March 16, 1954 M. BRAUER 2,672,161

APPARATUS FOR PLUGGING HOLES IN PIPE LINES

Filed May 24, 1949

2 Sheets-Sheet 1

FIG. 1.

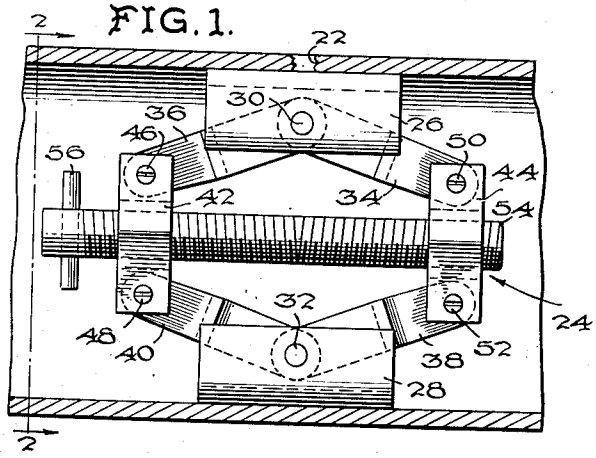


FIG. 2.

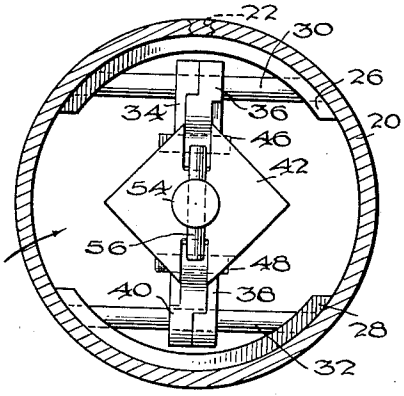
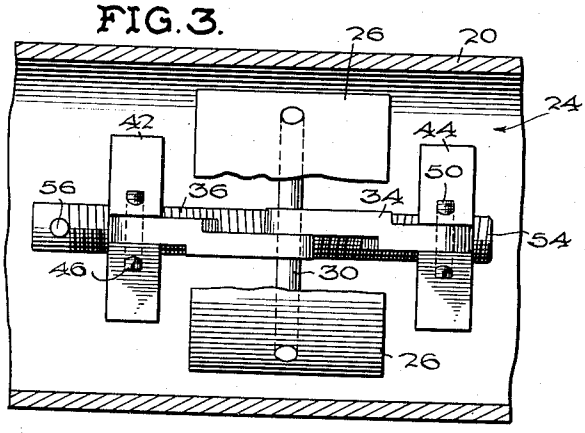


FIG. 3.



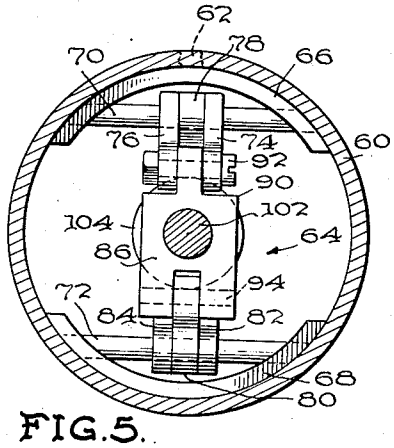
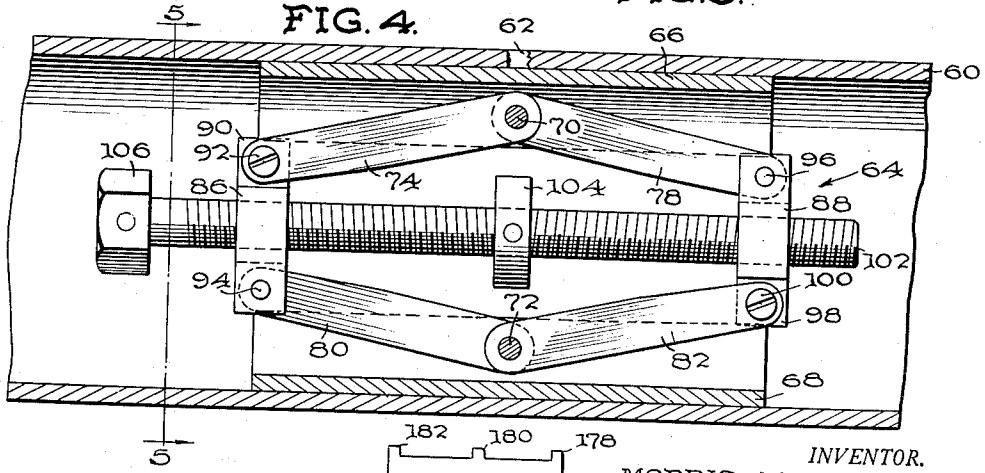


