Oct. 17, 1961 K. A. WRIGHT ET AL 3,004,606

PACKER DEVICE FOR WELLS

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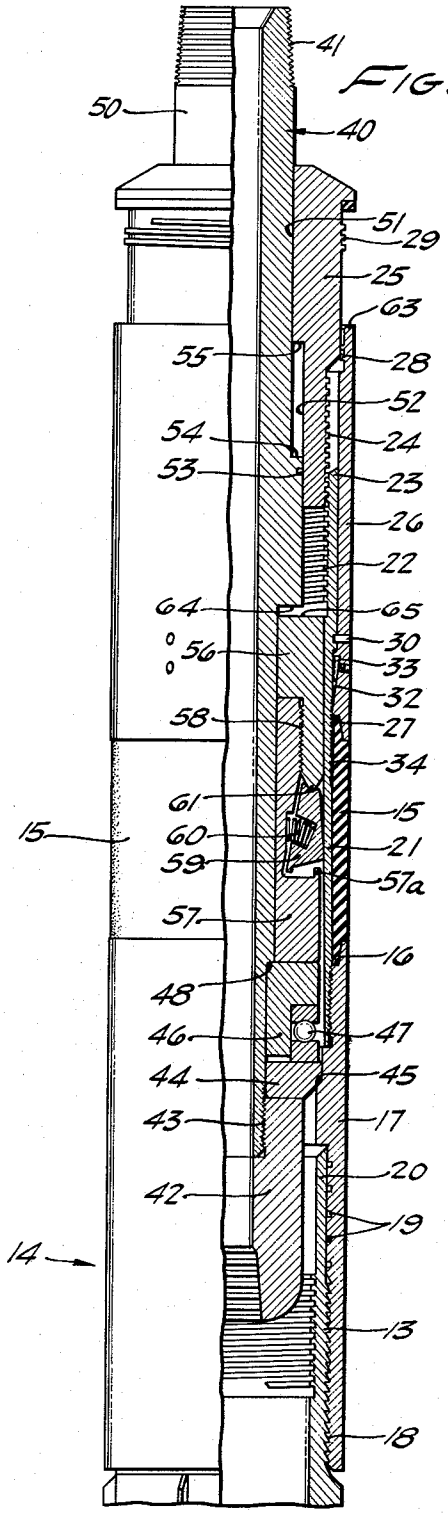
FIG. 4.



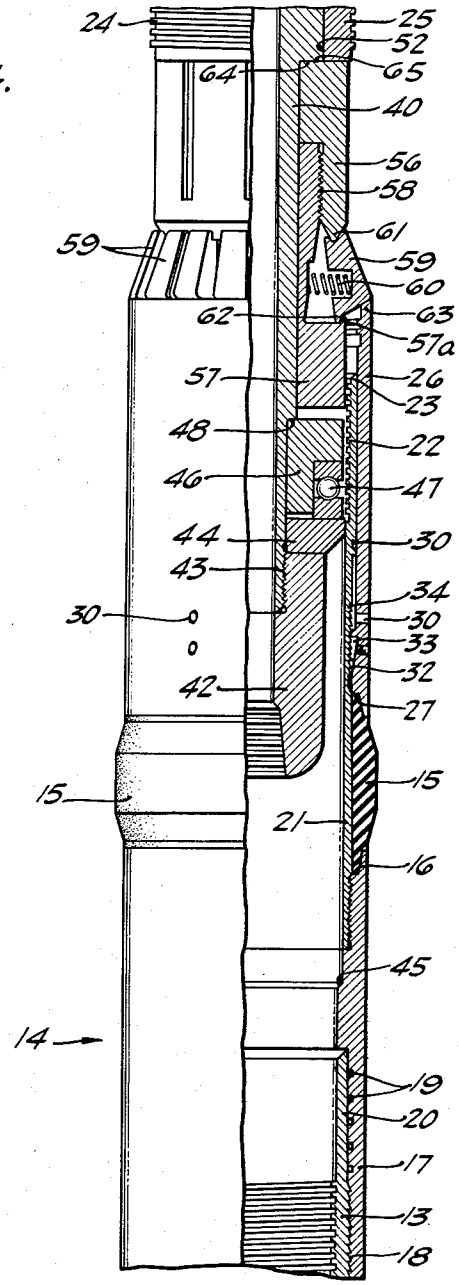


FIG. 5.

