

July 28, 1953

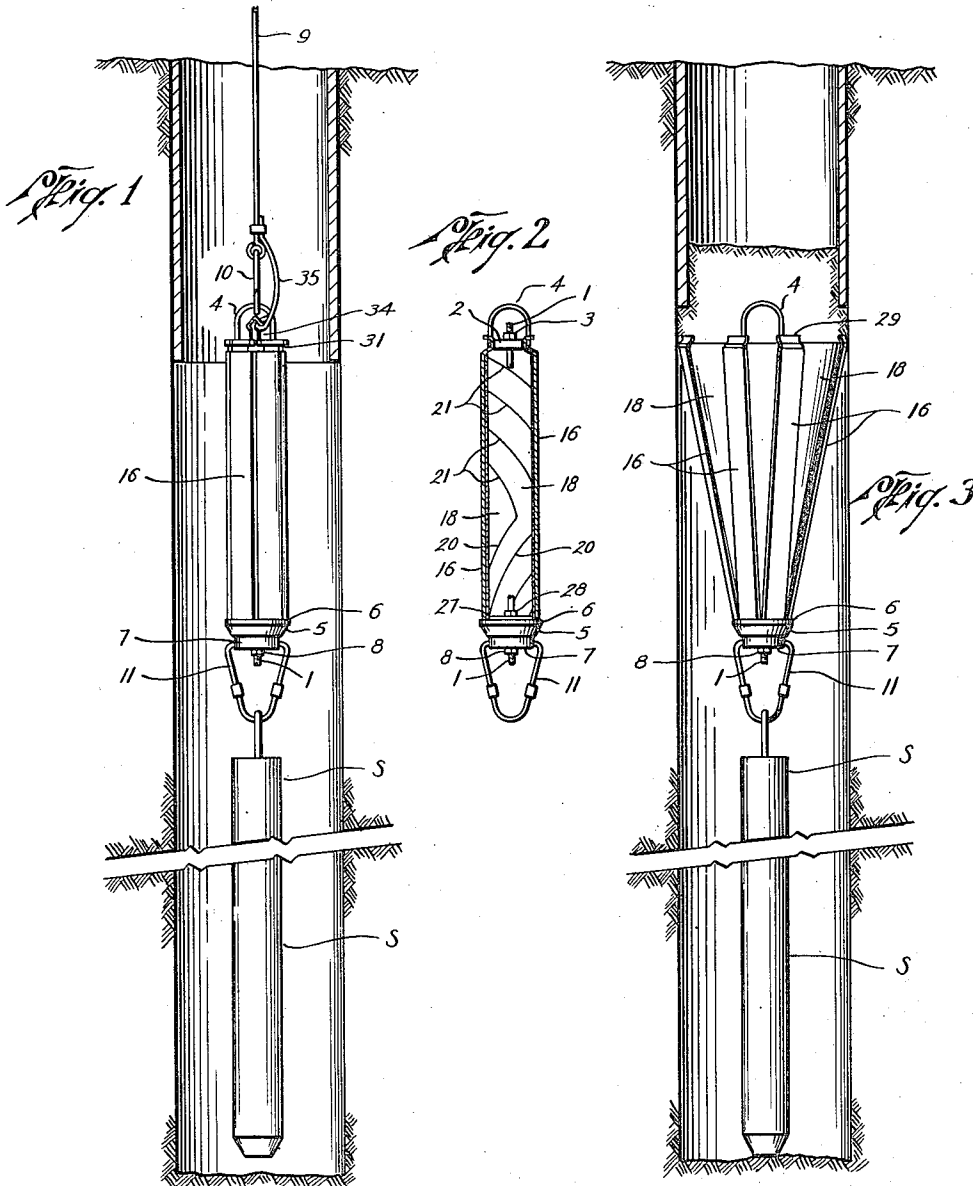
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2,646,845

