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APPARATUS FOR PLUGGING HOLES
IN PIPE LINES

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

This application is a continuation-in-part of my earlier U. S. application Serial No. 95,017, filed May 25, 1949.

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 and patches 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, and the patches have proven incapable of withstanding the boiler's normal operating conditions.

The present invention provides the first method and apparatus for successfully repairing permanently a boiler tube puncture. By the utilization of the present method and 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.

Therefore, this invention has as an object the provision of a method of permanently repairing punctured pipe lines.

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

A still further object is the provision of a

method for effecting permanent patches on punctured pipe line.

These and other objects are accomplished by the device of the present invention which comprises 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 an indentation, and means for distending said transverse shoes.

The method of my invention which comprises a process for repairing a pipe hole in pipe which normally carries a fluid, is accomplished by inserting into said pipe a collapsed distendable means, said means including a shoe having a distal surface conforming to the shape of said pipe, said shoe having on its distal surface an indentation portion containing a composition of matter adapted to create a permanent plug, manipulating said distendable means so that the indentation portion of said shoe covers said pipe hole, and distending said distendable means so that said indentation portion of said shoe seals off said pipe hole.

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

Figure 4 is a transverse section taken on line 4-4 of Figure 3.

Figure 5 is a perspective view of a rigid transverse shoe utilized in my invention.

Figure 6 is a perspective view of a pipe hole that has been patched through the use of my invention.

Figure 7 is a transverse section through a repaired pipe.

Referring to Figures 1, 2, and 5, 20 represents a pipe such as a boiler tube or pipe conduit having a hole or puncture 22. My pipe line device is indicated by 24 and comprises a pair of rigid transverse shoes 26 and 28. The outer or distal surfaces of shoes 26 and 28 conforms to the inner surface of pipe 20. The central portion of shoe 26 which is the shoe covering hole 22 contains an indented portion 27. In the preferred form of my invention, this contains a suitable composition of matter 29 adapted for plugging said pipe and forming a permanent plug capable of withstanding the temperatures and/or pressures normally found within pipe 20. This composition of matter 29 is shown in a cut-away perspective view in Figure 5. In addition to being a suitable composition for plugging hole 22, it is preferable

that composition of matter 29 be attached to shoe 26 by a detachable ginding means in such a manner that it may become detached. This may be accomplished in various ways such as the insertion of a thin foil 31 (shown in Figure 1) between the indentation 27 and the composition of matter 29, said thin foil 31 being melted away under the conditions of temperature normally found within the pipe. Other means may be utilized such as detachable coatings and/or binders on the surface of indentation 27 which permit the composition 29 to be detached when the normal conditions found within the pipe are achieved or when other conditions that may be effected for this purpose are established. The coating or binder may operate through being burnt or melted off. As examples of the foil which may be utilized, any of the low melting alloys which are now commercially available will serve the purpose. The coating or binder may comprise any plastic or metallic composition which may be burnt or melted off under conditions which would not adversely effect the plugging composition 29.

For the plugging composition 29 I have found that any substances which form seals capable of withstanding the normal conditions found within the tube may be utilized. These include cementing substances which form seals under the conditions of normal operation, in addition substances forming seals under other conditions could likewise be used and these conditions would then be effected. I have found that both plastic and metallic plug compositions are suitable. Among the plastic compositions that have proved to be successful are phenol-plastic asbestos impregnated mixtures, while among the metallic cements which I have found to be suitable are the numerous commercial solders and welding materials having temperatures of fusion of the order of those present in boilers.

Shoes 26 and 28 are pivotally attached by respective bars 30 and 32 to links 34, 36, 38, 40, 42 and 44; shoe 26 being pivotally attached to links 34, 36 and 38, and shoe 28 being pivotally attached to links 40, 42 and 44. Links 34, 36, and 40 are pivotally attached to nut 46, and links 38, 42, and 44 are pivotally attached to nut 48; with links 34 and 36 pivotally attached to extended member 50 of nut 46 by pin 52, and link 40 pivotally attached in a slot of nut 46 by pin 54. Link 38 is likewise pivotally attached to a slot in nut 48 by pin 56, and links 42 and 44 are pivotally attached to extended member 58 of nut 48 by pin 60. Nuts 46 and 48 are mounted on threaded shaft 62 which has right and left hand threaded sections. Nut 46 is mounted on the right hand threaded section of shaft 62, and nut 48 is mounted on the left hand threaded section of shaft 62. Fixed collar 64 is inserted between the right hand threaded section of shaft 62 and the left hand threaded section of shaft 62. Shaft 62 may be rotated by turning pin 66.

Another modification of my invention is shown in Figures 4 and 5. In these figures 70 represents a pipe having a hole or puncture 72. My pipe line device is indicated by 74 and comprises a pair of rigid transverse shoes 76 and 78. The outer or distal surfaces of shoes 76 and 78 conforms to the inner surface of pipe 70. The central portion of shoe 76 which is the shoe covering hole 72 contains an indented portion 77. In the preferred form of my invention this contains a suitable composition of matter 79 adapted for plugging said pipe hole, and forming a permanent plug capable of withstanding the conditions nor-

mally present within pipe 70. As explained in the description of my device 24 in Figures 1, 2 and 5, this plugging composition should preferably be detachably held in the indentation portion 77 of the shoe covering the pipe hole (shoe 76). The types of plugging composition, and manner and types of detachable coating, binder, foil etc. are similar to those mentioned in the description of device 24.

