Feb. 10, 1970 J. C. JACKSON 3,494,504

PIPE CLOSURE PLUG

Filed Dec. 10, 1968 2 Sheets-Sheet 1

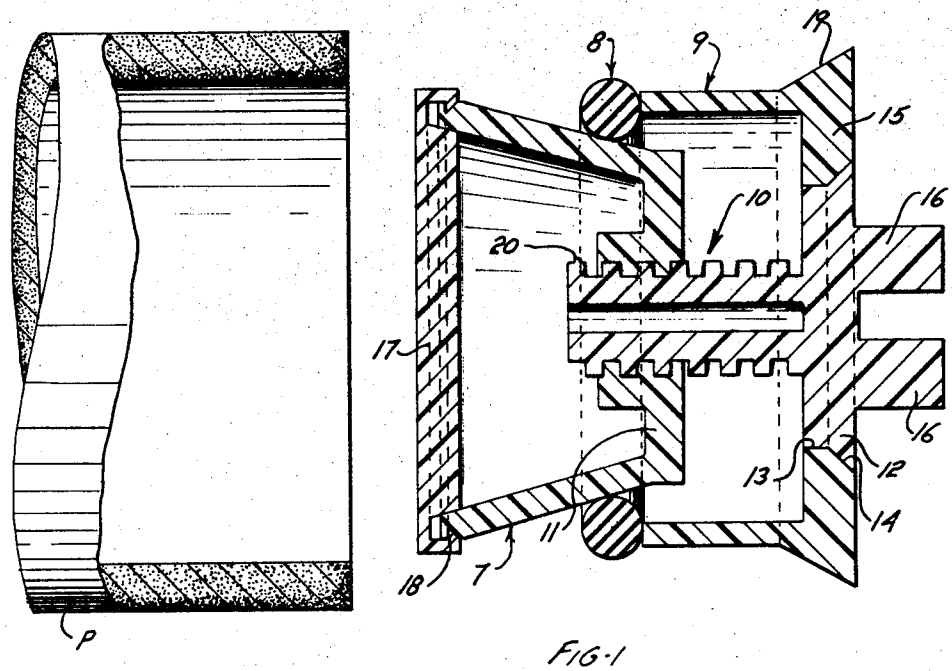

FIG-1

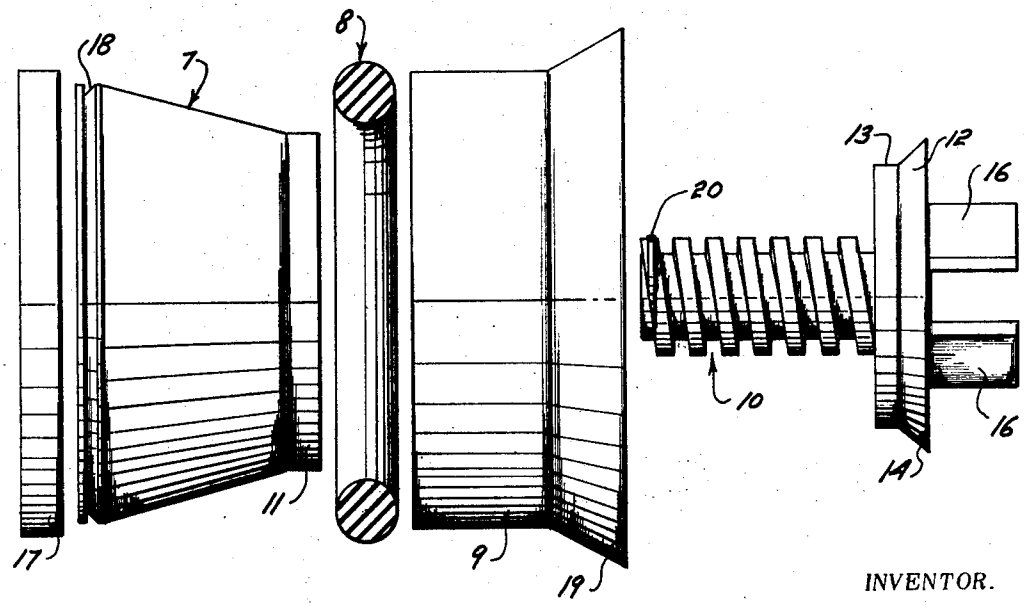

FIG-2

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Feb. 10, 1970 J. C. JACKSON 3,494,504

