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Nagai et al.

[11] **3,733,871**

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[54] **METHOD OF EJECTING PLUG FOR ROLLING MILL AND AN APPARATUS THEREFOR**

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[52] **U.S. Cl.** **72/209**, 72/201

[51] **Int. Cl.** **B21b 17/10**

[58] **Field of Search** 72/209, 250, 97

[56] **References Cited**

UNITED STATES PATENTS

1,931,571	10/1933	Burns	72/209 X
1,537,206	5/1925	Wikstrom	72/209 X
3,394,568	7/1968	Calmes	72/209 X
2,771,800	11/1956	Kritscher	72/209 X
2,237,983	4/1941	Findletter	72/209 X

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[57] **ABSTRACT**

The invention is to pneumatically eject a plug on the end of mandrel after completing steel rolling, thereby to improve the plug treating operation.

18 Claims, 8 Drawing Figures

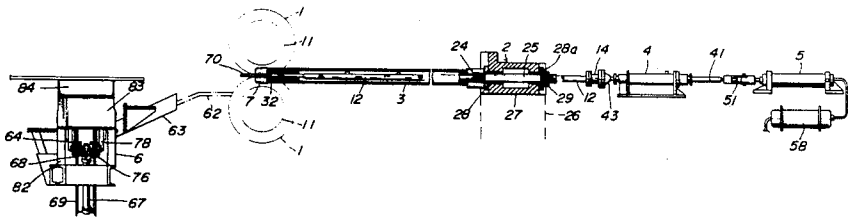


FIG. 1

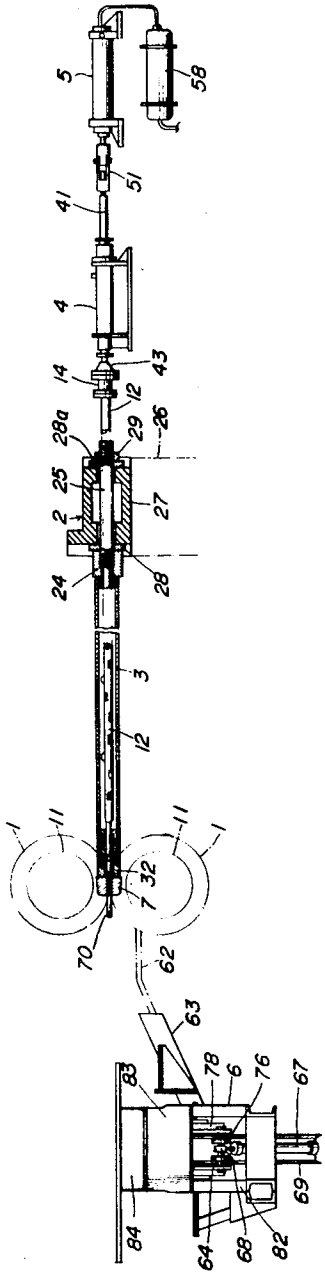
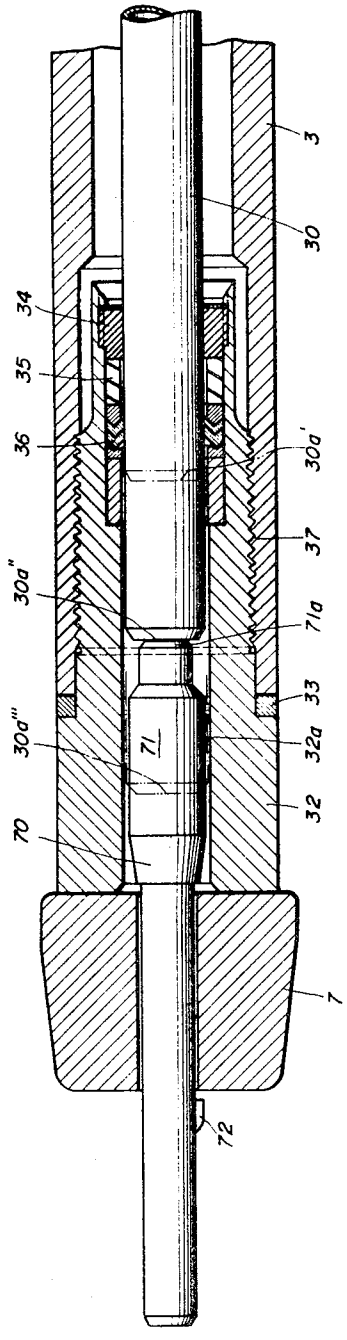


