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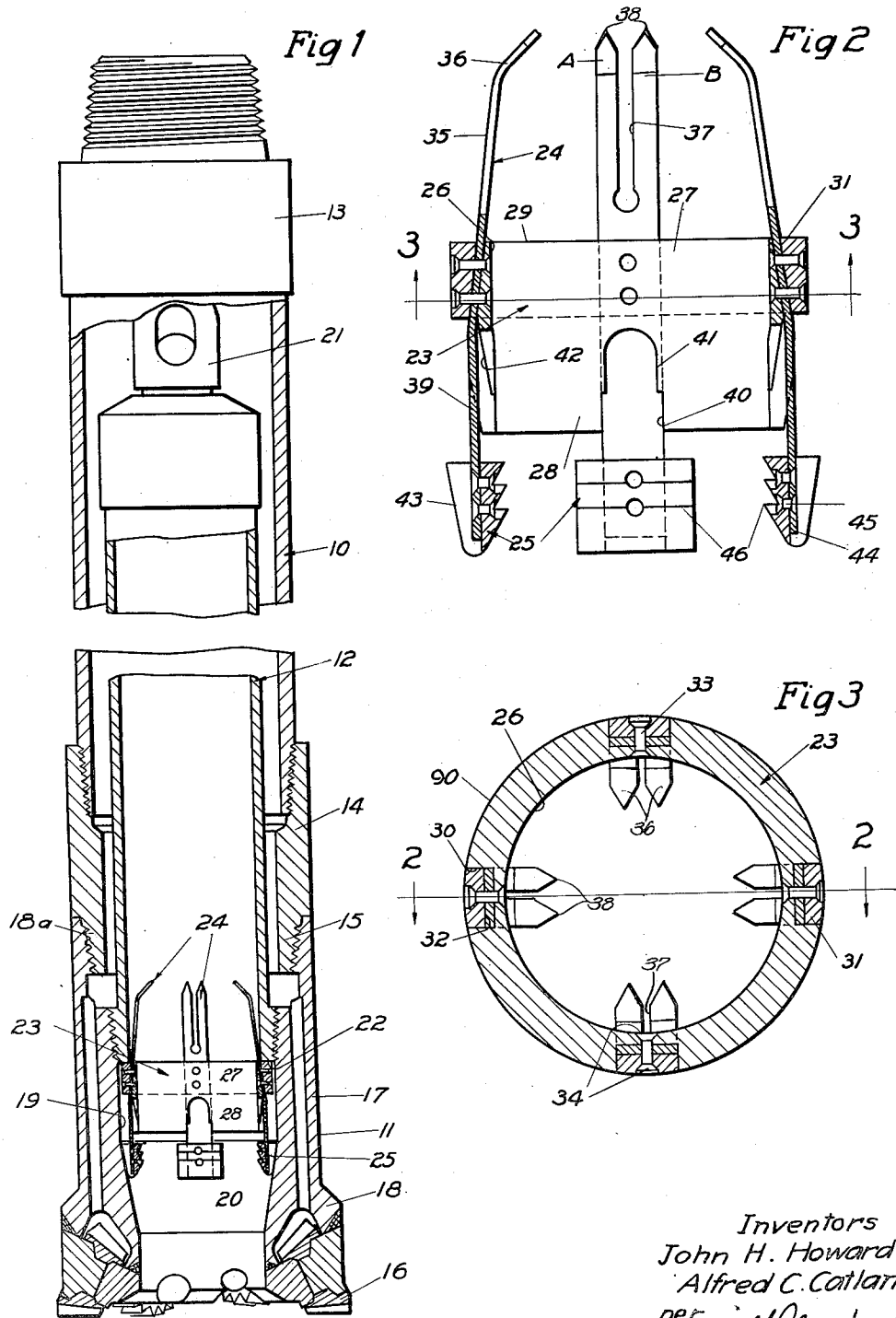
J. H. HOWARD ET AL

2,014,806

CORE CATCHER

Filed March 18, 1933

2 Sheets-Sheet 1



Inventors  
John H. Howard &  
Alfred C. Catland  
per *W. H. Catell*  
Atty.

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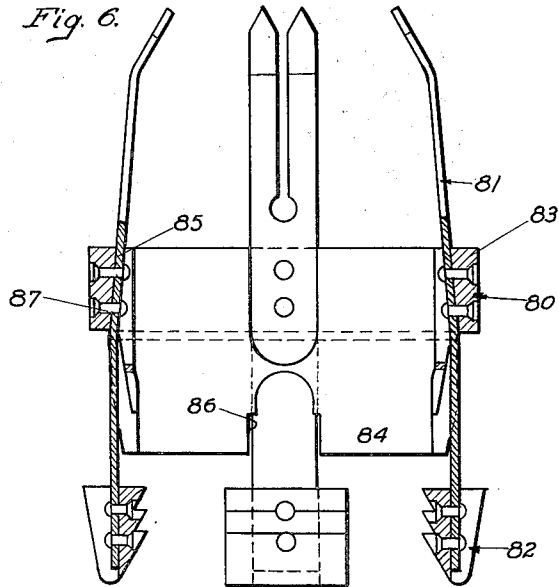
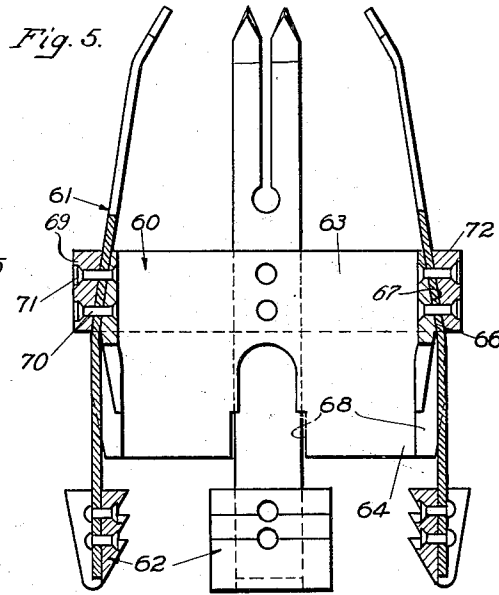
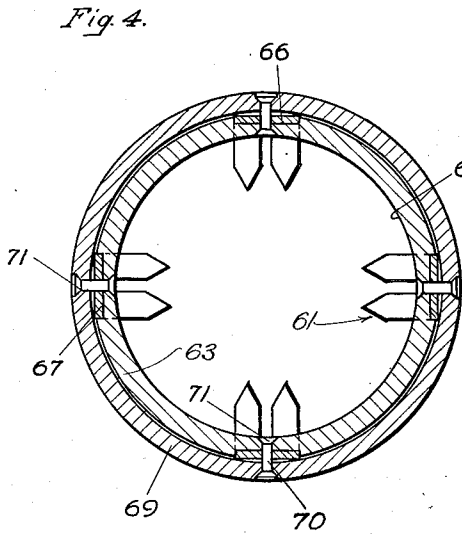
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2 Sheets-Sheet 2



Inventors  
John H. Howard &  
Alfred C. Catland  
per  
*W. H. Leafell*  
Atty.

# UNITED STATES PATENT OFFICE

2,014,806

## CORE CATCHER

John H. Howard, Huntington Park, and Alfred C. Catland, Alhambra, Calif., assignors to Globe Oil Tools Company, Los Nietos, Calif., a corporation of California

Application March 18, 1933, Serial No. 661,482

5 Claims. (Cl. 255—72)

This invention relates to well core drills, and relates more particularly to core catchers for use in core drills. A general object of the invention is to provide a practical dependable and effective core catcher of novel and improved construction.

Core drills employed in well drilling for obtaining samples of the earth formation are usually provided with core catchers for gripping the core to retain it in the drill when the drill is withdrawn from the well bore. One form of core catcher that has gone into general use includes a ring shiftable in the drill, and springs attached to the ring for yieldingly engaging the core and for carrying the core gripping slips. In some instances, these springs are attached to the ring so that they are rendered inoperative by accumulations of sand or cuttings, and so that they are often broken loose from the ring when subjected to heavy strains. In the common forms of core drills of the character mentioned, the inward movement of the springs or spring members is not limited and the slips carried by the members are sometimes engaged by the upper end of the core as it enters the drill so that the spring members are bent inwardly and broken, and prevent the further passage of the core into the drill. The upper end parts of the springs or spring members are intended to yieldingly engage the core to hold the core catcher against movement, and to bite into the core to aid in supporting it. The core catchers that have been introduced usually embody spring members that are shaped so that they do not effectively bite into the core, and that are formed so that they engage the core with such force that the core catcher binds in the drill causing it to rotate therewith so that the spring members are subjected to excessive torsional strains which often break them.

An object of the present invention is to provide a core catcher that is simple and sturdy in construction and that is operable to tightly and effectively grip the core.

Another object of the invention is to provide a core catcher that does not interfere with the passage of the core into the drill.

It is another object of the invention to provide a core catcher having spring members that are effective in biting into the core when the drill is moved upwardly, but which do not press against the core with excessive force to cause the core catcher to turn with the drill so that they are not subjected to excessive torsional strains.

It is another object of the invention to pro-

vide a core catcher that is not rendered inoperative by accumulations of sand or debris.

It is another object of the invention to provide a core catcher in which the core gripping slips have substantial inward movement when actuated and have comparatively small areas for contacting with the core so that they are operable to obtain firm, tight grips on the core.

Another object of the invention is to provide a core catcher of the character mentioned in which the spring members are securely and effectively attached to the ring or body of the core catcher in a novel manner. In accordance with the present invention, the spring members extend through slots in the ring or body so that the rivets are not subjected to shearing forces and the heads of the rivets are countersunk so that they cannot be worn off through engagement with the core.

A further object of the invention is to provide a core catcher of the character mentioned in which the inward movement of the spring members is limited so that the slips cannot be engaged by the upper end of the core as it is entering the drill.

Further objects and features of the invention will be better and fully understood from the following detailed description of typical forms and applications of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a vertical detailed sectional view of a more or less typical core drill illustrating one embodiment of the present invention in an inoperative position in the drill. Fig. 2 is an enlarged vertical detailed sectional view of the core catcher illustrated in Fig. 1. Fig. 3 is a transverse detailed sectional view as indicated by line 3—3 on Fig. 2. Fig. 4 is a transverse detailed sectional view of another embodiment of the invention. Fig. 5 is a vertical detailed sectional view of the core catcher illustrated in Fig. 4, and Fig. 6 is a vertical detailed sectional view of still another form of the invention.

The core catchers provided by the present invention may be used in different makes and classes of core drills, it being understood that they may be modified somewhat to adapt them for use in various types of drills. Throughout the following detailed disclosure, we will describe three typical embodiments of the invention adapted for use in a more or less common form of core drill illustrated in Fig. 1 of the drawings. The invention is not to be taken as limited or restricted to the specific forms or applications about to be described, but is to be taken

as including any features or modifications that may fall within the scope of the claims.

The core drill illustrated in the drawings includes an outer barrel 10, a bit head 11, and an inner barrel 12 for receiving the core. The drill is adapted to be operated on the lower end of a string of drill pipe, or the like, and a suitable sub 13 is provided on the upper end of the outer barrel 10 to facilitate the connection of the drill with the operating string. A sub or connecting member 14 is screw-threaded on the lower end of the outer barrel 10, and is provided at its lower end with a threaded pin 15. The bit head 11 carries cutters 16 operable to make an annular cut in the earth formation. In the particular core drill illustrated in the drawings, the bit head 11 includes a comparatively long tubular shank 17 and an enlarged lower portion 18 carrying the cutters 16. The pin 15 is screw-threaded into a socket 18<sup>a</sup> in the upper end of the shank 17. The vertical opening 19 in the shank 17 has a downwardly and inwardly tapered portion 20.

The inner barrel 12 for receiving the core extends longitudinally through the outer barrel 10 and is provided at its upper end with a suitable valve 21 normally preventing the passage of circulation fluid into the upper end of the inner barrel 12, and operable to discharge fluid from the inner barrel during the passage of the core into the tool. In the particular drill illustrated in the drawings, the lower end portion of the inner barrel 12 is screw-threaded in the opening 19 of the bit head shank and its lower end presents a downwardly facing annular shoulder 22 in the upper portion of the opening 19. The shoulder 22 is spaced some distance above the tapered portion 20 of the opening.

The form of the invention illustrated in Figs. 1, 2 and 3 includes generally, a body 23 shiftable in the opening 19 of the drill, flexible members or spring members 24 attached to the body 23, and slips 25 on the spring members 24 for gripping the core.

The body 23 is an annular or tubular member having a central longitudinal opening 26 adapted to pass the core. The body 23 is proportioned so that it is freely shiftable or slidable vertically in the opening 19 of the drill and its opening 26 is of sufficient diameter to readily pass the core upwardly into the inner barrel 12. In accordance with the invention, the body 23 includes an upper portion 27 and a skirt 28. The upper portion 27 of the body has a flat upper end 29 adapted to engage the shoulder 22 and has a cylindrical periphery 30 for slidably fitting the opening 19. The skirt 28 extends downwardly from the upper portion 27 and is preferably integral with the portion 27 as illustrated throughout the drawings. In the preferred construction, the exterior of the skirt 28 is tapered downwardly and inwardly to provide for a maximum vertical movement of the core catcher. The upper end portion of the skirt 28 may be of considerably less diameter than the body portion 27.

The spring members 24 are provided to engage and bite into the core and to carry the slips 25. In accordance with the broader principles of the invention, there may be any suitable number of spring members 24 provided on the body 23. In the form of the invention being described there are four like spring members 24 attached to the body 23 at equally spaced points. The members 24 are in the nature of flat springs or leaf springs attached to the upper portion 27 of the

body at points between their ends so that they project from the upper and lower ends of the body 23. In accordance with the invention the spring members 24 extend through vertical slots or recesses 30 in the periphery of the upper portion 27 of the body. The inner walls of the recesses 30 are preferably inclined downwardly and outwardly, and the flat inner sides of the spring members 24 seat against the inclined walls of the recesses. The opposite edges of the spring members 24 engage the vertical side walls of the recesses 30 so that the spring members have no tendency to twist or rock. Blocks 31 are arranged in the recesses 30 and have inclined inner sides 32 seating against the spring members 24. The outer sides of the blocks 31 are preferably flush with the periphery 30 of the upper portion 27 of the body. Connecting members in the form of rivets 33 extend through radial or horizontal openings in the portion 27, members 24 and blocks 31 to attach the spring members and blocks to the body. It is a feature of the invention that the heads 34 of the rivets 33 are countersunk in the body and blocks 31 so as to be flush with the walls of the opening 26 and with the periphery of the body. The heads 34 of the rivets, in being counter-sunk, cannot be engaged by the core or the walls of the opening 19 of the drill. The rivets 33 very securely and effectively attach the spring members 24 to the body 33 and the spring members 24 in fitting the recesses 30, are positively held against twisting or rocking so that the rivets are not subjected to excessive shearing forces.

The spring members 24, in being clamped between the inclined inner walls of the recesses 30 and the inner sides 32 of the blocks have their upper portions 35 inclined upwardly and inwardly. The portions 35 of the spring members 24 projecting upwardly from the body 23 are operable to yieldingly engage the core to hold the core catcher against movement during the drilling operation, and when the drill is raised, and are operable to bite into the core upon continued upward movement of the drill. The extreme upper end parts 36 of the spring members 24 are bent inwardly and upwardly at a greater angle than the portions 35. In accordance with the invention, the upper portions 35 of the spring members 24 are bifurcated or split, each having a vertical cut or slot 37 extending downwardly from its upper end. The cuts or slots 37 divide the upper portion of each spring member 24 into branches A and B. The two forks or branches A and B of each spring member, in being free to bend or flex independently of one another, are more flexible than the remaining portions of the members 24.

It will be apparent that the width and length of the cuts or slots 37 determines the flexibility of the branches A and B and that where it is desirable to have comparatively stiff or rigid branches for engaging the core, the slots 37 may be narrow, and where it is desirable to have more flexible branches, the slots 37 may be comparatively wide. It is a feature of the present invention that the upper ends 38 of the branches A and B are bevelled or pointed so that they are adapted to effectively bite into the core when the drill is raised to break the core loose from the formation and remove the core from the well.

The portions 39 of the spring members 24 projecting downwardly from the upper portion 27 of the body carry the slips 25, and are adapted to flex inwardly through vertical slots 40 in the skirt 75

28. The lower portions 39 of the spring members are preferably of equal length, and the slips 35 are attached to their lower ends at points below the lower edge of the skirt 28. In the embodiment of the invention being described, the lower portions 39 of the spring members are normally substantially vertical as illustrated in Figs. 1 and 2 of the drawings. The slots 40 are in radial and vertical alignment with the recesses 30 and are sufficiently wide to readily receive the spring members. The invention includes means for limiting the inward movement of the lower portions 39 of the spring members 34. Stop projections or stops 41 are provided on the opposite vertical walls of the slots 40 and are adapted to be engaged by the portions 38 of the spring members to limit the inward flexing of the said portions. The stops 41 may extend downwardly from the upper ends of the slots 40 and preferably terminate at points spaced above the lower ends of the slots. The outer sides 42 of the stops 41 are inclined downwardly and inwardly to permit free inward flexing of the lower portions 39 of the spring members and thus allow the slips 25 to come into effective gripping engagement with the core.

The slips 25 carried on the lower end portions 39 of the spring members are operable through cooperation with the tapered portion 20 of the drill opening to move inwardly to grip the core. The slips 25 are attached to the lower end portions 39 of the spring members at points spaced below the lower end of the skirt 28. The outer sides 43 of the slips 25 are inclined downwardly and inwardly and are transversely rounded to effectively cooperate with the tapered portion 20 of the opening in the drill. Recesses or slots 44 are provided in the outer sides of the slips 25 to receive the lower end parts of the spring members 24. Rivets 45, or the like, attach the slips 25 to the spring members 24. Core gripping teeth 46 are provided on the inner sides of the slips 25. The slips 25 may be comparatively short and narrow to present a comparatively few gripping teeth 46 for gripping the core that are adapted to obtain firm dependable holds on the core.

It is believed that the utility and practicability of the embodiment of the invention illustrated in Figs. 1, 2 and 3 of the drawings will be readily apparent from the foregoing detailed description. During the drilling operation, the branches A and B at the upper ends of the spring member 24, yieldingly engage the core to hold the core catcher against rotation and to yieldingly resist downward movement of the core catcher so that the shoulder 22 engages the upper end 29 of the body as illustrated in Fig. 1 of the drawings. As the core passes into the drill, the slips 25 remain outwardly against the walls of the opening 19 and do not interfere with the upward passage of the core. The stops 41 effectively limit the inward flexing of the spring members 24 so that the spring members have only restricted inward movement, such movement being insufficient to permit the slips 25 to foul the core.

When sufficient core has been taken and it is desired to break the core loose from the formation, the drill is raised causing the tapered portion 20 of the drill opening to cooperate with the slips 25 and force the slips inwardly. During this initial upward movement of the drill the pointed branches A and B at the upper ends of the spring members engage the core to resist upward movement of the core catcher and thus insure effective cooperation between the slips 25

and the tapered wall 20. Continued upward movement of the drill results in the core being broken away from the formation. The slips 25 and the pointed branches A and B at the upper ends of the spring members are effective in retaining and supporting the core in the drill.

The spring members 24 in being counter-sunk in the recesses 30 are effectively supported against lateral and torsional strains. The upper end portions 35 of the members 24 are adapted to engage and partially support the core while the slips 25 on the lower ends of the spring members grip and engage the core so that the spring members are subjected to direct vertical or longitudinal strains and minimum shearing forces are put on the rivets 33. The comparatively short skirt 28, while effectively guiding the spring members 24, allows a maximum inward gripping movement of the slips 25. The slots 40 provide for considerable inward movement of the lower portions 39 of the spring members, which inward movement is limited to the stops 41 so that the slips 25 cannot catch on the upper end of the core. The slots 40 prevent sand or debris from accumulating under the lower portions 39 of the spring members so that the core catcher is not made inoperative by the presence of sand, or the like. The upper end portions 35 of the spring members 34 may be provided with cuts or slots 37 of suitable width to give them the desired flexibility. The split flexible upper portions 35 of the spring members engage the core with only sufficient pressure to properly resist movement of the core catcher and do not exert heavy forces on the core which might cause the core catcher to bind in the drill and rotate with the drill.

The embodiment of the invention illustrated in Figs. 4 and 5 of the drawings includes a body 60, spring members 61, and slips 62 carried by the spring members.

The body 60 is an annular or tubular member including an upper portion 63 and a skirt 64. The opening 65 in the body 60 is of round cross section and extends completely through the body from one end to the other. A plurality of circumferentially spaced slots or recesses 66 is provided in the periphery of the body 60. The inner walls 67 of the recesses 66 are inclined downwardly and outwardly. The skirt 64 may be identical with the skirt 28 described above, that is, it may have vertical slots 68 in alignment with the recesses 66, and may have a downwardly and inwardly tapered exterior.

The spring members 61 and the slips 62 are of the same construction and operation as the spring members and slips included in the form of the invention illustrated in Figs. 1, 2 and 3. The embodiment of the invention illustrated in Figs. 4 and 5 of the drawings provides a modified or alternate means of attaching the spring members 61 to the upper portion 63 of the body. The spring members 61 extend vertically or longitudinally through the recesses 66 and their inner sides seat against the inclined inner walls 67 of the recesses. An annular member or ring 69 surrounds the upper portion 63 of the body 60. Connecting members or rivets 70 extend through openings in the ring 69, the spring members 61, and the body portion 62, to attach the ring and spring members to the body. The heads 71 of the rivets 70 are counter-sunk in the walls of the opening 65, and in the periphery of the ring 60. The upper end 72 of the ring 69 is preferably flat so as to cooperate with a downwardly facing shoulder in the drill, while the exterior

or periphery of the ring is cylindrical to slide in the opening of the drill. The ring 69 operates to positively retain the spring members 61 in their proper positions in the recesses 66 and carries the outer portions of the rivets 70. The opposite vertical edges of the spring members 61 engage the side walls of the recesses 66 so that the spring members are effectively held against turning and lateral movement.

10 The form of the invention illustrated in Fig. 6 of the drawings includes a body 80, spring members 81 attached to the body, and slips 82 for gripping the core.

The body 80 includes an upper portion 83 and a reduced skirt portion 84 identical with the skirt 28 described above. In accordance with this embodiment of the invention, a plurality of spaced slots or recesses 85 is provided in the interior of the upper portion 83. The recesses 85 have outwardly and downwardly inclined outer walls and the spring members 81 seat outwardly against these inclined walls. The vertical slots 86 in the skirt 84 for allowing inward flexing of the spring members 81, are in vertical alignment with the recesses 85 and their upper ends join the lower ends of the recesses. The spring members 81 extend vertically through the recesses 85 and project downwardly into the slots 86. Rivets 87 attach the spring members 81 to the portion 83 of the body. The heads on the inner ends of the rivets 87 are held in the recesses 85 so that they do not project into the core passing opening of the body while the heads on the outer ends of the rivets are counter-sunk to be flush with the periphery of the body. The construction and operation of the spring members 81 and slips 82 are identical with those of the spring members 24 and slips 25 included in the form of the invention illustrated in Figs. 1 to 3 of the drawings. The spring members 81 are held in the recesses 85 so that they are effectively held against lateral movement and twisting.

Having described only typical preferred forms of our invention, we do not wish to limit or restrict ourselves to the specific forms or applications herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

50 Having described our invention, we claim:

1. A core catcher including, a body, a flexible member attached to the body and projecting from the opposite ends thereof, one projecting end portion of the member being longitudinally split into two branches, the ends of said branches being pointed to bite into the core, there being a longitudinal slot in the body to permit the other

end portion of the member to be bent inwardly, and a slip on the said other end portion of the member to grip the core.

2. A core catcher including, a body, a flexible member attached to the body and projecting from the opposite ends thereof, one projecting end portion of the member being longitudinally split into two branches to render it more flexible for contacting the core, there being a longitudinal slot in the body to permit the other end portion of the member to be bent inwardly, a stop on the wall of the slot for limiting inward movement of the said other end portion of the member, and a slip on the said other end portion of the member to grip the core.

3. A core catcher including, an annular body having an upper portion and a downwardly extending skirt, there being a vertical slot in the interior of the upper portion and a vertical slot in the exterior of the skirt having its upper end joining the first mentioned slot, and a flexible core engaging member extending through the slots and projecting from the ends of the body to have core engaging parts at its ends above and below the body.

4. A core catcher including, an annular body having an upper portion and a downwardly extending skirt, there being a vertical slot in the interior of the upper portion and a vertical slot in the exterior of the skirt having its upper end joining the first mentioned slot, a flexible member attached to the upper portion of the body and extending through said slots to project from the ends of the body, the projecting upper end of the member being adapted to engage the core, the flexible member being adapted to be bent inwardly through the second mentioned slot, and a core engaging slip on the lower end part of the flexible member.

5. A core catcher including, an annular body having an upper portion and a downwardly extending skirt, there being a vertical slot in the interior of the upper portion and a vertical slot in the exterior of the skirt having its upper end joining the first mentioned slot, a flexible member attached to the upper portion of the body and extending through said slots to project from the ends of the body, the flexible member being adapted to be bent inwardly through the second mentioned slot, the upper end portion of the flexible member being split into two branches, the upper ends of said branches being pointed to bite into the core, and a core engaging slip on the lower end part of the flexible member.

JOHN H. HOWARD.  
ALFRED C. CATLAND.