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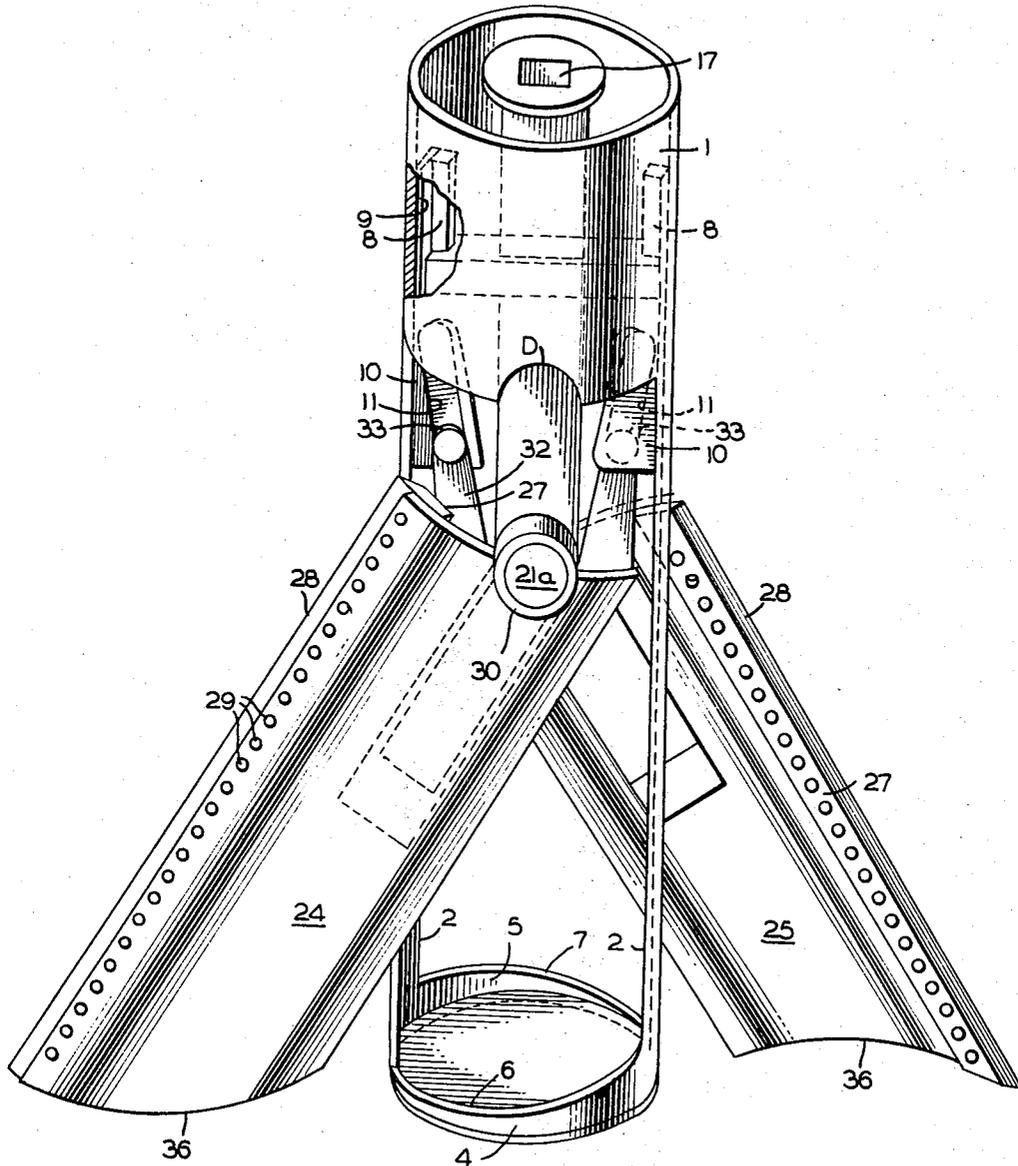
A. H. BECK, JR
UNDER REAMING DEVICE

3,342,276

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4 Sheets-Sheet 1

FIG 1.



