

March 7, 1933.

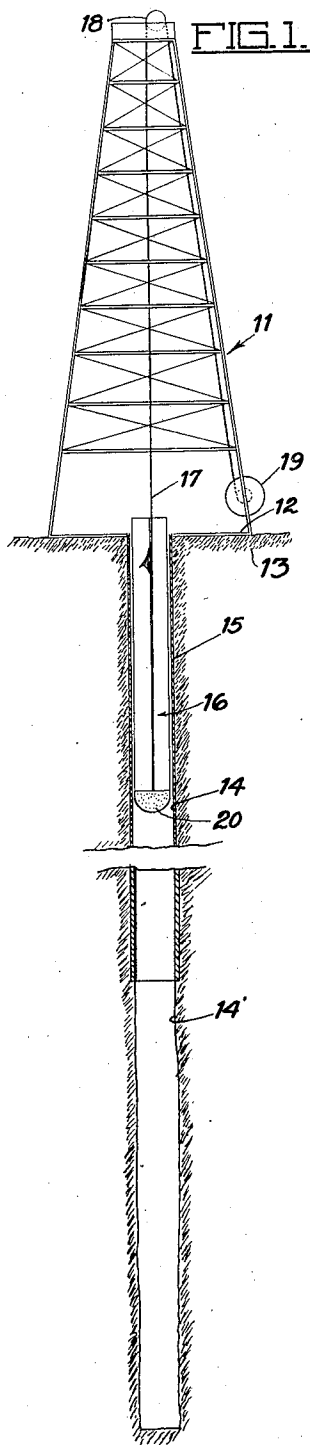
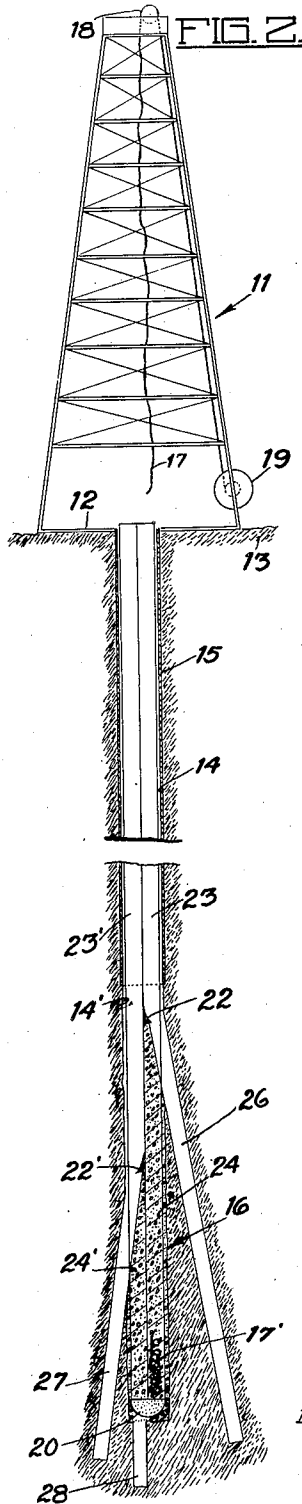
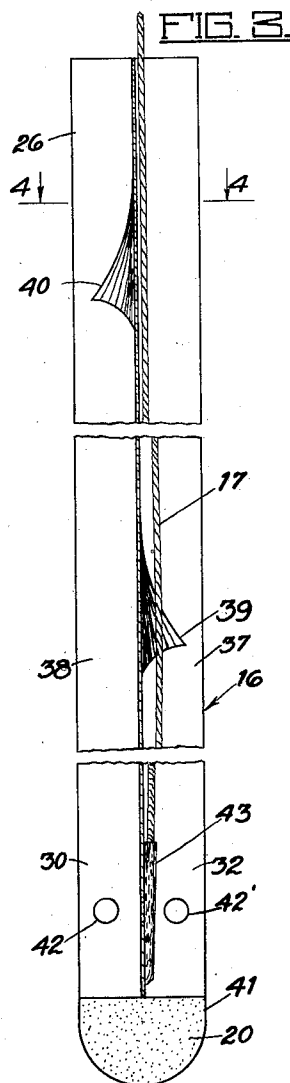
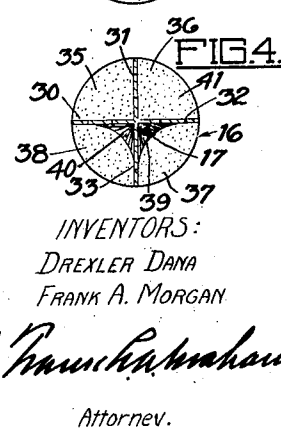
D. DANA ET AL

