

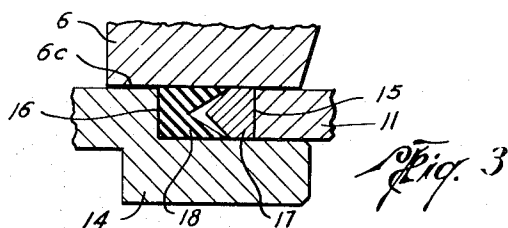
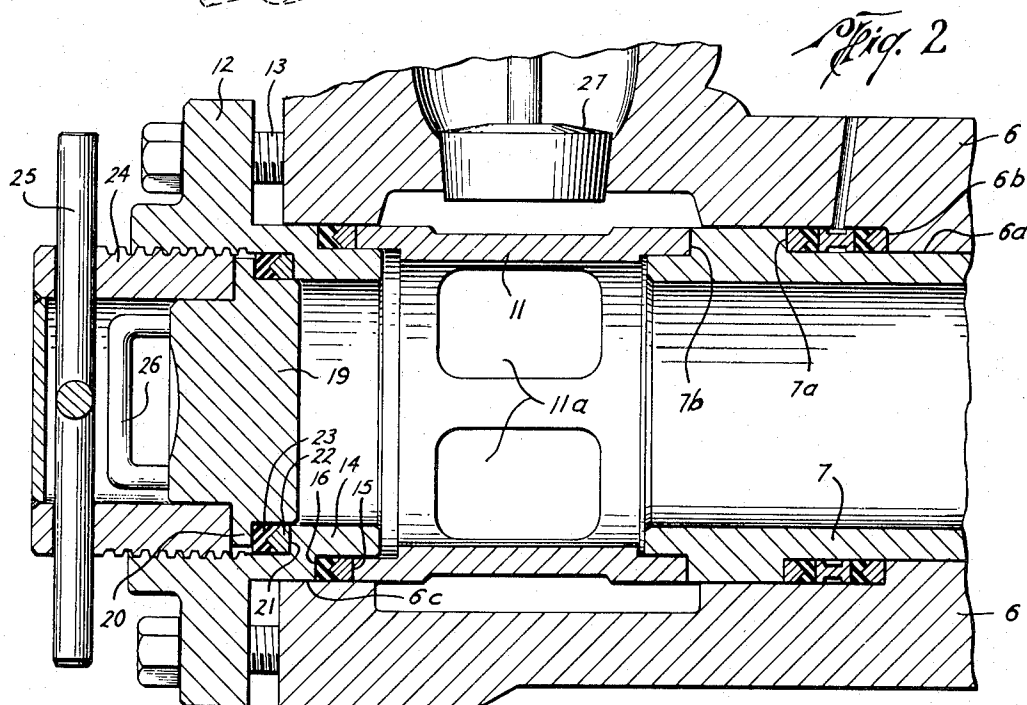
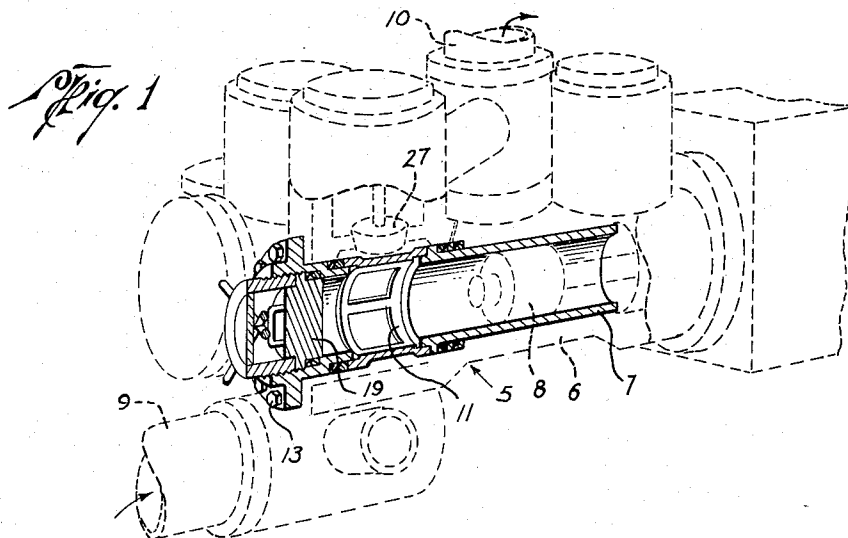
Jan. 31, 1956

V. R. MATTINGLY ET AL

2,732,809

LINER ASSEMBLIES

Filed Oct. 3, 1952



Virdean R. Mattingly
George C. Mallory
INVENTORS

BY *Browning & Ames*

ATTORNEYS

1

2,732,809

LINER ASSEMBLIES

Virdean R. Mattingly, Houston, Tex., and George C. Mallory, New Iberia, La., assignors to Matco, Inc., Houston, Tex., a corporation of Texas

Application October 3, 1952, Serial No. 313,004

13 Claims. (Cl. 103—216)

This invention relates to improvements in high pressure heavy duty pumps and refers more particularly to the removeable cylinder liner and the hold-down and cap or cylinder head assembly therefor. The pumps to which the invention pertains are utilized primarily in the oil field for circulating drilling mud, cement and the like under high pressures.

In such pumps the fluids pumped are very gritty and abrasive and the pistons which reciprocate within the cylinder have a very short life and are necessarily replaced quite frequently. Due to the heavy pressures which are developed by the pump, the equipment is quite massive and the cylinder head opening of necessity must be covered by a cap or cylinder head having heavy duty fastening means for securing it to the pump body. In order to change the piston in a pump, it has heretofore been necessary to remove the cap from the cylinder head opening together with the cylinder liner and the hold-down assembly therefor. When conducting this operation, it is usually considered good practice to then replace the cylinder liner inside packing. The result is that usually several hours of down time are required for the replacement of a piston. This is expensive, not only in the time of labor which is consumed, but also in connection with the liner packing that must be replaced, and the possibility of damage to an oil well which is sometimes caused by cessation of circulation of drilling fluid within the well bore.

This invention is an improvement upon our invention shown in our co-pending application for United States Letters Patent entitled "Liner Assemblies," filed July 22, 1949, Serial No. 106,234, and now matured into Patent No. 2,701,743, issued February 8, 1955, wherein an arrangement has been provided and disclosed for tightening both the packing between a cylinder liner and a cylinder and the cylinder head cap and the pump body by tightening a single series of bolts or studs.

It is an object of this invention to provide an improved liner assembly employing a single fastening means for securing the liner within a hollow body with an open end and sealing between the body and liner and the body and the closure cap for the open end of the body.

Another object is to provide in a heavy duty high pressure reciprocating pump a liner and cap assembly in which the piston of the pump, the liner, and the packing for the liner is readily accessible for quick and easy repair or replacement.

Another object is to provide a closure means for closing off a cylinder head opening for use on oil field slush pumps and the like in which the pump piston is always readily accessible for quick exchange or repair.

Another object is to provide a closure means for closing off a cylinder head opening for use on oil field slush pumps and the like in which the pump piston is always readily accessible for quick exchange or repair without the necessity of removing or loosening the cylinder liner or the packer means for sealing between the cylinder and liner.

2

Another object is to provide a cylinder head or cap having a single series of studs or other fastening means for securing it to a slush pump body or the like wherein the cap has a central opening of sufficient size to accommodate a piston of such pump with a plug for closing off the opening and having readily operable cam means for simultaneously securing the plug in operative relation within the cap opening and for expanding the sealing means for sealing between the cap and plug.

Other and further objects of the invention will appear as the description proceeds.

In the accompanying drawings which form a part of the instant specification and are to be read in conjunction therewith, and wherein like reference numerals are used to indicate like parts in the various views:

Fig. 1 is a perspective view, with parts shown in section, embodying this invention and illustrating the main portion of a slush pump in phantom;

Fig. 2 is a sectional view upon an enlarged scale illustrating the liner hold-down and seal assembly of the Fig. 1 drawing but in more detail; and

Fig. 3 is a sectional view upon an enlarged scale illustrating the seal assembly between the cylinder, cage, and cap with the seal ring shown not under compression.

Referring to the drawings, a slush pump, shown chiefly in dotted lines in Fig. 1 is designated by the numeral 5. The slush pump has the usual pump cylinder 6 receiving a liner sleeve 7 in which the pump piston 8 is adapted to reciprocate. Connection 9 is an inlet for the pump for fluid to be pumped and the outlet for the pumped fluid is shown at 10.

A fragment of the pump body and cylinder is shown in Fig. 2, the cylinder 6 having a bore 6a for receiving the liner 7. A shoulder 6b is arranged to oppose a confronting shoulder 7a formed on the liner by an annular part which also provides an oppositely faced abutment shoulder 7b. The usual inside liner packing may be employed between opposing shoulders 6b and 7a to provide an inside seal between the cylinder and liner. The tell-tale type packing shown in Fig. 2 is preferred and is believed to be well understood by those skilled in the art.

The liner 7 is slidably and movably mounted in the cylinder and is tightened down into clamping engagement with the inside liner packing to perfect a seal. A means is provided for effecting this tightening of the packing and securing the liner in operative position. The hold-down means includes a hold-down and expander cage 11 of generally cylindrical contour but having openings 11a to permit circulation of fluid during the pumping operation. The cage is provided with an abutment shoulder which may be one end of the cage for engaging the abutment surface 7b of the liner.

A cylinder head or cap 12 is provided for closing off the cylinder head opening 6c and holding down the cage 11 and liner 7. The cap has a flange with a circumferentially arranged group of openings for receiving a series of studs 13 or other fastening means. The cap has a circular extension 14 which has telescoping parts relative to the end of cage 11. In the embodiment shown, the telescoping parts include the reduced diameter end portion of extension 14 which fits preferably closely within the end portion of cage 11. With this arrangement, the telescoping parts provide surfaces 15 and 16 which confront each other and together with the cylinder head opening wall 6c and the inner telescoping part 14 provide a substantially closed chamber of variable capacity for receiving a sealing means.

This sealing means will be called upon to withstand tremendous pressures during the pumping operation and also must provide a power transmitting connection between the cap and the cage so as to force down the liner 7 and hold it in position during the pumping operation.

3

Because of this, it has been found highly desirable to employ the type of packing means shown in Figs. 2 and 3 in some detail. This preferred packing means includes an expander ring of rigid or metallic material 17, and a very hard viscous rubberlike material 18. The ring 17 is crowned and the ring 18 has a V-groove for receiving the crown of ring 17. However, the pitch of the groove in ring 18 is on a lesser angle than is the pitch of the crown on ring 17. With this arrangement, the material of ring 18 is compressed exceedingly tightly at its inner and outer edge where it engages the expander ring 17 as the joint is made up. In the Fig. 3 showing, the joint is shown not under compression. While under compression, as shown in Fig. 2, the material of ring 18 conforms to the contour of the expander ring 17 due to the pressure of the make up of the joint. Under this high compression, the material of ring 18 becomes confined fluid to provide a power transmitting connection between cap 12 and the cage 11 to solidly hold the latter in place. This connection has been found in practice to be entirely satisfactory in withstanding the tremendous forces imposed on it in pumping operations due to the drag of the piston in the cylinder where the pumping operations develop pressures commonly in the neighborhood of 1500 p. s. i., and on occasion as high as 6000 p. s. i. and sometimes even higher. Obviously then, the fit of the enlarged outer diameter portion of the circular extension on cap 12 within the cylinder opening 6c should be of very close tolerance as should the fit of ring 17 with the smaller diameter portion of the circular extension of cap 12 and the cylinder opening 6c.

While the cap or head 12 has only a single series of studs or cap screws 13 securing it to a pump body and the cap can, therefore, be removed with relative ease compared to the arrangements heretofore used, nevertheless, to remove this fastening means in the cap will effect a release of the cage 11 which loosens liner 7 and the inside liner packing between the shoulders 6b and 7a. In order that the piston within the cylinder liner may be removed without the necessity of removing the cap, cage 11 and liner 7 on releasing a series of studs, the cap is provided with an opening therethrough; the smallest diameter portion of the opening is at least as great in diameter as the diameter of the cylinder liner 7. This opening is normally plugged and sealed off, but a quick change means for releasably securing the plug in the opening is employed whereby access is had to the interior of the cylinder liner 7 very quickly without loosening or disturbing either the studs 13, cage 11, liner 7 or the packing for sealing these parts in operative position.

The means for closing off the opening in the cap includes the plug 19 having an externally extending flange 29 which confronts an internal shoulder 21 formed in the cap opening. These confronting shoulders and the lateral walls provided by the plug and cap opening respectively, provide a substantially enclosed recess for receiving a sealing means adapted to be expanded upon movement of the plug 19 toward the shoulder 21. Preferably a rigid metallic expander ring 22 and a rubber-like ring 23 are employed which utilizes the same principle of the seal element 17 and 18 heretofore explained in detail.

In order that the plug 19 may be quickly and easily forced into sealing relation with the packing means 22 and 23 and released therefrom, a means is provided having cam parts inter-engaging with cam parts carried by the cap opening to advance and retract and to hold the plug 19 in place. The preferred form of this means is shown to include the thrust gland 24 having the cam connection with the cap 12 in the form of threads. These threads may be fast lead threads such as four to the inch and preferably acme or square threads are employed because of the ease of making up this connection and because they provide heavy duty threads for withstanding the terrific pressures to which the thrust gland will be subjected.

With this arrangement, the gland may be rotated or screwed into place forcing the plug 19 into sealing relation

4

with the sealing means 22 and 23 expanding the ring 23 into sealing engagement with the plug and the cap opening walls. The rotation of the gland 24 should not impart rotative movement to the plug 19 for as the joint is made up, the packing ring 23 will be expanded under considerable pressure into engagement with the walls of plug 19 so that were the plug rotated, it would tend to drag the packing and make it very difficult if not impossible to effect a perfect seal. To this end the confronting or abutting surfaces between the gland and the plug 19 may be slightly lubricated to facilitate turning the gland relative to the plug.

The thrust gland 24 may be provided with a crossed handle 25 to facilitate quick installation and withdrawal of the thrust gland. The plug 19 may be equipped with the handle 26 to facilitate its manipulation.

It is important to note that the pistons usually employed within cylinder liners of pumps of this character employ a lip type outer seal for sealing engagement with the liner. These seal elements usually have a slight initial seal with the liner so that to facilitate their withdrawal from the liner and their placement within the liner without removing or loosening the cap 12 or cage 11, the smallest diameter through these parts should preferably be somewhat larger than the internal diameter of cylinder liner 7 and must be, in any event, large enough to allow passage of the piston.

It is believed that the operation of the pump and the hold-down and cap assembly will be apparent from the foregoing description. As the piston 8 is moved to the right in the pumping operation, as viewed in Fig. 1, fluid to be pumped is pulled into the cylinder liner to the left of the piston. Upon movement of the piston to the left, this fluid is placed under pressure and is forced through the pump cage past the valve 27 and out through the outlet 10. As the piston is reciprocated, its outer lips are forced into pressure tight engagement with the liner by the pressure developed in the pump to cause a terrific drag to be placed upon the liner tending to move the liner in the direction of movement of the piston. The hold-down connections for the liner must be able to withstand these tremendous forces as it will be appreciated that the forces are actually transmitted through a substantially fluid link provided by the sealing means between the shoulders 6b and 7a and the seal ring 18. For that reason, packing of the type illustrated in enlarged detail in Fig. 3 is desirable both for the inside and outside liner packing. Also these packing rings should be completely housed in close tolerance metal fittings and the ring such as 17 is desirable for this purpose for it may be carefully formed to provide the proper close tolerances.

It will be readily seen that a substantial mechanical advantage is provided for releasing the thrust gland 24 by manipulating handle 25. The gland may be quickly removed and plug 19 readily withdrawn allowing easy and quick access to the interior of the liner 7.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A cylinder head cap and liner assembly for high pressure heavy duty reciprocating pumps having a pump body with a cylinder formed therein, comprising a cylinder liner slidable into a cylinder, said liner having an external annular part providing oppositely faced abut-

5

ment surfaces, one for engagement with a liner packing; a generally cylindrical hold-down and expander cage having a shoulder engageable with the other of said liner surfaces; and a cap with a flange having a series of circumferentially arranged openings for receiving cylinder head studs, a cylindrical extension on the cap, the extension and cage having telescoping parts with confronting shoulders formed on the parts providing a packing receiving space therebetween; an opening in the cap, a closure plug for the opening, means for sealing between the plug and cap including a hold-down gland removably secured to the cap and abutting the plug to secure it in the opening in sealed relation to the cap, the smallest internal diameters of the cage and cap opening being of at least as great a diameter as the internal diameter of the liner whereby with the gland and plug removed, a piston within the liner is accessible.

2. The assembly of claim 1 wherein cooperating parts between the cap and gland inter-engage and are arranged to advance the gland into the cap opening and to retract it upon relative rotation between the gland and cap.

3. The assembly of claim 1 wherein the gland is threaded in the cap opening.

4. A liner and hold-down assembly comprising an elongate cylindrical annular liner, a liner hold-down and expander cage having an abutment face engaging an abutment face upon the liner, the engagement being radially exterior of the inner cylindrical surface of the liner; and a cap having a flange adapted to be secured to the pump body, said cap and cage having parts telescoping one within the other with confronting abutment packer expanding surfaces, an opening within the cap having a reduced diameter portion providing an internal shoulder facing away from the cage, a plug at least partially within the enlarged diameter portion of the opening having a shoulder confronting said internal shoulder in the opening with a circular extension internally of the shoulder lying in the direction of the cage, and a gland removably connected in the cap opening and abutting the plug, the connection of the gland with the cap being such that rotation of the gland relative to the cap will advance or retract the gland dependent upon the sense of rotation, the smallest internal diameter of the cap opening and the cage being at least as great as the internal diameter of the liner.

5. The assembly of claim 4 wherein the gland is threaded to the cap.

6. A liner and hold-down assembly comprising an elongate cylindrical annular liner; a liner hold-down and expander cage having an abutment face engaging an abutment face upon the liner, the engagement being radially exterior of the inner cylindrical surface of the liner; and a cap having a flange adapted to be secured to the cylinder head, said cap and cage having parts telescoping one within the other with confronting abutment packer expanding surfaces, an opening within the cap having a reduced diameter portion providing an internal shoulder facing away from the cage, a plug at least partially within the enlarged diameter portion of the opening having a shoulder confronting said internal shoulder in the opening, a cylindrical extension on the plug internally of the shoulder and lying in the direction of the cage providing an inner seal wall extending toward the shoulder in the opening, cam means between the plug and cap for advancing the plug within the cap opening.

7. A cap assembly for closing off the cylinder head opening on a high pressure heavy duty reciprocating pump for circulating drilling muds, cement or the like comprising a flanged member with a series of circumferentially arranged stud receiving openings, said member having a central cylindrical extension, a central opening extending through the member and cylindrical extension, a reduced diameter portion in the opening providing an internal shoulder facing one end of the opening, said reduced diameter portion of the opening being of suffi-

6

ciently great diameter to allow for passage of a pump piston therethrough, a plug having an annular shoulder of a diameter to closely fit the large diameter portion of the opening, said shoulder confronting the shoulder on the member, a smaller diameter cylindrical extension on the plug extending from its shoulder providing an inner seal wall extending toward the shoulder in the opening, and means for releasably securing the plug within the opening and for forcing the plug and member shoulders toward each other.

8. A cap assembly for closing off the cylinder head opening on a high pressure heavy duty reciprocating pump for circulating drilling muds, cement and the like comprising a flanged member with a series of circumferentially arranged stud receiving openings, said member having a central cylindrical extension, a central opening extending through the member and cylindrical extension, a reduced diameter portion in the opening providing an internal shoulder facing one end of the opening, said reduced diameter portion of the opening being of sufficiently great diameter to allow for passage of a pump piston therethrough, a plug having an annular shoulder of a diameter to closely fit the large diameter portion of the opening, said shoulder confronting the shoulder on the member, a smaller diameter cylindrical extension on the plug extending from its shoulder providing an inner seal wall extending toward the shoulder in the opening, packing means between the plug and member shoulders and retained against inward expansion by the cylindrical extension, and means for releasably securing the plug within the opening and for forcing the plug and member shoulders toward each other.

9. A cap assembly for closing off the cylinder head opening on a high pressure heavy duty reciprocating pump for circulating drilling muds, cement or the like comprising a flanged member with a series of circumferentially arranged stud receiving openings, said member having a central cylindrical extension, a central opening extending through the member and cylindrical extension, a reduced diameter portion in the opening providing an internal shoulder facing one end of the opening, said reduced diameter portion of the opening being of sufficiently great diameter to allow for passage of a pump piston therethrough, a plug having an annular shoulder of a diameter to closely fit the large diameter portion of the opening, said shoulder confronting the shoulder on the member, a smaller diameter cylindrical extension on the plug extending from its shoulder providing an inner seal wall extending toward the shoulder in the opening, packing means between the plug and member shoulders, said means including a crowned expander ring and a very viscous hard rubber-like packing ring having a V-groove for receiving the crown of the expander ring, the angle of the V-groove at any cross-section being slightly less than the angle of the crown of the expander ring, said cylindrical extension retaining the rubber-like packing against inward expansion, and means for releasably securing the plug within the opening and for forcing the plug and member shoulders toward each other.

10. A cap assembly for closing off the cylinder head opening on a high pressure heavy duty reciprocating pump for circulating drilling muds, cement or the like comprising a flanged member with a series of circumferentially arranged stud receiving openings, said member having a central cylindrical extension, a central opening extending through the member and cylindrical extension, a reduced diameter portion in the opening providing an internal shoulder facing one end of the opening, said reduced diameter portion of the opening being of sufficiently great diameter to allow for passage of a pump piston therethrough, a plug having an annular shoulder of a diameter to closely fit the large diameter portion of the opening, said shoulder confronting the shoulder on the member, a smaller diameter cylindrical extension on the plug extending from its shoulder providing an inner seal wall

7

extending toward the shoulder in the opening, packing means between the plug and member shoulders sealing between the cylindrical extension and the opening of the flanged member, and a gland threadedly connected to the flanged member in position to abut and force the plug into the opening to expand the packing means.

11. In a high pressure heavy duty reciprocating pump having a cylinder with a cylinder head opening, a liner slidably received in said cylinder, packing means arranged between the liner and cylinder to be expanded to effect a seal upon the liner being forced into the cylinder, a hold-down and expander cage, the liner and cage having abutment surfaces radially outwardly of the inner cylindrical surface of the liner, a cap, fastening means securing the cap to the pump to close the cylinder head opening, abutment and sealing means between the cage and cap whereby when the cap is secured in place, the liner is forced into the cylinder to expand the packing between the liner and cylinder and is held in such position, an opening in the cap concentric with the cylinder and liner, an internal outwardly facing shoulder in the cap opening, a plug within the opening with a shoulder confronting the cap opening shoulder and having a reduced diameter part extending from the shoulder toward the liner, sealing means between the shoulders to seal between the plug and cap and retained against inward expansion by the reduced diameter part of the plug, a gland abutting the plug, and means between the gland and cap to force the plug toward the cap opening shoulder to expand the packing and secure the plug in sealed position within the opening.

12. In a high pressure heavy duty reciprocating pump having a cylinder with a cylinder head opening, a liner slidably received in said cylinder, packing means arranged between the liner and cylinder to be expanded to effect a

8

seal upon the liner being forced into the cylinder, a hold-down and expander cage, the liner and cage having abutment surfaces radially outwardly of the inner cylindrical surface of the liner, a cap, fastening means securing the cap to the pump to close the cylinder head opening, abutment and sealing means between the cage and cap whereby when the cap is secured in place, the liner is forced into the cylinder to expand the packing between the liner and cylinder, an opening in the cap concentric with the cylinder and liner, an internal outwardly facing shoulder in the cap opening, a plug within the opening with a shoulder confronting the cap opening shoulder and having a reduced diameter part extending from the shoulder toward the liner, sealing means between the shoulders to seal between the plug and cap and retained against inward expansion by the reduced diameter part of the plug, a gland abutting the plug, and means between the gland and cap to force the plug toward the cap opening shoulder to expand the packing and secure the plug in sealed position within the opening.

13. The combination of claim 12 wherein the gland is threaded to the cap whereby rotation of the gland forces the plug toward the cap opening shoulder to expand the packing and secure the plug in a sealed position within the opening.

References Cited in the file of this patent

UNITED STATES PATENTS

2,198,301	Campbell	Apr. 23, 1940
2,396,469	Meigs	Mar. 12, 1946
2,415,031	Kuhn et al.	Jan. 28, 1947
2,584,518	Walton	Feb. 5, 1952
2,701,743	Mattingly	Feb. 8, 1955