WELL BRIDGE

Filed Aug. 1, 1951

4 Sheets-Sheet 1



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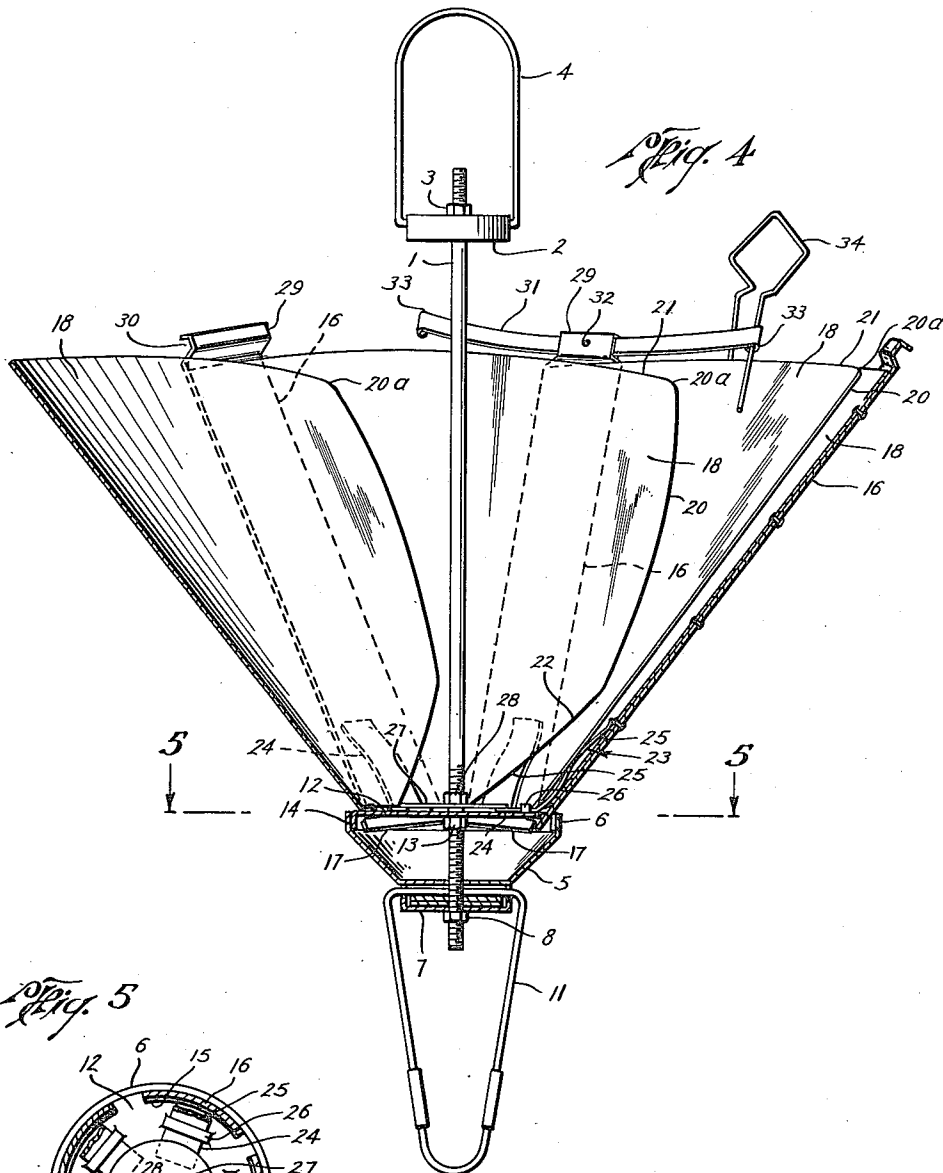
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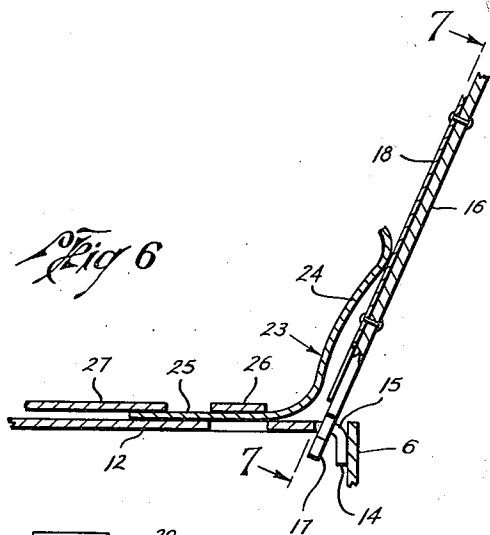