1,900,164

METHOD AND APPARATUS FOR DRILLING OIL WELLS

Filed July 5, 1932

2 Sheets-Sheet 1



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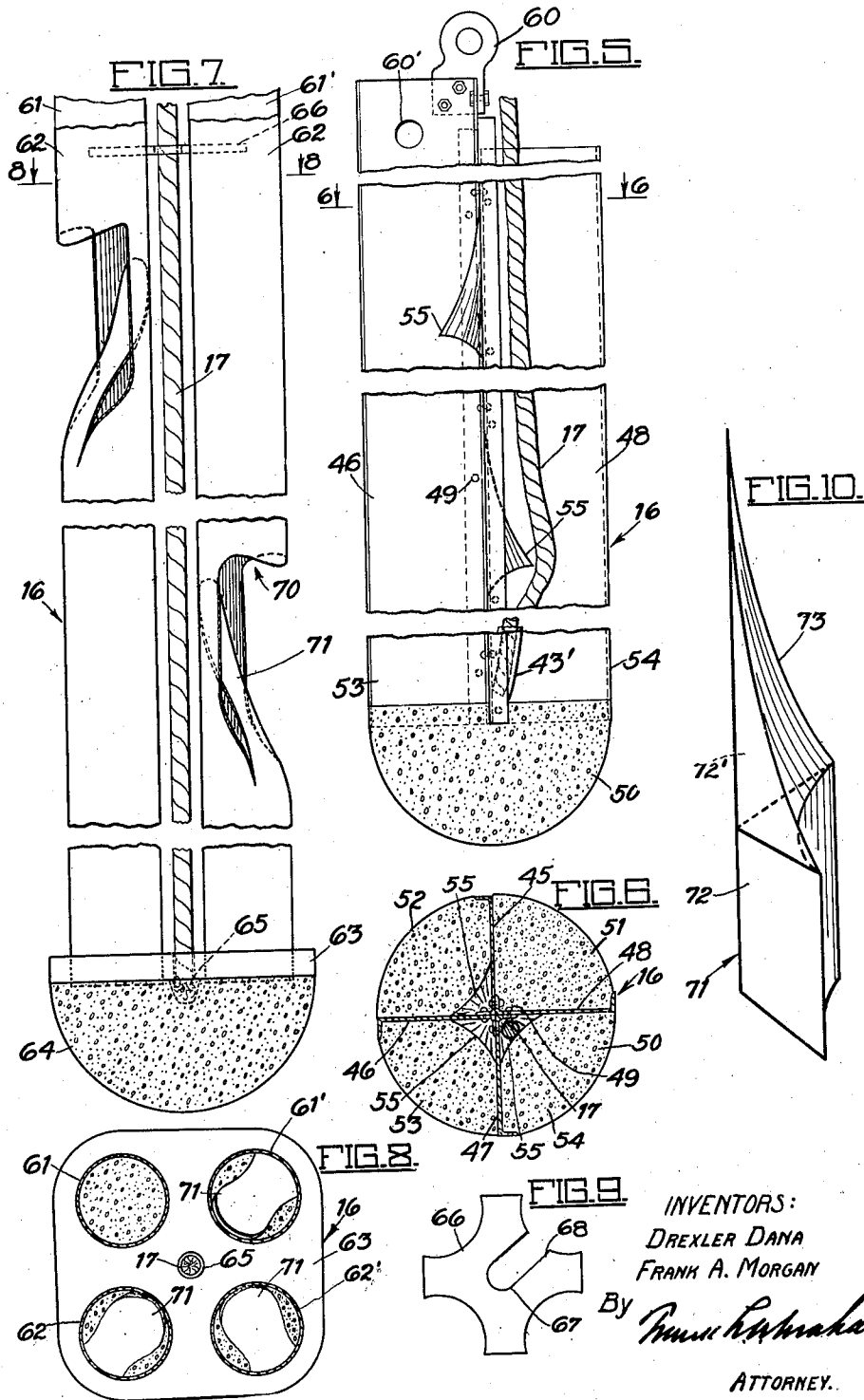
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METHOD AND APPARATUS FOR DRILLING OIL WELLS

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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR DRILLING OIL WELLS

Application filed July 5, 1932. Serial No. 620,826.

