

In the drawings, the numeral **10** designates a well bridging device which is adapted to be lowered into a well or bore hole A upon a wire line or cable **11**. The well hole may be open as shown or may be cased in the conventional manner. Fluid is usually standing in the well hole and its level is indicated by the letter B. The bridging device **10** includes a dump bailer **12** having a long, tubular container or hollow body **13**, formed in one or more sections and attached to the line **11** by a suitable bailer **14**. As shown in Fig. 2, a suitable closure or plug **15** closes the lower end or opening of the body **13**, the upper end of which may be open. The plug **15** is preferably circular and has a snug or tight fit within the bottom of the body so as to require appreciable force in order to be removed.

An expansible, collapsed supporting member or umbrella **16** is loosely confined or fitted about the lower end of the body and may be of any suitable construction. For purposes of illustration, the umbrella **16** has been shown as having an inverted, conical cover **17**, of canvas, rubber, leather or other suitable material, mounted upon a plurality of upstanding, radial ribs **18** (Fig. 4). Short radial arms **19** are disposed within the ribs **18** with their outer ends pivotally connected to the outer end portions of said ribs and their inner ends pivoted to a central connecting ring or element **20**. An axial head **21**, which is preferably weighed, and having a rounded nose or lower end, is provided for pivotally connecting the inner lower ends of the ribs. The arms **19** assist in expanding the ribs and maintaining the same in the engagement with the well bore. The umbrella is connected to the plug **15** and is adapted to be supported by a detachable connection with the bailer **10**. A short line **22**, for example, approximately three feet in length, depends from a screw eye **23** carried by the plug and is fastened to the ring **20** by a suitable bridle **24**. Also, the bridle **24** is attached to the body **13** by a longer line **25** which may be approximately twenty feet in length and which may be secured by a suitable clip **26** carried by said body.

In use, the plugged body of the bailer **12** is preferably filled with a slurry of quick-setting calcined gypsum, gypsum cement, or other known materials having a prede-

termined set, such as quick-set cement, alumonite cement or thermosetting resin. The lines **22** and **25** are attached and coiled with the umbrella **16** prior to loosely confining the latter around the lower end of the body. With the umbrella partially open, the bailer is attached to the wire line **11** by the bail **14** and lowered into the well hole A to a desired or predetermined depth which is preferably below the fluid level B (Fig. 1). The bailer is then raised so as to disengage and move the same away from the umbrella. Since the umbrella is partially open and has the inner ends of its arms **19** connected to the plug **15** by the short line **22**, continued upward movement of the bailer causes upward and outward pivoting of said arms so as to expand the ribs **18** (Fig. 2). This expansion is assisted by the fluid acting against the inner surface of the umbrella cover **17**. Usually, the resistance of the umbrella to upward movement through the fluid is sufficient to expand or open the same.

Due to the resistance of the open umbrella, the plug **15** is pulled out of the bottom of the bailer body by continued upward movement of said body so as to open the same and dump or unload the slurry therein. It is noted that the resistance created by the fluid acting against the umbrella is sufficient to disengage the plug and that it is unnecessary for the umbrella to engage the well bore. Manifestly, the umbrella may be held or supported in a fixed position by the longer line **25**. The slurry is dumped onto the umbrella and is supported thereby until set sufficiently to form a bridge. Although the bailer remains stationary during setting of the slurry, the length of the line **25** permits positioning of said bailer above the bridge to prevent sticking of the bailer therein. The bailer is then raised so as to remove the same from the well bore. Since the slurry has set, the line **25** is broken upon such movement; if desired, however, a weak point **27** may be provided to assure parting of this line. Additional material may be dumped upon the bridge to build the same to the desired thickness or height.

In addition to placing a cementitious plug, the bridging device may be used to form bridges of gravel, crushed stone, marble or other loose material. When the bailer reaches the desired depth, it is raised and the resistance of the open umbrella to such movement through the fluid expands said umbrella sufficiently to create the drag necessary to pull out the plug. The material in the bailer is dumped onto the umbrella and forms a bridge due to the frictional engagement of the mass with the well bore. If desired, additional material may be dumped upon this bridge after removal of the bailer, in the manner desired hereinbefore. A bridge of this type is desirable in a well making gas which prevents most cementitious materials from setting. The use of hard stone or other hard materials, such as hard dolomite, in forming a bridge is advantageous in side tracking holes or setting whipstocks. Of course, a bridge of calcined gypsum also will sidetrack a bit.

In cased well holes or in open holes having no fluid, it is desirable to provide the ribs **18** of the umbrella with pointed or barbed ends **28** whereby the same are in the nature of spears (Fig. 4). When the umbrella is moved upwardly in a well hole, the spears may catch on joints in cased wells or tend to embed themselves in the formation so as to expand said umbrella. The rounded nose or lower end of the head **21** prevents the umbrella from catching on joints or irregularities upon lowering of the bridging device.

In Figs. 5 through 14, a modified form of device **30** is shown and includes a similar dump bailer **31** in the form of a long, tubular body or container adapted to be lowered into a well hole C by a wire line **32** connected to the body by a suitable bail **33**. The well hole C has casing D suspended therein and its lower portion is usually filled with fluid. A suitable closure or plug **34** closes the lower end of the body (Figs. 7 and 10), the upper end of which is preferably open. The plug **34** is

cylindrical, being of greater length than the plug **15**, and its upper portion has a snug, sliding fit in the smooth bore of a short sleeve or box **35** attached to the lower end of the body by a coupling collar **36** and forming the discharge opening of said body. An O-ring **37** encircles the upper portion of the plug to seal off between said plug and the bore of the box **36**. For connecting the plug to an umbrella **38**, similar to the umbrella **16**, a short tube or sleeve **39** depends from said plug in snug, telescoping relation to its lower portion below the box. The upper end of the sleeve **39** is held in engagement with the lower end of the box by a coiled spring **40** fastened to the bottom of the plug by a screw eye **41** and to a pin or rod **42** extending across the lower portion of said sleeve above its lower end.

As shown in Fig. 7, the plug is detachably connected to the box by upright, radial dogs or latches **43** engaging in an annular, internal groove **44** formed in the lower end of the box bore. The latches **43** are angular and are pivotally mounted in arcuate, substantially complementary recesses **45** by transverse pins **46** (Figs. 10 and 11). Outwardly-directed bills or lugs **47** and **48** are provided at the upper and lower ends of the latches and the upper lugs **47** project into the groove **44** and are held therein (Fig. 8) when the lower lugs **48** are confined by the sleeve **39** telescoping the plug. It is noted that the pivot pins **46** are offset outwardly relative to the longitudinal axes of the latches, whereby the lugs **47** swing inwardly and the lugs **48** outwardly when said latches are unconfined (Fig. 10). The arcuate shape of the recess **45** limits the swing or outward projection of the lugs. As shown by the numeral **49**, the lower face of each lug **47** is inclined upwardly relative to the lower wall of the groove **44** so as to facilitate disengagement of the lug upon upward movement of the plug relative to the sleeve. Manifestly, when the upward pull of the body is sufficient to overcome the resistance of the spring **40**, the plug moves upwardly relative to the sleeve so as to uncover the lugs **48** and permit projection or outward swinging of said lugs. Since the lugs **47** are retracted or swung inwardly out of engagement with the groove, the plug is disconnected from the box **35** and remains stationary with the sleeve and umbrella **38** upon continued upward movement of the body and box. The plug and sleeve are held in the relative positions shown in Fig. 10 by the force of the spring urging said sleeve upwardly against the projecting lugs **48** and said spring serves to connect said plug to the umbrella. From the foregoing, it is obvious that a predetermined upward pull is required to remove the plug and that it is virtually impossible to accidently or prematurely remove said plug.

The umbrella **38** is in the form of an expansible, collapsed supporting member and preferably has a cover **50**, similar to the cover **17**, supported by and having its upper, outer margin attached to a plurality of upstanding, flat ribs **51**. The lower ends of the ribs are hinged or pivotally mounted in a circular plate **52** at the lower end of the sleeve **39**. A circular block **53** is fastened in the lower end of the sleeve below the transverse pin **42** by suitable screws **54** and an axial screw-threaded rod or bolt **55** extends therethrough. A nut **56** on the upper end of the rod overlies the block **53** and the plate **52** is confined upon said rod below said block. The lower margin of the block extends below the lower end of the sleeve and preferably is reduced in diameter to provide an external, annular recess **57** for receiving the lower, inner margin of the cover **50**. An inverted, conical, guide nose **58** is mounted on the lower end of the rod **55**.

The operation of this form of the invention is substantially the same as that described hereinbefore. The modified device **30** is lowered into the well hole C with its parts in the position shown in Figs. 5 and 7. Suitable material is contained in the bailer **31** which is supported by the wire line **32** and bail **33** and which has its lower end closed by the plug **34** due to the engagement of the latch

lugs **47** in the groove **44** of the box **35**. When the desired depth is reached, preferably and usually below the fluid level, the bailer is raised and the resistance of the umbrella to this upward movement expands or opens the same through the fluid. When the resistance of the umbrella to the upward movement through the fluid becomes sufficient to overcome the force of the spring **40**, the plug moves upwardly relative to the sleeve **39** to uncover and release the latches **43** so as to permit pivoting of said latches which retracts the lugs **47** and projects the lugs **48**. Continued upward movement of the bailer removes the plug from the box (Fig. 6) to permit dumping of the bridging material onto the umbrella. It is noted that the opening of the umbrella is independent of the same engaging the well bore.

