April 20, 1965 W. E. ROSENGARTEN, JR., ETAL 3,178,793

APPARATUS FOR SEALING MAINS

Filed May 7, 1962

3 Sheets-Sheet 1

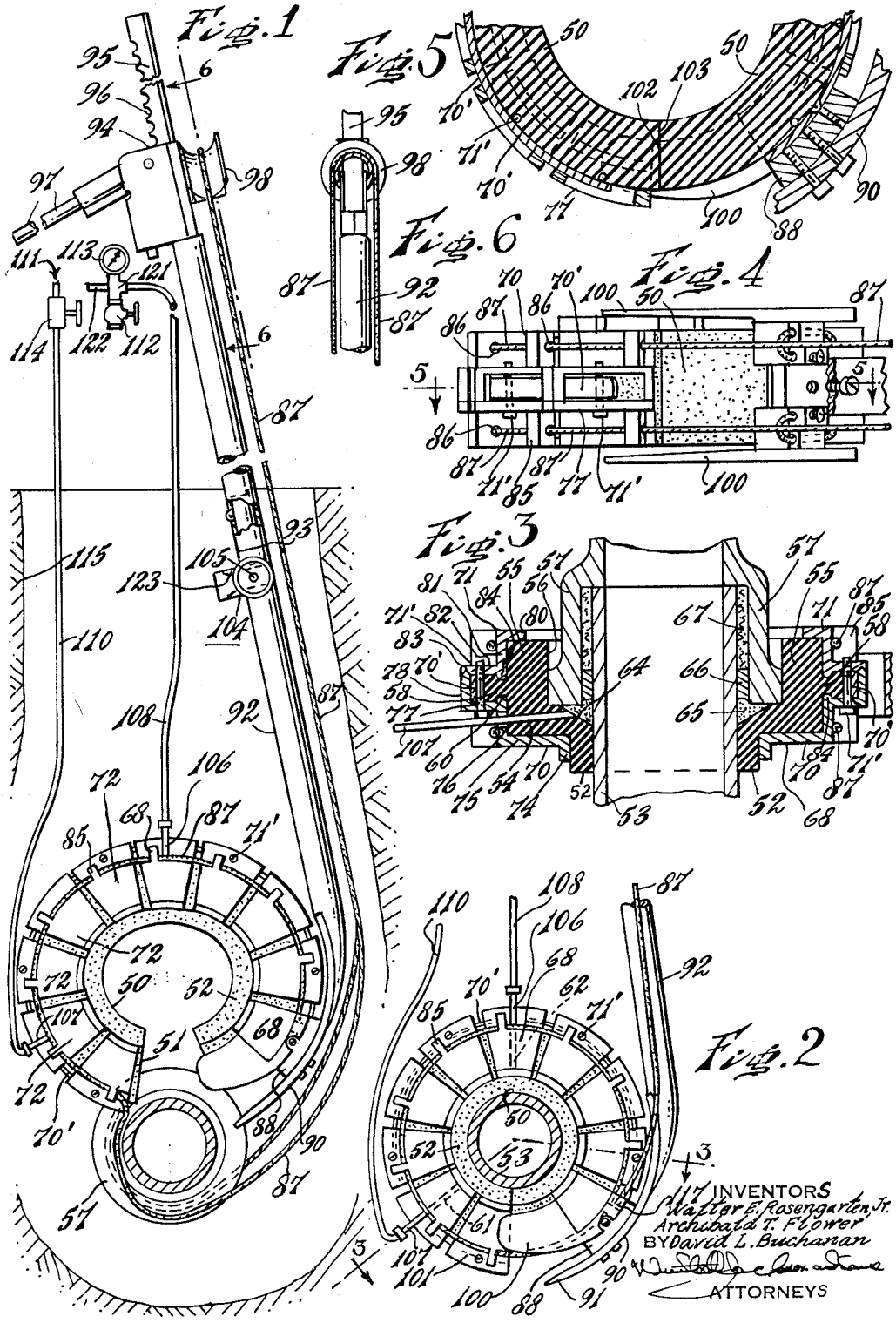


Fig. 1

Fig. 5

Fig. 6

Fig. 4

Fig. 3

Fig. 2

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Fig. 8

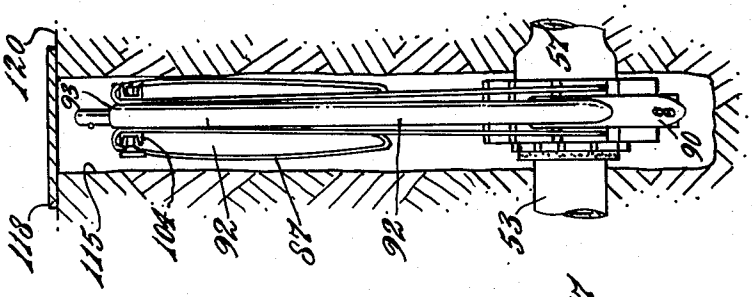
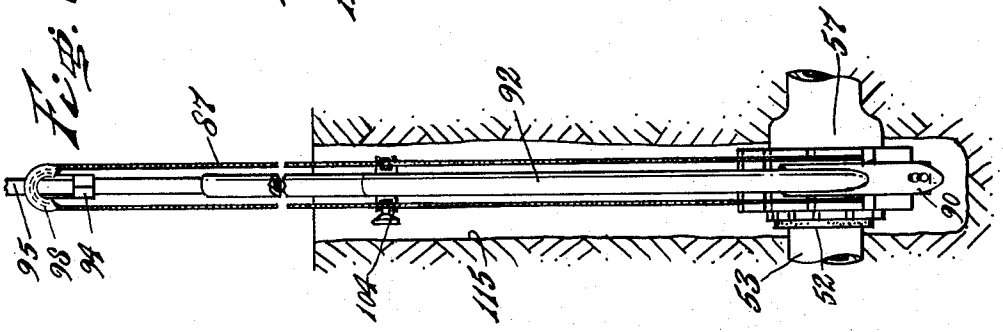


Fig. 7



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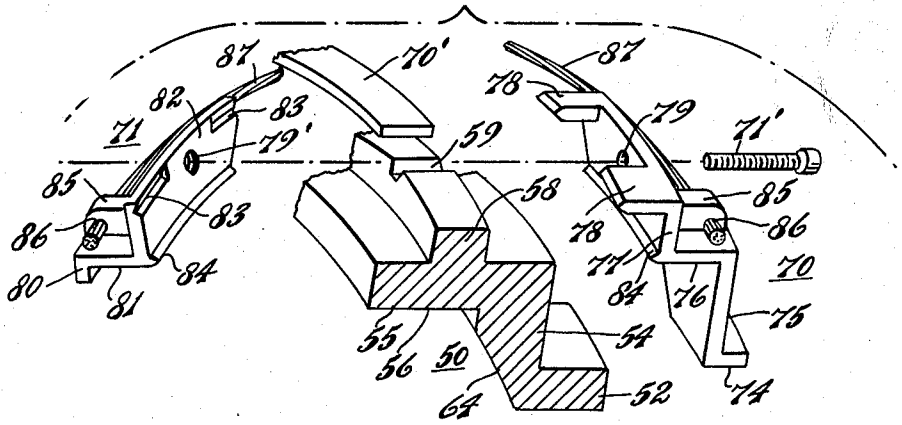
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APPARATUS FOR SEALING MAINS

