The invention relates to rotary earth drilling and more particularly to a device used in changing the direction of the bore of the well being drilled.

In rotary drilling it is sometimes desirable to change the direction in which the hole is being drilled; for example, an intended vertical hole actually may be proceeding at an angle, and it becomes necessary to change the bore of the hole to its original vertical direction. In some cases, when drilling a normally vertical hole, it may be desirable to have the hole proceed at an angle to the vertical axis to avoid certain formations or to lead to other formations.

The principal object of the invention is to provide a device which may be used in changing the direction of the bore of a well. Hereinbefore when it has been desired to change the direction of a bore it has generally been the practice to cement or otherwise secure a whipstock in a properly oriented position in the well and then continue the drilling. The inclined surface of the whipstock deflects the drill as it proceeds downward. In other devices known in the prior art, the amount of deflection of the bore of the well that is obtained is dependent upon the length and angle of the inclined surface of the whipstock, and the amount of drilling that can be done before the drill has to be removed and the whipstock reset is limited by the length of the whipstock.

It is an object of the invention to provide a device which eliminates the use of whipstocks entirely; the amount and angle of the deflection may be controlled at will from the surface of the well, after the device has been lowered into the well.

The device comprising the invention makes it possible to eliminate the numerous trips in and out of the well now necessitated by conventional whipstocks.

The invention has other objects and the device has other advantages, and includes other features of novelty in addition to those above mentioned as will be apparent from a consideration of the accompanying drawing forming a part of the specification and in which:

Figure 1 is a view in elevation diagrammatically illustrating the complete device in an operative position in the well.

Figure 2 is a view partly in a vertical section taken on line II—II of Figure 4, and partly in elevation showing a portion of the device in position in a well.

Figure 3 is a view partly in vertical section and partly in elevation showing a portion of the device in closed position prior to being placed in operative position in the well.

Figure 4 is a horizontal cross-section taken on the line IV—IV of Figure 2.

The assembled drill hole deflector is illustrated in Figure 1, and consists of a laterally expandable member indicated generally at A. Secured to the lower end of the member A is a limber joint 14, to the bottom of which the drill string 5 is secured. A limber joint 3 is secured at its lower end to the upper end of the member A by means of a suitable coupling 4; the upper end of the limber joint 3 is secured to the drill string 5 by a coupling 6.

The limber joints 1 and 3 are constructed of pipe of a diameter such that it will bend under the pressure exerted by the drill string during normal drilling operations.

The laterally expansible member A includes a hollow stem 7, extending through the center of the tool. This stem is attached to and rotated by the limber joint 3 which is in turn attached to and rotated by the drill string 5. The drill string 5 extends to the surface of the well and is rotated by any well known driving mechanism. Drilling fluid may pass through the stem 7 and then through the opening 8 in the limber joint to exit around the drill and to the surface of the well in the usual manner.

Around the stem 7 is an upper tubular body member 9 and a lower tubular body member 10, in telescoping relation thereto at the portions 11a and 11b. The body members may be moved axially with respect to each other. Attached to the stem 7 is a collar 11 which is located above an upper thrust bearing 12 mounted on a shoulder 13 within the upper body member 9. The collar 11 receives the weight and thrust of the drill string and through the bearing 12 transmits it to the body member 9. When the stem 7 is moved downward, the body member 9 will thus be moved axially in a downward direction with respect to the lower body member 10.
Between the stem 7 and the body members 9 and 10 is the tube 14 which is threaded on its lower end to receive a collar 15, to which collar 15 is attached the upper end 16 of the limber joint.

1. A thrust bearing 17 is located between the body member 10 and the collar 15. Keyways 18 are formed on the upper portion of the tube 14. Keys 19 mounted on or formed integral with the stem 7 are inserted into these keyways 18 as the stem 7 moves in a vertical direction relative to the tube 14 and the body member 10. The rotation of the drill string 6 and the limber joint 3 is transmitted through keyways 18 to the tube 14, which in turn transmits the rotation to the limber joint 1 and the drill 2. The tube 14 also serves as a bearing to turn on the inside of the two body members 9 and 10.

It will thus be seen that the stem 7, the tube 14, the limber joint 1, and drill 2 will rotate with the drill string, while the body members 9 and 10 will not rotate; this action is permitted by the thrust bearings 12 and 17 which prevent excessive friction when pressure is applied through the drill string.

2. After being screwed to the said bore and deflect said drill.

Two arms 21 and 22 are pivoted to the body members 9 and 10 at 23 and 24 respectively, and are pivoted together at 26. The arms 21 and 22 are provided with sharp outer edges 25. A shear screw 27 secures the body member 9 to the tube 14 at such a position that the arms 21 and 22 are held natural within an aligned recess 28 in the body member. Preferably two pairs of arms 21 and 22 are employed as shown in Figure 4.

When pressure is applied to the stem 7, the pressure is transmitted through the collar 11 and the thrust bearing 12 to the body member 9. The shear screw 27 is constructed of a material which will not permit it to shear under this pressure, and the body member 9 will be moved downwardly, swinging the arms 21 and 22 outwardly about their respective pivots 23 and 24 as shown in Figure 2.

Locate the said screw 27 in such a position that the arms 21 and 22 are, in opposition to the arms 21 and 22, are fins or blades 29. When pressure is applied to force the arms 21 and 22 outwardly, the edges 25 of the arms will contact one side of the wall of the bore and force the entire assemblage in the opposite direction so that the blades 29 will contact the opposite side of the wall. The body members 9 and 10, the arms 21 and 22, and the blades 29 will not rotate but move downwardly as the drilling proceeds. The body members 21 and 22 and the blades 29 move in a straight line along the sides of the well. This action is due to the narrow edges 28 of the arms and the narrow ends of the blades which form cuts in the wall of the bore.

The extent of the deflection in the bore may be regulated by the pressure which is applied to the drill string through the surface of the well. If a large deflection in the bore is desired, a greater pressure will be exerted. This will cause the limber joints 1 and 3 to bend or bow, as illustrated in Figure 1, to a greater extent. The greater pressure on arms 21 and 22 will be urged outwardly a greater distance, and will assist in increasing the bending of the limber joints. When a relatively small amount of pressure is applied to the drill string, the limber joints will bend to a lesser extent; the arms 21 and 22 will also be extended with less force. As a result the deflection of the bore will be less. The drilling may be continued without interruption until the bore has acquired the desired digging depth.

Screwed into the upper body member 9 is a nut 30 through which the drill stem 7 may move. When the device is to be withdrawn from the bore, the drill string is raised, which in turn raises the collar 15. The collar 15 acts against the nut 30 and through it raises the body member 9, 15 bringing the arms 21 and 22 into nested position within the recess 28. The nut 20 engages the collar 15 and raises the limber joint 1 and the drill 2, as well as the body member 10. The device can then be withdrawn from the bore.

Before the device is to be used the bore is surveyed to determine the direction in which the deflection is to be made, and the amount of it required. The body member 9 and the tube 14 are then secured together with the shear screw 27, and the device is inserted into the bore with the arms 21 and 22 in proper oriented position. When the device is located at the bottom of the bore, pressure is applied to the drill string. The pressure is transmitted to the stem 7 with the result that the screw 27 shears. Continued pressure on the drill string causes the arms 21 and 22 to be extended laterally and causes the limber joints 1 and 3 to bow in the proper direction. The drilling may then proceed until the bore has the proper direction.

If it is desired the limber joint 1 may be omitted and the drill 2 secured directly to the collar 15. I intend such a modification to be within the scope of my invention.

The arms may be extended laterally by other means such as springs or similar resilient means; however, we find better control may be exerted in the form specifically disclosed. Arms may be provided which are extensible in parallelism generally with the tool. The shear screw 27 may be replaced by a spring action between the body members to hold them in predetermined relationship axially with the arms within the recesses; the force of such a spring would then be overcome by the pressure applied through the stem. It will be seen from the arms disclosed are equivalent of cam means or other extensible means which might be substituted to urge the drill laterally.

It will be obvious that many other modifications of as well as and detailed structure of the device illustrated in the specification and accompanying drawing may be made without departing from the spirit and scope of the invention as defined in the following claims.

We claim:
1. A rotary earth boring device comprising a drill adapted to be secured to a rotatable drill stem and rotate therewith, means movable axially with said drill and adapted to be held in non-rotatable position, and means mounted on only one side of said axial means non-rotatable, and means mounted on only one side of said axial means non-rotatable, and means adapted to engage one side of said bore and deflect said drill.
2. In an earth boring device, upper and lower limber joints, said upper limber joint being adapted to be secured to a rotatable drill stem and rotated, said lower limber joint, means connecting said limber joints.
whereby said drill is rotatable with said drill stem, means movable axially with said limber joints and drill and adapted to be held in non-rotatable position, and laterally extensible means movably disposed on only one side of said axially movable non-rotatable means laterally extensible to engage one side of the bore to deflect said drill.

3. In an earth boring device, a stem, a drill adapted to be rotated with said stem, body members surrounding said stem, and movable axially relative to each other, and means adapted to move said stem and body members laterally of the axis of the bore, said means including laterally extensible means carried by said body members on only one side thereof and engageable with one side of the bore when said body members are moved relatively.

4. In an earth boring device, a stem, a drill adapted to be rotated with said stem, body members surrounding said stem and adapted to move axially with respect to each other, and means adapted to move said stem and body members laterally of the axis of the bore, said means including means pivoted to said body members on only one side thereof and adapted to be moved laterally when said body members are moved relatively.

5. In an earth boring device, a stem, a drill adapted to be rotated with said stem, body members surrounding said stem and adapted to move axially with respect to each other, means adapted to move said stem and body members laterally of the axis of the bore, said means including means pivoted to said body members on only one side thereof and adapted to be urged laterally when said body members are moved together, and means releasably holding said body members in relatively fixed positions.

6. In an earth boring device, a limber member, a stem connected to said limber member, a drill adapted to be rotated with said stem, body members surrounding said stem and adapted to move axially with respect to each other, means adapted to move said stem and body members laterally of the axis of the bore, said means including means pivoted to said body members on only one side thereof and adapted to be urged laterally when said body members are moved together, and means releasably holding said body members in relatively fixed positions.

7. In an earth boring device, a stem, a drill adapted to be rotated with said stem, body members surrounding said stem having recesses therein and adapted to move axially with respect to each other, arms pivoted to said body members and normally located within said recesses, said arms being urged axially when said body members are moved together.

8. In an earth boring device, an upper limber member, a stem connected to said upper limber member, a drill secured to said lower limber member, body members surrounding said stem having recesses therein and adapted to move axially with respect to each other, arms pivoted to said body members and normally located within said recesses, said arms being urged axially when said body members are moved together.

9. In an earth boring device, a stem, a tube surrounding said stem, a drill associated with said tube, means connecting said stem to said tube whereby the rotation of the said stem is imparted to the drill, body members surrounding said tube having recesses therein and adapted to move axially with respect to each other, arms pivoted to said body members and normally located in said recesses, said arms being urged axially when said body members are moved together.

10. In an earth boring device, a stem, a tube surrounding said stem, a drill associated with said tube, means connecting said stem to said tube whereby the rotation of the said stem is imparted to the drill, upper and lower body members surrounding said tube having recesses therein and adapted to move axially with respect to each other, a collar attached to said stem adapted to transmit pressure from the stem to said upper body member and move it toward said lower body member, arms pivoted to said body members and normally located in said recesses, said arms being urged axially when said body members are moved together.

11. In an earth boring device, a stem, a tube surrounding said stem, a drill associated with said tube, means connecting said stem to said tube whereby the rotation of the said stem is imparted to the drill, upper and lower body members surrounding said tube having recesses therein and adapted to move axially with respect to each other, a collar attached to said stem adapted to transmit pressure from the stem to said upper body member to move it toward said lower body member, arms pivoted to said body members and normally located in said recesses, said arms being urge laterally when said body members are moved together, means holding said upper body member in a fixed position so that said arms are within said recesses, said holding means being adapted to be severable to permit said body members to be moved relative to each other to move said arms laterally.

12. In an earth boring device, an upper limber member, a stem connected to said upper limber member, a tube surrounding said stem, a lower limber member connected with said tube, a drill connected with said lower limber member, means connecting said stem to said tube whereby the rotation of the said stem is imparted to the drill, upper and lower body members surrounding said tube having recesses therein and adapted to move axially with respect to each other, a collar attached to said stem adapted to transmit pressure from the stem to said upper body member to move it toward said lower body member, arms pivoted to said body members and normally located in said recesses, said arms being urged axially when said body members are moved together, means holding said upper body member in a fixed position so that said arms are within said recesses, said holding means being adapted to be severable to permit said body members to be moved relative to each other to move said arms laterally.

JOHN D. BRACK.
HERMAN F. WHITON.