PIPE CLOSURE PLUG

Filed Dec. 10, 1968 2 Sheets-Sheet 2

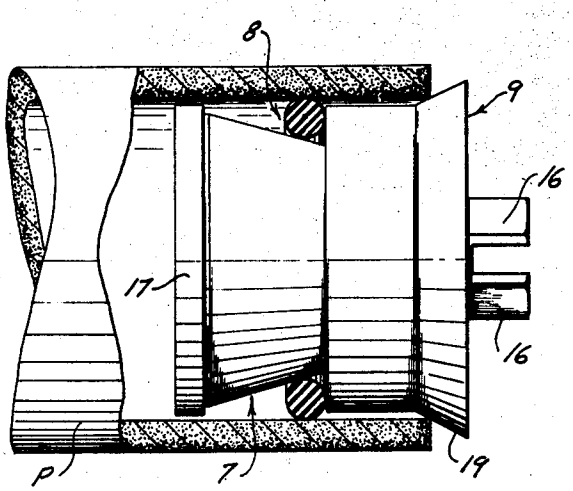

FIG-3

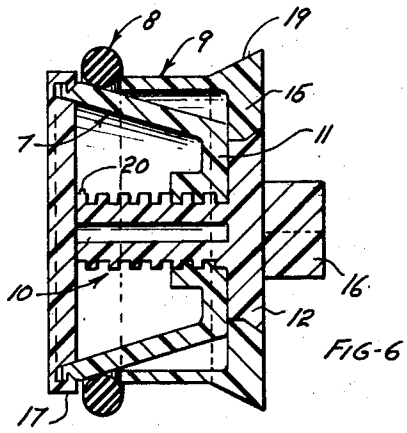

FIG-6

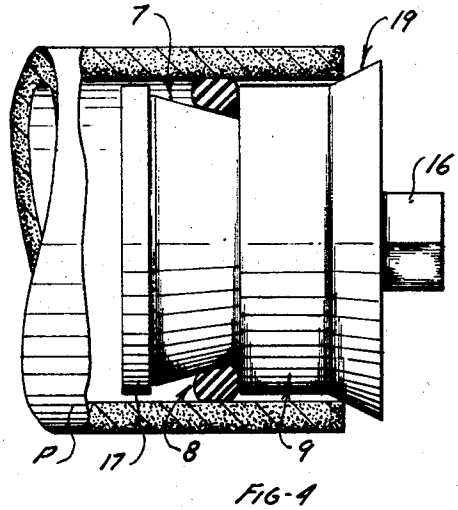

FIG-4

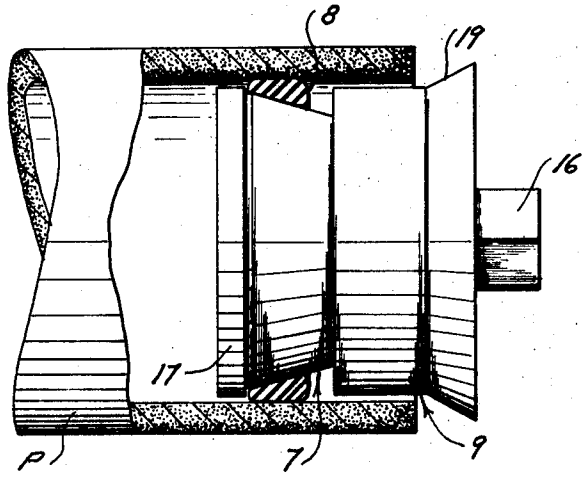

FIG-5

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United States Patent Office 3,494,504
Patented Feb. 10, 1970

3,494,504

PIPE CLOSURE PLUG

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Filed Dec. 10, 1968, Ser. No. 782,618
Int. Cl. B65d 39/12
U.S. Cl. 220—24.5 8 Claims

ABSTRACT OF THE DISCLOSURE

An adjustable closure plug for the open end of a pipe, comprising a conical member, a packing ring surrounding the conical member, a sleeve for engaging the packing ring and advancing it up the inclined surface of the conical member to expand the ring and bring it into pressure engagement with the inside surface of the open end of the pipe in which the device is used, and a threaded plug cooperating with the sleeve and the conical member and serving to adjustably advance the sealing ring up the inclined surface of the conical member. The threaded plug also serves to retain the conical member, sealing ring and the sleeve in assembled relation, even when the threaded plug is loosened, to thereby prevent unintentional falling of parts of the device into the pipe.