FIG. 5.

FIG. 4.



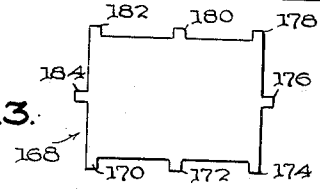


FIG. 13.

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FIG. 6.

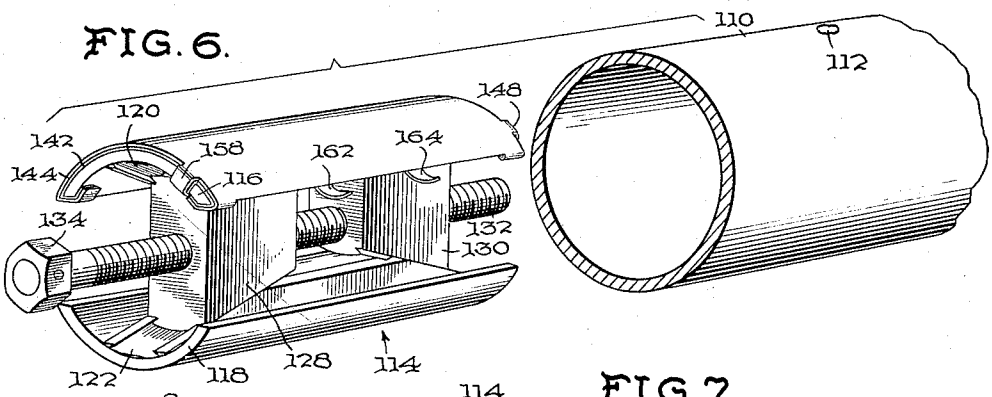


FIG. 7.

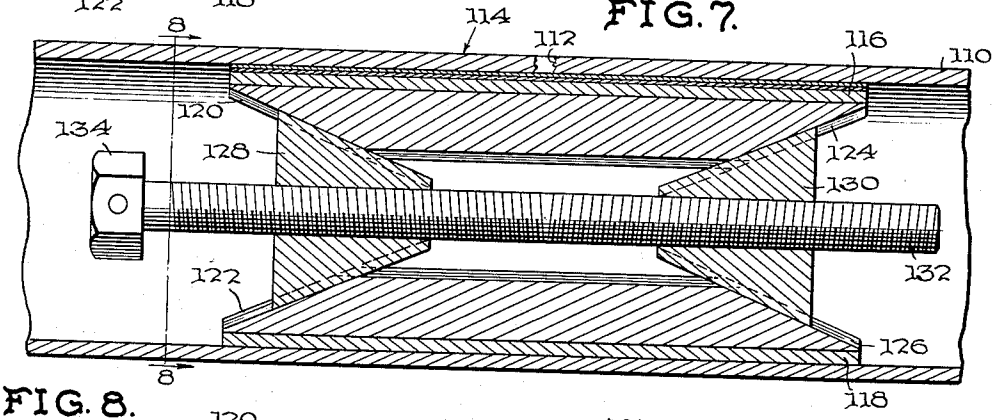


FIG. 8.

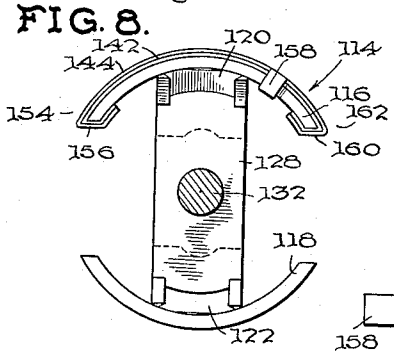


FIG. 9.

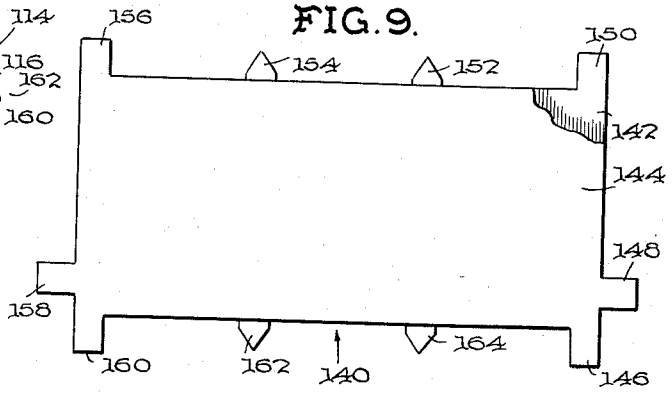
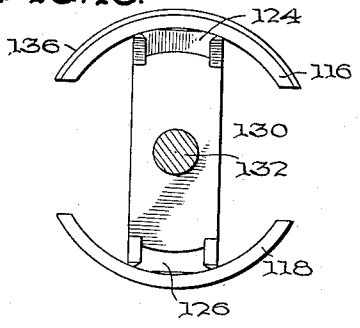


FIG. 10.



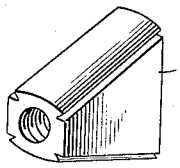


FIG. 11.

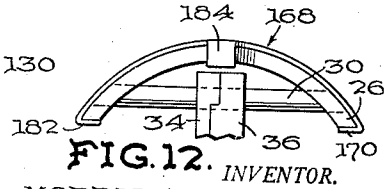


FIG. 12.

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APPARATUS FOR PLUGGING HOLES IN PIPE LINES

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Application May 24, 1949, Serial No. 95,017

4 Claims. (Cl. 138—97)

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This invention relates to an apparatus for plugging holes in pipe lines, and more particularly to the repairing of boiler tubes and other high pressure and high temperature conduits.

Among the most serious difficulties concomitant with boiler operations is the lack of adequate methods and apparatus for boiler tube repair. Thus when a puncture results in a boiler tube, the sole recourse available is to plug the ends of the tube wherein the leak is, and thereby remove this tube from operation. This involves turning off the boiler fire and having a repairman creep into the fire box to plug one end of the tube, after which the other end is tapped in. Not only is the tube useless for further heat transmission, but the very act of repairing due to the hammering required to jam in the plug is apt to disturb the surrounding area and thereby induce further leaks in surrounding tubes. In addition, this type of repair affords only temporary relief in that safety requirements will entail the necessity of retubing shortly thereafter. This latter operation is exceedingly costly and moreover prevents the utilization of the boiler for lengthy periods.

There have been attempts in the past to create boiler plugs which could be inserted within the tube to seal up punctures, but until the present date these have not proved to be successful. Due to the great heat differential between the temperature at which the plug is tightened, and the temperature at which the boiler tube is on-stream, the skeleton of the plug is affected thus preventing adequate seals.

The present invention provides the first apparatus for successfully repairing permanently a boiler tube puncture. By the utilization of the present apparatus it is not necessary to reduce the boiler pressure while the repairs are being effected, and the hammering and jamming present with earlier methods is completely eliminated. The utilization of the boiler tube may be continued immediately after repairs, and retubing is unnecessary.

An object is the provision of apparatus for the permanent repair of punctured pipe line.

This and other objects are accomplished by the apparatus of the present invention which comprises a pipe line device for plugging a pipe hole comprising a pair of transverse shoes, means comprising nuts and leverage members for distending said transverse shoes, a threaded shaft comprising sections oppositely threaded to each other, with said nuts located on said oppositely threaded sections, and means for rotating the shaft.

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The process of the present invention for repairing a pipe hole in pipe which normally carries a fluid under high temperature and pressure comprises inserting into the pipe a collapsed distendable means, said means including a rigid member conforming to the shape of the pipe, said member being coated with a composition of matter adapted to create a permanent plug, manipulating said distendable means so that said rigid member covers the pipe hole, distending said distendable means so that said rigid member seals off said pipe hole, and reutilizing said pipe by conducting the fluid under its normal temperature and pressure through said pipe.

Figure 1 is a vertical section through a punctured pipe showing my invention applied thereto.

Figure 2 is a transverse section taken on line 2—2 of Figure 1.

Figure 3 is a horizontal section through a punctured pipe showing my invention in top plane, parts being broken away to show clearness.

Figure 4 is similar to Figure 1 but shows a modified form of my invention.

Figure 5 is a transverse section taken on line 5—5 of Figure 4.

Figure 6 is a disassembled perspective view of a modified form of my invention about to be applied to a punctured tube.

Figure 7 is a longitudinal section through a punctured tube with the modified form of my invention shown in Figure 6 applied thereto.

Figure 8 is a transverse section taken on line 8—8 of Figure 7.

Figure 9 is a view of the patch utilized in Figure 6.

Figure 10 is an end view of the modified form of my invention shown in Figure 6 having a plastic type patch.

Figure 11 is a perspective view of a cam nut as utilized in the modified form of my invention shown in Figure 6.

Figure 12 is a fragmental end view of my invention showing the utilization of a patch on the form of my invention shown in Figure 1.

Figure 13 is a plan view of the patch utilized in Figure 12.

Referring to Figures 1, 2 and 3, 20 represents a pipe such as a boiler tube having a hole or puncture 22. My pipe line device is indicated by 24 and comprises a pair of transverse shoes 26 and 28. The outer surface of shoes 26 and 28 conforms to the inner surface of pipe 20. As is shown in Figures 1 and 2, shoe 26 is in place against hole 22. Shoes 26 and 28 are pivotally attached by respective bars 30 and 32 to links 34, 36, 38, 40; shoe 26 being pivotally attached

to links 34 and 36 and shoe 28 being pivotally attached to links 38 and 40. Links 34, 36, 38 and 40 are pivotally held in slotted nuts 42 and 44; with links 36 and 40 being held in pivotal position in slotted nut 42 by respective pins 46 and 48, and links 34 and 38 being held in pivotal position in slotted nut 44 by respective pins 50 and 52. Slotted nuts 42 and 44 are mounted on threaded shaft 54 which has right and left hand threaded sections. Slotted nut 44 is mounted on the left hand threaded section of shaft 54 and slotted nut 42 is mounted on the right hand threaded section of shaft 54. Shaft 54 may be rotated by turning pin 56.

Thus pipe line device 24 may be inserted into pipe 20 with shoes 26 and 28 closer together than the inside diameter of pipe 20, and by rotating pin 56 slotted nuts 42 and 44 are brought closer together and shoe 26 is forced against the inner surface of pipe 20 effectively sealing off hole 22.

A modified form of my invention is shown in Figures 4 and 5. In these figures, 60 represents a pipe such as a boiler tube having a hole or puncture 62. My pipe line device is indicated by 64 and comprises a pair of transverse shoes 66 and 68. The outer surface of shoes 66 and 68 conforms to the inner surface of pipe 60. As is shown in Figures 4 and 5, shoe 66 is in place against hole 62. Shoes 66 and 68 are pivotally attached by respective bars 70 and 72 to links 74, 76, 78, 80, 82 and 84; shoe 66 being pivotally attached to links 74, 76 and 78, and shoe 68 being pivotally attached to links 80, 82 and 84. Links 74, 76, and 80 are pivotally attached to nut 86 and links 78, 82 and 84 are pivotally attached to nut 88; with links 74 and 76 pivotally attached to extended member 90 of nut 86 by pin 92, and link 80 pivotally attached in a slot of nut 86 by pin 94. Link 78 is likewise pivotally attached to a slot in nut 88 by pin 96 and links 82 and 84 are pivotally attached to extended member 98 of nut 88 by pin 100. Nuts 86 and 88 are mounted on threaded shaft 102 which has right and left hand threaded sections. Nut 86 is mounted on the right hand threaded section of shaft 102, and nut 88 is mounted on the left hand threaded section of shaft 102. Fixed collar 104 is inserted between the right hand threaded section of shaft 102 and the left hand threaded section of shaft 102. Shaft 102 may be rotated by turning nut 106.

Thus pipe line device 64 may be inserted into pipe 60 with shoes 66 and 68 closer together than the inside diameter of pipe 60, and by rotating nut 106 nuts 86 and 88 are brought closer together forcing shoe 66 against the inner surface of pipe 60 effectively sealing off hole 62.

Another modification of my invention is shown in Figures 6, 7, 8, 10, and 11. In these figures 110 represents a pipe having a hole or puncture 112. My pipe line device is indicated by 114 and comprises a pair of transverse shoes 116 and 118. The outer surface of shoes 116 and 118 conforms to the inner surface of pipe 110. Figure 6 illustrates device 114 about to be inserted into pipe 110 and Figure 7 shows device 114 in place within pipe 110 with shoe 116 against hole 112. The inner surfaces of shoes 116 and 118 have angularly raised cam ways 120, 122, 124 and 126. Cam nuts 128 and 130 having runners adapted to conform to cam ways 120, 122, 124 and 126 are mounted on shaft 132 and attach shoes 116 and 118 to shaft 132. Cam nut 128 rides in cam ways 120 and 122, and cam nut 130 rides in cam ways 124 and 126. Shaft 132 has right and left hand threaded sections and cam nut 128 is

mounted on the right hand threaded section of shaft 132 and cam nut 130 is mounted on the left hand threaded section of shaft 132. Shaft 102 may be rotated by turning nut 134.

Thus pipe line device 114 may be inserted into pipe 110 with shoes 116 and 118 closer together than the inside diameter of pipe 110 as shown in Figure 6. When device 114 is in line with hole 112, nut 134 is rotated and cam nuts 128 and 130 are brought closer together and shoe 116 is forced against the inner surface of pipe 110 thus effectively sealing off hole 62.

In many cases it may be desirable to leave my pipe line device in the tube and simply pass the hot fluids through the tube as in normal operation wtih my device remaining in the tube. This is entirely practical since my device does not block off the tube since as shown in Figures 2 and 5 the cross sectional area of my device is but a fraction of the cross sectional area of the boiler tube. In many instances it may prove desirable to coat the outer or distal surface of one shoe (i. e. the surface which is to face the hole), or of both shoes with a suitable composition of matter adapted to create a permanent union between the shoes and the inner surface of the pipe, and which is also capable of acting as a permanent plugging material. Such compositions of matter may take the form of substances which undergo thermal transformations to create permanent cement plugs. When using these substances my device is to be inserted with the shoe to be placed against the hole or both shoes coated with the substance. After the device is distended against the hole, the repaired tube is placed on-stream and the substance undergoes a thermal transfusion induced by the hot fluids passing through the tube thereby forming a permanent seal and plug. Cementing substances which form seals under other conditions could likewise be used, and these conditions effected after my device has been inserted and expanded into place. I have found that both plastic and metallic compositions are suitable, among the plastic compositions that have proved to be successful are phenol-formaldehyde asbestos impregnated resins, and shellac-pine tar asbestos impregnated mixtures, while among the metallic cements which I have found to be suitable are the numerous commercial solders having temperatures of fusion of the order of those temperatures present in boilers. I have shown shoe 116 coated with a cementing and plugging substance 136 in Figure 10.

However, in many cases, it may be desirable to repair the boiler tube and not leave any obstruction within the repaired tube. Accordingly, I have devised a method for accomplishing this.

A collapsed distendable means having a rigid member conforming to the shape of the inner surface of the tube, such as my device 114 in Figure 6 is inserted into the tube so that the rigid member is below the puncture. Prior to the insertion the rigid member is coated with a composition of matter adapted to create a permanent plug such as those compositions described in the previous paragraph, and said composition is attached to the rigid member by a detachable binding means which permits the release of said composition from the distendable means. In Figures 6, 8 and 9, I have shown a suitable detachable binding means and plug composition unit 140 comprising a backing of thin metal 142 surfaced with plug composition 144. The unit 140 is attached to the rigid member which consists of shoe 116 by means

of flanges 146, 148, 150, 156, 158 and 160 as shown in Figures 6 and 8. Metallic prongs 162, 164, 152, and 154 are provided and serve to prevent the device 114 from turning out of position while it is being distended by fixing themselves in relation to the inner surface of the pipe. In some cases these metallic prongs may be dispensed with. A similar unit 168 to that shown in Figure 9 for utilization with the form of my invention shown in Figures 1, 2 and 3 is shown in Figure 13. The attachment of this unit to shoe 26 by the utilization of flanges such as 170, 172, 174, 176, 178, 180, 182, and 184 is indicated in Figure 12. After the distendable means has been positioned within the tube it is expanded so that the detachable binding means and plug composition unit covers the hole. The necessary conditions for converting the plug-cement composition into a cemented plug are then effected, such as by permitting the tube to remain on-stream for a period, following which the distendable means is collapsed and removed from the tube. This removal can easily be affected without injury to the plug since the flanges such as 158, 160, 146, 148, 150 and 156, or 170, 172, 174, 176, 178, 180, 182 and 184, as a body are opened and released when the distendable means is collapsed. Alternatively, in place of units embodying mechanical holding flanges such as units 140 and 166, other detachable binding means may be employed. These include utilizing as a detachable binder between the cement-plugging composition and the rigid member comprising a plastic or metallic binding means which either burns or melts off under the cementing conditions, or a binding means which due to the cementing conditions expands off.

The apparatus and process herein described may be modified somewhat. These modifications which are readily apparent to one skilled in the art constitute part of my invention. They include modifications in the shape of the various members utilized in my invention, and the different conditions which may be utilized for effecting the plug-cementing of my process.

I claim:

1. A pipe line device for plugging a pipe hole comprising a pair of transverse shoes, each of said shoes having located on its inner surface an angularly raised cam way, cam nuts adapted to conform to said cam way, a threaded shaft having oppositely threaded sections, said cam nuts mounted on said shaft's oppositely threaded sections and arranged so that when said shaft is rotated the cam nuts move upon said angularly raised cam way thereby distending said transverse shoes.

2. A pipe line device for plugging a pipe hole comprising a pair of transverse shoes, at least one of said shoes having located on its distal surface a composition of matter adapted for plugging said pipe hole, each of said shoes having located on its inner surface an angularly raised cam way, cam nuts adapted to conform to said cam way, a threaded shaft having oppositely threaded sections, said cam nuts mounted on said shaft's oppositely threaded sections and arranged so that when said shaft is rotated the cam nuts move upon said angularly raised cam way thereby distending said transverse shoes.

3. A pipe line device for plugging a pipe hole comprising a pair of transverse shoes, at least one of said shoes having located on its distal surface a detachable patch containing a composition of matter adapted for plugging said pipe hole, each of said shoes having located on its inner surface an angularly raised cam way, cam nuts adapted to conform to said cam way, a threaded shaft having oppositely threaded sections, said cam nuts mounted on said shaft's oppositely threaded sections and arranged so that when said shaft is rotated the cam nuts move upon said angularly raised cam way thereby distending said transverse shoes.

4. A pipe line device for plugging a pipe hole comprising a pair of transverse shoes, each of said shoes having located on its inner surface an angularly raised cam way, cam nuts adapted to conform to said cam way, a threaded shaft having oppositely threaded sections, a fixed collar separating said sections, said cam nuts mounted on said shaft's oppositely threaded sections and arranged so that when said shaft is rotated the cam nuts move upon said angularly raised cam way thereby distending said transverse shoes.

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