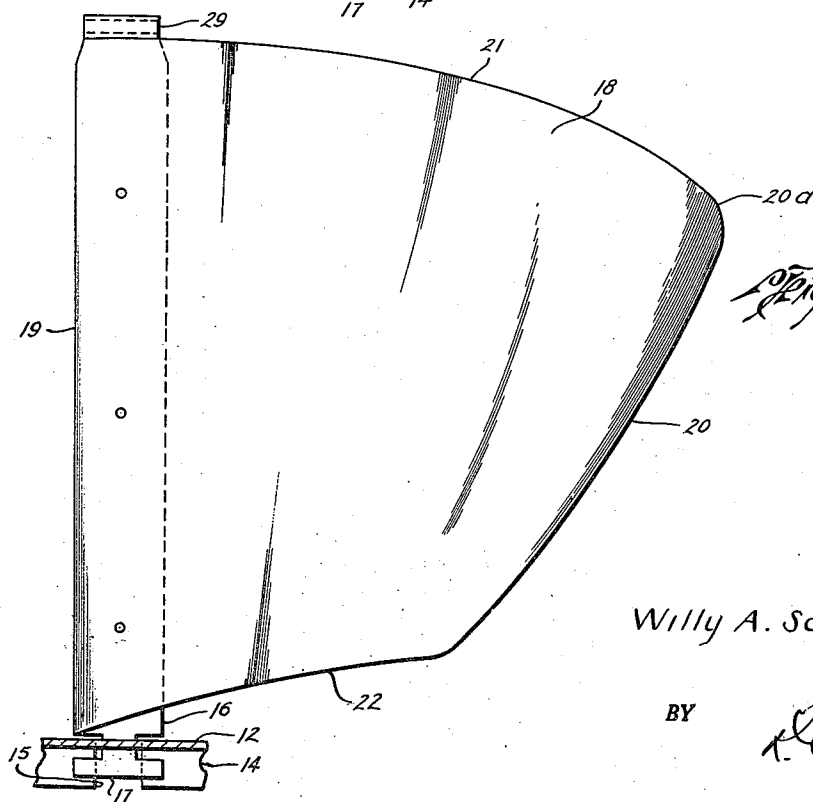
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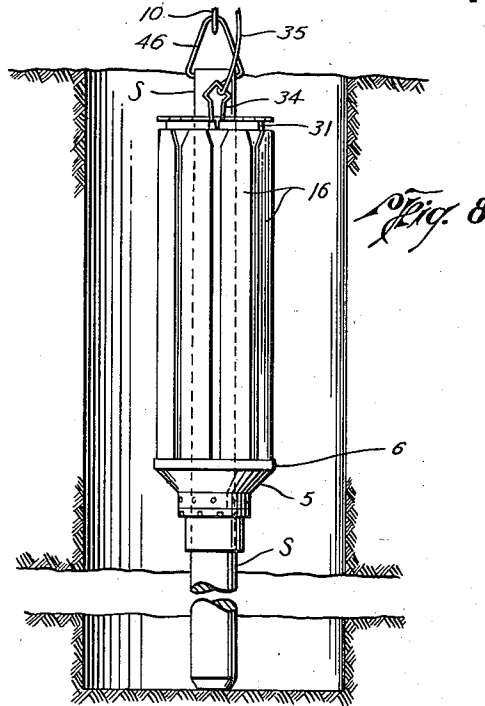
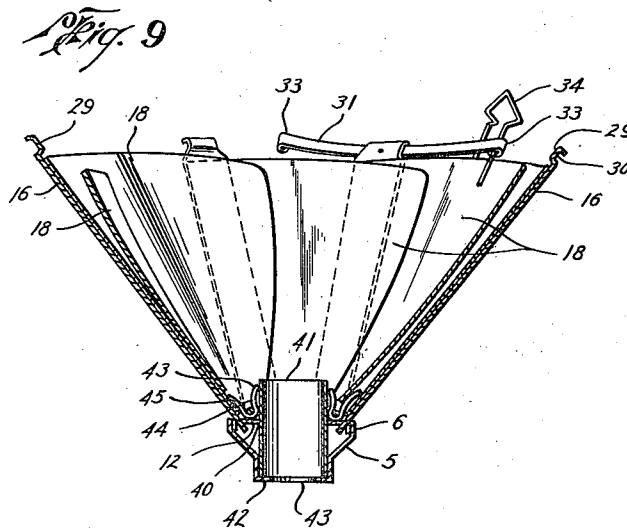
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,646,845