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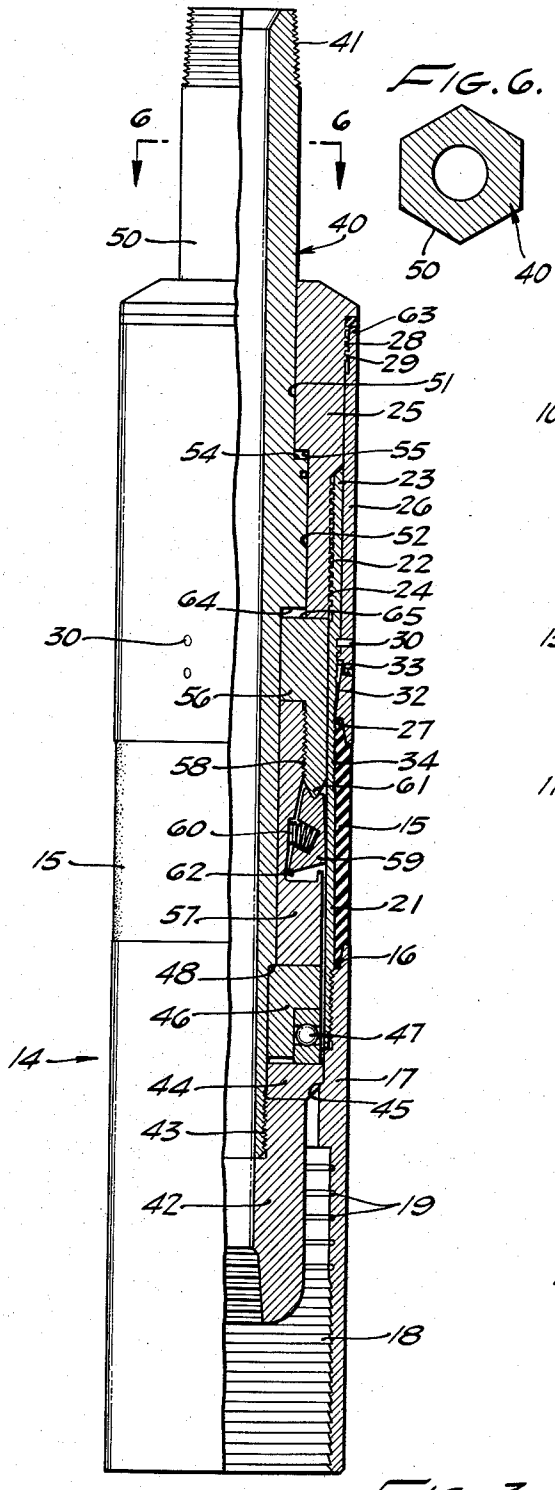

FIG. 3.

FIG. 6.

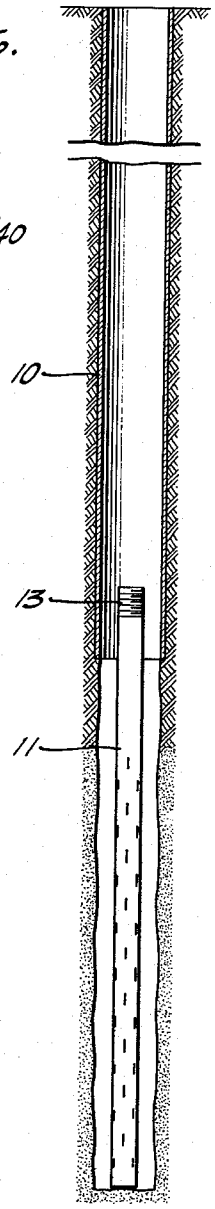

FIG. 1.