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Fig. 9



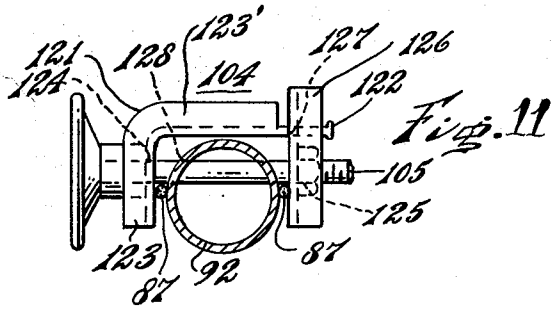


Fig. 11

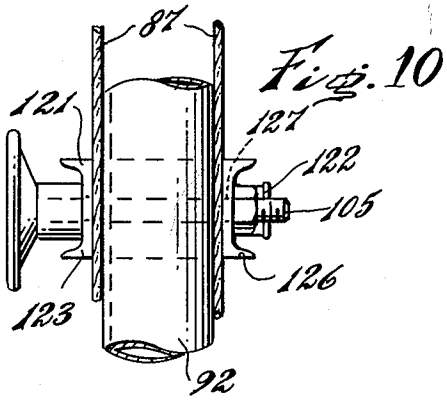


Fig. 10

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APPARATUS FOR SEALING MAINS

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Filed May 7, 1962, Ser. No. 192,817
6 Claims. (Cl. 25—127)

The present invention relates to an apparatus for sealing mains and particularly for sealing bell and spigot joints in existing mains carrying fluids such as fuel gas, water, and other liquids.