This invention has to do in a general way with the art of drilling wells, and is more particularly related to the improvements in the method and apparatus in our copending application, Serial No. 534,481, filed May 2, 1931, which has as its primary object the reduction of oil well drilling expenses. As is pointed out in our copending application, this invention is especially adapted for use in drilling oil wells over water where the foundation and derrick structure are extremely costly as compared to the actual expenses of drilling the bore hole. It is to be understood, however, that the method and apparatus contemplated by this invention may be used with equal facility in land drilling operations.

Like the invention of our former application, it is a primary object of this invention to produce a method and apparatus for drilling a plurality of bore holes or wells from a single derrick structure. In the method contemplated by our former application, this was accomplished by drilling a large diameter bore hole of comparatively shallow depth, and from the bottom of this bore hole drilling a plurality of angularly disposed small diameter bore holes. The apparatus contemplated by our former application consisted in a general way of a conductor casing adapted to be lowered into the large diameter bore hole, such casing having a plurality of radially disposed partitions therein and having a bit deflecting shoe at its lower end.

In the development of this invention we have found it to be extremely important that each small diameter hole be started and guided so as to avoid intersection with the established or prospective path of any other bore hole which is drilled prior to or which is to be drilled subsequent to the hole in question.

It is therefore a primary object of this invention to produce a method of the class described whereby the possible interference or intersection of bore holes is positively avoided. We prefer to accomplish this by starting the individual small diameter bore holes at various elevations in the large diameter bore hole.

It accordingly becomes a further object of this invention to produce a novel type of apparatus in the form of a bit director or bore hole divider which is provided with means for deflecting small diameter drill bits angularly into the formation at various predetermined elevations in the large diameter bore hole.

In this connection it is not absolutely necessary that all of the small diameter bore holes be drilled at an angle with respect to the large diameter bore hole. It therefore becomes a further object of this invention to produce a bore hole divider and bit director by means of which one or more of the small holes can be drilled from various elevations and at a predetermined angle or at predetermined angles with the axis of the main hole, and in which one or more of the small diameter bore holes can be drilled vertically from the bottom of the large diameter bore hole. In this connection our invention contemplates a novel type of guide shoe mounted on the bottom of the director member which is of a frangible character so as to permit the passage of a drill bit there-through.

It is a further object of this invention to produce a directing member which may be easily handled and installed. For accomplishing this we prefer to secure to the lower end portion of the directing member, a cable or other flexible means whereby the unit can be lowered into the well by a suitable drum on the surface. In this manner the divider can be stopped at any time for attachment or installation of new sections to accommodate any depth in the large diameter bore hole.

The cable just referred to may be secured to the lower end of the divider by some suitable releasable means, but we prefer to rigidly secure the lower end of the cable. When the divider has reached the proper position, the cable is cut at the upper end of the bore hole and falls into the compartment of the divider in which its lower end is secured.

In order that the cable may not interfere with drilling operations, we prefer to secure it in a compartment which contains a deflect-

ing member so that the cable falls to the bottom of the compartment below the deflecting member and will thereby not interfere with the drilling of the small diameter bore hole subsequently to be drilled within that compartment.

It sometimes occurs in the drilling of wells of this character that the bit becomes lodged and the drill stem twists off in a manner such that it cannot be removed. In order that a new well may be started when this occurs in the drilling operations contemplated by this invention, we have devised a novel type of deflecting shoe which is adapted to be lowered into the divider and to rest on a suitable foundation of concrete or cement which is pumped into the compartment in the usual manner. This type of shoe has a decided advantage over an ordinary type of whip stock in that it has flat faces corresponding to the sides of the compartment in which it is received so that it is held against rotation, thus directing the bit over its new course in a predetermined direction.

The details in the method and apparatus contemplated by this invention will be best understood from the following description of the accompanying drawings which are chosen for illustrative purposes only and in which—

Fig. 1 is an elevational view partly in section showing a derrick structure and illustrating the manner in which a divider of the type contemplated by this invention is installed therein;

Fig. 2 is an elevational view similar to Fig. 1 showing the divider as having been installed, and illustrating the manner in which the small diameter bore holes are started into the formation;

Fig. 3 is an elevational view showing one form of divider contemplated by this invention;

Fig. 4 is a plan section taken in the plane represented by the line 4—4 in Fig. 3;

Fig. 5 is an elevational view of a preferred form of our invention which is similar in a general way to the form shown in Fig. 3 but has certain structural advantages thereover;

Fig. 6 is a plan section taken in a plane represented by the line 6—6 of Fig. 5;

Fig. 7 is an elevational view showing a modified form of our invention;

Fig. 8 is a plan section which may be considered as having been taken in a plane represented by the line 8—8 in Fig. 7;

Fig. 9 is a plan view showing a spacing member which may be used in connection with the divider of the type shown in Fig. 7; and

Fig. 10 is a perspective view illustrating a preferred form of auxiliary bit deflecting shoe of the type contemplated by this invention.