FIG. 2



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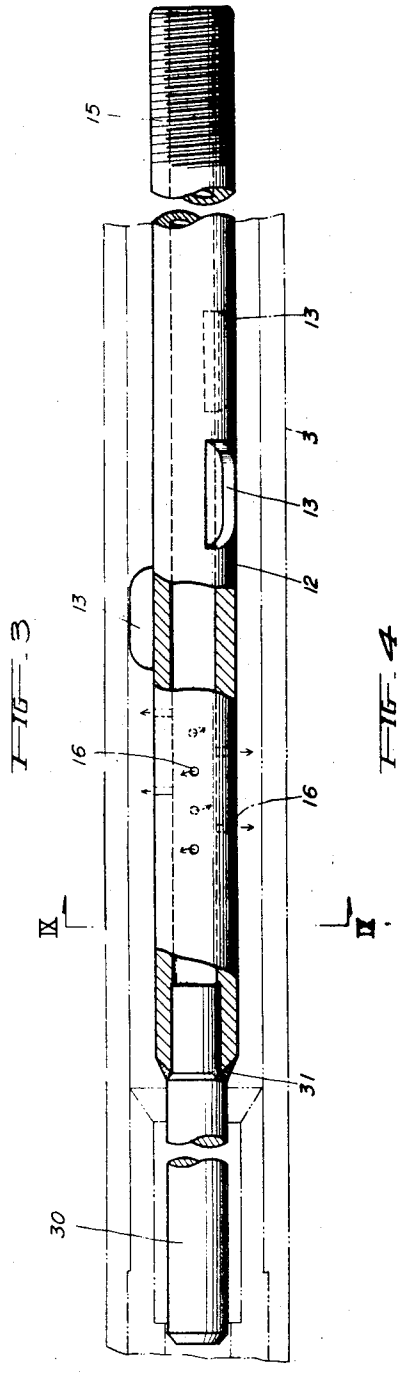