This invention relates to pipe closure devices or plugs and is particularly concerned with a closure device adapted for ready application to and separation from the open end of a pipe. Although not limited in its application, the device of the present invention is especially useful in connection with the temporary closure of sewer lines.

In the construction of sewer lines, especially in connection with multiple unit housing projects, it is customary practice to construct sewer mains along streets and to construct individual lateral sewer lines extended to individual properties or houses. Frequently, the work in the housing project progresses from house to house along a street, with completion of some houses before others, although the sewer laterals for the individual houses for the entire street or block are completed in advance of the completion of all of the houses and, indeed, frequently in advance of the completion of any of the houses.

For various purposes it is desirable to provide a closure or plug device for the individual sewer laterals which are not yet in service. Naturally, such laterals must be closed in any case where other laterals in the same area are in use. In addition, it is frequently desired to utilize a closure device for the purpose of pressure testing the sewer system as a whole or various parts thereof.

Many devices have been utilized heretofore for this purpose, but devices in general use have been subject to one or another or several disadvantages, such as those mentioned herebelow.

In many cases the prior devices require blocking, for instance by means of a concrete block or a large stone placed against the closure in order to prevent its displacement under the influence of internal pressure applied under normal operating conditions or for pressure testing. Various of the prior art devices have also been subject to the disadvantage that upon loosening or release of the device for removal, part or all of the device has tended to fall into the pipe, with attendant annoying retrieval problems.

The foregoing and numerous other disadvantages have been encountered with prior art devices and it is a general objective of the present invention to provide an improved pipe closure device or plug which overcomes the disadvantages of prior art arrangements.

More specifically, it is an object of the invention to provide a closure device which is easily installed and which provides an effective seal in the open end of the pipe, without damage either to the pipe or to the plug. The device of the invention is also conveniently arranged for loosening and removal after use in one pipe and for ready reuse in other pipes.

Still further the device of the invention is adapted to withstand test pressure of air or water, for instance a test pressure of water at about 4.3 p.s.i. (about 10 feet water head), which is a common requirement for plugs of this sort.

The closure device of the invention is also of relatively low cost and of relatively great useful life, and is well able to withstand the rigors of earth loading and infiltration, such as commonly encountered in underground sewer lines, especially where the plug is required to be buried even for periods as long as several years, which not infrequently occurs in large scale housing development projects.

A further object of the invention is the provision of a closure device of the general type above referred to in which the working parts employed for tightening and loosening the device are well protected or shielded from the interior of the pipe and thus from the corrosive influences present therein.

The invention also has in view an arrangement providing for the tightening of a sealing ring against the internal surface of the open end of the pipe, provision also being made for automatic tightening of the pressure of engagement of the sealing ring with the pipe under the influence of increase of pressure within the pipe, to thereby avoid blow out of the device. The invention additionally contemplates an arrangement by which, following an increase in pressure, when the pressure again is reduced, the pressure of engagement of the sealing ring against the internal surface of the pipe is again restored to the original preset value.

The invention still further provides means for limiting the tightening action so that the tightening of the closure device cannot rupture the pipe in which it is used.

The closure device of the invention is so constructed as to make possible the use of certain resin or plastic type of materials which are highly resistant to corrosive influences and which may readily be molded in the shapes required for the device, thereby enhancing the life of the device and also reducing the manufacturing costs.