If desired, the upper end of the plug may be connected to the bailer body by a suitable screw eye **59** and a weak, breakable line **60** for supporting the umbrella during dumping of the bridging material. It is pointed out, however, that this supporting connection is not essential and its use is optional, since the umbrella may be employed merely as a means of removing the plug by fluid resistance upon a predetermined upward pull of the bailer.

It is sometimes desirable to provide the umbrella with an underlying support **61** in place of the line **60**. The support **61** includes depending radial arms or legs **62** having their upper ends pivotally connected to a circular head **63** mounted on the intermediate portion of the rod **55** between the plate **52** and nose **59** (Fig. 10). The head **63** is supported upon the rod by a nut **64** and has an axial, upstanding shank portion **65** bearing against the underside of the plate. An upwardly-directed thimble or skirt member **66** is confined upon the shank portion **63** with its upper margin encircling the plate to enclose the space between the head and plate. As most clearly shown in Fig. 13, transverse pivot pins **67** and depending lugs **68** connect the legs **62** to the head. The lower ends of the legs are bevelled at their inner edge portions to provide points **69** at their outer edge portions for embedding in the well bore C or engaging joints of the casing D. For urging the legs outwardly, a coiled spring **70** has its upper end connected to an eye **71** made integral with the upper end of each leg inwardly of its pivot pin **67** and its lower end fastened to a hook **72** carried by the rod **55**. A spacer sleeve **73** is interposed between the hook **72** and the nut **64** for maintaining the springs **70** in tension.

A retaining element or block **74** is supported on the rod by a nut **75** immediately below the hook and above the nose **58**. The upper portion of the block **74** is of enlarged diameter and has radial slots **76** therein for receiving the lower portions of the legs **62** which are confined by a flat strap **77** encircling the lower portion of said block. A depending screw **78** is threaded in the underside of the enlarged upper portion of the block for securing one end of the strap **77** thereto and the other end of said strap is detachably fastened by a latch pin **79** extending through an opening **80** in said head portion adjacent the screw (Figs. 9, 10 and 14). The upper portion of the latch pin **79** is offset inwardly and extends upwardly through the head **64** (Fig. 13), skirt member **65**, plate **52**, in block **53** (Fig. 12) and the bore of the sleeve **39**. The upper extremity of the latch pin is screw-threaded in the lower end of the plug **34** and is held against displacement by a lock nut **81**. Due to this arrangement, upward relative movement of the plug disengages the latch pin from the strap whereby the retracted legs are pivoted outwardly by the force of the springs **70** into engagement with the well bore or casing. The support **61** assures setting of the umbrella in cased and uncased or open well holes since the legs embed in well bores and engage in the joints of casing. It is noted that when the support is employed, the rod **55** is of sufficient length to accommodate said support and dispose the nose **58** below the lower ends of the retracted legs.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A well bridging device including, a container for material adapted to be lowered in a well hole having fluid therein, a closure at the lower end of the container, and an expansible member having connection with the closure and surrounding the lower end of said container so as to be directly below and movable downwardly with said container, the member being expanded by and resisting upward movement through the fluid so as to open said closure upon upward movement of said container and dump said material, said expanded member being below the open lower end of said raised container to receive and support the dumped material.

2. A well bridging device including, a container for material adapted to be lowered in a well hole having fluid therein, closure means at the lower end of the container, and expansible upwardly-opening means having connection with the closure means and surrounding the lower end of said body so as to be directly below and movable downwardly with said container, the expansible means being expanded by and resisting upward movement through the fluid for opening the closure means to dump the material upon upward movement of said container, said expanded means being below the open lower end of said raised container to receive and support the dumped material.

3. A dump bailer including, a tubular body for lowering material in a well hole containing fluid, a plug closing the lower end of the body, a member surrounding the lower end of said body so as to be directly below and movable downwardly with said body, the member having upwardly facing expansible means resisting upward movement through the fluid so that said body is movable upwardly from said member due to the fluid resistance of said member and independent of its engagement with the well bore, and means connecting the plug to said member so as to remove said plug from said body upon a predetermined upward pull of said body, the upwardly-facing means of said member being expanded by relative upward movement of said body and being disposed below the open lower end of said raised body to receive and support the dumped material.