FIG. 3

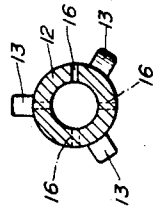

FIG. 4

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FIG. 5

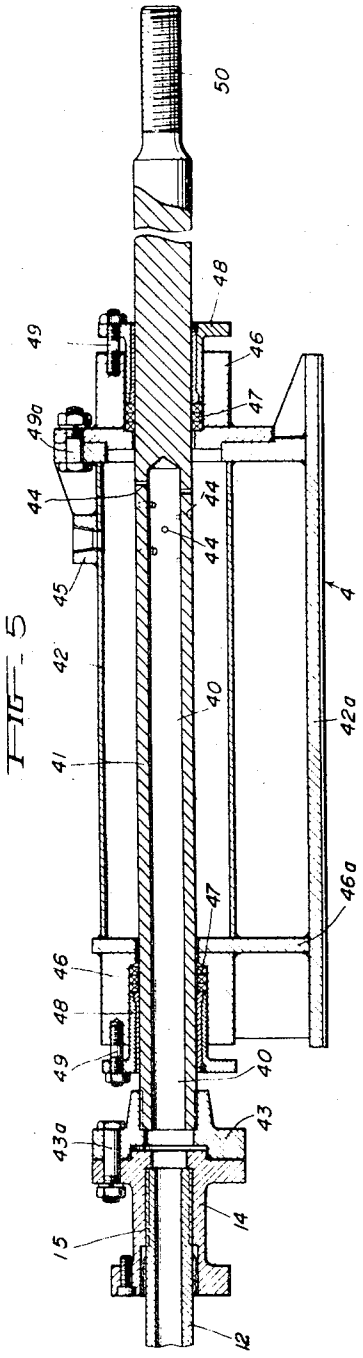

FIG. 6

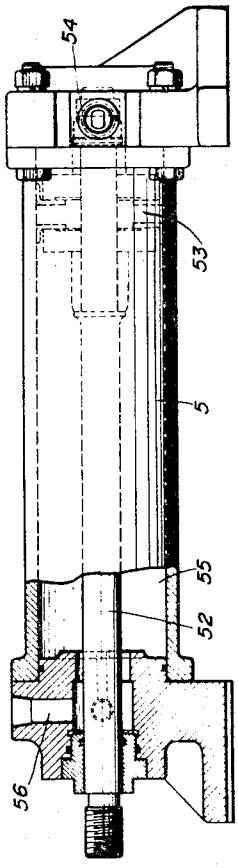

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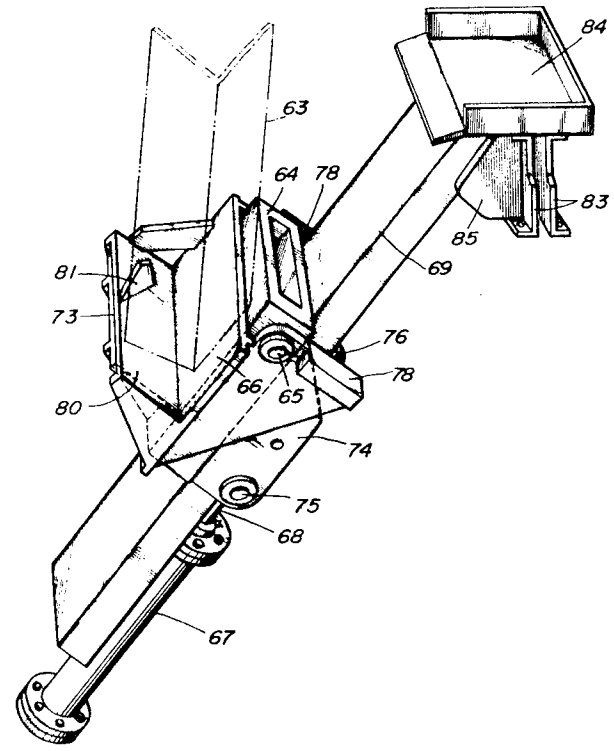
FIG. 7



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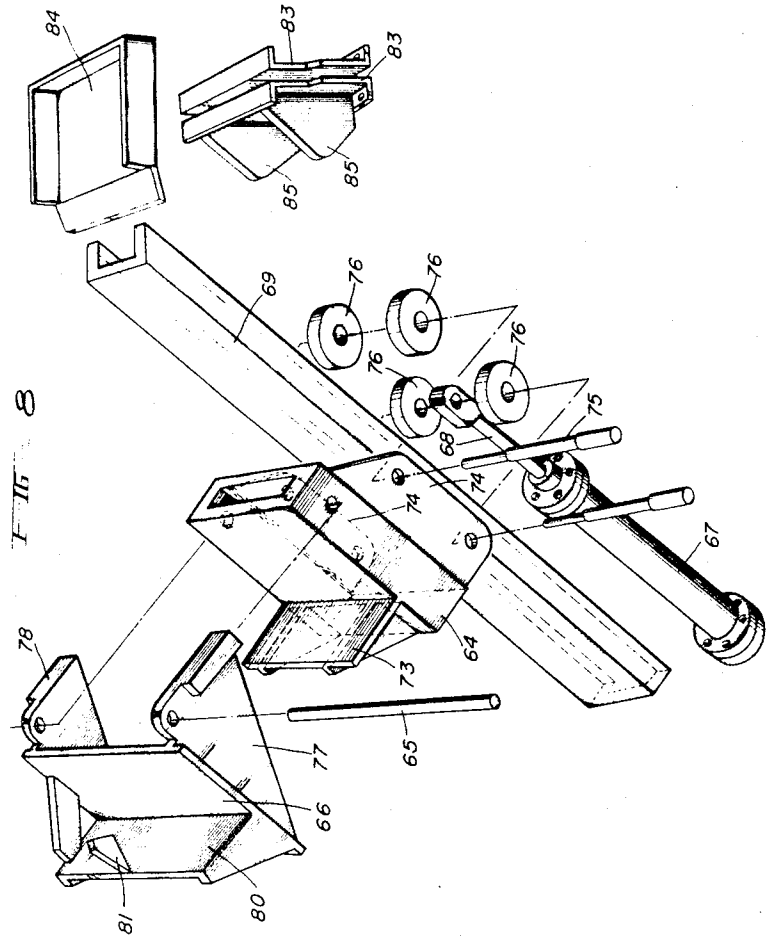

