Nov. 1, 1966 D. V. CHENOWETH 3,282,347

WELL BORE BRIDGE APPARATUS

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Fig. 1

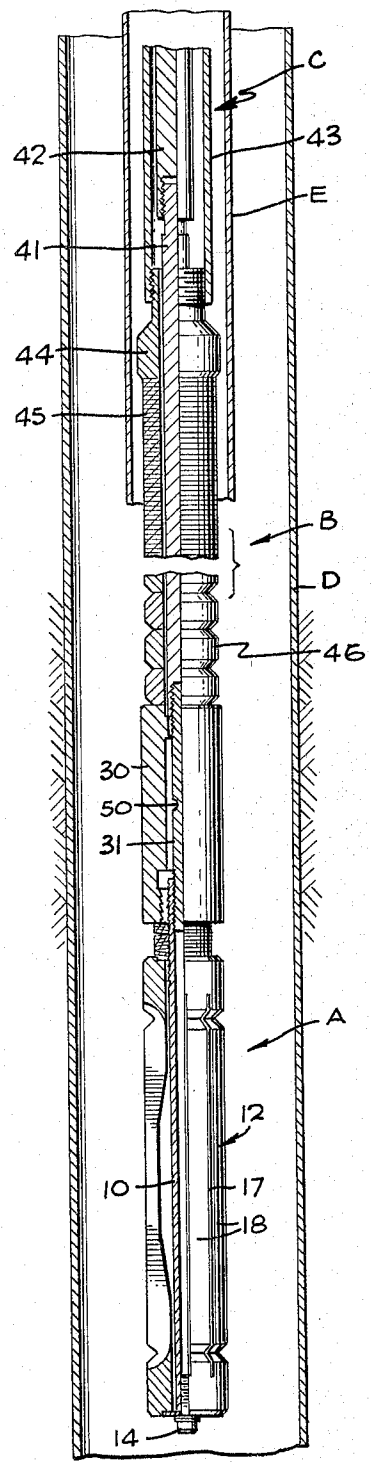


Fig. 2

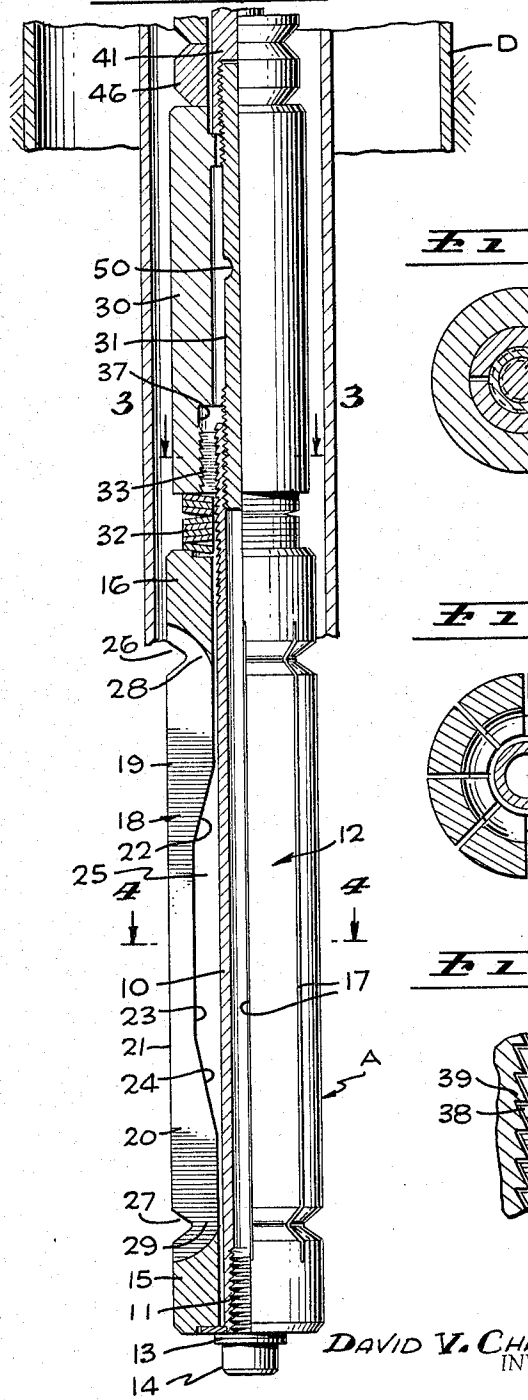


Fig. 3

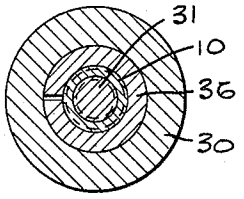


Fig. 4

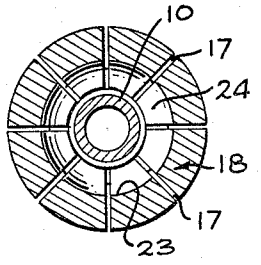
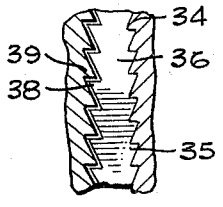