A purpose of the invention is to seal gas mains at the bell and spigot joints by means of a mold applied by an operator located at a point remote from the main.

A further purpose is to reduce the size of the hole necessary to gain access to the main to seal the joint.

A further purpose is to reduce the area of paving destroyed to gain access to seal the joint.

A further purpose is to keep the main in service while the joint is being sealed.

A further purpose is to provide means for keeping the entire mold mechanism below the surface level during the setting or curing.

A further purpose is to provide an articulated mold frame on a flexible mold whereby the mold and frame can compensate for variations from true roundness or lack of concentricity in the main or angular alignment between the joining lengths of pipe.

A further purpose is to permit restoring traffic conditions during periods when workmen are not at work, as for example at night and over weekends, by retracting the compact mechanism into the small hole and applying a cover over the top of the hole.

A further purpose is to seal a pipe joint in a main by applying a reusable mold around the joint and introducing material to seal the joint into the mold. The mold can then be removed and applied for subsequent use to seal other joints.

Further purposes appear in the specification and in the claims.

In the drawings we have chosen to illustrate one embodiment only of the cleaning device and one embodiment only of the device for sealing the leak, choosing the forms shown from the standpoints of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

FIGURE 1 is a transverse section through the pipe, showing the mold of the invention being applied to a main at a bell and spigot joint.

FIGURE 2 is a partial axial elevation of the mold device of the invention in place on a main for molding.

FIGURE 3 is an enlarged section taken on the line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary plan view of the mold of the invention.

FIGURE 5 is a section taken on the line 5—5 of FIGURE 4.

FIGURE 6 is a section taken on the line 6—6 of FIGURE 1.

FIGURE 7 shows the mold of the invention applied to the joint.

FIGURE 8 shows the manner in which the mold may be left in the hole while the sealing material is setting.

FIGURE 9 is an enlarged exploded sectional perspective of a mold and articulated frame.

FIGURE 10 is an enlarged fragmentary side elevation showing the clamp and the related handle.

FIGURE 11 is an end elevation of the clamp of FIGURE 10 showing the handle in transverse section.

Describing in illustration but not in limitation and referring to the drawings:

In the distribution of gas for domestic, commercial and industrial use, a network of mains is employed to carry the gas from central points to points of usage. These mains in many instances have bell and spigot joints which are typically packed by jute and then usually leaded or cemented at the outside. When these joints were originally installed, many of the mains were distributing carbureted water gas or coke oven gas or other manufactured gas which contained a substantial content of moisture, tars and oils. These liquids had over a period of time, saturated the packing materials to provide relatively leak-free joints.

In recent years, there has been a shift over to natural gas which is of a comparatively dry nature. The natural gas has reduced by absorption the content of tars and oils which has been built up in the joints, and thus drying out the joints. Furthermore, many of the textile packing materials tend to shrink when they dry. The result encountered in a widespread way has been a tendency of the packing to shrink, causing openings through the dried-out packing which permit leakage of gas.

In other instances, leaks have been caused in many areas of the country by active earth conditions which in certain localized areas has involved settling or movement of the earth in the order of half inch or even one inch a year. This settling has caused a certain tendency for misalignment of the various pipe sections, both vertically and also horizontally, and this has further increased the tendency toward leakage. This misalignment in some instances has caused a withdrawal to some extent of the pipe from the spigot causing additional leakage.

All of these factors have made it quite important to develop some technique for sealing the joints. One approach to the problem has been to cut out the line, and actually introduce a self-propelled crawler which both cleans the line and locates the joint, sometimes electronically, and then to coat the inside with a suitable sealing compound. This involves several complications, the worst of which is taking the line out of service and the need to provide an alternate temporary supply to the customer and also the need to operate on relatively straight pipe stretches and not on pronounced bends.