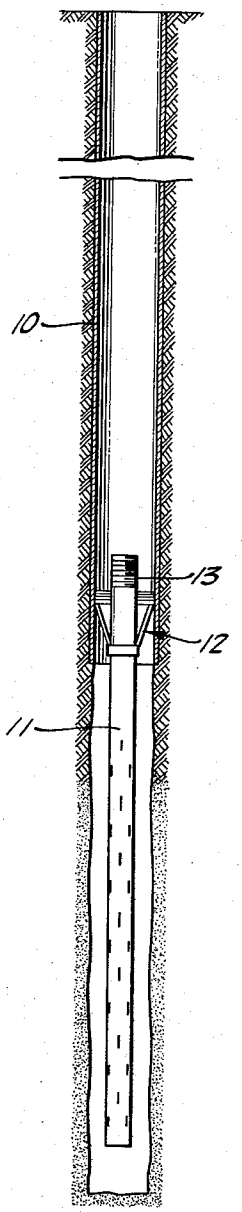

FIG. 2.

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3,004,606

PACKER DEVICE FOR WELLS

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Filed Aug. 20, 1957, Ser. No. 679,204
9 Claims. (Cl. 166—182)

This invention relates to the art of producing fluid from wells and is particularly directed to improvements in apparatus of the general type commonly used to provide a seal between the lower end of a well casing and the upper end of a liner pipe extending below the casing into the well formation.

An annular expansible packer element is commonly mounted between telescoping metallic parts so that the packer element is expanded upon relative axial movement of the metallic parts. It is also a common practice to employ frangible means, such as for example, shear pins to prevent relative movement of the metallic telescoping parts until the packer has been lowered to the desired position within the well. Premature breaking of the shear pin sometimes occurs, however, when the packer assembly encounters an obstruction on being lowered into the hole with the result that the packer mechanism may be tripped and the packer "set" at the wrong location in the hole. It is the principal object of this invention to provide a well packer assembly which cannot be set prematurely upon being lowered into the hole. It is another object of this invention to provide latch means in addition to the shear pin for preventing relative movement of the telescoping metallic parts of the packer assembly until the packer assembly reaches the desired elevation in the well bore.

Another object is to provide such a device in which the latching assembly takes the form of a rotary member having threads connecting it to both of the telescoping metallic parts of the packer assembly together with means for rotating the member while a downward force is applied to the packer assembly. Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

FIGURE 1 is a diagrammatic view of a well showing a perforated liner pipe resting on bottom and projecting upward into the lower portion of the well casing.

FIGURE 2 is a similar diagrammatic view showing the perforated liner pipe suspended from the lower end of the casing by means of a conventional liner hanger.

FIGURE 3 is a sectional elevation showing a packer assembly embodying a preferred form of our invention, the parts being shown in the position during lowering of the device on a pipe string into the well casing.

FIGURE 4 is a view similar to FIGURE 3 showing the position of the parts of the device after engagement with a tubular element at the upper end of the liner pipe and after the mandrel and threaded member have been rotated for a number of turns.

FIGURE 5 is a view similar to FIGURE 2 showing the position of the parts when the annular packer has been expanded into engagement with the inner surface of the casing.

FIGURE 6 is a sectional view taken substantially on lines 6—6 as shown in FIGURE 3.

Referring to the drawings, the well casing, generally designated **10**, extends down into the hole and the perforated liner pipe **11** is positioned adjacent the producing formation and projects into the lower end of the casing. The liner pipe **11** may rest on bottom as shown on FIGURE 1 or may be supported in a conventional liner hanger **12** as shown in FIGURE 2. In either case, a tubular element **13** is mounted on the upper end of the

liner pipe **11**. The liner pipe **11** as shown in FIGURE 1 may be maintained in central position by means of conventional centralizers, not shown.

In accordance with our invention, we provide a packer device generally designated **14**, which is engageable with the tubular element **13** and which acts to form a seal between the casing **10** and the liner pipe **11**. This well packer device **14** includes an annular resilient packer element **15** having its lower end fixed to and abutting a shoulder **16** provided on the shell **17**. Internal wickers **18** are provided on the shell **17** adjacent its open lower end and are adapted to engage the outer surface of the tubular element **13**, as shown in FIGURES 4 and 5. A series of O-rings **19** may also be provided on the shell **17** for sealing contact with the cylindrical extension **20** on the element **13**.

The shell **17** includes a tubular extension **21** which extends through the bore of the packer element **15** and which is provided with internal threads **22** near its upper end **23**. These threads engage the external threads **24** provided on the rotary member **25**. A sleeve **26** is slidably mounted on the outer surface of the shell extension **21** and a shoulder **27** at the lower end of this sleeve engages the upper end of the anular packer **15**. The upper end of the sleeve **26** is provided with internal threads **28** which are engageable with external threads **29** provided on the rotary member **25**.