WELL BRIDGE

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Application August 1, 1951, Serial No. 239,772

4 Claims. (Cl. 166—13)

1

This invention relates to plugging devices for oil wells, and more particularly to a device for supporting stemming material, such as sand, rock, cement or the like, at a desired point in the bore of the well to confine the force of an explosive when shooting the well.

It has heretofore been proposed to provide a plugging device or bridge in the form of an inverted umbrella which may be freely lowered in the well bore in closed position and which, when expanded, will conform to the cross-section of the well and support the stemming material in the desired position. In such prior art structures, the bridge is usually constructed of a suitable fabric, such as canvas, and is carried on a series of bow members secured to a central rod or other suitable support in such manner that the bridge is biased toward an opened position but may be held in a closed position by a suitable releasable keeper structure during its descent into the well. Structures of this type are illustrated in W. Y. Bleakley, U. S. Patent No. 2,253,224, August 19, 1941.

While such structures have produced very satisfactory results in operation, they are open to the objection that when opened in a well, the segments of the canvas bridge member between the bow members may be snagged or pushed inwardly by projections in the well so that the rim of the bridge will not be in close contact with the well bore throughout its circumference. Such a condition will permit stemming material to be lost through the bridge and the bridge will fail to form a tight seal. Moreover, since the full open diameter of the bridge is ordinarily greater than the diameter of the well bore, folds may result in canvas or fabric between the supporting bows or ribs which may likewise form undesired openings through the bridge.

Moreover, projections in the well may cause the bridge, when opened, to be disposed at an angle to the axis of the well which will tend to weaken the grip of periphery of the bridge on the well wall, by imbalance of the expansive forces exerted by springs or other resilient structure usually employed to expand the bridge and hold its edge in contact with the well wall.

To overcome these objections, the present invention employs a bridge composed of a plurality of segmental wings or leaves constructed of sheet spring metal, such as spring brass or steel, which are assembled in an overlapping arrangement and each provided along one side edge with a reinforcing stave or bow member. The lower ends of the wings are suitably hinged

2

to a central supporting structure and the wings are biased toward the open position by suitable spring members arranged between the wings and the central supporting structure and by the natural resilience of the metal wings.

By this construction, the natural resilience of the wing elements is employed to supplement the biasing force of the springs so that the expansive force, when the bridge is opened, will be very greatly intensified and thereby greatly increase the tightness of the contact and the gripping forces between the upper edge of the bridge and the well wall. At the same time the relative stiffness of the spring metal employed for the wing elements will prevent wrinkling of the wings and thereby avoid formation of leakage channels through the bridge. Moreover, the overlapping construction of the wing segments will form an expansible pocket for receiving and supporting the stemming material which will allow the bridge segments to move circumferentially relative to one another to thereby permit the bridge to accommodate itself to any irregularities in the wall of the well bore and to conform closely thereto throughout its circumference, without forming any openings or leakage channels through the pocket formed by the wings.

Other and more specific features and advantages of the present invention will become apparent from the following detailed description, when read in conjunction with the accompanying drawings which illustrate useful embodiments in accordance with this invention.

In the drawings:

Fig. 1 is a view of the bridge in closed position in the course of being lowered into a well with an explosive shell secured to its lower end;

Fig. 2 is a longitudinal sectional view of the bridge structure when in closed position showing the generally spiral over-lapping arrangement of the bridge segments;

Fig. 3 is a view of the bridge in the open position in the well after it has reached the desired position with the stemming or tamping material arranged in the pocket and closing the well bore;

Fig. 4 is a longitudinal sectional view of the bridge in expanded position;

Fig. 5 is a cross-sectional view of the lower end of the bridge structure looking downwardly generally along line 5—5 of Fig. 4;

Fig. 6 is an enlarged detail of structure for resiliently biasing the wings relative to the central supporting structure for the bridge;

Fig. 7 is a view of one of the bridge segments

or wings, taken generally along line 7—7 of Fig. 6;

Fig. 8 is an elevational view of another embodiment of the bridge structure in accordance with this invention showing the bridge in closed position in the course of being lowered in a well; and

Fig. 9 is a longitudinal sectional view of the embodiment of Fig. 8 shown in expanded position.