4. A well bridging device including, a tubular body adapted to be lowered into a well hole containing fluid, a closure for the lower end of the body, a collapsed support below and surrounding the lower end of said body so as to be lowered with said body into the well hole, the support resisting upward movement through the fluid so as to be expanded upon upward movement of said body whereby said body is movable upwardly from said expanded support and the latter is disposed below the open lower end of said raised body, means connecting the support to the closure for opening said closure and dumping the contents of said body onto said support upon continued upward movement of said body relative to said support, and means attaching said support to said body for sustaining said support during dumping of the body contents.

5. A well bridging device including, a dump bailer containing a bridging material, a removable closure for the bottom of the bailer, a partially open umbrella loosely confined upon the lower end of said bailer so as to be lowered therewith into a well hole, the umbrella being expanded upon upward movement of said bailer, and a line extending between the closure and umbrella for removing said closure and dumping the bridging material onto said umbrella to form a bridge upon upward movement of said bailer relative to said umbrella, and a line of greater length attaching said umbrella to said bailer to support said umbrella and permit limited upward move-

ment of said bailer above the bridge without breaking the connection between said bailer and umbrella.

6. A well bridging device including, a container for receiving and lowering a bridging material into a well hole containing fluid, means closing the lower end of the container, an expansible upwardly-directed umbrella, and means connecting the umbrella to the container closing means and to said container, said umbrella surrounding the lower end of said body so as to be directly below and lowered with said container, said umbrella resisting upward movement through the fluid whereby said container is movable upwardly relative to said umbrella and said umbrella is expanded and opens said closing means upon upward movement of said container so as to dump the bridging material onto said umbrella, said umbrella remaining attached to said container by said connecting means so as to be supported during the dumping of said bridging material.

7. A well bridging device including, a container for receiving and lowering a bridging material into a well, a plug closing the lower end of the container, an umbrella, a line connecting the umbrella to the plug, a second and longer line connecting said umbrella to said container, whereby said umbrella is suspended from and lowered into the well bore with said container and whereby limited upward movement of said container relative to said umbrella is permitted, said umbrella being opened and said plug removed upon initial relative movement of said container to dump the bridging material onto said umbrella, the longer line retaining the connection between said umbrella and container during the dumping of said bridging material to support said umbrella.

8. A well bridging device including, a tubular body for lowering material in a well hole containing fluid, a plug closing the lower end of the body, latch means releasably connecting the plug to said body, an expansible upwardly-directed umbrella connected to the plug and surrounding the lower end of said body so as to be directly below and lowerable with said body, the umbrella resisting and being expanded by upward movement through the fluid whereby said body is movable upwardly from said umbrella, and releasing means carried by the umbrella and operable upon upward movement of said body to release said latch means whereby said plug is removed and the material dumped onto said expanded umbrella upon such upward movement due to the fluid resistance of said umbrella and irrespective of its engagement with the well bore.

9. A well bridging device including, a tubular body for lowering material in a well hole containing fluid, a plug closing the lower end of the body, a latch releasably connecting the plug to said body, an expansible upwardly-directed umbrella directly below and lowerable with said body, the umbrella resisting and being expanded by upward movement through the fluid, and sleeve means connecting said plug to said umbrella and being movable relative to said plug, the sleeve means confining the latch in engagement and releasing said latch upon upward movement of said body whereby said plug is removed and the material dumped.

10. A dump bailer including a tubular body for lowering material in a well hole containing fluid, a plug closing the lower end of the body, and an expansible upwardly-directed member having connection with the plug and surrounding the lower end of said body so as to be directly below and lowered with said body, the member being expanded by and resisting upward movement through the fluid whereby said body is movable upwardly from said member due to the fluid resistance of said member and independent of its engagement with the well bore, the connection between said plug and member removing said plug from said body upon a predetermined upward movement of said body relative to said member to dump the material, the expanded member being disposed below the open lower end of said raised body to receive and support the dumped material.

11. A well bridging device including a tubular body containing material adapted to be lowered in a well hole having fluid therein, a plug closing the lower end of the body, expansible upwardly-directed umbrella means surrounding the lower end of said body so as to be directly below and lowered with said body, the umbrella means resisting upward movement through the fluid so that said body is movable upwardly from said member, and means connecting the plug to said umbrella means so as to remove said plug from said body upon a predetermined upward movement of said body to dump the material, said umbrella means being expanded by relative upward movement of said body and being disposed below the open lower end of said raised body to receive and support the dumped material.

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