Frangible means are provided to connect the sleeve **26** to the shell **17** and as shown in the drawings, this means includes a plurality of shear pins **30** extending into aligned openings on the sleeve **26** and sleeve extension **21**. The shell **26** is provided with a tapered bore **32** for reception of a plurality of wedge slips **33** which engage the outer surface of the sleeve extension **21**. This outer surface may be serrated as shown at **34**. Engagement of the wedge slips **33** with the serrated surface **34** serves to prevent upward movement of the sleeve **26** with respect to the shell **17**.

The device **14** includes a mandrel **40** attached to the lower end of a string of drill pipe (not shown) by means of threads **41** and annular terminal fitting **42** is connected by threads **43** to the lower end of the mandrel **40** and a thrust collar **44** rests on this terminal fitting **42**. The thrust collar **44** has an outer portion which engages an upwardly facing abutment **45** provided on the shell **17**. A collar **46** on the mandrel **40** carries a bearing assembly **47** which rests against the thrust collar **44**. A downwardly facing shoulder **48** on the mandrel **40** engages this collar **46**. From this description it will be understood that when a downward force is applied to the mandrel **40** that this force passes through the shoulder **48**, collar **46**, bearing **47**, thrust collar **44**, abutment **45** and shell **17** although the lower portion of the mandrel **40** is cylindrical, the upper portion of the mandrel **40** is hexagonal as shown at **50**, and a complementary hexagonal bore **51** is provided in the rotary member **25** so that the member **25** turns with the mandrel **40** but may slide axially thereon. The member has a cylindrical counterbore **52** which is engaged by a seal ring **53** carried on the mandrel. A shoulder **54** on the mandrel underlies a shoulder **55** on the rotary member **25**.

Cooperating annular elements **56** and **57** are threaded together at **58** to form a cage for a series of expanding lugs **59**. A spring **60** acts on each lug to move it outwardly about the rocking pivot **61**. In the position shown in FIGURES 3 and 4, the lugs **59** are maintained in retracted position by the inner surface of the shell extension **21**. When the lugs **59** are in the expanded position shown in FIGURE 5, a toe portion **62** on each lug **59** engages under a lip **57***a* on the member **57** to limit outward movement of the lug under the force of the spring **60**.

In operation, the device **14** is lowered into the casing **10** on the lower end of the drill string (not shown). The drill string is connected to the mandrel **40**. During the operation of lowering the device **14** into the hole, the parts are in the position shown in FIGURE 3. It should be noted that the sleeve **26** and shell **17** on opposite ends of the resilient packer **15** are prevented from having any relative motion since they are each connected by threads to the member **25**. Accordingly, there is no danger of shearing the pins **30** should the device encounter a tight spot in the hole during the operation of lowering the device into position. Each time a new section of drill pipe is added at the surface to lengthen the drill string, the device is raised for a short distance in the hole, in accordance with conventional pipe handling practice. The two sets of threads **28**, **29** and **22**, **24** prevent relative axial movement of the parts **21** and **26** in either direction, and hence there is no danger of premature setting of the packer at the wrong elevation in the casing. The device **14** is lowered through and guided by the casing **10** until the lower end of the shell **17** strikes the upper end of the tubular element **13** associated with the liner **11** or the liner hanger **12**. Weight is then rested on the mandrel to cause the downward force to be applied through the shoulder **48**, collar **46**, bearing **47**, thrust collar **44** and abutment **45**. This downward force causes the lower end of the shell **17** to telescope over the tubular element **13** and to bring the internal wickers **18** into engagement with the outer surface of the tubular element **13**. With the weight still applied to the mandrel **40**, the drill pipe and mandrel are rotated to disconnect the threads **28**, **29** and the threads **22**, **24**. The threads are preferably left hand so that the drill string may be rotated in the conventional right hand direction without danger of disconnecting threaded sections of the drill pipe. A predetermined number of revolutions, for example, **20**, is sufficient to insure that both sets of threads are disconnected. During turning movement of the mandrel **40** and member **25** the member **25** moves upward along the mandrel **40** from the position shown in FIGURE 3 to the position shown in FIGURE 4.