How the foregoing objects and advantages are attained, together with others which will occur to those skilled in the art will appear more fully from the following description referring to the accompanying drawings illustrating the preferred embodiment of the invention and in which:

FIGURE 1 is an axial sectional view through a closure device constructed according to the present invention, the device being here shown with the parts thereof adjusted for insertion into the open end of a pipe, a portion of which is also illustrated in the figure in axial section;

FIGURE 2 is an exploded view of the several parts of the device shown in FIGURE 1, the parts here being shown in elevation, excepting only for the sealing ring, which is shown in transverse section;

FIGURE 3 is a view on a reduced scale as compared with FIGURES 1 and 2 illustrating the device in elevation, except for the sectional showing of the sealing ring, the device being shown in position in the open end of a pipe, the terminal portion of which appears in axial section, as in FIGURE 1;

FIGURE 4 is a view similar to FIGURE 3 but illustrating the parts after adjustment thereof to tighten the seal provided by the device;

FIGURE 5 is a view similar to FIGURE 4 but illus-

trating the position occupied by various parts of the device under the influence of an increase of internal pressure within the pipe; and

FIGURE 6 is an axial sectional view through the device with the parts thereof tightened to the maximum extent provided for.

As seen in the drawings, the device of the invention is made up of several parts, one of which is a cone generally indicated at **7**, another of which is a sealing ring **8** which surrounds the cone, a third of which is a sleeve **9** adapted to bear against the sealing ring, and a fourth of which is a threaded plug **10**.

The ring **8** is desirably of O-ring shape, i.e., has a circular section and is formed of a resilient material such as rubber. The ring is adapted to roll upon the external conical surface of the cone or conical member **7**. The ring may be moved, i.e., rolled upon the conical surface by the action of the sleeve **9** which is mounted and adjustably movable by means of the threaded plug member **10**. The threaded shank of the plug member **10** is provided with a square thread as indicated and this member has threaded interengagement with a complementarily threaded axial bore formed in the end wall portion **11** of the cone **7**.

The base or head of the threaded plug **10** comprises an annular portion **12** having cylindrical and tapered surfaces **13** and **14** as indicated in FIGURE 2, which surfaces cooperate with complementary cylindrical and tapered surfaces formed in an aperture in the end wall portion **15** of the sleeve member **9**.

The internal diameter of the sealing ring **8**, when the ring is at rest, is desirably not substantially larger than the small end of the conical surface on the cone member **7**, and when the parts are assembled as shown in FIGURE 1, the interengagement of the edge of the sleeve **9** with the ring **8** cooperates with the threaded plug **10** in centering and positioning the sleeve **9**.

The threaded plug also has projecting lug parts **16—16** which are spaced from each other so that a turning tool may be inserted therebetween. The external surfaces of the lug **16** are also configured so that taken together they substantially form a hexagonal shape such as commonly employed on bolts or nuts, and may thus be engaged by any suitable wrench, especially a socket wrench for the purpose of rotating the threaded plug.

The cone **7** is also provided with an inner closeure disc **17** which may be fastened to the inclined cone wall in any suitable manner, desirably by a snap fit indicated at **18**. When the parts are formed of certain plastic or resin materials of the kinds hereinafter mentioned, the snap fit will provide a liquid tight joint so that the interior of the cone is tightly closed at its larger end, thereby protecting the threaded interconnection between the plug **10** and the cone **7** and preventing damage to these working parts when the closure device is inserted into the open end of a pipe and is thus subjected to the materials therein, with possible blocking of the threads by deposit of solids thereon.

As viewed in FIGURE 1, the parts of the closure device are shown assembled and adjusted to the relative positions appropriate for insertion of the device into the open end of a pipe indicated at P. Here it will be seen that the ring **8** is positioned by the sleeve **9** on the conical member **7** so that the outside diameter of the ring approaches but is not greater than the inside diameter of the pipe, thereby faciliating insertion of the device into the end of the pipe.

FIGURE 3 illustrates the device upon insertion into the end of the pipe and it will here be noted that the device has been inserted far enough to bring the limiting stop **19** into engagement with the end of the pipe. The limiting stop **19** may take a variety of forms but perferably comprises a tapered flange or peripheral projection extending from the end wall portion **15** of the sleeve member **9**. This stop serves to properly position the closure device upon insertion in the end of the pipe before the threaded plug is tightened so as to tighten the seal, and in addition this stop serves as a means to prevent unintentional entry of the entire device into the end of the pipe, either as a result of mishandling, or as a result of externally applied forces, for instance the force of dirt or rock engaging the end of the closure when the pipe with the closure therein is buried.