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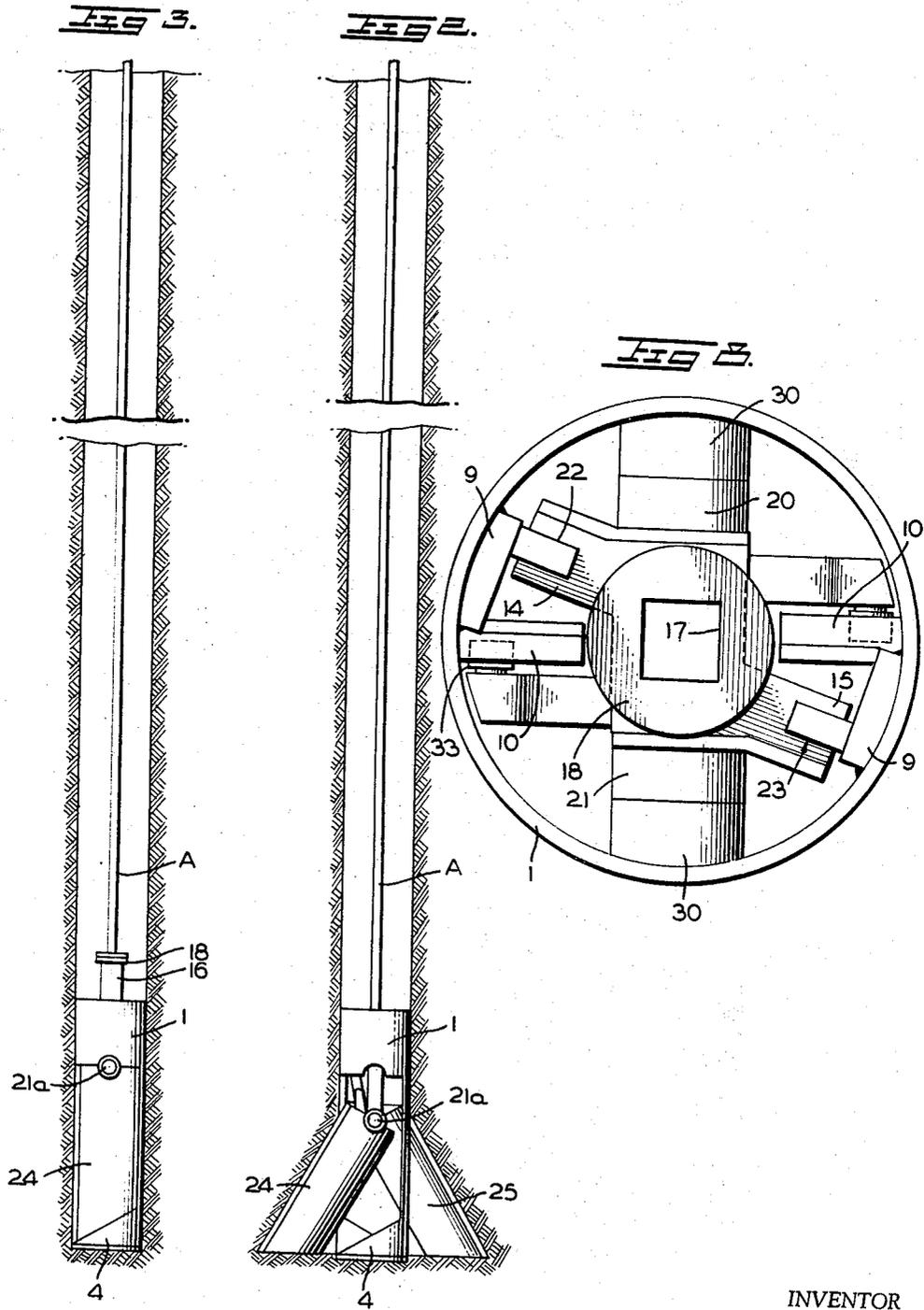
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FIG 4.