More particularly describing the invention as herein illustrated, reference numeral 11 indicates a derrick structure which is

shown as being mounted with its floor 12 on shale or other formation indicated by reference numeral 13.

In proceeding with the method contemplated by this invention, a large diameter bore hole, indicated by reference numeral 14, is first drilled below the derrick structure to any suitable depth. A large diameter conductor pipe 15 is then set or cemented in this bore hole and a second large diameter bore hole 14' is drilled through and to a substantial distance below the conductor pipe 15. A divider or partitioning member generally indicated by reference numeral 16 is then lowered through the conductor pipe 15 and into the bore hole 14' by means of a cable 17 which has its lower end portion secured to the bottom of the divider or partitioning member 16 and is shown as extending over a pulley 18 at the top of the derrick to a drum at 19 whereby the movement of the cable and the consequent movement of the partitioning member or divider is controlled.

It will be understood that the partitioning member or divider, certain preferred forms of which will be hereinafter more completely described, is of a nature such that additional sections may be added thereto from time to time as the unit enters the bore hole. In making such additions the drum 19 is stopped by means of a suitable brake, not shown, and an additional section is added to the partitioning member or divider. This procedure is followed until the guide shoe 20 of the partitioning member has reached the bottom of the bore hole 14'. When this position has been reached the cable 17 is cut at a point near the top of the divider and the lower portion of the cable drops into the bore hole and assumes a position as indicated at 17' in Fig. 2.

Reference numerals 22 and 22' indicate bit deflecting members which are mounted at different elevations in compartments 23 and 23' of the divider or partitioning member. These bit deflecting members may be composed of metal or other wear-resistant material and are so arranged as to direct a small diameter drill bit from the corresponding compartments into the formation comprising the wall of the bore hole 14'. In this connection it is to be understood that a part or all of the compartments formed by the partitioning member may be provided with bit deflectors of this nature. It is not essential, however, that all of the compartments be so constructed, but it is important that the lower end of the cable 17 be secured in a compartment which has a partitioning member mounted therein at a substantial distance above its lower end. This construction is followed to permit the cable to fall to the lower end of such compartment so as not to interfere with the drilling operation as was pointed out above.

After the partitioning member has been

lowered to the bottom of the hole 14', we prefer to lock the divider in the bore hole by running tubing into one or more of the compartments and pumping cement through such tubing to fill the entire hole or one or more compartments thereof from the bottom upward to a point determined by the local conditions encountered, such cement or concrete being indicated at 24 and 24'. The tubing thus employed is of course withdrawn immediately after the cementing operation.

It is to be understood that the bit deflecting members are preferably formed or shaped so as to permit the passage of a tube for pumping concrete into the bottom of the hole and it is preferable to fill the compartments to a point above the bit deflecting members. This may be accomplished by calculating the volume of the compartment below the desired level and pumping such volume into the well. It is to be understood, however, that concrete is of a frangible nature which is easily drilled so that no particular harm is done if it comes to a point well above the bit deflecting members.

After the cement has hardened, the process of drilling the small diameter bore holes will be, in each case, the same as that currently employed in drilling a single well beneath a derrick, except that the rotary table and part of the other drilling equipment must be moved to center over each compartment successively. Furthermore the operation of the drill must be carefully regulated by modern drilling methods and apparatus so that the drill bit follows its predetermined course.

Reference numerals 26 and 27 indicate angular bore holes formed by the process outlined above. It will be understood that in the event the partitioning member is provided with four compartments, four such deflecting bore holes may be formed or one or more of the compartments may be left open so that the bit passes vertically downward therethrough, passing through the frangible shoe 20 and forming a vertical well or bore hole of the type indicated by reference numeral 28.

