Dec. 9, 1969 J. F. COCHRAN 3,482,889

STABILIZERS FOR DRILLING STRINGS

Filed Sept. 18, 1967

FIG. 2.

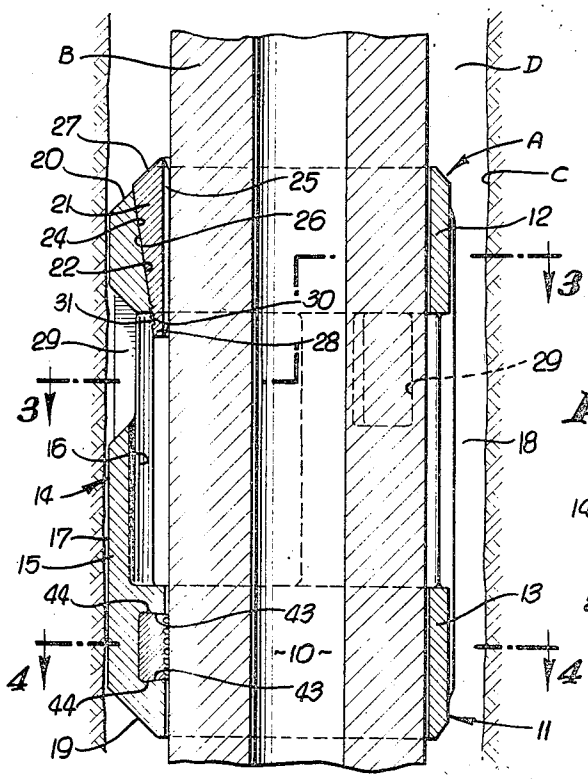


FIG. 5.

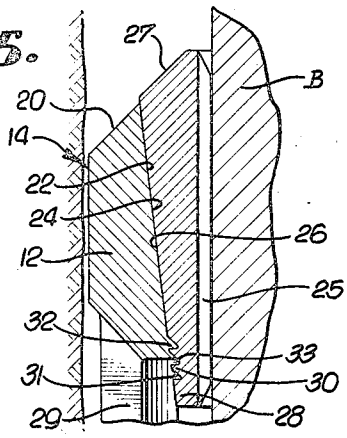


FIG. 3.

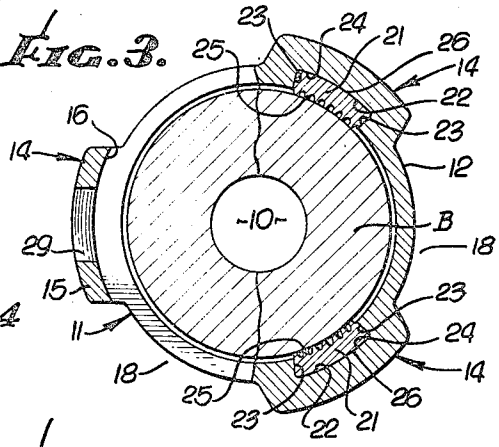


FIG. 1.

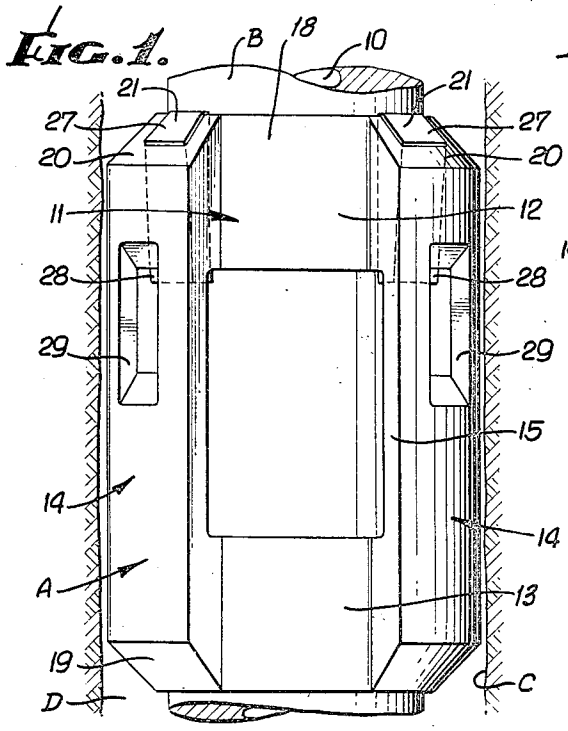
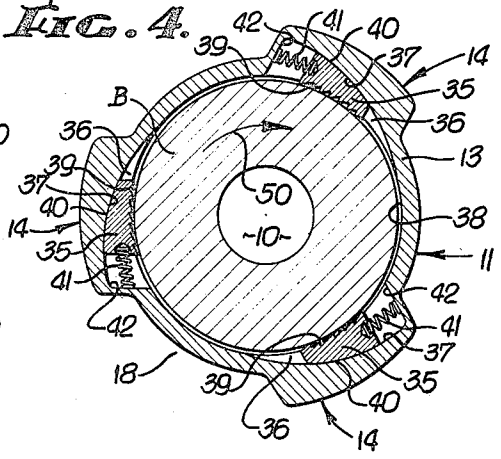


