

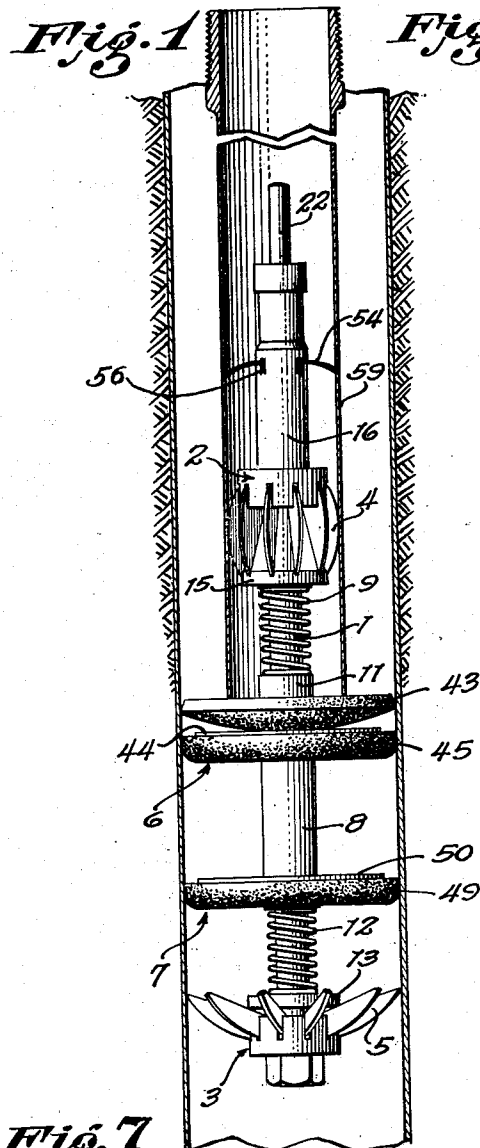
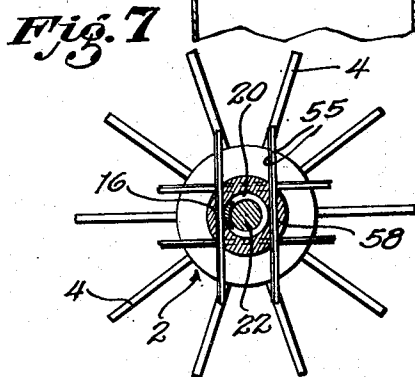
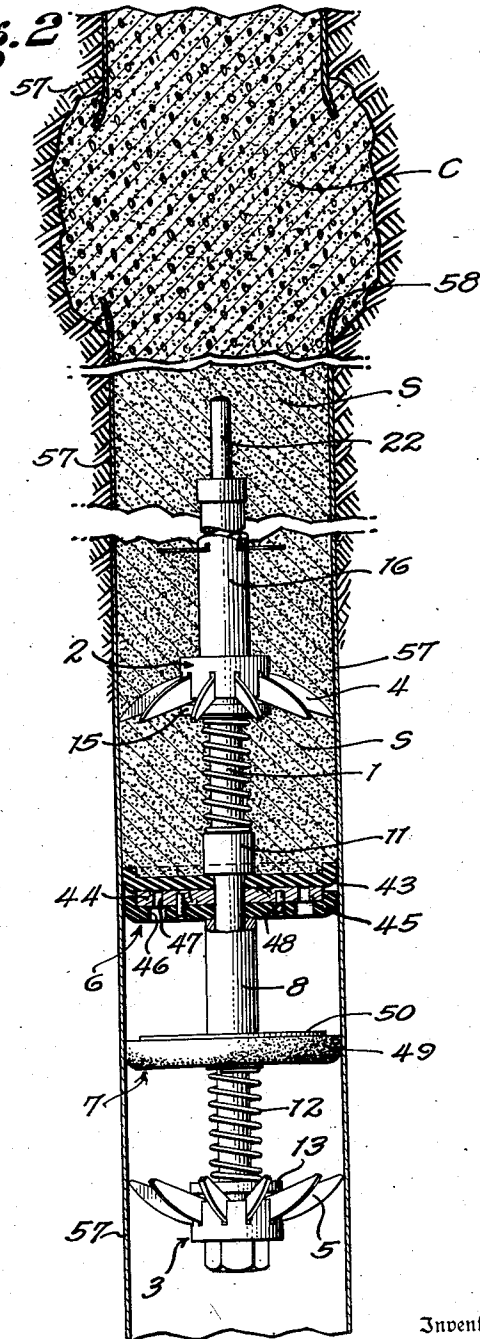
April 20, 1954

R. R. MacGREGOR
BRIDGING AND HEAVING PLUG

2,675,878

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2 Sheets-Sheet 1



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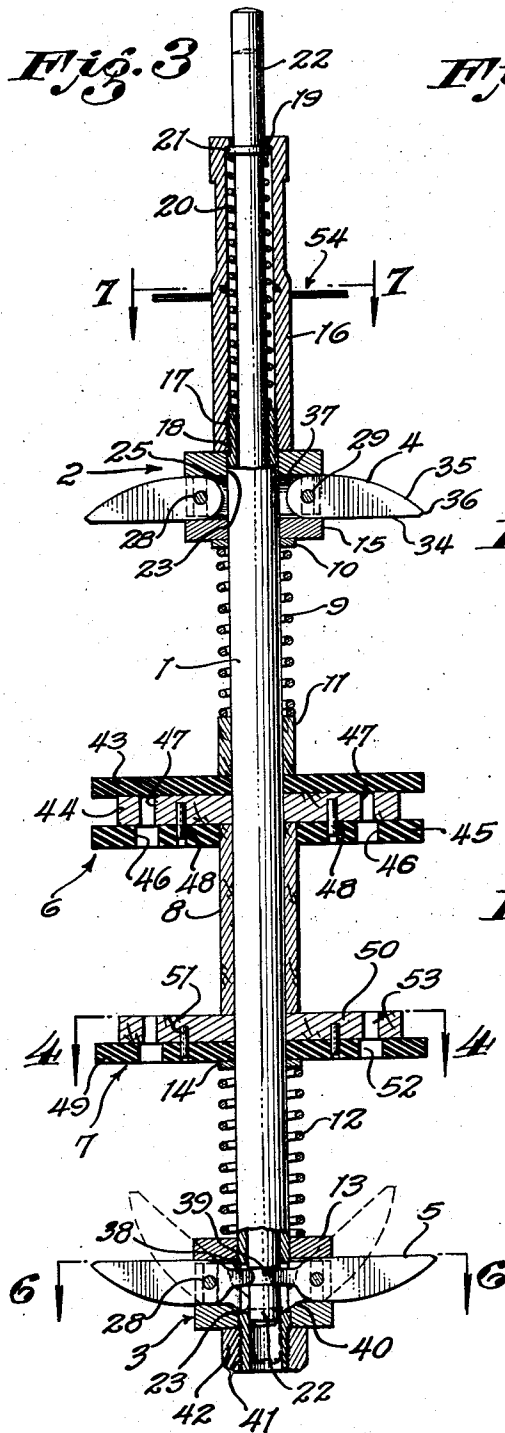
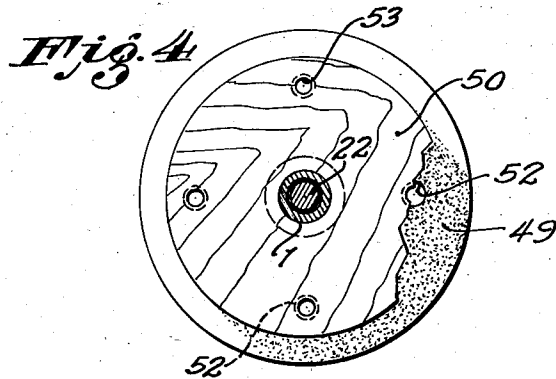
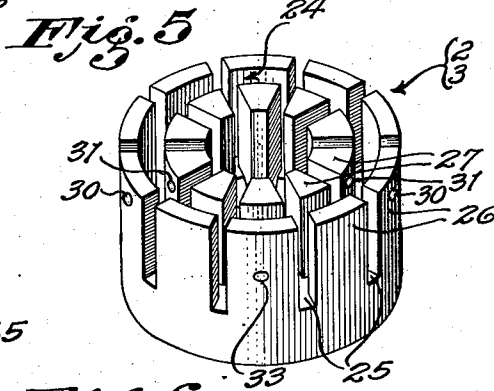
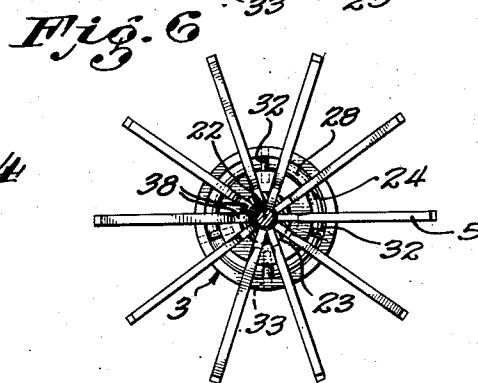
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UNITED STATES PATENT OFFICE

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BRIDGING AND HEAVING PLUG

Robert Roy MacGregor, Long Beach, Calif.

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3 Claims. (Cl. 166—13)

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The present invention relates to what is known in the oil industry as a bridging and heaving plug and is adapted for use in producing wells. Particularly, the invention has to do with that type of plug which contemplates using whip stocks in order to redrill a well hole at a certain area or to repair the casing, or to reopen what might be termed an abandoned hole, or to plug such an abandoned hole. The invention is to be distinguished from that class of plugs which are generally utilized for cementing around a casing.

The invention has for an object, the provision of a bridging and heaving plug, which may be readily set within a well casing at any desired location thereof, or for that matter, readily set in an open hole and which packs off the area both above and below the said plug in such a manner as to permit removal of said plug from the well hole or casing when desired.

A further object is the provision of a bridging and heaving plug which may be positioned at any desired location in a well hole and which plug is effectively held against movement in two directions when once positioned within the well hole.

It has been found in actual practice that the average plug when inserted within a well hole, may serve as a means for obstructing the well hole, but does not always function if there is any heaving within the well hole, such as may be caused by excess pressure of gas. This excess pressure will often lift the plug out of the well hole with possible injury to the operator and the well rig. It is therefore imperative that the plug be held against movement in two directions, that is, up or down in the well hole. So far as the inventor is aware, no bridging or heaving plug at present is capable of, through simple mechanism, being released so that the plug may be retrieved.

Other objects of the invention consist in a bridging and heaving plug which is of simple construction, foolproof in operation, inexpensive in cost of manufacture, easy to manipulate and generally superior to plugs now known to the inventor.

In the drawings:

Figure 1 is a longitudinal sectional view of a well hole showing casing in position with the bridging and heaving plug within the well casing, and prior to releasing the same;

Figure 2 is a fragmentary longitudinal sectional view of a well hole illustrating a broken area in the casing which is to be repaired to-

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gether with the bridging and heaving plug of the invention within the casing, and in operative position;

Figure 3 is an elevational view, partly in section of the bridging and heaving plug;

Figure 4 is a fragmentary sectional view on the line 4—4 of Figure 3;

Figure 5 is a perspective view of means carrying blades of the invention;

Figure 6 is a sectional view on the line 6—6 of Figure 3; and

Figure 7 is a sectional view on the line 7—7 of Figure 3.

Referring now with particularity to the drawings, reference is made to Figure 3, wherein is illustrated an elongated tubular-type mandrel 1, carrying two spaced apart cages 2 and 3, of the type illustrated in Figure 5. These cages each support, for movement, blades 4 and 5, of which there may be a multiple number, and interposed between the cages and in spaced-apart relationship are packers designated generally as 6 and 7. It is intended that the arrangement of the cages and their respective blades should be such that the blades 4 are capable of movement from the horizontal position shown in Figure 3 downwardly to the position illustrated in Figure 1 so as not to obstruct passage of the tool through an oil casing. In the case of the blades 5, said blades are so carried by their cage 3 that the blades will move from the horizontal position shown in Figure 3 upwardly in the manner illustrated in Figure 1 to allow the tool to readily pass downwardly within the casing. The construction of the cage and associated elements will be described later.

The packers 6 and 7 are mounted on the mandrel 1 and spaced apart by means of a spacer sleeve 8. Normally, the cages 2 and 3 are capable of slide movement upon the mandrel. However, this slide movement is restricted by means of coil springs. In the case of the cage 2 a coil spring 9 surrounds the mandrel, and engages at one end, a washer 10 which bears against a plate which engages the top of the cage, while the opposite end of said spring engages the top of a short length sleeve 11. The opposite end of the sleeve 11 abuts the top of the packer 6. The packer 7 is resiliently held against the lower end of sleeve 8 by means of a coil spring 12, which surrounds the mandrel, the lower end of said spring engaging an annular plate 13, while the opposite end of the spring engages a washer 14, positioned beneath the packer 7.

There is provided at 15 an annular plate, which

surrounds the mandrel below the cage 2. A tubular housing 16 is internally threaded at 17 for engagement with the threads 18 of the mandrel 1. The housing 16 has a reduced diameter end at 19, and said housing is adapted to confine a coil spring 20, one end of which spring engages the top of the mandrel, while the opposite end is adapted to engage a flange 21 for urging the flange in one direction. This flange is formed on an elongated release rod 22, which extends outwardly of the housing 16 and downwardly through the mandrel and cage 3. This release rod is adapted to actuate the blades 5.

Cages 2 and 3 have identical construction, which construction is illustrated in Figure 5, wherein the cage comprises a cylindrical body of more or less castellated form, which is to say, the body is provided with an axial bore 23, an annular groove 24 concentric to the bore 23, and which groove extends inwardly from one end of the said body, together with spaced-apart radial grooves 25. Such a construction results in the provision of outer segments 26 and inner segments 27. If in viewing Figure 5 we term the end of the body provided with castellations as the top, and the opposite end as the base, then the top of one cage is adapted to engage the washer 10 when the cage is carried upon the mandrel. A split ring 28, see Figure 6, is received within the annular groove 24, and each blade 4 is transversely bored or perforated at 29 adjacent the heel end thereof for reception on the ring 28. The blades are arranged to permit a blade to be received within each radial groove 25. Certain of the aligned inner and outer segments 26 and 27 are provided with transverse bores 30 and 31 adapted to receive pins 32, which span the annular groove 24, and whereby when the ring 28 with its blades is received within the cage, the said pins will hold the ring against removal from the cage, by being above the ring. To prevent any tendency of the ring 28 to rotate, a pin is inserted through a transverse bore 33, in the inner and outer segments, which pin passes between the split ends of the ring 28.

It will be observed that the blades 4 have a straight bottom edge 34, an arcuate or curved top edge 35 merging with the bottom edge in a point 36 with a curved heel 37 joining the arcuate top edge and the straight bottom edge. The annular plate 15 has a diameter equal to the external diameter of the cage and rests on the castellations. Plate 15 will move downwardly to compress spring 9 when the blades 4 are moved from the horizontal position of Figure 3 to the position shown in Figure 1. In the case of the lower cage 3, and the blades carried therein, said blades 5 have a straight upper edge and a curved back, the heel portions of which are provided with short length extensions or arms 38. This is the only change in construction between blades 4 and blades 5.

It is to be observed that the release rod inwardly from its lower end is provided with an annular groove 39 to receive the arms or extensions 38 of the blades 5. As in the case of blades 4, the blades 5 are provided with a transverse perforation to receive a ring of the type shown at 28, which ring with its blades 5, are assembled within the cage and held therein by the same type of pins 32. The single difference between the two cages resides in the provision of a conical wall 40, to accommodate the extensions 38 when the blades 5 are swung upwardly upon movement of the release rod in a downward direction.

The lower end of the mandrel is screw threaded at 41 to receive a nut 42, which bears against the base of the cage 3.

The packer 6 includes a flexible pack-off ring or disc 43, a backing plate 44 of some firm material, such as metal, wood, et cetera, and a second flexible pack-off ring 45 beneath the backing plate 44. The ring 43 is of greater diameter than the backing plate, while the pack-off ring 45 has the same diameter as ring 43. There is, however, a difference between the two pack-off rings in that ring 45 is provided with transverse, enlarged bores 46 at spaced points thereof, and which bores are in axial alignment with transverse bores 47 in the backing plate. To prevent any shifting in alignment of the bores 46 and 47, the backing plate and the ring 45 are held by pins 48.

The bottom packer 7 includes a pack-off ring or disc 49 of flexible material, and a rigid backing plate 50, the backing plate in this instance being on top of the ring 49, and secured thereto by pins 51. Ring 49 is provided with spaced apart transverse bores 52 which communicate with transverse bores 53 in the backing plate.

In addition to the elements just described, there is provided what is known as flexible guide means 54 (see Figures 3 and 7). The flexible guide means is used with the landing nipple in setting the tool within the well hole. Said means comprises a series of short length wires 55 passed through bores 56 in the housing 16, said wires extending beyond the housing as shown in the drawings. The ends of the wires may take different geometric forms although in Figure 7, pairs of wire members are in substantially right angular relationship to a second pair thereof. It is preferable that the transverse bores in the housing should lie within the wall of the housing so that the wires do not interfere with any movement of the spring 20.

The operation, uses and advantages of the invention just described are as follows:

In Figure 2, I have shown a well casing 57 within a well hole. This casing is damaged and broken away at 58, and it is necessary to cement the well hole at portion 59 to prevent water seepage within the casing. The tool of the invention is lowered in the well hole, utilizing a landing nipple 59. The nipple is, of course, attached to tubing, well line or drill pipe in the customary manner, and in Figure 1, the landing nipple is internally engaged by the wires 54 which function as a flexible guide for the tool. The landing nipple holds the blades 4 in a collapsed downward position, as illustrated, with the spring 9 compressed. As the landing nipple is lowered within the well hole, the bridging and heaving plug is passed beyond the portion 58 which is to be cemented, to the position illustrated in Figure 2. In moving downwardly through the well casing 57, the pack-off disc or ring 43 will be cupped upwardly, that is to say, the lower surface will assume a convexity and the upper surface a concavity, while the pack-off ring or disc 45 engages the base and curved edge of the backing plate 44 and bears against the inner surface of the casing.

The lower pack-off ring or disc engages the periphery of the backing plate 50 and the inner surface of the casing 57 in the manner illustrated in Figure 1, but as the blades 5 are swung upwardly relative to the cage during downward movement of the device, the spring 12 is compressed as shown in Figure 1. When the desired

location for release of the tool is reached, the landing nipple 59 is raised upwardly to release the blades 4, the device of the invention not following the landing nipple for the reason that the ends of the blades 5 will engage the casing and prevent such movement. The next operation consists in placing sand within the casing and over the top of the tool in the manner illustrated in Figure 2, wherein sand indicated by the letter S engages the pack-off ring 43 to move the ring from the position shown in Figure 1 to that of Figure 2 wherein the edge of said ring tightly engages the inner surface of the casing. Thus, the tool above said pack-off ring is completely covered with sand. Cement C is then poured into the casing in the area defined by the break 58 and into the formation. After this cement has hardened sufficiently, it is drilled by the usual tools to provide a hole therethrough having the internal diameter of the casing, thus leaving the cement in the formation and sealing off this particular area.

The device of the invention may then be withdrawn to the surface of the well by means of a drop overshot which will strike the top of the release rod 22 and move the blades 5 at their inner ends downwardly and the outer ends upwardly so that said outer ends no longer tightly engage the inner surface of the casing in the well hole. The usual means associated with the overshot will then raise the device to the surface of the well, and the device is saved for further use.

It is apparent that any tendency to heave within the casing will not affect the tool, for the reason that the blades 5 prevent upwardly movement thereof and the transverse openings in the backing plates and the pack-off rings permit relief of pressure beyond the packers and upwardly of the well casing. Thus, the packers effectively hold sand against dropping through the casing to a lower level and at the same time assure that the tool will not be lifted outwardly of the well hole, with disastrous results to the equipment, in the event of a blow-off. Quite obviously, after the cement has been placed in position and bored, means may be utilized to remove the sand and the ground cement. In no case, during this sequence of operation has any portion of the well hole beneath the bridging and heaving plug been contaminated or fouled by the material thereabove. It is evident that the use of two spaced packers acts to stabilize the device within the well hole, so that the device will not shift position to one side or the other or have any tendency to rock when it is supporting sand above the top packer.

I claim:

1. A bridging and heaving plug including a tubular mandrel, upper and lower cages spacedly carried on said mandrel, spaced blades pivoted to and radially extending from each cage, annular plates longitudinally slidably mounted on the mandrel, and overlying each cage, for engagement with the blades carried thereby, pack-off means comprising an annular flexible disc and a backing plate therefor carried on the mandrel between the cages, and separate coil springs carried on the mandrel on either side of the pack-off means and engaging the annular plates to move each plate into blade engagement, to urge the blades into a horizontal position.

2. The device as set forth in claim 1, including a tubular housing carried by the upper end of said mandrel, an elongated rod extending beyond and through said tubular housing and said mandrel, and a coil spring surrounding and engaging said rod and positioned within the tubular housing, for urging the rod outwardly of the tubular housing; said blades carried by the lower cage provided with means engaging the rod whereby downward movement of the rod moves the blades upwardly from a horizontal position.

3. A bridging and heaving plug including a tubular mandrel, upper and lower cages spacedly carried on said mandrel, spaced blades pivoted to and radially extending from each cage, annular plates longitudinally slidably mounted on the mandrel, and overlying each cage, for engagement with the blades carried thereby, pack-off means interposed between the cages and comprising a first set having an imperforate flexible disc, a perforate flexible disc, and a perforate rigid plate between said discs, and a second set having a perforate flexible disc and a rigid perforate backing plate, means on said mandrel for spacing the said sets apart from each other, and separate coil springs carried on the mandrel between each set of the pack-off means and an annular plate to move each plate into blade engagement to urge the blades into a horizontal position.

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