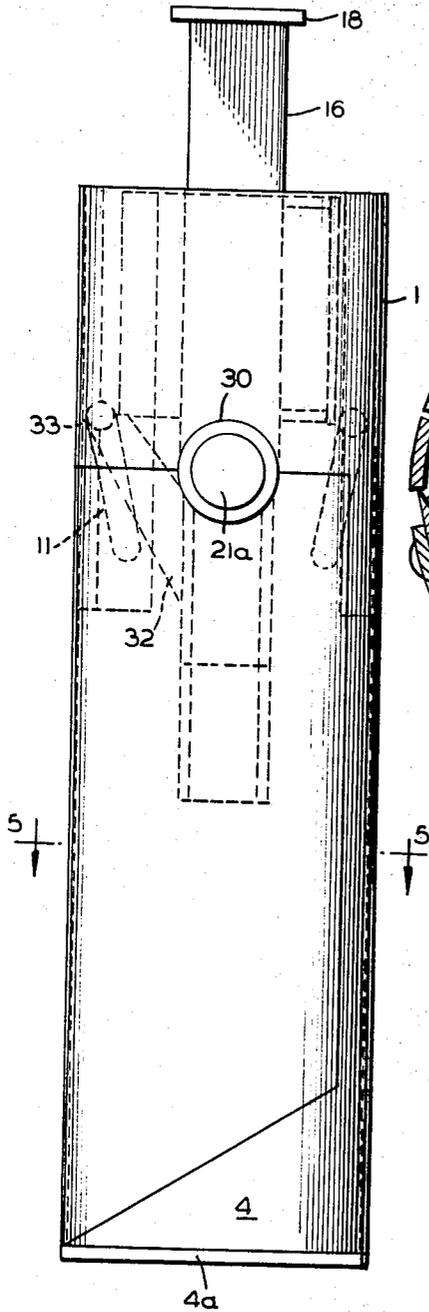
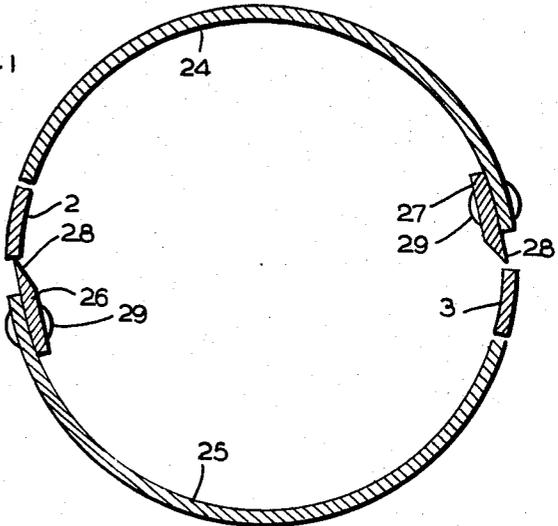


FIG 5.



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UNDER REAMING DEVICE

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10 Claims. (Cl. 175—286)

This invention relates to an under reaming device for use in the excavations of drill shafts or under-reamed piles and has for its primary function the enlargement of the bottom of a hole to a bell-shaped or conical-shaped excavation.

One of the main objects of this invention is to provide an under-reamer for attachment to a rotary drilling machine, drill stem or kelley bar, which under-reamer includes a pair of hinged expansible cutter elements or doors which form a part of a cylindrical housing and which are automatically operated to perform an under reaming cutting operation, or shiftable to a closed position to provide with a cylindrical skeleton frame an earth removal unit.

Another object of the invention is to provide an elongated cylindrical under-reamer in which the cutter elements are in the form of arcuate shaped doors including cutting edges which are movable outwardly under the weight of an associated drill stem to perform a cutting or under reaming operation or are moved to closed position to provide a complete housing for the under-reamer for encasing a load of earth removed by the cutters for its removal.

Another object of the invention is to provide in conjunction with an elongated under-reamer cylindrical housing or shell, guideways associated with a coupling unit carried on the drill stem, the coupling unit carrying associated elements cooperating with parts fixed to the shell to actuate hinged doors of the shell to and from cutting position.

A still further object of the invention is the provision of an under-reamer shell of elongated cylindrical form, the shell body being of skeletonized form and constructed and arranged for association with a pair of hinged cutter doors which, through suitable mechanism, are moved outwardly on hinges to a cutting position under weight of the drill stem or retracted to complete a cylindrical load-carrying structure.

It is a further object of the invention to provide a skeletonized under-reamer shell body having oppositely disposed bottom angular faces at its lower closed end, the angular faces at the bottom of the shell providing clearance for lateral swinging movement of hinged doors of arcuate construction carried at the upper portion of the shell body structure.