After the closure device is positioned in the open end of the pipe as shown in FIGURE 3, the threaded plug **10** is then turned to tighten the seal, while the sleeve member **9** is held in position in the mouth of the pipe. This turning may be effected in part by hand or may be effected by means of a tool engaging the lugs **16—16**. The turning of the threaded plug draws the conical member **7** toward the sleeve **9** and thus results in advancement of the sealing ring **8** up the inclined surface of the conical member. Some rolling action of the ring on the conical member will take place until the pressure of engagement of the sealing ring with the internal surface of the pipe becomes substantial. At this time the sealing ring will also be somewhat flattened or distorted in cross section as is indicated in FIGURE 4 and the ring will now provide a tight seal between the internal surface of the pipe and the conical surface of the member **7**. In this condition, and with a tight joint between the end cap **17** and the conical member **7**, the working parts, i.e., the adjustable threaded interconnection between the threaded plug and the cone member **7**, are effectively protected from the liquids and materials within the pipe. It will be observed that some clearance is provided not only around the cone member **7** and its cap **17**, but also around the sleeve **9**, in view of which the sealing action of the resilient sealing ring **8** will accommodate irregularities in contours of various pipes, including ovality or differences in inside diameter.

From the foregoing it will be noted that the compression of the sealing ring **8** and thus the pressure of the sealing engagement of the ring with the cone and with the internal pipe wall, may be adjusted and pre-set to a desired value adequate to withstand the particular pressure conditions to be encountered either in service or for test purposes. However, in the event of an increase in pressure inside the pipe, the compression and thus the pressure of sealing engagement of the ring will automatically be increased and thereby prevent blow out of the closure. The operation of the closure device for this purpose is illustrated in FIGURE 5. In this figure it is assumed that a pressure increase has occurred beyond the value expected to be encountered. The pressure acting upon the inner face of the cap **17** will tend to move the conical member **7** slightly toward the open end of the pipe. This will cause the sealing ring to roll upon the surface of the pipe and of the conical member, so that the sealing ring advances up the inclined surface of the conical member and is further stretched and is also placed under greater compression between the conical member and the internal wall of the pipe. This increase in compression of the sealing ring will again be reduced because the resilience of the sealing ring will tend to roll the ring downwardly again on the inclined surface of the conical member. This is desirable because the maintenance of compression in the sealing ring beyond the value actually needed to effect the seal under normal operating conditions is undesirable. This feature of the arrangement is of particular advantage in a situation where the closure is inserted and the compression is pre-set to the value expected to be encountered in normal service, but in which it is expected for test purposes to temporarity subject the pipe to higher than normal internal pressure. The higher test pressure will not blow out the closure but will merely increase the compression in the ring, after which the compression will return to normal value as pre-set by the initial adjustment.

For effecting the purposes above referred to it has been

found that a cone angle of the general order of 15° from the cone axis will provide not only for the desired increase in compression upon increase in pressure, but also for the reduction in compression, upon return of the pressure to the normal value. In this connection it is also preferred to utilize various materials for the conical member and sealing ring as described hereinafter. Moreover, the conical surface preferably is roughened, as by providing circular striations or by etching, so as to increase frictional resistance and thereby accomplish the desired rolling action of the sealing ring **8**, instead of sliding of that ring.

FIGURE 6 illustrates the positions of the parts when the threaded plug **10** is tightened to the maximum extent. Here it will be seen that the free edge of the sleeve member **9** has come in contact with the conical surface of the member **7** and this acts as a limiting stop. Thus the sealing ring **8** cannot be expanded beyond the extent provided in the condition illustrated in FIGURE 6 and it is contemplated that this limit will represent a condition lying within the safe limit of internal pressure which may be applied to the pipe to be closed. In the absence of such a limiting stop, an adjustable screw device such as that illustrated might well be tightened to an extent which would rupture the pipe, especially where the pipe is formed of certain types of materials such as asbestos-cement, impregnated fiber, or ceramics. It is also desirable that the motion of the sleeve **9** and the conical member **7** toward each other is limited to a range which will not displace the sealing ring from its position on the cone, whether or not the closure device is positioned within a pipe.