The drill pipe and mandrel are then raised upward for a sufficient distance to bring the expanding lugs **59** upward beyond the upper end of the sleeve **26**. The lugs **59** are expanded upward by means of the springs **60** into a position to engage the upper end **63** of the sleeve **26**. Subsequent downward force applied through the mandrel **40** acts through the abutting shoulders **64** and **65**, member **56**, pivot **61** and lugs **59** to the upper end **63** of the sleeve **26**. This downward force shears the pins **30** and permits the sleeve **26** to move downward relative to the shell **17** and shell extension **21**, thereby axially contracting the annular packer **15** and causing it to expand radially into contact with the inner surface of the casing **10**. The wedge slips **33** engage the serrated surface **34** under action of the compression springs **33***a* to maintain the packer **15** in expanded position.

The mandrel **40** and its associated parts **42**, **44**, **47**, **57**, **59**, **56** and **25** are then withdrawn upward through the casing.

Having fully described our invention, it is to be understood that we do not wish to be limited to the details herein set forth, but our invention is of the full scope of the appended claims.

We claim:

1. In a well packer device, the combination of: a tubular shell having a shoulder, an annular expansible packer mounted on and encircling a portion of the shell and having upper and lower ends, said lower end engaging said shoulder, a sleeve slidably mounted upon the shell and having a shoulder engaging the upper end of said packer, internal threads on said shell, internal threads on said sleeve, a rotary member having external threads engaging said internal threads on the shell and having external threads engaging said internal threads on the sleeve, means including a mandrel extending within and engaging said rotary member for turning the said rotary member to release its external threads from engagement with the internal threads on said sleeve and said shell, expansible lugs carried on the mandrel, and means for moving said lugs to a position to overlie a portion of said sleeve upon upward movement of the mandrel following disengagement of said threads, whereby a downward force may be transmitted from the mandrel through said lugs to said sleeve for expanding the packer.

2. The combination set forth in claim 1 in which the tubular shell is provided with an open lower end having internal wickers, whereby the shell may telescope over and engage an upwardly projecting tubular element in a well.

3. In a well packer device, the combination of: a tubular shell having a shoulder, an annular expansible packer mounted on and encircling a portion of the shell and having upper and lower ends, said lower end engaging said shoulder, a sleeve slidably mounted upon the shell and having a shoulder engaging the upper end of said packer, the sleeve extending above the upper end of the shell, internal threads on said shell at the upper end thereof, internal threads on said sleeve at the upper end thereof, a rotory member having a first series of external threads engaging said internal threads on the shell and having a second series of external threads engaging said internal threads on the sleeve, means including a mandrel extending within for engaging said rotary member for turning the said rotary member to release both series of threads from engagement with the internal threads on said sleeve and said shell, and means carried by the said mandrel for engaging the sleeve after upward movement of the mandrel following disengagement of the said threads, whereby the sleeve may be moved axially toward the shell for expanding the packer.

4. In a well packer device, the combination of: a tubular shell having a shoulder, an annular expansible packer mounted on and encircling a portion of the shell and having two ends, one end of said packer engaging said shoulder, a sleeve slidably mounted upon the shell and having a shoulder engaging the other end of said packer, internal threads on said shell, internal threads on said sleeve, a rotary member having external threads engaging said internal threads on the shell and having external threads engaging said internal threads on the sleeve, and means including a mandrel extending within and engaging said rotary member for turning the said rotary member to release its external threads from engagement with the internal threads on said sleeve and said shell, and means carried by the said mandrel for engaging the sleeve after upward movement of the mandrel following disengagement of the said threads, whereby the sleeve may be moved axially toward the shell for expanding the packer.

5. In a well packer device, the combination of: a tubular shell having a shoulder and having threads thereon remote from said shoulder, an annular expansible packer mounted on and encircling a portion of the shell and having two ends, one end of said packer engaging said shoulder, a sleeve slidably mounted upon the shell and having a shoulder engaging the other end of said packer, said sleeve having threads thereon, a rotary member having a first series of threads engaging said threads on the shell and having a second series of threads engaging said threads on the sleeve, means including a mandrel extending within and engaging said rotary member for turning the said rotary member to release both series of threads from engagement with the threads on said sleeve and said shell, and means carried by the same mandrel for engaging the sleeve after upward movement of the mandrel following disengagement of the said threads whereby the sleeve may be moved axially toward the shell for expanding the packer.