In order to overcome the disadvantages of sealing by a self-propelled crawler inside the line, extensive use has been made in some areas of external sealing techniques which may be used without taking the line out of service. These usually involve digging an excavation at each joint large enough for a man to descend to the area around the bell or pipe and to fix a bolted clamp fitting around the joint. The fitting compresses a rubber gasket which seals against the outside of the bell and also against the adjoining straight pipe section of the spigot.

There is also another technique which in effect butters epoxy resin around the face of the bell in order to accomplish sealing. This method also requires extensive excavation.

The present invention permits the line to remain in service at normal pressure without any interruption of gas flow and can be carried on with a minimum of excavation. The process and equipment can function using a slit about 18 inches in length and about 4 inches in width where it penetrates the sidewalk or other paving, and slightly wider in the earth at the bottom where the pipe joint is located.

The present invention as compared to any preformed gasket technique gives greatly improved seal by providing a bond to the metal surface.

Principally due to the reduced amount of excavation, the speed of the operation is considerably increased com-

pared to the other techniques. It is believed that the time is not more than one-half that of the best prior technique.

By virtue of the relatively very small size of the opening in the paving it is much less costly to repave after sealing the leak than it was in prior art methods. In addition highway authorities have permitted openings of this size in paving to be repaired with a mere block of concrete, rather than expensive cutback and repaving according to specifications. This provides quite substantial savings. Also, it is usually possible to work around reenforcing rods in concrete paving, thus eliminating the necessity for replacing and/or tie welding new rods when repaving.

In accordance with the present invention, a suitable cleaning technique is employed.

Considering now the mold, frame, and handle of the invention as best seen in FIGURE 1, a mold **50** suitably of any flexible resilient material such as rubber or the like, has a radial separation **51**. The mold shape conforms circumferentially to a pipe circumference for covering a bell and spigot joint and leaves suitable interior space for sealing material to be introduced. The mold in longitudinal section, as best seen in FIGURES 3 and 9, comprises a flange section **52** of an inner circumference conforming in a closed position to the circumference of the spigot **53**. A radially extending web **54** extends for a suitable distance, and has at its radially outward extremity a longitudinally extending flange **55** whose inner face **56** conforms circumferentially to the outer face of the bell **57**. An integral circumferential extension **58** extends circumferentially around flange portion **55**.

Two circumferentially spaced radially extending openings **61** and **62** extend through the mold. At the inner face of the mold **50** a bevel face **64** extends from the spigot to the bell when the mold is in closed position during the sealing of a joint. Thus, there is created a circumferentially extending mold cavity **65** about the bell and spigot joint. This mold cavity **65** extends longitudinally adjacent existing lead packing **66** and jute packing **67**. In some cases cement has been used instead of lead.

Extending circumferentially around and radially outward from flexible mold **50** is an articulated circumferentially segmented frame **68**. Frame **68** is composed of a plurality of longitudinally segmented segments **70** and **71** which are held in radial relation to one another in a circle and in abutting relationship to mold **50** by a leaf spring **70'** which passes circumferentially around the outside of the mold **50** and passes over a series of bolts **71'** which longitudinally loosely join segments **70** and **71**.

It should be understood that while the action of one pair of segments is described, these segments extend around the complete circumference of the mold as at **72**.

As shown in FIGURE 9, segment **70** has a portion **74** which rests against the flange **52** of mold **50**, a web **75** which extends radially outward and has extending at right angles a portion **76** with a bearing surface which circumferentially rests against mold **50**. A radially outwardly extending portion **77** has at its radially outer end lateral extensions **78** adjacent its circumferential ends which engage with notched portions on mating longitudinal segment **71**.

Mating longitudinal segment **71** has a radially extending flange **80** which conforms to the longitudinal extension **55** of mold **50**. A circumferential portion **81** fits against the mold at its outer circumference and has a radially extended portion **82** whose inward surface has circumferential notches **83** at its radially outer end for engagement with the extensions **78**. It should be noted that the notches form fulcrums for the pointed extensions **78** on the mating longitudinal segment **70** which act to form pivots for the longitudinal segments. This serves to articulate the mold frame both radially and longitudinally, so that the mold will always close against the outside of the spigot and against the outside of the bell

even though one or the other may lack perfect concentricity or may vary somewhat in diameter.

The portions **77** and **82** of the respective segments **70** and **71** carry longitudinally inward circumferential extensions **84** disposed adjacent their radial inner ends. The longitudinal sections of the frame **70** and **71** are held together in position by the bolt **71'** which passes through a longitudinal opening **79** centrally in the portion **77** of the segment **70** and engages a threaded corresponding opening **79'** in the portion **82** of the segment **71**. The extension **58** of the mold **50** is engaged between the portions **77** and **82** in such manner that the extensions **84** engage and indent at **60** the radial inward portions of the lateral sides of the extension **58** and hold the mold **50** securely in the position as shown in FIGURE 3. The radial outward edge of the extension **58** has notches **59** which engage the respective bolts **71'** and properly position the several segments of frame **68** with respect to the mold **50**.

Radially outward extensions **85** of the portions **76** and **81** having circumferential openings **86** receive flexible cables **87** which extend circumferentially around the mold frame radially inward of the bolt **71'** and force the frame segments radially inward upon the application of tension to the cables. When the elements shown in FIGURE 9 are assembled as in FIGURES 1 to 5 inclusive, the spring **70'** is disposed radially outward of the bolts **71'** and radially inward of the extensions **78**.

A terminal segment **88** has attached thereto an arcuate guide **90** by bolting or other means. The guide **90** has a bevelled end portion **91** at one end and a handle **92** of suitable length and desirably of tubular construction which extends tangentially from the mold frame. This handle can be suitably for instance of a length of seven feet so that it can conveniently be manipulated from above the ground. The handle is desirably sub-divided at **93** by telescoping or by any other suitable means. The handle has at its end away from the mold a tension mechanism which can suitably be of the conventional jack type as shown at **94**. This jack mechanism **94** has a portion **95** extending longitudinally of handle **92** and is, for instance, of rectangular cross section having spaced notches **96**.

A lever **97** has suitable fulcrum and engaging means not shown for engaging notches **96** whereby a mechanical advantage is secured so that a tangential force applied in a direction away from the mold can be secured on a curved saddle **98** by the application of force on lever **97**. The curved saddle **98** receives a loop integral with and formed from cables **87**.

Guides **100** lying in parallel phase transverse to the pipe axis extend circumferentially from the side faces of the terminal segment **88**. The guides **100** act to guide terminal segment **101** into position longitudinally and the guide **91** acts to align segment **101** with segment **88** circumferentially when force is applied to cable **87**. When the mold **50** is in closed position, as best seen in FIGURE 5, the mold **50** has terminal faces **102** and **103** which come into abutting relationship and serve to form a closed mold which extends circumferentially continuously about the bell and spigot joint.

A clamp **104** is fixed to the portion of the handle closest to the frame in such manner that the cable **87** can be clamped by tightening bolt **105** so that the force at the jack mechanism **94** may be released without releasing the force exerted by the cable at the mold frame.

Clamp **104** is comprised of a channel element **121** bent into a right angle with outwardly protruding flanges, having a longitudinal extension **122** of a substantial part of the web of one leg **123'** of the angle and an opening **124** in the web of the other leg **123**. The wheel-handled bolt **105** passes through the opening **124** and engages a threaded opening **125** in a keeper element **126**, conveniently of a channel similar to element **121**, which is provided with a slot **127** to receive and anchor the enlarged end of the

extension 122, the latter being spread at the end to prevent separation of the elements 121 and 126.

The handle 92 is provided with a transverse opening 128 offset from the diameter, to receive the bolt 105. The clamp 104 is applied to the handle 92 so that the leg 123' is adjacent the side nearest the opening 128. The clamp in the open position receives cables 87 in such manner that they are engaged between the jaws 123 and 126 of the clamp beyond dead center or inward of a diameter of the handle 92. When the clamp is tightened, the cables are thus firmly grasped and tend to be forced inwardly of the jaws toward the leg 123' rather than to be squeezed out therefrom.

Extending through the radially extending openings 61 and 62 is an inlet orifice 107 and an outlet orifice 106 which can suitably be short lengths of small diameter rigid tubing. Connected to the inlet orifice 107 is flexible tubing 110 and connected to the outlet orifice 106 is flexible tubing 108. A source of fluid plastic not shown supplies fluid plastic through valve 114, tube 110 and inlet tube 107. Outlet tube 106 connects through tube 108, through pressure indicating gage 113, and through valve 112 to the atmosphere.

The process of the invention can use any suitable curable sealing material, although we have preferably used an epoxy resin of the character described in the text "Epoxy Resins: Their Application and Technology," published in 1957 by H. Lee and K. Neville.

It will be evident that in the preferred embodiment the sealing material should have several different properties which will cooperate to render it most suitable for use in the present invention. The sealant should initially be a liquid which can be injected into the mold under a moderate pressure. After the sealant has been injected and has filled the mold, it should undergo a change of state within a reasonable time and not excessive time. For good results the change should not take place until about fifteen minutes have elapsed so as to allow adequate time for injection, and the change should take place within sixteen hours so that it will not be necessary to leave the mold in place indefinitely. The material may cure or set either chemically, as by polymerizing or cross linking, or other plastic curing mechanism, or it may simply cool and solidify. The sealant should form a bond of adequate strength to the suitably clean surface of the main. Thus, where the main is of cast iron cleaned by sand-blasting, we have found that bonds having an adhesive tensile strength of the order of 500 p.s.i. can readily be obtained by using the epoxy resins above referred to. The sealant should of course be capable of releasing from the mold by a suitable mold release agent as well known.

The sealant in its final form should preferably remain flexible to a sufficient extent to absorb energy due to traffic passing overhead without failure. The sealant should also be resistant to chemical deterioration by contact with the earth and the medium within the main, and therefore should not undergo softening, cracking, dissolving or disintegration within its normal service life.

The sealant should have negligible cold flow at normal temperatures and under the pressure to which it is normally subjected.

In operation, a hole 115 is dug from the street or pavement surface to the level of the main. This hole can be suitably of a cross section of 4" x 18" at the surface and is then extended to any necessary dimension surrounding the pipe to introduce the mechanism for cleaning and sealing. After digging and cleaning the hole, the parts of the joint to be sealed are cleaned.

The mold device of the invention is then introduced into the hole by the following method. The cable 87 which forms the loop around saddle 98 is removed and dropped into the hole on one side of the pipe while the rest of the device is above the hole. A suitable fishing mechanism, such as a pole with a hook on the end, is introduced on the opposite side of the pipe and the loop of cable 87 in the hole is fished under the main. Also, a block of magnetic material may be attached to the bight of the cable and a suitable fishing magnet can then be used to pull the cable through under the main. The mold and frame are then lowered by means of handle 92. The mold and frame are in an open position, as shown in FIGURE 1, by virtue of the resilience of the flexible mold 50 which has a tendency to circumferentially separate at faces 102 and 103 so that a gap exists between these faces as shown in FIGURE 1.

The mold and frame are lowered completely over the main as shown in FIGURE 2. This is conveniently accomplished by alternately pushing down on the handle 92 and pulling up on the cable which has been passed under the pipe. The bight of the cable 87 is then looped over the saddle 98. The guides 90 and 100 on the terminal segment 88 guide the terminal segment 101 of the frame into position as tension is applied to cable 87 by saddle 98 so that the cable is drawn upwardly along the handle by operation of the jack mechanism.

A linear force on cable 87 along handle 92 is converted to a tangential force at 117 (FIGURE 2) so that a radially inward force is created by the cable at each segment of the mold frame. Since separate cable portions extend circumferentially along longitudinal segments 70 and 71, separate radial forces are exerted upon these segments. Each segment 71 acts independently against mold section 55 to contract and retain the mold against the outer circumferential face of the bell end. Each segment 70 also acts independently against mold section 52 to contact and retain the mold against the spigot.

By virtue of these articulated segments compensation is automatically made for any variance of the bell or spigot from true roundness and for any variance of any fixed relationship between the bell and the spigot longitudinally, axially or otherwise.