The inner surfaces of shoes 76 and 78 have angularly raised cam ways 80, 82, 84, and 86. Cam nuts 88 and 90 having runners adapted to conform to cam ways 80, 82, 84, and 86 are mounted on shaft 92 and attach shoes 76 and 78 to shaft 92. Cam nut 88 rides in cam ways 80 and 82, and cam nut 90 rides in cam ways 84 and 86. Shaft 92 has right and left hand threaded sections and cam nut 88 is mounted on the right hand threaded section, and cam nut 90 is mounted on the left hand threaded section. Shaft 92 may be rotated by turning nut 94.

While my invention has been described in connection with devices such as 24 and 74 it is to be understood that the present invention is not limited to these devices. My invention comprising a rigid shoe having an indentation into which patching material for plugging pipe holes may be placed is applicable to all kinds of pipe line devices for plugging pipe holes, in which a shoe is forced into place against the pipe hole. It embraces all devices in which a shoe having an indentation on its outer surface is connected to means for distending said shoe against a pipe hole. The preferred forms of my device embody those in which the distendable means comprises a threaded shaft comprising sections oppositely threaded to each other, having nuts and leverage members located on said oppositely threaded sections, which on rotation of the shaft distend the shoe. These devices are described in my copending application U. S. Serial No. 95,017 filed May 25, 1949, and the modified forms of these devices are also embraced in the present application.

My invention also includes the process of making permanent repairs of pipe punctures which comprises inserting into a pipe a device having a collapsed distendable means which includes a shoe having a distal surface conforming to the inner surface of the pipe, and having on its distal surface an indentation portion containing a composition of matter adapted to create a permanent plug capable of withstanding the normal operating conditions within and without said pipe. The device is inserted so that the indentation portion of the shoe covers the puncture and the distendable means is then manipulated so that the indentation portion seals off the puncture. Suitable conditions are then effected for converting the composition of matter contained in the indentation portion into a permanent plug. These conditions vary with different compositions but usually include the normal passage of hot fluids within and/or without the tube. Other variations obvious to one skilled in the art may be used for transforming the composition into a permanent plug and these are to be considered included in my invention.

While the device may be left within the tube, in the preferred form of my invention it is withdrawn therefrom following the formation of the permanent plug, so as to avoid a hindrance in flow due to a reduction in cross sectional area. This is effected by the use of a detachable binding means which permits the composition to be

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removed from the device after it has formed a plug. As indicated heretofore, this may be achieved by the use of a binding means, coating, foil separant, etc. which has previously been placed between the plug composition and the indentation portion of the shoe. During the course of the conversion of the composition to a permanent plug and/or during the course of the resumption of flow through the tube following the sealing off of the puncture by the device, the detachable binding means is burnt or melted away, thereby permitting the device to be separated from the formed plug and to be withdrawn. On withdrawing my device the reduction in cross sectional area is negligible.

Figures 6 and 7 show a pipe 100 whose puncture 102, has been repaired by permanent plug composition 104, and from which the pipe line device has been removed.

Using 24 or 74 as illustrative of devices capable of being utilized in my process; these devices would be inserted into a pipe having a puncture so that the indentation portion 27 or 77 of shoe 26 or 76, containing a composition of matter adapted to form a permanent pipe plug and being attached to the indentation portion by means of a detachable binding means, would cover the puncture. Pin 66 or nut 94 would be rotated so that indentation portion 27 or 77 of shoe 26 or 76 sealed off the puncture. Suitable conditions for converting the plug composition to a permanent cemented plug and detaching it from the indentation portion would then be effected such as by placing the tube onstream and permitting the composition and detachable means to come in contact with high temperature fluids. Following the formation of the permanent plug, and detachment of same from the device, device 24 or 74 is withdrawn from the tube.

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 and detaching from the device of my process.

I claim:

1. A pipe line device for plugging a pipe hole at the internal pipe wall comprising a pair of transverse shoes having distal convex surfaces, at least one of said shoes having its distal surface conforming to the inner surface of said pipe, and having located on its distal convex surface an indentation for containing a composition of matter adapted for plugging said hole, and means for distending said transverse shoes comprising angularly raised cam ways located on the inner surfaces of said transverse shoes, cam nuts

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adapted to conform to said cam ways, 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 ways.

2. A pipe line device for plugging a pipe hole at the internal pipe wall comprising a pair of transverse shoes having distal convex surfaces, at least one of said shoes having its distal surface conforming to the inner surface of said pipe, and having located on its distal convex surface an indentation, said indentation containing a detachable patch comprising a composition of matter adapted for plugging said hole, and means for distending said transverse shoes comprising angularly raised cam ways located on the inner surfaces of said transverse shoes, cam nuts adapted to conform to said cam ways, 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 ways.

3. A pipe line device for plugging a pipe hole at the internal pipe wall comprising a pair of transverse shoes having distal convex surfaces, at least one of said shoes having its distal surface conforming to the inner surface of said pipe, and having located on its distal convex surface an indentation, said indentation containing a detachable patch comprising a composition of matter adapted for plugging said hole, and means for distending said transverse shoes comprising angularly raised cam ways located on the inner surfaces of said transverse shoes, cam nuts adapted to conform to said cam ways, 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 ways, and a fixed collar separating said threaded shaft's oppositely threaded sections.

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