Fig. 5



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Fig. 6

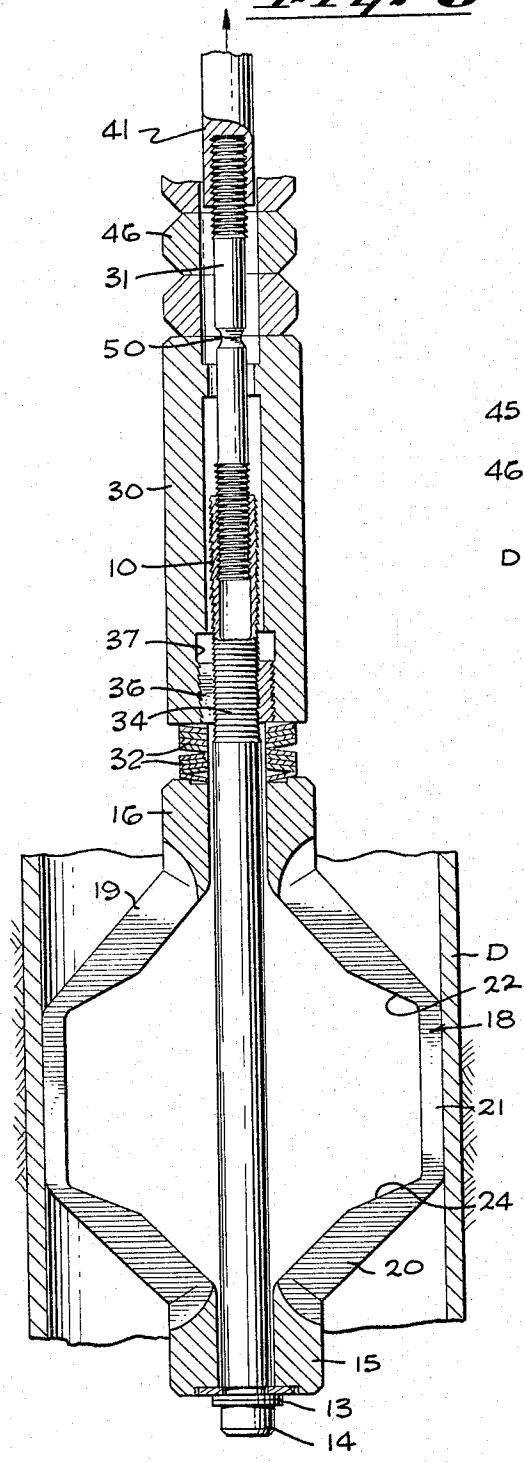
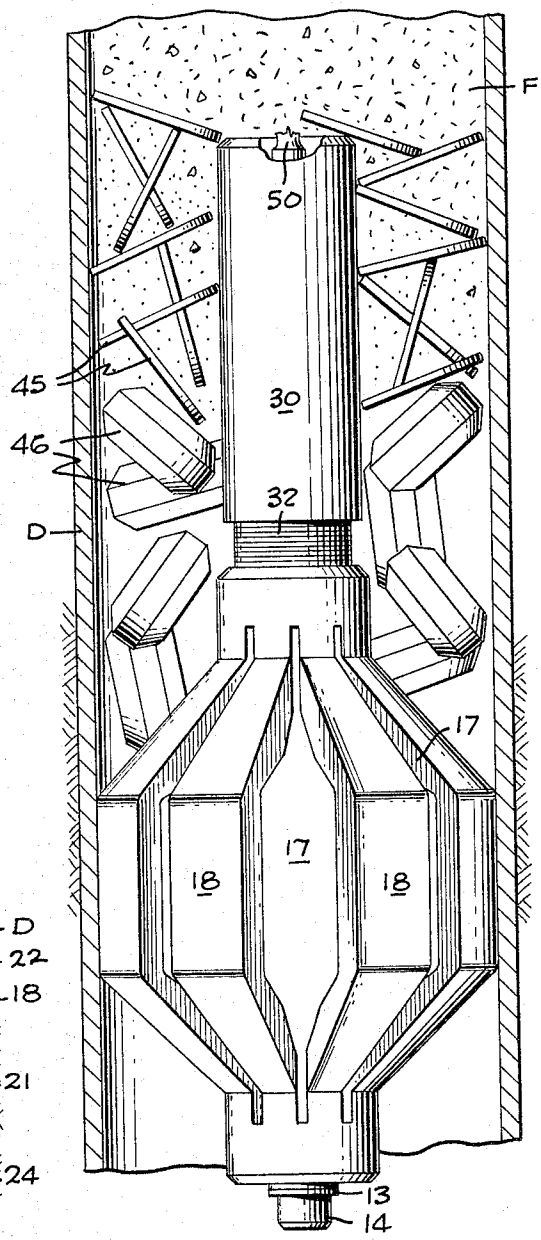