6. In a well packer device, the combination of: a tubular shell having an open lower end adapted to tele-

scope over and engage an upwardly projecting tubular element in the well, an annular expansible packer mounted on the shell and having an upper and lower end, means fixing the lower end of the packer to the shell, a sleeve slidably mounted on the shell, means fixing the sleeve to the upper end of the packer, a mandrel extending within the sleeve and having a shoulder, a threaded member slidably and non-rotatably mounted on the mandrel above the mandrel shoulder, first thread means connecting said member to the shell, second thread means connecting said member to the sleeve, thrust means mounted on the mandrel and engaging the shell whereby the mandrel may turn while applying a downward force to the shell, such turning movement of the mandrel serving to disconnect the first and second thread means, expansible lugs carried on the mandrel, and means for moving said lugs to a position to overlie a portion of said sleeve upon upward movement of the mandrel following disengagement of said threads, whereby a downward force may be transmitted to the sleeve to move the sleeve downward relative to the shell to expand the packer.

7. In a well packer device adapted to be run into a well on a pipe string for establishing a seal between the lower end of a well casing and the upper end of a liner pipe, the combination of: a tubular shell having an open lower end adapted to telescope over and engage an upwardly projecting tubular element on a liner pipe, an annular expansible packer mounted upon the shell, means fixing the lower end of the packer to the shell, a sleeve slidably mounted upon the shell, means fixing the sleeve to the upper end of the packer, frangible means preventing relative axial motion between the sleeve and the shell, a mandrel extending within the sleeve and having a shoulder, a threaded member slidably and non-rotatably mounted relative to the mandrel above the mandrel shoulder, first thread means connecting said member to the shell, second thread means connecting said member to the sleeve, an abutment within the shell, thrust means including a bearing assembly mounted on the mandrel engageable with the abutment whereby the mandrel may turn while applying a downward force to the shell, such turning movement of the mandrel serving to disconnect the first and second thread means to permit upward movement of the threaded member and mandrel relative to the sleeve and shell, lug means carried by the mandrel within the shell biased to expand outwardly upon upward movement of the mandrel to engage the upper end of the sleeve, whereby a downward force may be applied to the sleeve by the lug means to break the frangible means and move the sleeve downward relative to the shell to expand the packer, and means for

engaging the said sleeve and said shell for preventing upward movement of the said sleeve relative to the said shell after the packer has been expanded.

8. The combination of claim 7 wherein the means for preventing the said upward movement of the sleeve relative to the shell includes one or more circumferentially extending wedge means mounted between and engaging said sleeve and said shell.

9. In a well packer device adapted to be run into a well on a pipe string for establishing a seal between the lower end of a well casing and the upper end of a liner pipe, the combination of: a tubular shell having an open lower end adapted to telescope over and engage an upwardly projecting tubular element on a liner pipe, an annular expansible packer mounted upon the shell, means fixing the lower end of the packer to the shell, a sleeve slidably mounted upon the shell, means fixing the sleeve to the upper end of the packer, frangible means preventing relative axial motion between the sleeve and the shell, a mandrel extending within the sleeve and having a shoulder, a threaded member slidably and non-rotatably mounted relative to the mandrel above the mandrel shoulder, first thread means connecting said member to the shell, second thread means connecting said member to the sleeve, an abutment within the shell, thrust means including a bearing assembly mounted on the mandrel engageable with the abutment whereby the mandrel may turn while applying a downward force to the shell, such turning movement of the mandrel serving to disconnect the first and second thread means to permit upward movement of the threaded member and mandrel relative to the sleeve and shell, lug means carried by the mandrel within the shell biased to expand outwardly upon upward movement of the mandrel to engage the upper end of the sleeve, whereby a downward force may be applied to the sleeve by the lug means to break the frangible means and move the sleeve downward relative to the shell to expand the packer.

References Cited in the file of this patent

UNITED STATES PATENTS

1,870,779	Layne et al.	Aug. 9, 1932
2,067,885	Brown	Jan. 19, 1937
2,092,048	Brown	Sept. 7, 1937
2,120,982	Layne	June 21, 1938
2,137,997	Bendeler	Nov. 29, 1938
2,312,862	Bermingham	Mar. 2, 1943
2,877,850	Burns	Mar. 17, 1959