FIG. 4.



INVENTOR.
JOHN F. COCHRAN
By Bernard Kriegel
ATTORNEY.

United States Patent Office 3,482,889 Patented Dec. 9, 1969

3,482,889

STABILIZERS FOR DRILLING STRINGS

John F. Cochran, Long Beach, Calif., assignor to Driltrol, Long Beach, Calif., a corporation of California

Filed Sept. 18, 1967, Ser. No. 668,507
Int. Cl. F16c 1/26, 17/00, 29/00
U.S. Cl. 308—4 20 Claims

ABSTRACT OF THE DISCLOSURE

A drilling string stabilizer used in drilling a well bore, which is adapted to be slipped over a drill pipe section to a desired location thereon, at which the stabilizer is secured to the drill collar section against relative longitudinal movement by longitudinally acting slips or dogs wedged against the section, and against relative circumferential movement by circumferentially acting slips or dogs wedged against the section.

The present invention relates to the drilling of oil, gas, water, and similar well bores, and more particularly to stabilizers mounted on drill collar or drill pipe sections forming parts of drilling strings employed in rotating well drilling bits secured thereto.

In connection with the drilling of an oil well, or similar well bores, stabilizers are often used, being secured to a drill collar section of the drilling string at a point above and close to the drill bit attached to the lower end of the drilling string. Stabilizers usually have a plurality of centering wings or ribs of an effective diameter conforming to the diameter of the hole being drilled. Heretofore, such stabilizing wings have been welded onto a drill collar section or they have been held in grooves formed in a special body constituting a short length of drill collar secured to other drill collar sections in the string of pipe, such as disclosed in United States Patent No. 2,657,907. The prior stabilizers are inflexible with respect to the specific location along the length of the drill string at which they were attached; whereas, at times, it would be desirable to provide a stabilizer at a particular point along the length of the drilling string. In addition, they are required to be mounted on the drill collar at a shop location, or a special shape of drill collar must be provided, requiring the maintenance of costly inventories of drill collars or stabilizers mounted thereon.

In accordance with the present invention, the aforenoted difficulties are avoided since a stabilizer is provided that can be secured, if desired, on a drilling string section at the well location, and at any desired point along the length of a drill collar section, or, for that matter, of a drill pipe section of the appropriate outside diameter. The stabilizer is essentially of a latch-on or wedge-on type and is secured to the drill collar against both relative longitudinal movement thereon and relative rotational or circumferential movement thereon by the action of slips or wedge members that are wedged between the main body of the stabilizer and the drill pipe, to prevent both rotational and longitudinal movement of the stabilizer body, which includes circumferentially spaced stabilizer wings or ribs, relative to the drill collar section. The stabilizer also lends itself to removal from the drill collar section, or its release therefrom and its shifting to a new longitudinal location thereon, if desired.

This invention possesses many other advantages, and has other purposes which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIG. 1 is a side elevational view of a stabilizer mounted on a section of drill collar and disposed in a well bore;

FIG. 2 is a vertical section through the stabilizer and drill collar combination illustrated in FIG. 1 and disposed in the well bore;

FIG. 3 is a cross-section taken along the line 3—3 on FIG. 2;

FIG. 4 is a cross-section taken along the line 4—4 on FIG. 2; and

FIG. 5 is an enlarged fragmentary longitudinal section of an upper portion of the apparatus disclosed in FIG. 2.