The bridge structure consists of a central rod 1 carrying on its upper end a head 2 secured to the rod by means of a nut 3. A bail 4 is attached to head 2. The lower end of the rod carries a short downwardly tapering frusto-conical sleeve 5 surrounding the rod and having an upstanding flange 6 about its upper edge radially spaced from the rod. The lower end of sleeve 5 is closed by means of a cap 7 through which the lower end of rod 1 extends and is secured thereto by means of a nut 8. A lowering line 9 may be releasably secured to bail 4 by means of a hook 10, which may be any of the well known forms of releasable torpedo hooks. A safety bail 11, such as the safety hook described in Bleecker Patent No. 2,017,581 is attached to cap 7 and provides means for suspending torpedoes or explosive shells S from the bridge.

A base member includes a circular base plate 12 which is mounted transversely on rod 1 at a point generally level with the upper edge of flange 6 and is supported thereon by means of a nut 13. Base plate 12 has a down-turned peripheral flange 14 which is adapted to fit snugly inside flange 6. The peripheral portion of base plate 12 is also provided with a plurality of angularly spaced arcuate slots 15 forming receptacles for the lower ends of a plurality of reinforcing ribs 16, constructed preferably of rectangular sections of sheet steel having appreciable width, such that when the bridge is in the closed position the ribs will be closely adjacent edge-to-edge relation and thereby form a substantially continuous smooth sheath about the exterior of the bridge, as shown in Fig. 1. The lower ends of ribs 16 are provided with T-shaped heads 17, the side arms of which are adapted to extend laterally under the portions of base plate 12 forming the adjacent ends of slots 15 whereby to lock the lower ends of the ribs against withdrawal from slots 15. The connections thus formed between the ends of ribs 16 and base plate 12 constitute loose hinges about which the ribs may pivot in plate 12 radially with respect to the longitudinal axis of the device. (See particularly Figs. 5 and 6.)

The bridge proper is of segmental construction, being formed by a plurality of wing members 18, each of which is constructed of a single continuous piece of thin spring sheet metal, such as spring brass or spring steel, which has a relatively high degree of resilience when bent and has appreciable structural strength. Wing members 18, as illustrated particularly in Fig. 7, are all substantially identical in size and shape, having one side edge 19 which is vertically straight and the opposite side edge 20 somewhat shorter than side edge 19 and tapering generally upwardly and outwardly with respect to the latter. The upper edge 21 of the wing member defines a slightly downward curve from side edge 19, merging into the upper end of edge 20 in a rounded corner 20a. The lower edge 22 of the wing member which is, of course, somewhat shorter than upper edge 21 defines a slight upward curve from side edge 19 to its juncture with

side edge 21. In general, wing members 18 may be described as being of irregular trapezoidal shape.

Each of the wing members 18 has its straight edge 19 rigidly secured to the inner face of one of the ribs 16, as by brazing, spot welding, soldering or other conventional securing means, the edge 19 being disposed substantially flush with the left-hand edge of the rib so that the body of the wing member extends in the right-hand direction across the inner face of rib 16, which, by its width, provides a degree of supporting stiffness for the leading edge of the wing member. The remainder of the wing member trails from the rib into over-lapping relation with the inner surface of the next succeeding wing member, substantially as shown in Fig. 4. The length of each wing member along edge 19 is made such as to extend from a point immediately adjacent the upper end of the rib to which it is fastened to a point just above base plate 12. It will be seen that by means of this construction, the wing members will cooperate to form a flexible pocket having a continuous wall which is circumferentially extendible and contractible as ribs 16 pivot radially outwardly and inwardly, respectively, with respect to the longitudinal axis of the device. In the closed position the pocket will be generally cylindrical in form, open at its upper end and closed at its lower end by means of base plate 12. In the open position, the pocket will have a generally downwardly tapering conical shape, as illustrated.