In Fig. 3, we show one form of the divider or director unit of the type contemplated by this invention. This unit is shown as being made up of longitudinal plate members 30, 31, 32 and 33 which intersect so as to form a unit which is substantially cross-shaped in cross section. Plates of this nature are preferably welded along the line of intersection, and it will be observed that they cooperate to form four compartments or chambers 35, 36, 37 and 38. In this form of our invention we show two of the chambers 37 and 38 as being provided with downwardly and outwardly inclined bit deflecting members 39 and 40 respectively. It is to be understood that such divider or director unit may be designed so as to form any plural number of compart-

ments within the initial bore hole and the figures and descriptions here presented which specify a four-way divider are for purposes of illustration only. The lower end of the unit formed by the plates is secured to a guide shoe 41 which is composed of some frangible material such as wood, concrete, or the like. Additional guide members may be placed on the plates throughout the length of the unit. In order that the cement which is pumped into the compartments may completely fill the bore hole so as to form a more secure anchorage, the plates may be provided with openings as indicated by reference numerals 42 and 42'. The cable 17 in this form of our invention is shown as being secured in a suitable pocket 43 which is positioned at the extreme lower end of the plate section 37 so that the cable when cut will fall into this compartment and will arrange itself below the deflecting member 39.

The preferred form of our invention shown in Figs. 5 and 6 is similar in its general construction to the form just described. This last mentioned construction, however, has certain advantages in ease of handling and fabrication. This divider or directing unit is made up of four channel members indicated by reference numerals 45, 46, 47 and 48. The channel members are arranged with their edges along a common axis and have their flanges secured to adjacent channel members by means of rivets or other suitable attaching means indicated by reference numeral 49. The outer flanges on the channel act as guides to prevent the members digging into the formation and the lower ends of the bottom channels are secured to a frangible guide shoe indicated by reference numeral 50.

In this form of our invention in which the compartments are indicated by reference numerals 51, 52, 53 and 54, we show three of the compartments, 52, 53 and 54 as being provided with bit deflecting members 55 which, as pointed out above, are arranged at different elevations throughout the height of the unit.

The cable 17 is shown as being secured in a socket member 43' at the lower end of the unit.

A reference numeral 60 indicates an eye which is shown as being secured to the upper end of one of the channel members and is adapted for use in handling the unit in the derrick. In this connection it might be pointed out that the cable 17 could be dispensed with and the lowering of the divider into the well could be accomplished by means of the eye 60. Under these circumstances the upper ends of the channels are preferably offset as shown in Fig. 5 and as one channel is added thereto, an eye is placed on the upper end of this channel and the weight of the unit is transferred to the upper eye, the lower

one being removed. While fabricating any of the proposed divider or director units in this way the completed portion, which is already in the hole, may be conveniently supported at the derrick floor through the use of iron rods passing through holes 60' in the plates.

In the form of our invention shown in Fig. 7, we show the divider as being made up of a plurality of small diameter pipes indicated by reference numerals 61, 61' and 62, 62'. These pipes have their lower ends secured to a suitable basal ring 63 which in turn is secured to a frangible guide shoe 64. The cable 17 in this form of our invention is shown as being secured in a suitable socket 65 provided in the guide shoe 64.

For the purpose of holding the pipes in predetermined spaced relation with each other, we prefer to provide, from time to time, along the unit spacing plates, one of which is indicated by reference numeral 66. One form of such plate is shown in Fig. 9 where it is illustrated as being provided with a hole 67 to admit the passage of the cable 17 and a notch 68 to facilitate the installation of the plate over the cable. In this form of our invention the pipes 62, 62' and 61' are shown as being provided with bit deflecting members and pipe 61 is open to permit the drilling of a vertical small diameter bore hole from this pipe. The bit deflecting units in this form of our invention are preferably formed by cutting longitudinal openings 70 in the pipe in such a manner to leave tongues of metal extending upwardly from the line of attachment. These tongues are indicated by reference numeral 71 and are bent inwardly so as to form a bit deflecting surface.

In Fig. 10 we show another form of bit deflecting unit which, as pointed out above, is adapted for use in connection with a divider or partitioning member of the type shown in either Fig. 3 or Fig. 5. This unit is made in the form of a block 71 which has two flat side faces 72 and 72' adapted to engage against the angularly disposed plates which define one of the segmental compartments in the divider. The top surface of this block is inclined downwardly and outwardly as indicated at 73 so as to deflect the bit into the formation. In using the block, the compartment in which it is to be used, is first filled with concrete to the desired level. The block is then dropped into the compartment through which it falls onto the top of the concrete where it may be rigidly fixed by the further introduction of concrete. The bit may then be advanced into the compartment and will be deflected into the formation at an angle which is determined by the inclination of the surface 73.