More specifically, the invention comprehends an under-reamer assembly which includes a structure for association and connection with a rotary drill stem or kelley bar by a novel form of coupling, whereby when the drill stem is lowered to the bottom of the shaft and the under-reamer assembly comes to rest on the bottom of the hole, the weight of the drill stem actuates a coupling slide member which, through associated parts, actuates arcuate cutter doors to move the latter in an outward direction into contact with the adjacent walls of the shaft and wherein the upward movement of the drill stem after rotation thereof has stopped will cause the cutter doors to swing about their hinge pins to a closed position to move loose

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cut material within the under-reamer housing and contain the latter for removal from the shaft in which the drill stem is located.

These and other objects of the invention will more clearly hereinafter appear by reference to the accompanying drawings forming a part of the instant specification and wherein like characters of reference designate corresponding parts throughout the several views, in which:

FIG. 1 is a side elevation with the cutter doors in open position;

FIG. 2 is a side elevation of the under-reamer assembly in open position mounted on a drill shaft in a drilled hole;

FIG. 3 is a view similar to FIG. 2 with the hinged cutter doors in closed position;

FIG. 4 is an enlarged view of the under-reamer assembly with the hinged cutter doors in closed position;

FIG. 5 is a transverse section on line 5—5 of FIG. 4;

FIG. 6 is a top plan view of the under-reamer assembly with the cutter doors in expanded position;

FIG. 7 is an enlarged perspective view of the coupling member between the drill stem and the under-reamer;

FIG. 8 is an enlarged top plan view of the under-reamer assembly showing the coupler in position.

The under-reamer body is of cylindrical skeletonized form including a cylindrical upper section or shell 1, elongated oppositely positioned relatively narrow side wall sections 2 and 3 forming connecting structures for the oppositely facing angular bottom portions 4 and 5, shown more clearly in FIG. 1. The angular bottom portions 4 and 5 have downwardly inclined arcuate top faces 6 and 7 for seating associated faces of the hinged cutter blades when the latter are in closed position, as will be more clearly hereinafter described.

Referring particularly to FIGS. 1 and 5, it will be seen that the upper cylindrical section 1 of the under-reamer body has mounted therein adjacent the top thereof a pair of oppositely positioned vertical guides 8, these vertical guides 8 being mounted on suitable blocks 9 welded or otherwise secured within the housing wall. Laterally spaced and below the guides 8 inwardly projecting members 10, which may be plates or castings, are likewise fixed or welded to the inner wall of the upper shell 1 and each is formed with pilot pin slots or channels 11 which are of pre-determined length and which extend radially outwardly and upwardly for controlling and defining the movement of hinged cutter doors, as will more clearly hereinafter appear.

In FIGS. 2 and 3 a conventional rotary powered drill stem is indicated at A and this drill stem has its bottom end appropriately connected to the coupling assembly, shown in perspective in FIG. 7. The coupling assembly includes a body 12 having a pair of oppositely positioned laterally offset vertical wing members 14 and 15, a central vertical stem connecting portion 16 provided with a stem-receiving socket 17 with a coupling flange 18, and lower spaced aligned hinge sections 20 and 21. All of these parts are preferably formed as a cast unit and when the coupling assembly is fixed to the lower end of the drill stem A, the vertical slots 22 and 23 formed at the outer marginal edge of the wing members 14 and 15 register with and travel along the vertical guides 8 fixed within the upper section 1 of the under-reamer housing.

The under-reamer housing is completed by a pair of hinged doors 24 and 25 associated with the skeletonized body heretofore described and it will be noted from

FIG. 5 that the doors 24 and 25 are of arcuate form in cross-section and each door partially completes a circumference of the under-reamer housing between the opposite sides of the narrow vertical side wall sections 2 and 3 and each door carries, at an opposite vertical marginal edge and throughout the length of the edge, earth cutter elements 26 and 27 having cutting edges 28. These earth cutter elements 26 and 27 are shown as secured adjacent the opposite vertical edges of the door 24 and 25 by rivets 29 which may be appropriately spaced for securing the cutters in fixed position. Each of the doors 24 and 25 has secured thereto hinge section 30 corresponding in dimension to the hinge sections 20 and 21 of the coupling element shown in FIG. 7, and when axially aligned with the hinge sections 20 and 21 a hinge pin 21a and an appropriate bushing are inserted, whereby the doors are hinged to the bottom of the coupling assembly to move vertically with the latter and in aligned and associated relation with the skeletonized shell structure. When the doors are moved vertically as the drill stem A is lifted, the doors are shifted to a position to close the housing and enclose accumulated earth.