Each of the wing members is normally biased toward its expanded or open position by means of a strong detent, indicated generally by the numeral 23, which has one end portion 24 held downwardly against the upper surface of base plate 12 by means of a suitable U-shaped bracket 25 through which this end portion of the detent may be inserted, during assembly, by sliding it radially inwardly along the upper surface of base plate 12 toward the center of the base plate. The free end portion 26 of detent 23 is bent upwardly at an angle to portion 24 and bears against the inner surface of wing member 18 opposite the rib 16 to which the wing is fastened. The force of the detent is thus resiliently applied against the inner face of each wing member and thereby normally urges the wing member outwardly toward its open position. The inner ends of portions 24 of the detents, which extend through brackets 26, are clamped firmly to the upper surface of base plate 12 by means of a circular clamping plate 27, which is of smaller diameter than base plate 12, and is mounted on rod 1. A nut 28 is threadedly mounted on rod 1 above clamping plate 27 and when tightened is adapted to urge the latter toward base plate 12 and thereby tightly clamp the inner ends of detent portions 24 therebetween.

A releasable locking means is employed for locking the bridge structure in the closed position when handling or shipping the bridge and while it is being lowered into a well. As shown, the upper end portion of each of the ribs, which extends above upper edge 21 of the attached wing member, is provided with an inwardly off-set portion 29 and these off-set portions form an annular groove 30 for the reception of suitable fastening means when the bridge is in closed position shown in Figs. 1 and 2. To retain the bridge in closed position against the pressure of detents 23 and other forces tending to open the bridge, a retaining ring 31 is provided which is secured

5

to one of the ribs, as indicated at 32, and which is provided with an eye 33 in each end. The ring is preferably made of spring metal and is of sufficient length to encircle the upper ends of the ribs when in closed position. When the bridge is in the closed position the grooved upper ends of the ribs abut against head 2 and ring 31 may be brought around the ribs and a cotter pin 34 placed in the two eyes 33 to retain the ring in closed position. Cotter pin 34 is connected to line 9 by a jerk line 35, as shown in Fig. 1, to permit its withdrawal. The locking means above described is substantially identical with that described in the above-mentioned Bleakley Patent No. 2,253,224 and is intended to be merely exemplary of various known forms of such releasable locking means, the details of which do not form a part of the present invention.

When the wing members are moved inwardly to the closed position, preparatory to inserting it in a well, the trailing portion of each wing will be forced to slide generally circumferentially over the inner surface of the next wing member, and will be circularly compressed in attaining the cylindrical structure of relatively small diameter corresponding to the closed position of the bridge. The result is that each wing member, by reason of its shape and dimensions, will be wound generally helically within the next wing member about rod 1 as the longitudinal axis. This arrangement is illustrated particularly in Fig. 2. By reason of the strong resilient properties of the metal employed to form the wing members, the bridge, when closed, will develop the characteristics of a tightly wound strong helical spring, so that the energy which will be stored in the wing members when being forced to the closed position, will be released when retaining ring 31 is opened, and will cause the bridge to fly open very rapidly and with great force. This expansive force will supplement that exerted by detents 23 which will also be released by opening of retaining ring 31. This combination of forces will not only assure the positive opening of the bridge to whatever diameter is necessary to bridge the well bore, but will also force the upper edge of the bridge into very tight frictional engagement with the well wall. The segmental construction of the bridge will allow it to accommodate itself to any irregularities in the well wall, and the structural stiffness of the wing members, supplemented by that of the ribs will prevent inward folding or wrinkling of the free portions of the wing members. The over-lapping relation of the wing members will enable them to provide mutual support for each other in supporting the load of the stemming material which will be deposited thereon. It will be understood, of course, that the wing members will be dimensioned so that when opened to the diameter of the particular well bore into which the bridge is to be run, the wing members will be in over-lapping relation so that no gaps or slits will be formed therebetween, particularly in the upper edge of the bridge.