A suitable sealing compound is introduced through open valve 114 and tube 110 under pressure and through inlet opening 107 into mold cavity 65. Gases from the cavity escape through outlet opening 106 and outlet tube 108 through open valve 112 to atmosphere. As soon as the sealing fluid emerges through outlet opening 106 and is seen in transparent outlet tube 108, valve 112 is closed and the pressure is increased until it is slightly in excess of the pressure of the gas in the main, so that the sealant is forced into leak-passages and escape of gas is prevented and thus a tendency to form gas bubbles in the plastic sealing compound will not exist. The pressure of the air above the sealant in outlet tube 108 is read on gage 113. As the sealant cures it may have a tendency to shrink which together with the expansion of the plastic tubes 108 and 110 would cause a drop in pressure as registered on gage 113. Fitting 121 to which gage 113 is attached is also provided with stem 122 containing a check valve to which a bicycle pump may be applied to restore the desired pressure.

Where it is desired for the mold to remain in place while the sealing fluid is hardening without obstructing the street, the cable which is under tension by force applied through jack mechanism 94 is clamped to the lowermost portion of the handle by clamping means 104 which secures the cable under tension to the handle by tightening bolt 105. This allows force to be released on the cable at saddle 98 without releasing the tangential force being applied to the mold frame. The jack mechanism and the outmost sections of the handle are removed and the cable loop is permitted to drop into the hole as best seen in FIGURE 8. In this position, the entire mold mechanism and the lower portion of the handle is below the surface of the pavement 120 and a hole cover 118 is placed over the hole, secured in place if desired. In this condition traffic, both vehicular and pedestrain, can move over the covered hole in safety.

After the sealing material sets in the cavity 64, for ex-

ample, from less than one hour to about twelve hours, depending upon the sealant used, tension on cable **87** is released and the cable loop is allowed to drop into the hole. The resilience of the mold causes the mold and frame to open as shown in FIGURE 1, especially if a suitable parting compound has been employed to permit separation from the sealing material, and the mold and frame are removed from the hole by use of the handle **92**. The fill and vent tubes **107** and **106** and the associated plastic tubing are replaced with new tubes and the mold recoated with the release agent and the apparatus is then ready to reuse. The advantage of using sealants with shorter curing time is that more joints can be resealed per day with a single sealing apparatus.

In view of our invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of our invention without copying the method and structure shown, and we, therefore, claim all such insofar as they fall within the reasonable spirit and scope of our claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. In a device for sealing mains, a flexible mold, a segmented frame extending around the said mold, connecting means to interconnect said segments of said frame around said mold, and handle means extending from said frame, wherein said connecting means comprises a leaf spring whereby the segments float on the leaf spring with respect to radial and axial movement.

2. In a device for sealing mains, a flexible mold having an open position and a closed position, a frame surrounding said mold, means for holding said mold closed, and a handle attached to said frame whereby the mold can be applied in position from a point remote from said mold, said handle being composed of sections and having a clamp on the section closest said frame whereby force can be retained on said closing means while the outermost sections of said handle are removed.

3. In a device for sealing means, having bell and spigot joints, a flexible mold adapted to be placed around the joint, a frame surrounding said mold and segmented both circumferentially of said mold and longitudinally with respect to its axis for movement radially, circumferentially and longitudinally, and means for contracting said frame about said mold to provide tight engagement of said mold around the bell and around the spigot of the joint despite any misalignment of said bell and said spigot and variance thereof from true roundness.

4. A device of claim 3, wherein segments of said frame are provided with circumferential apertures and said contracting means includes a cable threaded through the apertures of the segments, and means for applying tension to said cable.

5. A device of claim 3, wherein said frame comprises a plurality of longitudinally articulated pairs of segments forming two circumferential bands of segments, each of said segments being provided with a circumferential aperture and said contracting means includes cable means threaded through the aperture in consecutive segments of each of said bands, and means for applying tension to said cable means.

6. In a device for sealing mains, a flexible mold, a segmented frame extending around said mold, means for interconnecting the segments of said frame around said mold, means for contracting said frame about said mold, means for introducing sealing compound into the mold, means for releasing trapped air from the mold and assuring filling of the mold with said compound, and means associated with the two last-mentioned means for maintaining said sealing compound in said mold under a pressure in excess of the pressure in the main to be sealed.

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