For the purpose of serving as a limiting stop, it is desirable that the diameter of the sleeve **9**, at least at the inner free edge thereof, should be intermediate the diameters of the conical surface of the member **7** at its large and small ends.

In the embodiment as illustrated, the annular portion **12** of the threaded plug also services to limit the tightening motion of the threaded plug by engagement with the end wall **11** of the conical member **7**.

Although, in FIGURE 6, the free end of the threaded plug **10** is shown abutting the inside surface of the cap **17**, it is preferred not to rely upon this as a limiting stop.

Still another feature of importance is the provision of a means for preventing loosening of the threaded plug to such an extent as to permit separation of the cone member **7** or of any other part of the closure device. This is desirably accomplished by providing an interference land **20** on the end portion of the thread of the threaded plug **10**. Although this land may be applied after assembly of the cone and sleeve (but before application of the cap **17**), when the parts are formed of materials such as those mentioned hereinafter, the interference land may be molded or applied to the thread when the plug **10** is initially fabricated and this land may be forced through the threading in the end wall **11** of the cone **7** without damage to the parts. Once the interference land has been forced all the way through the thread in the end wall **11**, it will then serve to interfere with the loosening or unscrewing of the threaded plug sufficiently to prevent separation of the parts when the closure device is in use in the field. The user of the closure device will at once be apprised of the normal intended limit of loosening of the plug by virtue of the large increase in resistance to unscrewing the plug when the interference land engages the threading in the axial bore provided in the end wall **11** of the conical member **7**. The importance of this lies in the fact that it is undesirable to have any of the parts of the closure device fall into the pipe when the closure device is being removed. This is not only undesirable because the presence of such parts in the pipe would represent obstructions therein, but also because it is contemplated that the device should be reusable.

Although various of the parts may be made of a variety of materials, in general it is preferred to form the sealing ring itself of rubber and the other parts of plastic or resin materials.

For the sealing ring the rubber is desirably of about 60 durometer hardness (Shore A) and the rubber should have a compression set of not more than 15% and preferably less than 10% by ASTM D–395 Method B at 50% compression. Various rubbers may be formulated to serve this purpose. Styrene-butadiene rubber has been used and found effective.

All of the other parts of the closure device are desirably formed of plastic materials and most preferably all of those parts are injection molded of natural color high density (0.96) polyethylene with a lightly etched finish for easy handling. However, other plastics may be used, such as polypropylene, acrylonitrile butadiene styrene, high impact polystyrene, and polyvinyl chloride. The high density polyethylene is preferred because of its low cost, high impact resistance, moldability, appearance, frictional characteristics, corrosion resistance, and generally good performance and life under various adverse conditions, such as heat, cold, sand, mud, etc.

Although the threaded plug may be formed of polypropylene, and the remaining parts of polyethylene with consequent reduction in friction, it is preferred to form the threaded plug of the same material as the conical member, in order to maintain essentially the same coefficient of thermal expansion for these two parts.

The threaded interconnection between the plug **10** and the conical member **7** desirably comprises square threads and the pitch of the threads should be such as to provide an irreversible threaded interconnection, i.e., a threaded interconnection which will not result in turning of the threaded plug as a result of application of an axial load on the threaded interconnection. With the frictional characteristics of resin materials of the kinds referred to, a thread having five turns per inch is effective for the purposes explained.

Although the threaded plug **10** and the sleeve member **9** need not necessarily be arranged to rotate relatively to each other and thus may even be integrally formed, it is preferred that the plug be separately formed and further that the plug and sleeve be made of resin type materials, as described above, which facilitates rotation of the plug with respect to the sleeve, because of the relatively low coefficient of friction of the resin materials. In this way, rotation of the edge of the sleeve in contact with the sealing ring **8** is not required (and preferably is to be avoided) in the operation of the device.

According to the foregoing, a pipe closure device is provided having many desirable features providing not only for convenience and effectiveness in use, but also making possible reuse of the device so that it is practical to utilize the desirable resin materials and still maintain relatively low cost levels.