As illustrated in the drawings, a latch-on type of stabilizer A is mounted on a drill collar section B forming part of a string of drill pipe extending to the top of a well bore C, and to the lower portion of which a drill bit (not shown) is secured for the purpose of drilling the well bore to the desired diameter. As is well known in the art, the drill collar sections provide the necessary drilling weight to the drill bit. Drilling fluid is pumped through the central passage **10** of the drilling string for discharge from the drill bit, to clean the bottom of the hole of cuttings and convey them through the annular space D between the string of drill pipe and the wall of the well bore to the top of the latter, the drilling fluid also serving to cool the bit and maintain its cutting elements in a clean condition.

The stabilizer A includes a main body **11** of an integral construction, including longitudinally spaced upper and lower sections **12, 13** having an inside diameter conforming to the outside diameter of the drill collar section B, on which the stabilizer is to be mounted, so that the body can be slipped over an end of the drill collar section to the desired location at which the stabilizer is to be fastened thereto. The upper and lower sections **12, 13** are secured to one another in spaced relation by circumferentially spaced and longitudinally extending centering wings or ribs **14**, the upper and lower portions of which are integral with the upper and lower sections **12, 13**, respectively, and the intermediate portions **15** of which have their inner surfaces **16** spaced at a greater radius from the axis of the drill collar section than the external radius of the upper and lower sections **12, 13**. The external surfaces **17** of the wings or ribs **14** are curved to conform substantially to the radius of curvature of the wall of the well bore C, being slightly less in radius than the radius of the well bore. Preferably, the outer surfaces **17** of the wings or ribs have hardfacing material (not shown) thereon, such as tungsten carbide, or the like, to resist wear.

As specifically disclosed in the drawings, three centering wings **14** are provided spaced equal distances from one another, these centering wings forming longitudinal fluid passages **18** therebetween through which the upwardly flowing drilling fluid and cuttings can pass freely. With the stabilizer mounted on the drill collar section, the intermediate portions **15** of the centering wings are spaced laterally from the periphery of the drill collar B so that the circulating fluid cannot only pass through the longitudinal passages **18**, but also through such spaces as well. The lower ends **19** of the wings are tapered in a downward and inward direction, their upper ends **20** being tapered in an upward and inward direction, to prevent the stabilizer apparatus A from hanging up on restrictions in the well bore, or digging into its wall, during both upward and downward movement of the drill string B.

The main body **11** is secured against longitudinal movement on the drill collar section B by a plurality of longitudinal slips, dogs, or coupling elements **21**, each of

which is mounted in the upper section **12** of the body to be wedged between the body and the periphery of the drill collar section. As specifically disclosed, a longitudinally extending groove **22** is located within the upper portion of each centering wing or rib **14**, this groove opening through the upper end **20** of the wing and having opposed sides **23** and a base **24** tapered or inclined in a downward and inward direction. A slip, dog, or coupling member **21** is inserted downwardly into each groove **22**, having longitudinally extending teeth **25** on its inner surface adapted to engage and embed themselves in the periphery of the drill collar B, and an outer inclined or tapered surface **26** conforming to the tapered base **24**, such that the downward driving of each slip **21** into the upper portion of its associated centering wing **14** will cause the tapered surfaces **24**, **26** to bear upon one another and force or wedge the slip **21** inwardly and cause its longitudinally extending teeth **25** to bite into the periphery of the drill collar section B.

The upper end **27** of each slip or dog is preferably tapered in a downward and outward direction. Each slip or dog is of a length such that its smaller or lower end **28** extends downwardly below the upper section **12**, being observable and accessible through a window or opening **29** provided in each wing or rib and extending downwardly from the upper portion **12** to the intermediate portion **15** of each centering wing or rib. The exterior of the lower portion **28** of each slip has a series of teeth **30**, providing longitudinally spaced grooves **31** into which the metal **32** of the body at the upper end of the window or opening **29** can be deformed, as by peening such metal into one or more of the grooves **31**, as more clearly illustrated in FIG. 5. The upper surfaces **33** of each tooth may be substantially normal to the axis of the stabilizer, so that any upward force on the slip **21** cannot deform or deflect the body portion **32** in the groove in a lateral outward direction.

The insertion of all of the slips **21** into their respective grooves **22**, and their downward wedging between the tapered bases **24** and the periphery of the drill collar B will prevent longitudinal movement of the stabilizer A on the drill collar, as well as centering the stabilizer thereon.

The stabilizer body **11** is also secured to the drill collar against relative rotational movement thereon by a plurality of tangential slips, dogs, or gripping members **35** mounted in the lower portion **13** of the main body. As disclosed in the drawings, the lower portion of the body has circumferential grooves **36** primarily in the lower parts of the stabilizer wings **14**, the base **37** of each groove having a tapered surface which is inclined in the direction of rotation of the drill collar toward the inner surface **38** of the lower body section, or toward the periphery of the drill collar section. A rotational or tangential type of slip or dog **35** is disposed in each of these grooves, its inner surface having teeth **39** adapted to engage and bite into the periphery of the drill collar B, these teeth being of ratchet form facing in a direction away from the rotational direction of the drill collar, the outer surface **40** of each slip or dog being tapered in conformance with the taper of the base **37** of its associated groove **36**. A helical compression spring **41** engages the end **42** of the groove and each slip **35**, urging the latter in a wedging direction between the base **37** of the groove and the periphery of the drill collar B. Each groove **36** has upper and lower sides **43**, each slip or dog having companion upper and lower sides **44** to prevent longitudinal movement of the slips in and relative to the stabilizer body **11**.

The drilling string and its drill collar B on which the stabilizer is mounted normally rotate in a clockwise direction, as indicated by the arrow **50** in FIG. 4. The stabilizer wings **14** engage the wall of the well bore C to center the drill collar and drill bit in the well bore, and also offering resistance to turning of the stabilizer body **11** with the drill collar. As a result, the rotation of the drill collar B tends to shift the rotational or tangential slips **35** toward the narrower portion of the circumferential grooves **36**, and causes the slips **35** to be urged radially inwardly and their teeth **39** to bite into the periphery of the drill collar, the stabilizer A being thereby effectively secured to the drill collar B to rotate therewith.

In the mounting of the stabilizer on a drill collar section, the tangential slips **35** are first held in the wide portions of their companion grooves **36** against the force of the springs **41** by any suitable means, and the body **11** with the tangential slips **35** therein slipped over an end of the drill collar to the desired location thereon. The restraint on the slips **35** is then released, which permits the springs **41** to urge the tangential slips toward the narrower parts of the grooves **36**, wherein they are in position to be firmly wedged between the drill collar B and the stabilizer body **11**. The longitudinal slips **21** are then inserted in their longitudinal grooves **22** through the upper end of the body, being driven downwardly into wedging relation between the internal tapered bases **24** of the longitudinal grooves and the periphery of the collar B, to embed the longitudinal teeth **25** in the drill collar. The body portions **32** adjacent to the lower ends **28** of the slips **21** are then peened inwardly at the upper ends of the windows **29** and into the slip grooves **31** to securely retain the longitudinal slips in their tapered grooves embedded against the drill collar, thereby insuring that the stabilizer A cannot move longitudinally with respect to the drill collar section B.

During rotation of the drill collar incident to the drilling action, the direction of rotation tends to wedge the tangential slips **35** more tightly in their companion grooves **36**, the entire stabilizer being rotated as a unit with the drill collar section B. Downward movement of the drilling string and the drill collar section B tends to shift the longitudinal slips **21** to a further extent downwardly within the longitudinal grooves **22**, causing the teeth **25** to tend to embed themselves more firmly in the periphery of the drill collar B, insuring against relative longitudinal movement of the stabilizer A on the drill collar section.

The stabilizer can be removed from the drill collar section by the introduction of a suitable tool through the wing openings **29** against the lower ends **28** of the slips and driving the longitudinal slips **21** in an upward or unwedging direction from their companion grooves **22**. The turning of the stabilizer body **11** in a clockwise direction on the drill collar section B, as seen in FIG. 4, will release the tangential slips **35** from the drill collar section B and permit the body **11** of the stabilizer to be moved longitudinally along the drill collar section and removed entirely therefrom, if desired, or to permit relocation of the stabilizer in a new position along the drill collar section, after which the longitudinal slips **21** can be reinserted in their companion grooves **22**.

It is, accordingly, apparent that a stabilizer for drilling strings has been provided which can be mounted on a drill collar section at the well location, if desired, and in a rapid manner. It is unnecessary to provide special lengths of drill collars as in the prior art devices. The stabilizer remains in its required position on the drill collar section, or other drill pipe section, on which it may be mounted secured against both relative longitudinal and rotational movement with respect to the drilling string.

I claim:

1. In stabilizer apparatus for a drilling string used in drilling a well bore: a tubular member adapted to form part of the drill string; a rigid body on said tubular member and including circumferentially spaced elongate rigid ribs engageable with the wall of the well bore to center said body and tubular member in the well bore, the radius of said ribs being substantially equal to the radius of the well bore; first means wedged between said body and tubular member to secure said body to said tubular member against longitudinal movement of said tubular

member, said first means being movable axially inwardly of said tubular member into wedging engagement with said body and tubular member; and second means separate from said first means and wedged between said body and tubular member to secure said body against rotation on said tubular member, said second means being movable circumferentially of said body and tubular member into solid wedging engagement with both said body and tubular member.

2. In stabilizer apparatus as defined in claim 1; said first means comprising a longitudinal tapered surface in said body and a slip wedged between said tapered surface and the periphery of said tubular member; said second means comprising a circumferential tapered surface in said body and a slip wedged between said circumferential tapered surface and the periphery of said tubular member.

3. In stabilizer apparatus for a drilling string used in drilling a well bore: a tubular member adapted to form part of the drill string; a rigid body on said tubular member and including circumferentially spaced elongate rigid ribs engageable with the wall of the well bore to center said body and tubular member in the well bore; first means wedged between said body and tubular member to secure said body to said tubular member against longitudinal movement on said tubular member; and second means separate from said first means and wedged between said body and tubular member to secure said body against rotation on said tubular member; said first means comprising circumferentially spaced longitudinal tapered surfaces in said body and slips wedged between said tapered surfaces and the periphery of said tubular member; said second means comprising circumferentially spaced circumferential tapered surfaces in said body and slips wedged between said circumferential tapered surfaces and the periphery of said tubular member.

4. In stabilizer apparatus as defined in claim 2; said circumferential tapered surface tapering toward the periphery of said tubular member in the direction of rotation of said tubular member.

5. In stabilizer apparatus as defined in claim 3; said circumferential tapered surfaces being tapered toward the periphery of said tubular member in the direction of rotation of said tubular member.

6. In stabilizer apparatus for a drilling string used in drilling a well bore: a tubular member adapted to form part of the drilling string; a body on said tubular member comprising upper and lower longitudinally spaced sections having internal diameters conforming to the outside diameter of said tubular member, said body further comprising circumferentially spaced elongate rigid ribs interconnecting said sections and engageable with the wall of the well bore, said ribs providing longitudinal fluid passages therebetween; one of said sections having circumferentially spaced longitudinally extending grooves therein having longitudinal tapered bases; the other of said sections having circumferentially spaced circumferentially extending grooves therein having circumferential tapered bases; longitudinal slips in said longitudinally extending grooves wedged between said longitudinal tapered bases and the periphery of said tubular member; and circumferential slips in said circumferentially extending grooves wedged between said circumferential tapered bases and the periphery of said tubular member.

7. In stabilizer apparatus as defined in claim 6; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof.

8. In stabilizer apparatus as defined in claim 6; and means on said body locking said longitudinal slips to said body.

9. In stabilizer apparatus as defined in claim 6; said longitudinal slips having external grooves therein, portions of said body being adapted to extend into said external grooves to lock said longitudinal slips to said body.

10. In stabilizer apparatus as defined in claim 6; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof through which said longitudinal slips are insertable into said longitudinally extending grooves; said longitudinal slips having external grooves therein, portions of said ribs being adapted to extend into said external grooves to lock said longitudinal slips to said body.

11. In stabilizer apparatus as defined in claim 6; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof through which said longitudinal slips are insertable into said longitudinally extending grooves; said ribs having openings therethrough adjacent to said longitudinal slips; said longitudinal slips having external grooves therein; rib portions adjacent to said openings being adapted to be forced into said external grooves to lock said longitudinal slips to said body.

12. In stabilizer apparatus as defined in claim 6; and spring means engaging said circumferential slips to urge said circumferential slips in a direction wedged between said circumferential tapered bases and the periphery of said tubular member.

13. In a stabilizer adapted to be mounted on a tubular member forming part of a drilling string used in drilling a well bore: a rigid body adapted to be mounted on the tubular member and including circumferentially spaced elongate rigid ribs engageable with the wall of the well bore to center said body and tubular member in the well bore, the radius of said ribs being substantially equal to the radius of the well bore; first means adapted to be wedged between said body and the tubular member to secure said body to the tubular member against longitudinal movement on the tubular member, said first means being movable axially inwardly of said tubular member for wedging engagement with said tubular member and the body; and second means separate from said first means and adapted to be wedged between said body and the tubular member to secure said body against rotation on the tubular member, said second means being adapted for movement circumferentially of said tubular member and the body into solid wedging engagement with both said tubular member and the body.

14. In a stabilizer as defined in claim 13; said first means comprising a longitudinal tapered surface in said body and a slip adapted to be wedged between said tapered surface and the periphery of the tubular member; said second means comprising a circumferential tapered surface in said body and a slip adapted to be wedged between said circumferential tapered surface and the periphery of the tubular member.

15. In a stabilizer adapted to be mounted on a tubular member forming part of a drilling string used in drilling a well bore: a rigid body adapted to be mounted on the tubular member and including circumferentially spaced elongate rigid ribs engageable with the wall of the well bore to center said body and tubular member in the well bore; first means adapted to be wedged between said body and the tubular member to secure said body to the tubular member against longitudinal movement on the tubular member; and second means separate from said first means and adapted to be wedged between said body and the tubular member to secure said body against rotation on the tubular member; said first means comprising circumferentially spaced longitudinal tapered surfaces in said body and slips adapted to be wedged between said tapered surfaces and the periphery of the tubular member; said second means comprising circumferentially spaced circumferential tapered surfaces in said body and slips adapted to be wedged between said circumferential tapered surfaces and the periphery of the tubular member.

16. In a stabilizer adapted to be mounted on a tubular member forming part of a drilling string used in drilling a well bore: a body adapted to be mounted on the tubular member and comprising upper and lower longitudinally spaced sections having internal diameters con-

forming to the outside diameter of the tubular member, said body further comprising circumferentially spaced elongate rigid ribs interconnecting said sections and engageable with the wall of the well bore, said ribs providing longitudinal fluid passages therebetween; one of said sections having circumferentially spaced longitudinally extending grooves therein having longitudinal tapered bases; the other of said sections having circumferentially spaced circumferentially extending grooves therein having circumferential tapered bases; longitudinal slips in said longitudinally extending grooves adapted to be wedged between said longitudinal tapered bases and the periphery of the tubular member; and circumferential slips in said circumferentially extending grooves adapted to be wedged between said circumferential tapered bases and the periphery of the tubular member.

17. In a stabilizer as defined in claim **16**; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof.

18. In a stabilizer as defined in claim **16**; said longitudinal slips having external grooves therein, portions of said body being adapted to extend into said external grooves to lock said longitudinal slips to said body.

19. In a stabilizer as defined in claim **16**; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof through which said longitudinal slips are insertable into said longitudinally extending grooves; said longitudinal slips having external grooves therein, portions of said ribs being adapted to extend into said external grooves to lock said longitudinal slips to said body.

20. In a stabilizer as defined in claim **16**; said longitudinally extending grooves being disposed in said ribs and opening through end portions thereof through which said longitudinal slips are insertable into said longitudinally extending grooves; said ribs having openings therethrough adjacent to said slips; said longitudinal slips having external grooves therein; rib portions adjacent to said openings being adapted to be forced into said external grooves to lock said longitudinal slips to said body.

References Cited

UNITED STATES PATENTS

1,183,204	5/1916	Johnson	287—52
1,890,529	12/1932	Santiago.	
2,440,441	5/1948	Hanes.	
2,855,052	10/1958	Wright.	
2,927,645	3/1960	Boer	166—241 X
2,989,326	6/1961	Seward	287—52
2,998,848	9/1961	Wright	166—241
3,164,216	1/1965	Hall.	
1,860,659	5/1932	Criley.	
1,888,216	11/1932	Bull.	
1,905,158	5/1933	Graig.	
2,162,426	6/1939	Fitzpatrick.	
2,188,119	1/1940	Prentice.	
2,288,124	6/1942	Creighton.	
3,322,217	5/1967	Cook.	

MARTIN P. SCHWADRON, Primary Examiner

LUCIOUS L. JOHNSON, Assistant Examiner

U.S. Cl. X.R.

166—241; 287—52