The structure is employed in the following manner: With the bridge in the closed position and locked therein, as described, by means of retaining ring 31 and cotter pin 34, the device is suspended by means of bail 4 from lowering line 9 by attachment to hook 10, and the torpedo or shells S are then suspended from safety bail 11. Jerk line 35 will be connected to cotter pin 34. The bridge structure together with the shells suspended therefrom will then be lowered into

6

the well by means of lowering line 9 until the lower end of the lowermost shell S touches the bottom of the well. In many cases a conventional shot anchor of any suitable length or design may be suspended from the lowermost shell so that the explosive shells may be stopped at any desired point in the well above the bottom. When the shell string thus comes to rest in the well, the tension in lowering line 9 will be relieved permitting torpedo hook 10 to be released from bail 4 in the manner well understood by those skilled in this art. When hook 10 has been released, line 9 is pulled upwardly which will put tension on jerk line 35 and draw cotter pin 34 upwardly out of eyes 33 thereby opening ring 31 and releasing ribs 16, whereby the bridge will open quickly in the manner previously described and become firmly lodged in the bore of the well. Thereupon, stemming or tamping material may be introduced into the well and will be received in and on the bridge and form the desired plug in the well bore.

Figs. 8 and 9 illustrate another modification of the bridge structure in accordance with this invention in which the structure is modified slightly to provide means by which shells or torpedoes may be mounted within the bridge itself for purposes well understood in the well-shooting art.

In this embodiment, the construction of the wing members is substantially identical with that in the previously described embodiment. Base plate 12 is modified by providing a central opening 40 therein through which a short tubular sleeve 41 extends from a point inside the bridge above base plate 12 to the lower end of sleeve 5 which is provided with an inwardly turned annular flange 42 having a central opening 43 registering with the bore of sleeve 41.

Detents corresponding in function to detents 23 are arranged between the outer surface of sleeve 41 and the inner surfaces of the respective wing members to normally urge the latter toward their expanded position. The detents in the present embodiment are modified slightly in form to adapt them to the modified central structure of the present embodiment. As illustrated in Fig. 9, the modified detents are of generally V-shape, the points of the V's being suitably anchored to the upper surface of base plate 12, the inner arm 44 of each V bearing against the outer surface of sleeve 41 and outer arm 45 of each V bearing against the inner face of one of the wing members 18 opposite the rib 16 to which it is attached.

The shell string S extends through sleeve 41 and axially through the bridge to the upper end thereof. This shell string will be fastened to flange 42 or other part of the bridge in any suitable manner, as well understood and practiced in the well-shooting art. A bail 46 will be attached to the upper end of shell string S for connection of the shell string and the bridge to torpedo hook 10.

The operation of this structure is generally the same as that described in connection with the previous embodiment.

It will be understood that various changes and alterations may be made in the details of the illustrative embodiments without departing from the scope of the appended claims but within the spirit of this invention.

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

1. A well bridge, comprising, a horizontally disposed base member, a plurality of wing members

constructed of sheet spring metal arranged circumferentially about said base member, each of said wing members being of irregular generally trapezoidal shape having its leading edge longitudinally straight and its trailing edge sloping upwardly and rearwardly relative to said leading edge, the upper edge of each wing member curving downwardly and rearwardly from the leading edge to said trailing edge, the trailing portion of each wing member over-lapping the leading portion of the next succeeding wing member and slidably laterally over the inner surface thereof in response to radially expansive and retractive movements of the wing members relative to said base member, a plurality of elongated ribs secured to the exteriors of said wing members along said leading edges thereof, the lower ends of said ribs being pivotally connected to said base member at angularly spaced points about its periphery, a plurality of detents mounted on said base member and normally biasing said wing members toward their open position, and releasable means normally holding said wing members in inoperative position.

2. A well bridge, comprising, a horizontally disposed base member, a plurality of elongated metal ribs having their lower ends pivotally connected to said base member at angularly spaced points about its periphery, a plurality of wing members of irregular generally trapezoidal shape having a longitudinally straight leading edge, an up-

wardly and rearwardly sloping trailing edge, and an upper edge curving downwardly and rearwardly from said leading edge into said trailing edge, each of said wings being secured along its leading edge to the inner face of one of said ribs and extending therefrom into internal overlapping relation with succeeding wing members, said wing members being constructed of sheet spring metal, detent means mounted on said base member and normally biasing said wing members toward their open position, and releasable means normally holding said wing members in inoperative position.

3. A well bridge according to claim 2 wherein said base member has an upwardly extending rod fixedly secured thereto, and the upper end of said rod carries means for connecting a lowering line thereto.

4. A well bridge according to claim 2 wherein said base member has a central passageway therethrough, and a tubular sleeve extending through said passageway to a point above said base member.

WILLY A. SCHILLINGER.

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2,117,538	Baker	May 17, 1938
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