Fig. 7



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Fig. 8

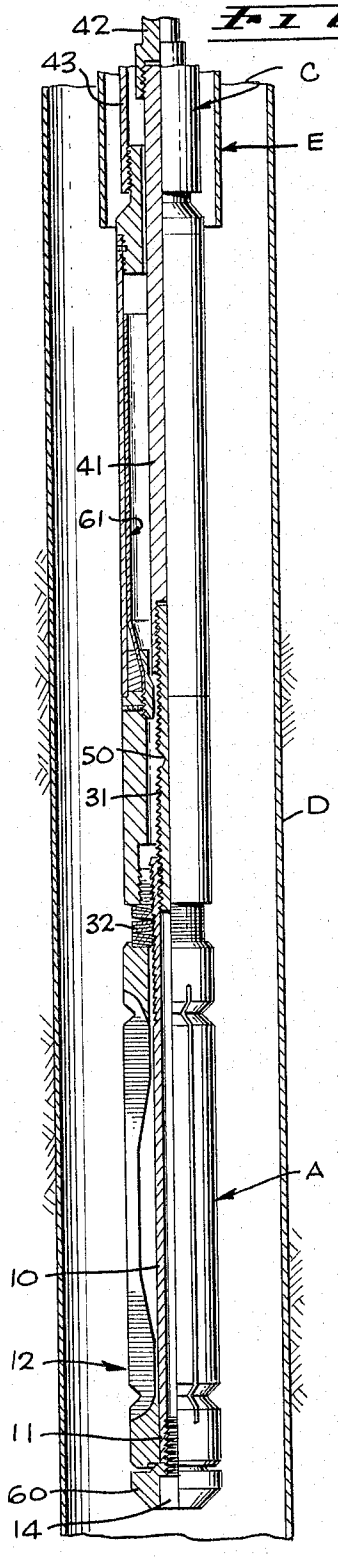


Fig. 9

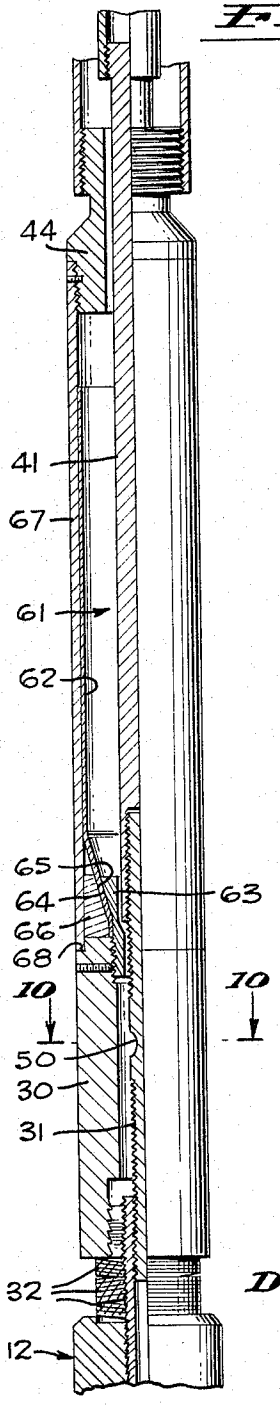


Fig. 10

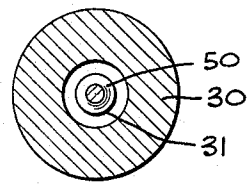
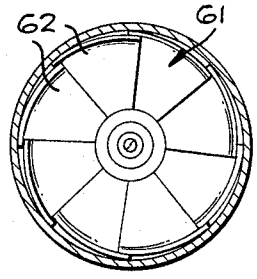


Fig. 13



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Fig. 11

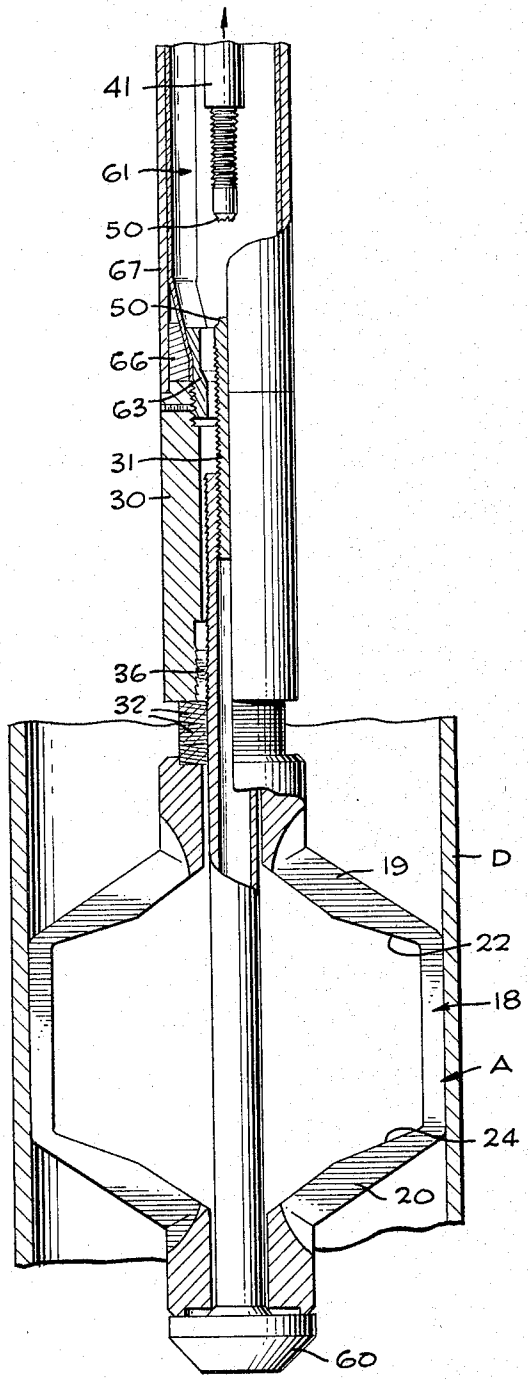
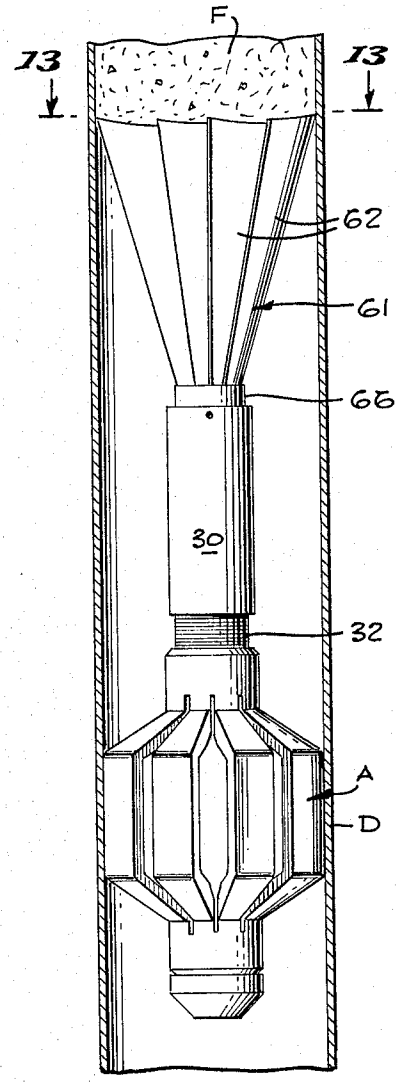


Fig. 12



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United States Patent Office

3,282,347

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3,282,347

WELL BORE BRIDGE APPARATUS

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Filed Mar. 9, 1964, Ser. No. 350,265
18 Claims. (Cl. 166—196)

The present invention relates to subsurface well bore equipment, and more particularly to bridging apparatus adapted to be provided in well bores, as within well casing and other conduit strings disposed in well bores.

An object of the invention is to provide an improved bridging plug adapted to be lowered in a conduit string disposed in the well bore and to be expanded into frictional engagement with the wall of the conduit string, the friction force of engagement being comparatively great, enabling the plug to offer substantial resistance to longitudinal displacement in the conduit string.

Another object of the invention is to provide a bridging plug adapted to be lowered in a conduit string in a well bore and to be expanded into frictional engagement with the wall of the conduit string over a large area, the plug inherently exerting a continuing force tending to maintain it in firm friction engagement with the conduit.

A further object of the invention is to provide an improved bridging plug adapted to be lowered in a conduit spring in a well bore and having a large range of expansion to frictionally engage it with the wall of the conduit string. Such large expansion of the plug allows it to be lowered through a tubing string disposed in the well conduit having a much greater diameter than the tubing string itself, and yet be firmly and tenaciously frictionally anchored against the conduit.

An additional object of the invention is to provide a bridging apparatus adapted to be lowered in a well conduit disposed in a well bore, and including a lower plug portion adapted to be expanded into frictional engagement against the wall of the conduit and a basket portion thereabove adapted to expand against the wall of the conduit to support bridging material that might be deposited thereupon. The plug and backet are capable of being run in a retracted state through a tubing string disposed in a conduit and of having a large range of outward expansion below the lower end of the tubing into appropriate engagement with the conduit wall.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a combined side elevational view and longitudinal section through an apparatus disposed in a well bore containing a string of well casing, or other conduit string, and a string of tubing within the casing string, the apparatus being in its initial condition;

FIG. 2 is an enlarged combined side elevational view and longitudinal section through the lower portion of the apparatus disclosed in FIG. 1;

FIG. 3 is an enlarged cross-section taken along the line 3—3 on FIG. 2;

FIG. 4 is an enlarged cros-ssection taken along the line 4—4 on FIG. 2;

FIG. 5 is an enlarged fragmentary section of the lock or latch portion of the apparatus;

FIG. 6 is a longitudinal section, with parts shown in elevation, of the briding plug portion of the apparatus expanded into frictional engagement with the wall of the well casing;

FIG. 7 is a side elevational view of the apparatus frictionally set against the wall of the well casing with other bridging material deposited therewithin, and with the running-in and setting equipment detached therefrom and removed from the well bore;

FIG. 8 is a combined side elevational view and longitudinal section corresponding to FIG. 1, and disclosing another embodiment of the invention;

FIG. 9 is a combined longitudinal section and side elevational view of the upper portion of the apparatus disclosed in FIG. 8;

FIG. 10 is a cross-section taken along the line 10—10 on FIG. 9;

FIG. 11 is a view corresponding to FIG. 9 disclosing the lower bridging portion of the apparatus set against the wall of the well casing;

FIG. 12 is a side elevational view of the apparatus of FIGS. 8 to 11 in its expanded condition within the well casing, and with other bridging material deposited upon its upper basket portion;

FIG. 13 is a section taken along the line 13—13 of FIG. 12.

In the form of invention illustrated in FIGS. 1 to 7, inclusive, a lower bridge plug A is operatively associated with a bridging device B thereabove, the upper portion of the apparatus being operatively associated with a setting device C of a known type, which has the purpose of setting bridging plugs against the wall of a well casing D, or other conduit string. The setting device, bridging member and bridge plug disclosed in the drawings initially are of a relatively small diameter to permit their movement downwardly through a tubing string E disposed in the casing string. When the apparatus A, B, C is located below the lower end of the tubing string E, the bridge plug device A is adapted to be expanded outwardly against the wall of the well casing D, the setting tool C disconnected therefrom, and the bridging elements B deposited upon the bridge plug, offering a composite structure bridging the interior of the casing string upon which suitable material F can be deposited, such as gravel, sand, cement or other cementitious material, and the like.

The bridge plug portion A of the apparatus includes a central longitudinal body 10, which may be tubular, the lower end of which is closed by a body plug or screw 11. Surrounding the body is an elongate bridging and anchoring member or sleeve 12, the lower end of which rests upon washers 13, or other thrust transmitting elements, bearing against the head 14 of the body plug 11. The bridging member 12 is an integral structure, in that it is made of one piece. It includes a lower circumferentially continuous portion 15 and an upper circumferentially continuous portion 16. Between such upper and lower portions, the member has circumferentially spaced longitudinal slots 17 extending therethrough, providing a plurality of longitudinal or elongate ribs or beam portions 18 of the sleeve. Each rib or beam may be deemed to have three essential parts, including an upper thrust arm 19 integral with the upper circumferentially continuous portion 16, a lower thrust arm 20 integral with the lower circumferentially continuous portion 15, and an intermediate casing gripping portion 21 integral with and extending between the upper and lower arms 19, 20. The exterior of each rib or beam 18 is initially substantially parallel to the axis of the apparatus, the exterior of the sleeve 12 itself being cylindrical throughout its length. Each upper arm 19 has an inner surface 22 inclined in a downward and outward direction, merging into an inner surface 23 of the intermediate gripping portion which may

be substantially parallel to the axis of the apparatus. The lower end of the inner surface 23 of the intermediate gripping portion merges into an inner tapered surface 24 of the lower arm 20 which is inclined in a downward and inward direction. In general, the inclined surfaces 22, 24 of the upper and lower arms of each rib or beam converge toward each other in a laterally outward direction, forming with the inner intermediate surface 23 an internal cavity 25 within the sleeve 12.

The bridging and anchoring member or sleeve 12 is made of a malleable deformable material, such as soft aluminum, so that the movement of the upper and lower circumferentially continuous portions 16, 15 longitudinally relatively toward each other will cause the upper arms 19 and lower arms 20 to pivot outwardly and expand the intermediate gripping portions 21 into frictional engagement with the wall of the well casing D. For the purpose of facilitating the outward swinging of the upper and lower arms, an external circumferential groove 26 may be formed around the upper portions of the upper arms 19, and a lower external circumferential groove 27 may be formed around the lower portions of the lower arms 20, providing upper and lower fulcrum regions 28, 29 at the upper and lower portions of the upper and lower arms, respectively, about which the arms may pivot when the upper and lower circumferentially continuous portions 16, 15 are moved longitudinally toward each other. As described hereinbelow, such relative longitudinal movement occurs as a result of moving the body 10 of the tool relatively upwardly, which will move the lower circumferentially continuous portion 15 relatively upwardly, and by exerting a downward force or movement on the upper circumferentially continuous portion 16, the shortening in the overall length of the bridging and anchoring member or sleeve 12 causing the upper and lower arms 19, 20 to swing outwardly about their upper and lower fulcrum portions 28, 29 to force the intermediate gripping portions 21 into firm frictional engagement with the wall of the well casing D.

A substantial force is imposed on the upper and lower ends of the bridging and anchoring member 12 in effecting the outward swinging of the upper and lower thrust arms 19, 20 and the bringing of the gripping portions 21 into firm frictional engagement with the wall of the well casing along an extended length and over a large area to stress the soft aluminum beyond its yield point, causing the arms and gripping portion to undertake a permanent deformation, such as disclosed in FIGS. 6 and 7. As described hereinbelow, the force on the upper and lower ends is maintained to insure the retention of the gripping portions 21 firmly against the wall of the well casing, the upper and lower thrust arms 19, 20 retaining the internal stresses that have been imposed upon them, and acting as diagonal beams or braces which are under considerable compression, exerting an outward force upon the intermediate gripping portions 21, which are also maintained in lengthwise compression.

Although it is preferred to make the bridging and anchoring member or sleeve 12 of soft aluminum, other malleable deformable materials can be used, as, for example, soft copper and soft brasses. Such materials are not only deformable to bring the intermediate gripping portions 21 into engagement with the wall of the well casing over large areas of extended length, but they also exhibit a comparatively high coefficient of friction against the wall of the well casing D, or other conduit string.

The downward force on the upper portion 16 of the bridging and anchoring member is transmitted through a thrust and retainer sleeve 30 surrounding a longitudinally extending release stud 31, the lower end of which is threadedly, or otherwise suitably, secured to the upper end of the body 10. Such downward force is transmitted through a plurality of spring-like members 32, which can exert a comparatively large force when compressed. As specifically disclosed, a plurality of conical springs

32, known as Belleville washers, surround the body 10 and rest upon the upper end of the bridging and anchoring member 12, the lower end of the thrust sleeve 30 engaging the upper end of the conical springs. To maintain the springs in compression following expansion of the ribs or beams 18 of the anchoring member 12, the thrust and retainer sleeve 30 is prevented from having return upward movement with respect to the body 10 through utilization of a one-way latch device 33. As disclosed, the upper portion of the periphery of the body has ratchet teeth 34 facing in a downward direction extending for a substantial distance along its length, these teeth being engageable by a plurality of companion upwardly facing ratchet teeth 35 on the interior of a split lock or ratchet ring 36 disposed within a counterbore 37 in the lower portion of the thrust sleeve. The split, expansible lock ring 36 has external cam teeth 38 facing in an upward direction adapted to mesh with companion internal cam teeth 39 formed in the wall of the counterbore of the thrust sleeve. By virtue of the lock ring arrangement described, the thrust sleeve 30 can move downwardly along the release stud 31 and body 10, but any tendency for the thrust sleeve to move upwardly relative to the body and release stud will cause the cam teeth 38, 39 to urge the lock ring 36 inwardly and hold the ratchet teeth 34, 35 in mesh with one another.

The upper end of the release stud 31 is threadedly connected to the lower end of a tension mandrel 41, the upper end of which is, in turn, threadedly secured to the lower end of a mandrel 42 forming part of the setting tool C, by means of which the apparatus is lowered in the well bore on a wire line (not shown). The setting tool may be of the type disclosed in United States Patent No. 2,653,666, but per se forms no part of the present invention. As described in such patent, the creation of a pressure in the setting tool causes upward movement of the mandrel 42 and downward movement of a thrust sleeve 43, the lower end of this setting sleeve being threadedly attached to an adapter 44 surrounding the tension mandrel 41, which bears against the upper end of a stack of washers 45 of suitable number and longitudinal extent, the lower end of the stack resting upon the upper end of a stack of thicker washers or beads 46 surrounding the tension mandrel 41, the lowermost bead bearing against the upper end of the thrust and retainer sleeve 30. Thus, the downward movement and force imposed by the setting tool C on its setting sleeve 43 is transmitted through the washers 45, 46 to the thrust sleeve 30 and from the latter through the conical spring washer members 32 to the upper portion 16 of the bridging and anchoring member 12. The upward motion and force of the setting tool mandrel 42 is transmitted through the tension mandrel 41 to the release stud 31, and from the latter to the body 10, and through the body, body plug 14 and washers 13 to the lower portion 15 of the bridging and anchoring member. The release stud 31 is provided with an intermediate peripheral groove 50 providing a weakened section at which the stud can pull apart when a predetermined tensile pull is imposed thereupon, as described hereinbelow.

The diameter of the apparatus A, B, C disclosed in FIGS. 1 to 5 is less than the inside diameter through the tubing string E disposed in the well casing D. The tubing string can have a much lesser diameter than the inside diameter of the casing, or other conduit string. The apparatus is suitably connected to the setting tool and is lowered by means of the wire line through the tubing string until it exits below the lower end of the tubing string and is located in the desired position within the well casing at which the bridging plug is to be set. When the setting point is reached, the setting tool C is actuated in the manner described in the above Patent No. 2,653,666, causing a substantial upward force to be exerted through the mandrel 42, tension mandrel 41, release stud 31 and body 10 upon the lower end of the bridging and

anchoring member sleeve 12, and a substantial downward force to be imposed through the setting sleeve 43, adapter 44, washers 45, beads 46, thrust sleeve 30 and conical springs 32 onto the upper end of the bridging and anchoring member, the upper and lower portions 16, 15 of the member 12 being moved toward each other and resulting in outward swinging of the upper and lower thrust arms or struts 19, 20 and the bringing of the intermediate or gripping portions 21 of the ribs or beams 18 into contact with the wall of the well casing. As the force of the setting tool C increases, the endwise force exerted on the upper and lower portions of the bridging and anchoring member 12 is increased to further place the thrust arms or struts 19, 20 into greater compression and exert a greater outward force on the gripping portions 21 of the ribs or beams, the latter being caused to engage the wall of the well conduit with great force. During downward movement of the thrust sleeve 30 along the body 10 of the tool, the ratchet ring 36 ratchets downwardly over the body teeth, the downward force effecting a compression of the conical springs 32 and storing spring energy therewithin of considerable magnitude, the spring force being transmitted to the upper end of the bridging and anchoring member 12. As the setting force continues to increase, it will eventually exceed the tensile strength of the weakened section 50 of the release stud 31, the latter disrupting at such weakened section, which will effect a release of the setting portion C of the apparatus from the bridge portion of the apparatus.

Following disruption at the weakened section 50, the setting force imposed by the setting tool is no longer being transmitted to the bridge plug A, but the energy imparted to the latter remains, inasmuch as the one-way latch ring 36 prevents relative upward movement of the thrust and retainer sleeve 30 with respect to the body 10, the parts remaining in the position illustrated in FIG. 6, with the springs 32 in a highly compressed state, and with a large amount of energy stored in the lever thrust arms or struts 19, 20 and in the intermediate gripping portions 21. Since these malleable members have been stressed beyond the yield point of their material in being expanded outwardly against the wall of the well casing, they will not tend to return to their initial retracted position disclosed in FIG. 1. The energy in the portions of the ribs or beams 18 will remain, being supplemented by a continuous force exerted by the springs 32 upon the upper end of the bridging and anchoring member 12 and also upon its lower end, since the springs are exerting upward force on the thrust sleeve 30, which is transmitted from the latter through the lock ring 36 to the body 10 of the tool, and from the latter through the body plug 11 and washers 13 to the lower end of the anchoring member.

Upon disruption of the release stud 31 at its weakened section 50, the setting tool C can be elevated, which will permit the mandrel 42 and setting sleeve 43 of the setting tool to move upwardly, carrying with it the tension mandrel 41 and the setting sleeve adapter 44. The removal of the tension mandrel 41 from within the washers 45 and beads 46 allows the latter to drop downwardly on the set bridging plug A, forming a conglomeration of washers and beads, such as disclosed in FIG. 7, which will assist the lower bridging device A in forming a supporting bridge across the well casing. The setting apparatus C can now be removed upwardly through the tubing E and suitable material F deposited through the tubing string thereupon. As an example, sand or gravel F may be dumped on the mass of beads 46 and washers 45, followed by the dumping of cementitious material, such as cement slurry, which will set and harden to form a desired plug in the well casing D, the sand, gravel or cement being dumped through use of a suitable bailer (not shown) capable of passing through the tubing.

In the form of invention disclosed in FIGS. 8 to 13, the bridging plug A is substantially the same as illustrated in the other embodiment of the invention. Specifically, a gauge ring 60 of greater transverse dimension surrounds the body plug 11, the head 14 of the cap screw or plug engaging such ring, which, in turn, engages the lower end of the bridging and anchoring member or sleeve 12. In lieu of the washers and beads, a different form of bridging device is employed. Specifically, a frusto-conical basket 61 is disposed above the plug. As shown in FIGS. 8 and 9, the basket is of a known type, being made of overlapping leaves or "petals" 62 of relatively thin sheet metal, such as spring steel, the lower ends of the circumferentially overlapping elements 62 being secured to the upper portion of the thrust sleeve 30. As shown, an inner clamp member 63 is threadedly secured to the upper end of the thrust sleeve 30, having a tapered surface 64 engaging the inner ends of the leaves 62, forcing them against an opposed tapered surface 65 on an outer clamp ring 66, which bears against the upper end of the thrust sleeve. It is evident that the threading of the inner clamp ring 63 downwardly within the thrust sleeve forces the outer clamp ring 66 against the upper end of the thrust sleeve 30 and clamps the lower ends of the leaves 62 between the inner and outer clamp members.

Initially, the circumferentially overlapping leaves or "petals" 62 are retained in a retracted position surrounding the tension mandrel 41 by an encompassing housing and thrust sleeve 67, the upper end of which is threadedly secured to the setting sleeve adapter 44 and the lower end of which bears against an upper shoulder 68 on the thrust sleeve 30.

The apparatus illustrated in FIGS. 8 and 9 is lowered through the string of tubing E by means of the wire line (not shown) connected to the setting tool C, of which the mandrel 42 and setting sleeve 43 form a part, until the apparatus is located at the required setting point in the well casing D below the lower end of the tubing. The setting tool C is is then actuated, resulting in an upward movement and force being transmitted through the mandrel 42, tension mandrel 41, release stud 31, body 10, body plug 11 and gauge ring 60 upon the lower end of the bridging and anchoring member 12. The downward force and movement of the setting sleeve 43 is transmitted through the adapter 44, basket confining housing 67, thrust sleeve 30 and springs 32 onto the upper end of the aluminum bridging and anchoring member or sleeve 12. As was described in connection with the other form of the invention, the movement of the upper and lower ends of the bridging and anchoring member toward each other will result in outward expansion of the upper and lower thrust arms 19, 20, expanding the intermediate gripping portions 21 into firm frictional engagement with the wall of the well casing, the conical springs 32 having energy stored in them, and the body lock device 33 preventing return upward movement of the thrust sleeve 30 relative to the body 10. When the setting force exceeds the tensile strength of the disruptable section 50, the latter is pulled apart, permitting the setting tool C to be elevated in the well casing, carrying the tension mandrel 41 upwardly with it, and elevating the housing 67 along the basket 61 until the housing is completely removed therefrom. Removal of the restraining housing 67 from its encompassing position around the basket "petals" permits the latter to expand inherently outwardly to bring their upper free ends against the inner wall of the well casing D, such as disclosed in FIGS. 12 and 13, the leaves or "petals" sliding circumferentially along one another. Thus, substantially the entire cross-sectional area of the well casing is bridged by the lower bridge plug A, which supports the expanded frusto-conical basket 61 thereabove.

The setting apparatus C can be removed through the tubing string E and a suitable bridging material F then lowered in a suitable dump bailer, or the like, through the tubing string to a position immediately above the expanded basket 61, being dumped thereupon. The bridg-

ing material may be sand or gravel, followed by the dumping of a charge of cementitious material.

I claim:

1. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a malleable deformable bridging member surrounding said body and comprising a plurality of longitudinally extending ribs; means for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body and to stress said ribs beyond their yield point; and means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly.

2. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; means for relatively moving said upper and lower portions toward each other to expand the intermediate portions of said ribs outwardly of said body; and means for preventing movement of said upper and lower portions away from each other to retain said intermediate portions expanded outwardly.

3. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; said ribs adjacent to said upper and lower portions having external circumferential grooves; means for relatively moving said upper and lower portions toward each other to expand the intermediate portions of said ribs outwardly of said body; and means for preventing movement of said upper and lower portions away from each other to retain said intermediate portions expanded outwardly.

4. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a malleable deformable bridging member surrounding said body and comprising a plurality of laterally extending ribs, the intermediate portions of said ribs being of substantially less cross-sectional area than the upper and lower portions of said ribs; means for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body and to stress said ribs beyond their yield point; and means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly.

5. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; the intermediate portions of said ribs being of substantially less cross-sectional area than the upper and lower portions of said ribs between said intermediate portions and said upper and lower circumferentially continuous portions, respectively; means for relatively moving said upper and lower portions toward each other to expand the intermediate portions of said ribs outwardly of said body; and means for preventing movement of said upper and lower portions away from each other to retain said intermediate portions expanded outwardly.

6. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; the intermediate portions of said ribs being of substantially less cross-sectional area than the upper and lower portions of said ribs between said intermediate portions and said upper and lower circumferentially continuous portions, respectively, said ribs adjacent to said upper and lower portions having external circumferential grooves; means for relatively moving said upper and lower portions toward each other to expand the intermediate portions of said ribs outwardly of said body; and means for preventing movement of said upper and lower portions away from each other to retain said intermediate portions expanded outwardly.

7. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a malleable deformable bridging member surrounding said body and comprising a plurality of longitudinally extending ribs; coengageable means on said body and lower portion of said member preventing downward movement of said lower portion along said body; shifting means engaging said upper portion of said member and movable downwardly of said body to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body and to stress said ribs beyond their yield point; and lock means on said body and shifting means preventing upward movement of said upper portion along said body to retain said intermediate portions expanded outwardly.

8. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a malleable deformable bridging member surrounding said body and comprising a plurality of longitudinally extending ribs; coengageable means on said body and one end portion of said member preventing longitudinal movement of said one end portion along said body; a spring device engaging the opposite end portion of said member; shifting means comprising said spring device movable longitudinally of said body toward said one end portion to expand the intermediate portions of said ribs outwardly of said body and to stress said ribs beyond their yield point; and lock means on said body and shifting means preventing return movement of said shifting means to retain said intermediate portions expanded outwardly.

9. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; coengageable means on said body and lower portion preventing downward movement of said lower portion along said body; shifting means engaging said upper portion and movable downwardly of said body to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body; and lock means on said body and shifting means preventing upward movement of said upper portion along said body to retain said intermediate portions expanded outwardly.

10. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; coengageable means on said body and lower portion preventing downward movement of said lower portion along said body; a spring device engaging said upper portion; shifting means engaging said spring device and movable downwardly of said body to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body; and lock means on said body and shifting means preventing upward movement of said shifting means along said body to retain said intermediate portions expanded outwardly.

11. In a bridging apparatus adapted to be lowered and set in a well bore: a body; a one-piece malleable bridging member surrounding said body, comprising longitudinally spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extend-

ing ribs interconnecting said portions, the intermediate portions of said ribs being of substantially less cross-sectional area than the upper and lower portions of said ribs between said intermediate portions and upper and lower circumferentially continuous portions, respectively, said ribs adjacent to said upper and lower portions having external circumferential grooves; a spring device engaging said upper portion of said member; shifting means engaging said spring device and movable downwardly of said body to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body; and lock means on said body and shifting means preventing upward movement of said shifting means along said body to retain said intermediate portions expanded outwardly.

12. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a malleable deformable bridging member surrounding said body means and comprising a plurality of longitudinally extending ribs; means for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body means and to stress said ribs beyond their yield point; means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly; a laterally expandible barrier surrounding said body means above said bridging member; retaining means initially confining said barrier in retracted position; and means for removing said retaining means from said barrier to allow said barrier to expand laterally outwardly.

13. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a bridging member surrounding said body means and comprising a plurality of longitudinally extending ribs; an expandible barrier above said bridging member; a housing surrounding and initially confining said barrier in retracted position; means including said housing for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body means; means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly; and means for elevating said housing from said barrier to allow said barrier to expand laterally outwardly.

14. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a malleable bridging member surrounding said body means and comprising a plurality of longitudinally extending ribs; means for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body means; means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly; a laterally expandible basket surrounding said body means above said bridging member; retaining means initially confining said basket in retracted position; and means for removing said retaining means from said basket to allow said basket to expand laterally outwardly.

15. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a bridging member surrounding said body means and comprising a plurality of longitudinally extending ribs; an expandible basket above said bridging member; a housing surrounding and initially confining said basket in retracted position; means including said housing for relatively moving the upper and lower ends of said ribs toward each other to expand the intermediate portions of said ribs outwardly of said body means; means for preventing movement of said upper and lower ends of said ribs away from each other to retain said intermediate portions expanded outwardly; and means for elevating said housing from said basket to allow said basket to expand laterally outwardly.

16. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a malleable bridging member surrounding said body means and comprising a plurality of longitudinally extending ribs; coengageable means on said body means and lower portion of said member preventing downward movement of said lower portion along said body means; an expandible basket surrounding said body means above said bridging member; means including a thrust sleeve engaging the upper portion of said member; a housing surrounding and initially confining said basket in retracted position and engaging said thrust sleeve; means for shifting said body means upwardly and said housing and thrust sleeve downwardly to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body means; lock means on said body means and thrust sleeve preventing upward movement of said upper portion along said body means to retain said intermediate portions expanded outwardly; and means for elevating said housing from said basket to allow said basket to expand laterally outwardly.

17. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a one-piece malleable bridging member surrounding said body means, comprising spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; coengageable means on said body means and lower portion preventing downward movement of said lower portion along said body means; means engaging said upper portion including a thrust sleeve; an expandible basket secured to said thrust sleeve and surrounding said body means; a housing surrounding and initially confining said basket in retracted position and engaging said thrust sleeve; means for urging said body means upwardly and said housing and thrust sleeve downwardly to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body means; lock means on said body means and thrust sleeve preventing upward movement of said upper portion along said body means to retain said intermediate portions expanded outwardly; and means for elevating said housing from said basket to allow said basket to expand laterally outwardly.

18. In a bridging apparatus adapted to be lowered and set in a well bore: body means; a one-piece malleable bridging member surrounding said body means, comprising spaced upper and lower circumferentially continuous portions and a plurality of longitudinally extending ribs interconnecting said portions; coengageable means on said body means and lower portion preventing downward movement of said lower portion along said body means; a spring device engaging said upper portion of said member; a thrust sleeve above and engaging said spring device; an expandible basket secured to said thrust sleeve and surrounding said body means; a housing surrounding and initially confining said basket in retracted position and engaging said thrust sleeve; means for urging said body means upwardly and said housing and thrust sleeve downwardly to move said upper portion toward said lower portion and expand the intermediate portions of said ribs outwardly of said body means; lock means on said body means and thrust sleeve preventing upward movement of said upper portion along said body means to retain said intermediate portions expanded outwardly; and means for elevating said housing from said basket to allow said basket to expand laterally outwardly.

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