In addition to the hinge sections 30 for connection with the hinge sections 20 and 21 of the coupler unit, each of the doors 24 and 25 includes a radially projecting arm 32, which arms have laterally projecting pins 33 which ride in the pilot slots or channels 11 carried in the fixed projections 10 positioned at the opposite sides of the vertical guides 8, as more clearly shown in FIG. 6. As previously stated, the slots or channels 11 form guideways in which the pins 33 travel and the outwardly radiating upwardly extending slots or channels 11 cause the hinged doors 24 and 25 to swing inwardly and outwardly as the coupling assembly is vertically positioned. The projecting arms 32 carrying the pins 33 being fixed to the hinged doors, and the hinged doors being mounted on the pivot pin 21a carried in the hinge assembly 20 and 21 on the coupling member, and the coupling member being fixed to the drill stem A, the hinged doors 24 and 25 are shifted vertically with regard to the under-reamer shell simultaneously with their outward swinging movement. The outward swinging movement caused by the lowering of the drill stem when the bottom of the under-reamer housing engages the bottom of the drill hole results in the upward travel of the under-reamer body and places the cutter elements 26 and 27 on the doors 24 and 25 in a position to engage the adjacent outer surface of the drill hole adjacent its base and the rotation of the under-reamer body by the rotation of the drill stem causes a gradual cutting away of the earth at the base.

It will be understood that the under-reamer includes a closure plate 4a at its base and after a plurality of rotations of the drill stem A and of the under-reamer, sufficient earth is cut away from the adjacent walls and drops to a position where it can be moved within the under-reamer body by an inward swinging of the doors 24 and 25, which occurs when the drill stem is initially moved upwardly. The initial upward movement of the drill stem A causes the pins 33 to travel upwardly towards the top of the slots 11 which swings the door 24 and 25 inwardly and the inward movement of the door causes the earth to be accumulated and impacted within the under-reamer shell which is closed by the inward movement of the doors 24 and 25 to complete cylindrical form.

By reference to FIG. 1 it will be noted that the upper casing section 1 is provided at each side with aligned recesses D which receive the ends of the hinge assembly carried in the spaced bearings or hinge sections 20 and 21 so that the parts will be secured in fixed assembled position with the doors closed. Likewise, the bottoms of the doors 24 and 25 include arcuate angled faces 35 and 36 which seat upon the upper angled faces 6 and 7 of the bottom sections 4 and 5 of the under-reamer body

assembly when the doors are in closed position. In the closed position of the doors 24 and 25, it will be noted from FIG. 5 that the cutting faces 28 are spaced inwardly from the outer peripheral wall surface of the under-reamer housing so that these cutter faces will not be injured during removal of the under-reamer with its load of earth when the doors are in closed position.

In the use and operation of the device, and as shown in FIGS. 2 and 3, the under-reamer forming the instant invention is connected to the rotary drilling machine on the end of the drill stem or kelley bar indicated at A. The drill stem or kelley bar A is connected to the coupling member 16 of the coupling shown in perspective in FIG. 7 and the under-reamer assembly is lowered to the bottom of the shaft after the shaft has been drilled for the purpose of enlarging the bottom of the hole to a bell-shape or conical shape excavation. When the under reaming device, after it has been coupled to the drill stem, comes to rest on the bottom of the shaft or hole, the weight of the drill stem pushes down on the coupling element and lowers the same within the shell causing the projecting arms 32 carrying the pins 33 fixed to the hinged doors 24 and 25 to slide downwardly in the pilot slots or channels 11 formed in the projections 10, forcing the doors 24 and 25 outwardly. The doors move outwardly into contact with the walls of the shaft. When the cutter elements 26 and 27 carried by the doors are in engagement with the adjacent earth structure at the bottom of the shaft, the downward movement of the drill stem is stopped and the rotation of the under-reamer is begun in a clockwise direction.

The hinged doors 24 and 25 swing outwardly from the shell assembly about the hinge pin 21a on which they are mounted. After several rotations of the under-reamer carrying the cutting elements, sufficient loose earth has been cut from the adjacent wall of the drilled shaft and falls to the bottom of the shaft, partially within the hollow shell of the under-reamer. After several cuts by the under-reamer the rotation of the drill stem is stopped and the drill stem is raised. The raising of the drill stem causes the pins 33 to travel upwardly within the channels which forces the doors 24 and 25 toward closed position and in closing the doors move the loose earth which has been cut from the shaft walls to the inside of the shell, which shell is then closed by the closing movement of the doors. The closed doors house the loose dirt within the shell and the under-reamer is then brought upward and out of the shaft. The under-reamer assembly is then set on top of the ground and this operation causes the doors to open and allows the loose dirt to fall from the cylindrical shell which is cleaned of the loose earth in that manner.

This process is repeated until the excavation has been completed to the extent desired or to the limit permitted by the outward swinging movement of the doors.

During the operation of the under-reamer, the coupling member shown in perspective in FIG. 7 is kept aligned within the under-reamer shell by the wing members 14 and 15 which engage and travel along the vertical guides 8 fixed within the upper section 1 of the under-reamer housing. Likewise, the diametrically oppositely positioned recesses D formed at the bottom portions of the upper section of the shell which receive the ends of the hinge assembly when the coupling member has been fully retracted tend to align and position the members under loaded conditions or under all conditions when the doors are in closed position. The pilot slots or channel 11 formed in the projecting members 10 welded to the inner wall of the upper shell 1 determine the limit of inward and outward movement of the wings and also control the extent of movement of the coupling member within the shell.

It will be noted that the doors 24 and 25 swing oppositely on the common hinge pin 21a which is arranged transversely of the coupling member and which insures

the positive and opposed swinging movement of the doors and controls the seating of the doors on the angular bottom faces 6 and 7 of the bottom portion of the shell structure.

What is claimed is:

1. In an under-reamer structure, an elongated cylindrical shell including an upper section, oppositely facing upwardly extending bottom portions, spaced connecting structures between the upper section and the bottom portions, and a closure plate for the bottom portions, a coupling assembly slidably arranged in said upper section of the shell, interengaging portions between the coupling assembly and the shell for guiding the coupling assembly for longitudinal movement in said shell, projecting members extending from the inner wall of the upper section of the shell, inclined channelways formed in the projecting members, hinged doors forming closures for the wall of the cylindrical shell between said connecting structures, a hinge connection between said doors and said coupling assembly, pin means fixed to the upper portions of said doors and engaging in said channelways for moving said doors from closed to open position upon sliding movement of said coupling assembly in said upper section of the shell, cutter elements extending along the opposite longitudinal edges of said doors for removing adjacent earth surfaces as said doors are moved towards open position, and means extending axially into the upper portion of said coupling assembly for rotating the same.

2. The structure of claim 1 characterized in that the oppositely upwardly facing bottom portions of the elongated cylindrical shell are inclined upwardly in reverse directions and the hinged doors form closures for the wall of the cylindrical shell and have similarly inclined faces for resting on the bottom portions when the doors are in closed position and the axes of the door hinges extend medially and transversely of the shell structure at the bottom portion of the coupling assembly, whereby the doors swing oppositely and transversely of the axes of their hinges.

3. The structure of claim 1 characterized in that the pin means fixed to the upper sections of the doors and engaging in the channelways are mounted on arms projecting from the inner upper portions of the doors with the channelways and arms extending laterally at each side of the door hinge.

4. The structure of claim 1 characterized in that the coupling assembly includes a body with a central vertical socket, the body including lateral wings formed with outer vertical portions for engagement with portions fixed vertically to the inner face of the upper section of the cylindrical shell.

5. The structure of claim 4 characterized in that the slidably arranged coupling assembly has mounted at its base and transversely of its wings hinge portions for supporting said doors.

6. In an under-reamer assembly, an elongated cylindrical shell including an upper section, inclined upwardly and oppositely facing lower wall portions forming a bottom for said shell, spaced connecting structures between the upper section and the lower wall portions, and a bottom closure plate for the lower wall portions, a coupling assembly slidably arranged in said upper section of the shell, interengaging portions between the coupling assembly and the shell for guiding the coupling assembly for longitudinal movement in said shell, projecting members extending from the inner wall of the upper section of the shell, inclined channelways formed in the projecting members, hinged doors forming closures for the wall of the cylindrical shell between said connecting structures, a hinge connection between said doors and said coupling assembly, arm means fixed to the upper inner portions of said doors, laterally projecting pins fixed to the upper portions of said arms and engaging in said channelways, for moving said doors from closed to open position upon sliding movement of said coupling assembly in said upper

section of the shell, cutter elements extending along the opposite longitudinal edges of said doors for removing adjacent earth surfaces as said doors are moved towards open position, and means extending axially into the upper portion of said coupling assembly for rotating the same.

7. In combination with a driven drill stem, an elongated under-reamer shell including an upper cylindrical shell portion, a closed bottom portion and spaced connecting side wall sections defining door openings, a coupling member adapted to be fixed to the drill stem for movement therewith, said coupling member comprising a body portion including a pair of laterally projecting spaced wing members, slots formed in the outer marginal edges of said wing members, hinge sections fixed to the bottom portion of said coupling member, a hinge pin carried by a hinge section, oppositely positioned vertical guide members fixed to the inner upper portion of said shell for engagement within the slots in said wing members to guide said coupling member in vertical movement within the upper portion of said shell, and a pair of hinged doors for closing the door openings in the wall of said shell, hinge members carried at the upper end portions of said doors for mounting on said hinge pin, pilot arms fixed to the inner walls of each of said hinged doors and projecting upwardly and outwardly therefrom, means fixed to and projecting inwardly of the upper cylindrical shell portion and formed with upwardly and outwardly inclined channels, pin means carried at the upper ends of said pilot arms and engaging in said channels for swinging said doors inwardly and outwardly on said pivot pin in opposite directions as said coupling member moves longitudinally within said shell, and cutters fixed along the opposite marginal edges of said doors.

8. An under-reamer for cutting and removing earth from the walls of a drilled opening including an elongated tubular casing formed with lateral side openings and a closed bottom, a first pair of vertical oppositely positioned guide members fixed to the inner face of the upper portion of said casing, a second pair of vertical guide members fixed to the upper portion of said casing and formed with upwardly and outwardly extending pilot channels, a coupling assembly in said casing having lateral wing portions formed with faces slidably interengaging with said first guide members to permit sliding movement between said coupling assembly and said casing and simultaneously transmitting rotary motion to said under-reamer when said coupling assembly is rotated, a hinge pin fixed to the lower portion of said coupling assembly and extending transversely thereof, and hinge door sections for closing said lateral side openings, said door sections each having a hinge mounting on said hinge pin for opposite swinging movement, cutting elements fixed along the opposite marginal edges of said door sections, said door sections including pilot arms having portions engaging in said channels, whereby said door sections will swing outwardly and inwardly on their hinge mountings upon movement of said coupling assembly relative to said casing.

9. In an under-reamer structure for use with a drilling device having a drill stem, said under-reamer structure including an elongated tubular housing formed with oppositely disposed side openings, a plurality of guide members fixed to the inner face of the upper portion of said housing, said guide members being oppositely disposed within the housing with one opposite pair formed with vertical guide faces and the other pair formed with vertically extending laterally diverging channelways, a coupler member positioned in the upper portion of said housing and adapted to be connected to the lower end portion of said drill stem, said coupler member including wing portions for engaging the laterally vertical guide faces of one pair of guide members, door members for closing said side openings hinged to the lower portion of said coupler member, and arms fixed to the upper portions of the inner faces of said door members, said arms having their free upper extremities formed with projections for engag-

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ing in said laterally diverging channelways, whereby vertical movement of said coupler member with said drill stem will move said door members from open to closed position, said door members each having one of its edges formed with a cutting surface.

10. The structure of claim 9 characterized in that the door members for closing the side openings in said housing are formed with transversely oppositely disposed angular faces at their bottom portions and the tubular housing at the bottom of said side openings is formed with complementary angular faces for receiving and seating the bottom portions of said door members.

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