It is to be understood that, while we have herein described and illustrated certain pre-

ferred forms of apparatus for practicing the method contemplated by this invention, the invention is not limited to the precise structure described above, but includes within its scope whatever changes fairly come within the spirit of the appended claims.

We claim as our invention:

1. A well drilling method which comprises: drilling a large diameter bore hole; partitioning said hole to form a plurality of longitudinal chambers; and drilling small diameter bore holes at different elevations from said chambers.

2. A well drilling method which comprises: drilling a large diameter bore hole; partitioning said hole to form a plurality of longitudinal chambers; and drilling small diameter bore holes from said chambers at different elevations and in angularly disposed relation with each other.

3. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; longitudinal partitioning means secured to said guide shoe and adapted to form a plurality of drilling compartments in a bore hole; and drill bit deflectors in some of said compartments.

4. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; longitudinal partitioning means secured to said guide shoe and adapted to form a plurality of drilling compartments in a bore hole; and drill bit deflectors in some of said compartments, said bit deflectors being arranged in vertically spaced relation with each other.

5. For use in drilling bore holes of the class described, a divider embodying: a frangible guide shoe; longitudinal partitioning means secured to said guide shoe and adapted to form a plurality of drilling compartments in a bore hole; and drill bit deflectors in some of said compartments.

6. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; longitudinal partitioning means secured to said guide shoe and adapted to form a plurality of drilling compartments in a bore hole; and drill bit deflectors in some of said compartments, and flexible supporting means secured to the lower end of said divider.

7. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; longitudinal partitioning means comprising a plurality of angularly disposed and interconnected plate members secured to said guide shoe and adapted to form a plurality of drilling compartments in a bore hole; and drill bit deflectors in some of said compartments.

8. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; a plurality of upwardly extending small diameter bit guiding pipes secured at

their lower ends to said shoe, some of said pipes having openings in their outer walls; and bit deflecting means in said pipes below said openings.

5 9. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; a plurality of upwardly extending small diameter bit guiding pipes secured at their lower ends to said shoe, some of said pipes
10 having openings in their outer walls; and bit deflecting means in said pipes at said openings, the openings in the respective pipes being in vertically spaced relation with each other.

15 10. For use in drilling bore holes of the class described, a divider embodying: a guide shoe; a plurality of upwardly extending small diameter bit guiding pipes secured at their lower ends to said shoe, some of said pipes
20 having openings in their outer walls; bit deflecting means in said pipes at said openings; and a flexible member secured to said guide shoe for lowering said divider into a bore hole.

25 11. For use in drilling bore holes of the class described, a divider embodying: a plurality of elongated plate members secured together at their edges so as to form a unit of cross-shaped cross section; guide means
30 at the lower end of said unit; and vertically spaced bit deflectors mounted in the spaces between some of said plates.

35 12. For use in drilling bore holes of the class described, a divider embodying: a plurality of elongated channels having their side flanges secured together along a common line to form a unit of cross-shaped cross section; guide means at the lower end of said unit;
40 and vertically spaced bit deflectors mounted in the spaces between some of said plates.

45 13. For use in drilling bore holes of the class described, a divider embodying: a plurality of elongated plate members secured together at their edges so as to form a unit of cross-shaped cross section; guide means at the lower end of said unit; vertically spaced
50 bit deflectors mounted in the spaces between some of said plates; and a flexible member secured in one of said spaces a substantial distance below the deflector therein for use in lowering said unit into a bore hole.

55 14. For use in drilling bore holes of the class described, a divider embodying: a plurality of elongated plate members secured together at their edges so as to form a unit of cross-shaped cross section; a cement guide shoe secured to the lower end of said unit; and
60 vertically spaced bit deflectors mounted in the spaces between some of said plates.

65 15. For use in combination with a divider of the class described which comprises a plurality of plate members disposed in angular relation with each other, a deflector embodying a block having two side faces adapted to engage plates in said divider, and having a

downwardly and outwardly inclined bit deflecting surface on its upper end.

In testimony whereof, the said DREXLER DANA has hereunto set his hand at Santa Barbara, California, this 15th day of June, 1932, and the said FRANK A. MORGAN has hereunto set his hand at Los Angeles, California, this 17th day of June, 1932.

DREXLER DANA.

FRANK A. MORGAN. 75

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