I claim:

1. A closure device for the open end of a pipe, comprising a hollow plug member having an external conical surface and adapted to be inserted into the open end of a pipe with its larger end presented inwardly and exposed to the interior of the pipe, a resilient sealing ring surrounding the conical member and being stretchable by advancing the ring up the incline of said conical surface, a sleeve for engaging the ring and advancing it up the conical surface, means comprising a threaded plug extended into the smaller end of the conical member and having adjustable threaded interengagement therewith for adjustably advancing said sleeve and thus the sealing ring with respect to the conical member, and a closure for the larger end of the conical member serving to shield the adjustable threaded interengagement from the interior of the pipe in which the closure device is used.

2. A closure device for the open end of a pipe, comprising a plug member having an external conical surface and adapted to be inserted into the open end of a pipe

with its larger end presented inwardly and exposed to the interior of the pipe, a resilient sealing ring surrounding the conical member and being stretchable by advancing the ring up the incline of said conical surface, a sleeve for engaging the ring and advancing it up the conical surface so as to engage the inner surface of the pipe and provide a seal between the pipe and the conical member, and means comprising a threaded plug extended into the smaller end of the conical member and having adjustable threaded interengagement therewith for adjustably advancing said sleeve and thus the sealing ring with respect to the conical member, the sleeve having a peripheral projection of larger diameter than the inside of the pipe to provide against movement of the sleeve entirely into the open end of the pipe.

3. A closure device as defined in claim 2 in which the threaded plug is rotatable relatively to the sleeve in which the threaded plug and the sleeve have interengageable portions restraining axial motion of the sleeve with respect to the threaded plug in a direction out of the open end of the pipe.

4. A closure device as defined in claim 3 and further including means providing against separation of the conical member from the threaded plug and thus against falling of the conical member into the pipe union loosening of the threaded interengagement of the threaded plug with the conical member.

5. A closure device for the open end of a pipe, comprising a plug member having an axial bore and an external conical surface and adapted to be inserted into the open end of a pipe with its larger end presented inwardly and exposed to the interior of the pipe, a resilient sealing ring surrounding the conical member and being stretchable by advancing the ring up the incline of said conical surface, a sleeve for engaging the ring and advancing it up the conical surface, means comprising a threaded plug rotatable with respect to the sleeve, extending through and beyond the axial bore in the conical member and having adjustable threaded interengagement with said bore for adjustably advancing said sleeve and thus the sealing ring with respect to the conical member and thus bring the sealing ring into engagement with the inner surface of the pipe ad provide a seal between the pipe and the conical member, and means for restraining loosening of said threaded interconnection sufficiently to prevent separation of the conical member, sleeve and threaded plug.

6. A closure device according to clai m5 in which the

restraining means comprises an enlargement on a thread of the threaded member lying beyond the axial bore of the conical member.

7. A closure device for the open end of a pipe, comprising a plug member having an external conical surface and adapted to be inserted into the open end of a pipe with its larger end presented inwardly and exposed to the interior of the pipe, a resilient sealing ring surrounding the conical member and being stretchable by advancing the ring up the incline of said conical surface, a sleeve for engaging the ring and advancing it up the conical surface so as to bring the sealing ring into pressure engagement against the inner surface of the pipe and provide a seal between the pipe and the conical member, and and means comprising a threaded plug extended into the smaller end of the conical member and having adjustable threaded interengagement therewith for adjustably advancing said sleeve and thus the sealing ring with respect to the conical member, surfaces of the conical member and of the sleeve being interengageable in the manner of stop means limiting relative motion thereof toward each other under the influence of the threaded plug to thereby limit the pressure of engagement of the sealing ring against the inner surface of the pipe in which the device is used.

8. A closure device as defined in claim 7 in which the threaded plug is rotatable relatively to the sleeve and in which the threaded plug and the sleeve have interengageable portions restraining axial motion of the sleeve with respect to the threaded plug in a direction out of the open end of the plug but in which the threaded plug and the conical member may move in said direction under the influence of pressure in the pipe and thereby increase the pressure of engagement of the sealing ring against the internal wall of the pipe.

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GEORGE T. HALL, Primary Examiner

U.S. Cl. X.R.

138—89

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,494,504 Dated February 10, 1970

Inventor(s) J. C. Jackson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 7, Line 17, before "in" insert --and--

Col. 7, Line 25, "union" should be --upon--.

SIGNED AND
SEALED
AUG 4 - 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents