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[54] **METHOD AND APPARATUS FOR REMOVING A PLUG**

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[51] **Int. Cl.** **B21b 25/06**

[58] **Field of Search** 72/97, 209

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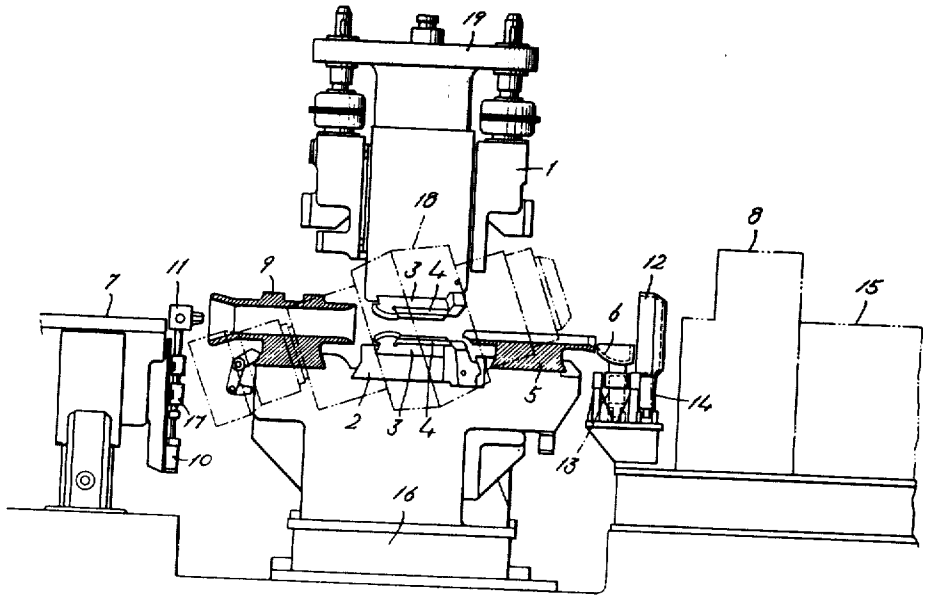
[57] **ABSTRACT**

A rolling mill of the type utilizing a plug for piercing, reeling or cross-rolling a workpiece, the plug being left in the mill after completion of the rolling operation, water being ejected under high pressure against the plug through a nozzle for removing the plug the ejected water being received by a water collector, and the removed plug being received in a plug recovering means. The nozzle and the water collector are advanced and retracted to and from the pass line of the mill.

6 Claims, 5 Drawing Figures



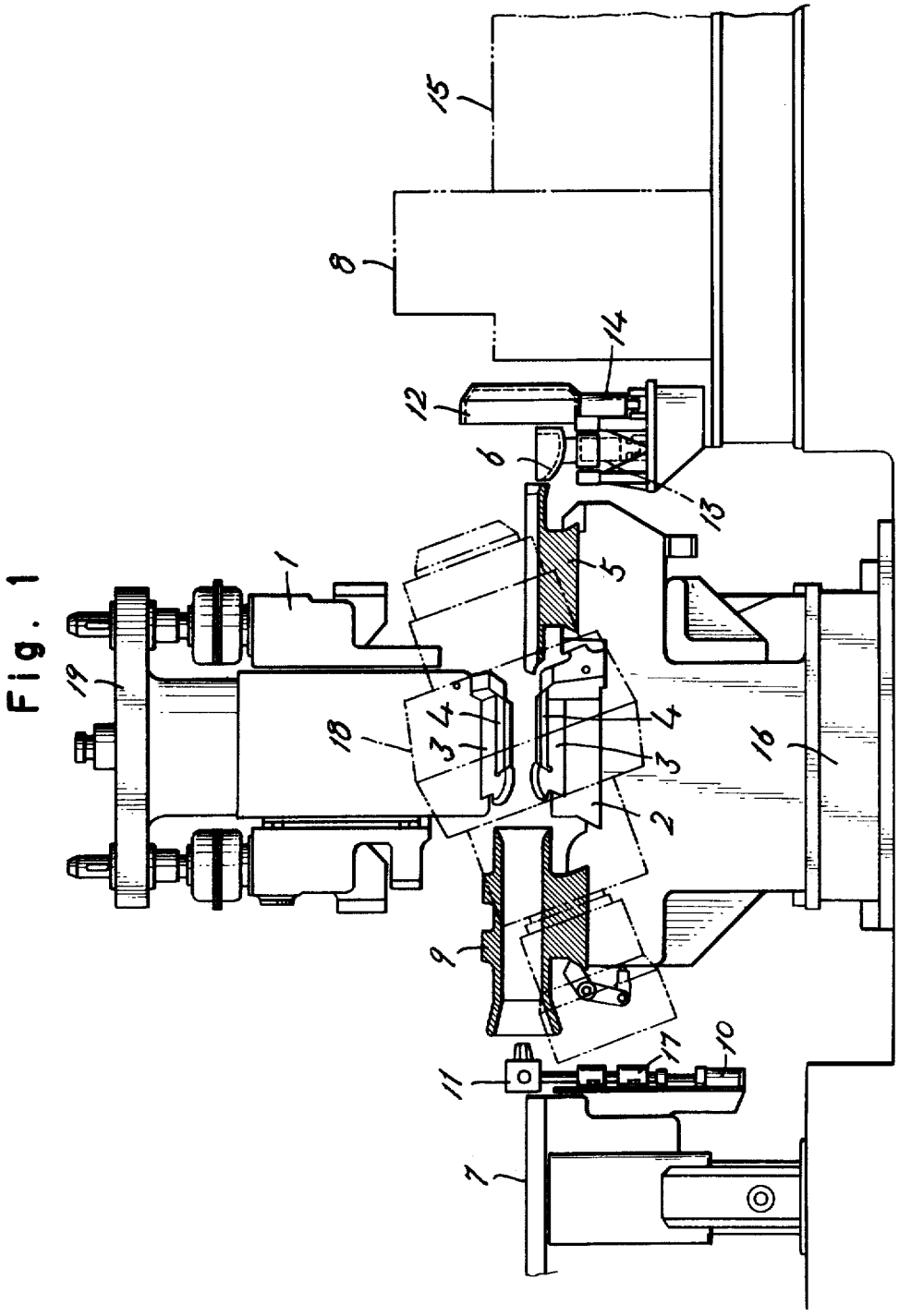


Fig. 1

Fig. 2

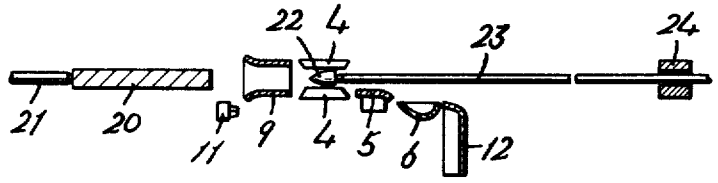


Fig. 3

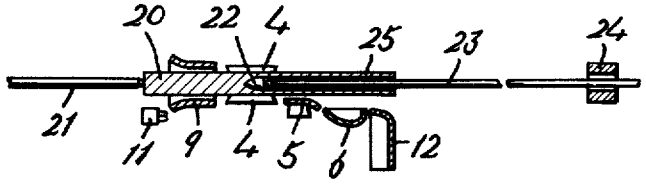


Fig. 4

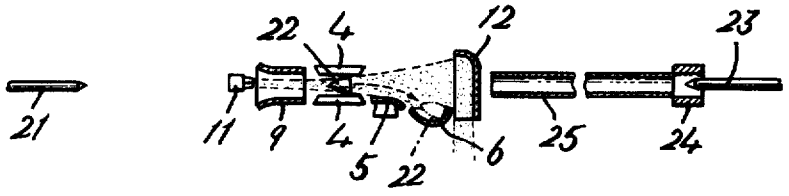
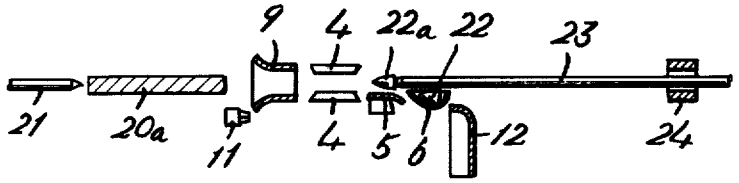


Fig. 5



METHOD AND APPARATUS FOR REMOVING A PLUG

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for removing a plug from a rolling mill such as a Mannesmann type piecing machine, a reeling mill and a cross-rolling mill or a rotary expander. In the operation of a mill of the type described above, a blank to be rolled is advanced into the mill while holding a plug mounted on one end of a mandrel between guide shoes of the mill. As is well known in the art, the plug is left in the mill after completing a rolling operation. To remove the plug from the mill, it has been the practice to use a rod shaped tool or a combination of a rod shaped tool and a lever. Such method, however, depends upon manpower, so that it requires a large labour, time and skill. It will be readily understood that it is not easy to remove a hard body having a circular cross-section, such as a plug, from a mill because the rolling operation is performed under high temperature environments so that the operator must manipulate a long rod-shaped tool from a position remote from the mill. Although it is necessary to remove the plug after each rolling operation for inspection and cooling, and to use a cold plug at each operation, the operator is unwilling to do so, with the result that there is a possibility of using a damaged or deformed plug and thus producing defective products. In addition, the plug is severely worn. To facilitate the operation of such a long rod-shaped tool there is often used a piston-cylinder assembly, but even when such an assembly is used, the tool is operated mainly by manpower. Further, the operation of the tool becomes more difficult because the operator must operate the tool in good timing with the operation of the piston-cylinder assembly. An alternative method has also be proposed wherein the plug is removed from the mill while the plug is being secured to one end of a mandrel. Although this alternative method permits ready removal of the plug from the mill, it is not easy to dismount the plug from the mandrel. More particularly, according to this method, where the plug is worn out it is necessary to stop the operation of the mill for exchanging the plug, to dismount the plug from the mandrel by securely holding the plug when it is completely removed from the workpiece, and then pulling out the mandrel bar or by moving the plug and mandrel together with the workpiece, clamping the plug at a definite position on the output side of the mill, and then withdrawing the mandrel bar. Such method of dismounting the plug is troublesome and requires a considerable time, 20 to 50 seconds for example, so that if such a dismounting operation was performed at each milling operation it would be necessary to operate the mill intermittently, thus decreasing the efficiency of operation. For this reason, the plug is exchanged less frequently, to the extent that there are also disadvantages such as defective products being formed due to a damaged plug. Moreover, according to this method, the operating efficiency of the mill is decreased because it is necessary to stop the operation of the rolling mill each time the plug is exchanged, and the life of the plug is decreased due to insufficient cooling. There has also been proposed an alternative method wherein a number of mandrel bars, each carrying a plug, are prepared, the mandrel bar being displaced to one side of the mill line together with the workpiece after each rolling operation, the mandrel bar and plug being removed from the workpiece after conveying them to a position not interfering with the operation of the mill. After cooling in a cooling tank, or by other suitable means, the mandrel bar and the plug are used again. Although this method can eliminate the various difficulties described above, it requires a large cost of installation and operation, because it is necessary to prepare a member of mandrel bars and plugs, and conveyors to convey long mandrel bars carrying the plugs, and apparatus for cooling them.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a novel method and apparatus for removing a plug from a rolling mill which can obviate the various difficulties described above, in other words to provide an efficient method and apparatus capable of readily removing the plug without using any manpower.

To accomplish this object, according to this invention, water under high pressure is utilized to remove the plug remaining in the mill. Thus, the ejecting force and the lubricating property of the water are utilized to readily remove the plug. Generally, the weight of the plug is about 30 Kg in the case of a piercing mill, or about 40 Kg in the case of a reeling mill. By using water under a high pressure of about 30 to 60 Kg/Cm^2, it is possible to readily and smoothly remove such a heavy plug in an extremely short time of less than 3 seconds, thus eliminating the necessity of using manpower and skill.

Another object of this invention is to provide a novel method and apparatus capable of smoothly removing the plug and conveying the removed plug to a mounting and dismounting station without splashing the water ejected under high pressure onto the mill and associated apparatus in the working area and without interfering with the operation thereof. To accomplish this object, in accordance with this invention, a water collector is disposed to oppose a nozzle, used to eject the high pressure water, for receiving the ejected water. With this arrangement it is possible to readily remove the plug without splashing the water in the operating area. The removed plug is conveyed to a plug recovering mechanism situated below the water collector and in front thereof.

Another important object of this invention is to provide a new and improved method and apparatus capable of preventing degrading of the products and decreasing of the production efficiency caused by a damaged plug, and of improving the useful life of the plug. In each of the prior art methods described above, as the plug is not exchanged frequently, production of defective products caused by a damaged or deformed plug is inevitable, thereby not only reducing the yield of satisfactory products but also requiring a large cost of installation and operation of the mill. According to the method of this invention, since the plug is removed readily without using any manpower, it is possible to exchange the plug after each rolling operation. Consequently, it is possible always to use a satisfactory plug, thus enabling to increase the yield of satisfactory products and to increase the operating life of the plug. Also, it is possible to reduce the cost of installation and operation of the mill because it is only necessary to install a nozzle for ejecting water under high pressure, a water

collector and a mechanism for moving these elements in the vertical direction.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 shows a side elevation, partly in section, of a piercing mill embodying the invention;

FIG. 2 is a diagram showing a condition of the mill immediately prior to the piercing operation;

FIG. 3 is a diagram showing a condition of the mill during the piercing operation;

FIG. 4 is a diagram showing the manner of removing the plug and

FIG. 5 is a diagram similar to FIG. 2 showing a condition immediately prior to pierce a new workpiece.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A piercing mill embodying the invention and shown in FIG. 1 comprises a housing 1 mounted on a base 16, a chair 2, and a pair of guide shoe holders 3 carrying opposed guide shoes 4. On the inlet side of the housing 1 are provided a water cannon 9 and a workpiece guide 7 having a V shaped cross-section. According to this invention, there is provided a nozzle 11 between the guide 7 and the cannon 9 for ejecting water under high pressure. In the example shown, the nozzle 11 is supported by a holder 17 and is operated in the vertical direction by a piston-cylinder assembly 10 between an elevated position in line with the pass line of the mill and a lowered position. Water under high pressure is supplied to the nozzle through a flexible piping, not shown. On the exit side of the housing 1 are provided a plug trough 5, a rearward assembly 8 including a guide for the pierced-workpiece receiving device, a mandrel holder and a mechanism for conveying the pierced workpiece to one side of the pass line, not shown, and a pull out and transfer mechanism 15 for the workpiece. Since these mechanisms are well known in the art it is believed unnecessary to show and describe them in detail. According to this invention, a plug recovering mechanism 6 and a water collector 12 are provided between the rearward assembly 8 and the plug trough 5. In the same manner as the nozzle 11, the plug recovering mechanism 6 and water collector 12 are operated into alignment with the pass line of the piercing mill by suitable operating mechanisms such as piston-cylinder assemblies 13 and 14 which are positioned beneath them. Although not shown in the drawing, suitable pipings and valves are provided for the piston-cylinder assemblies 10, 13 and 14 for supplying thereto air or liquid under pressure. Further, although the nozzle 11, plug recovering mechanism 6 and water collector 12 are shown to be movable in the vertical direction, it is also possible to move them in the lateral or oblique directions. For this purpose, instead of reciprocating them by piston-cylinder assemblies, it is also possible to use rotary or inclining type operating mechanisms. Further, instead of providing the water ejecting nozzle on the input side of the piercing mill for discharging the plug to the output side of the mill, the nozzle 11 may be positioned on the output side and the plug recovering mechanism and the water collector on the input side for discharging the plug to the input side. The plug recovering mechanism 6 is designed to receive the plug discharged through the plug trough while the water collector 12 is designed to have a cup-shaped configuration to collect the pressurized water ejected from nozzle 11 and prevent splashing of the collected water to the surrounding so as to prevent the water from reaching a product ahead of the water collector 12. As shown in the drawing, a pair of mill rolls 18 is positioned on the opposite sides of the center of guide shoes with their axes inclined with respect to the pass line. The housing 1 is provided with an upper guide hanger 19, in a manner well known in the art.

The operation of the piercing mill will now be described with reference to FIG. 2 through 5. For piercing, the nozzle 11 and water collector 12 are held in the positions below the pass line as shown in FIG. 2. A workpiece 20 to be pierced, such as a circular steel blank, is advanced by a pusher 21 toward the plug 22 mounted on one end of a mandrel bar 23 and held between upper and lower guide shoes 4 through the cannon 9. Thus, the workpiece is pierced as shown in FIG. 3 to form a hollow product 25. When the tail end of the workpiece passes between rolls 18, thus reaching a position not interfering with the upward movement of the nozzle 11, the nozzle 11 is raised to align with the pass line by the piston-cylinder assembly 10. Further, when the tail end of the hollow product 25 passes by the water collector 12, as shown in FIG. 4, the water collector 12 is also raised to the pass line, water under high pressure is ejected through nozzle 11, whereby plug 22 remaining between the guide shoes 4 after completion of the piercing operation is forced into the plug recovering mechanism through the plug trough 5 as shown in FIG. 4. The plug 22 can be readily advanced to the recovering mechanism 6 by the high pressure and the lubricating action of the water ejected from nozzle 11. Generally speaking, when the pressure of the water is higher than 30 Kg/cm^2, the plug is advanced in an extremely short time as described above. Once started to move by the high pressure water, the plug will have sufficient inertia of motion to continue its smooth movement towards the recovering mechanism although the driving force applied to the plug decreases gradually. The plug 22 received by the plug recovering mechanism 6 is recovered by lowering the same by operating piston-cylinder assembly 13. Then a new plug 22*a* ia mounted on the mandrel bar 23 as shown in FIG. 5 and advanced to the working position shown in FIGS. 2 and 3 for piercing a new workpiece.

The result of many field experiments shows that according to this invention it is possible to increase the operating life of the plug by 20 to 40 percent when compared with the conventional method. Further, it was noted that it is possible to substantially completely prevent scratches on the inner surface of the product. Although according to the prior art method the percentage of rejects was from 1 to 1.5 percent, according to this invention it was possible to greatly decrease this percentage.

To have better understanding of the invention the following examples are illustrated.

EXAMPLE 1 PIERCING MILL

In this example, circular steel rods were rolled by a Mannessmann piercing mill as shown FIG. 1 to obtain steel pipes having a diameter of 200 mm. A plug 22 having a weight of 45 Kg was mounted on a mandrel

rod and used for piercing the workpiece as shown in FIGS. 2 and 4. After the piercing operation the plug left in the guide shoes 4 was recovered by ejecting water under a high pressure of 40 Kg/cm² through nozzle 11 for only about 1.5 seconds. Of course the nozzle 11 was raised to the pass line and the total time required for recovering the plug from an instant at which the nozzle was raised to an instant at which the nozzle, plug collecting mechanism and water collector were lowered, was less than 3 seconds in each of many repeated operations. The time required for performing one cycle of operation was about 30 seconds showing that the method of this invention manifests high productivity.

In a conventional method wherein rod shaped tools are used to remove the plug it takes about 5 to 7 seconds to remove the plug from the guide shoes. Where a combination of the rod shaped tools and a lever is used, it takes about 4 to 6 seconds, whereas when rod shaped tools operated by such a power actuator as a piston-cylinder assembly are used in combination with a lever it takes about 6 to 8 seconds. In contrast, according to this invention, the time required for removing the plug is less than 3 seconds as described above, and this time is substantially equal for a number of consecutive operations. Typically, the time required for raising the water collector 12 is about 0.5 seconds and the time required for the mandrel bar 23 to retract after completion of the piercing operation is about 3 to 5 seconds. Further, as it is possible to lower the nozzle 11 and water collector 12 in a time shorter than the time required for advancing the mandrel bar 23, application of this invention for standard piercing mills for exchanging the plug never prolongs the operating cycle. In this example, it was confirmed that the useful life of the plug was increased 35 percent. Moreover, in none of 1,300 tubes manufactured by using the same plug was any evidence of a scratch on the internal surface noted.

EXAMPLE 2 REELING MILL

In a reeling mill for polishing steel tubes having an inside diameter of 230 mm, use was made of a plug having a drum-like shape, a diameter of 230 mm and a weight of 76 Kg. This plug was mounted on one end of a mandrel bar and the plug left in the guide shoes after each reeling operation was removed and recovered by ejecting water through the nozzle under a pressure of 30 Kg/cm².

It was possible to readily remove the plug by ejecting the high pressure water only for 1.6 seconds which should be compared with a time of from 5 to 9 seconds required for the prior art methods utilizing rod shaped tools and lever, or rod shaped tools actuated by piston-cylinder assemblies and lever. Similarly to Example 1, it was possible to increase the operating life of the plug, and decrease the percentage of rejects caused by internal scratches of the products.

While the invention has been shown and described in terms of some preferred embodiments thereof, it will be clear that the invention is not limited to these specific embodiments and that many changes and modifications will be obvious to one skilled in the art without departing from the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In a rolling mill of the type using a plug for piercing, reeling or cross-rolling a workpiece, a method of removing the plug left in the mill after completion of the rolling operation comprising the steps of advancing a nozzle for ejecting water under high pressure and a water collector into alignment with the pass line of the mill, ejecting the water against said plug for removing the same from the mill by the force applied to the plug by the ejected water and by the lubricating action of the water, and collecting the ejected water by said water collector so as to prevent splashing of the water.

2. The method according to claim 1 wherein the water is ejected through said nozzle under a pressure of 30 to 60 Kg/cm² for removing the plug from the rolling mill in less than 3 seconds.

3. The method according to claim 1 wherein said nozzle is advanced into alignment with the pass line immediately after the trailing end of the workpiece has passed by said nozzle, said water collector is advanced into alignment with the pass line immediately after the trailing end of the workpiece has passed by said water collector, and thereafter the water is ejected through the nozzle under high pressure, whereby while a mandrel bar is advanced and retracted, said nozzle and selectively said water collector are advanced and retracted.

4. In a rolling mill of the type wherein a plug mounted on one end of a reciprocating mandrel bar is used for piercing, reeling or cross-rolling a workpiece, and said plug is left between a pair of guide shoes in said rolling mill after completion of the rolling operation, the improvement which comprises a nozzle mounted on the inlet side of said mill for ejecting water under high pressure, a water collector mounted on the output side of said mill for receiving the ejected water, operating means for advancing said nozzle and said water collector into alignment with the pass line of said rolling mill and for retracting said nozzle and said water collector from said pass line, plug recovering means mounted on the output side of said mill, and means for ejecting water under high pressure through said nozzle against said plug remaining between said guide shoes forcing the plug toward said plug recovering means.

5. The rolling mill according to claim 4 which further comprises a cylindrical water cannon between said nozzle and said guide shoes for guiding said workpiece and a trough between said guide shoes and said plug recovering means for guiding the plug.

6. The rolling mill according to claim 4 wherein said operating means includes for advancing said nozzle into alignment with said pass line immediately after the trailing end of the workpiece has passed by said nozzle, and means for advancing said water collector into alignment with the pass line immediately after trailing end of the workpiece has passed by said water collector.

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