FIG 8

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METHOD OF EJECTING PLUG FOR ROLLING MILL AND AN APPARATUS THEREFOR

BACKGROUND OF INVENTION

This invention relates to a method of ejecting plugs formed in a steel pipe rolling mill and an apparatus therefor. The invention improves the plug ejecting operation.

In an ordinary type steel pipe rolling mill, a mandrel bar equipped with plug at one of its ends is located within a steel pipes, and the plug is held between rolling rolls. In such a rolling mill, however, the plug must be placed on or removed from the mandrel bar one at a time. The placing and removing operations are generally done by human operator. After finishing rolling, a plug which is set on the end point of mandrel bar is removed to be subsequently exchanged with another. Since this plug is highly heated during the rolling operation, it cannot be directly handled by hand. Hence a special clipping tool is used. Usually the plug's weight is substantially, some being 50Kg or more. Also, disadvantageously the plug's shape is circular cylindrical. Thus, even though it is held by a special clipping tool, a high degree of operating skill is required for this type of operation.

In this connection, it has been found that the operation is subject to errors. With the advance of rolling technology, it has become necessary to make this operation more efficient. The frequency of the setting and removing of the plug has increased and the completion of this operation in a short period has become more necessary, thus placing a greater burden upon the skilled operator. Although in practice, the operator is relieved for periods of 20 to 30 minutes at a time, it has been found that he is subject to heavy fatigue which causes mistakes and other accidents in the rolling operation.

SUMMARY OF INVENTION

The object of this invention is to remove such disadvantages and defects of the prior art and to improve plug treating by simplifying and improving the accuracy thereof.

In accordance with this invention, during the course of this rolling operation, air pressure is applied to a plug pin during the constrain condition of rolling rolls and at the termination of the rolling operation. The plug is suddenly ejected due to air pressure. The ejected plug is suitably recovered to prepare for subsequent work thereon. The invention automatically conducts these operations and thus greatly reduces the labor required therefor, and improves the speed, efficiency and productivity thereof.

In accordance with the invention which employs advantageous air pressure, at the time of rolling which takes place outside of the plug, the air pressure acts thereupon through a steel pipe, thereby to hold the plug at a suitable position. Even when the plug remains in steel pipe to be rolled, it is held at the end of a mandrel bar due to a pressing force used to smooth the rolling work. After rolling is completed, the plug which is now held between the rolls is given a sudden large pushing force of air pressure, and consequently the plug is suitably ejected. It is, therefore, unnecessary for the operator to extract the plug from the mandrel end one at a time as in the prior art. It is possible to extract the plug automatically, exactly and efficiently, and to

relieve the operator of heavy labor, and also reduce possibilities of errors and accidents.

Another object of the invention is to properly recover the extracted plug as mentioned above, and carry it up to a high position corresponding to the specified inserting position in preparation for the following operation. In the ordinary process, the plug ejected from the mandrel, is moved to a position below the working position (1m at least, and normally around 1.5 to 2m below). Furthermore, the plug is fairly heavy and retains a considerably high temperature. For in the prior art method, lifting the plug to the required position in preparation for the next step, stooping heavy labor is required of the operator, because he would normally use clipping tools in the same way as he would for the plug extraction. Accordingly the advantages of the automatic plug ejecting operation would be considerably diminished.

In accordance with the invention, the plug is automatically recovered to the original position in preparation for the following operation. The recovered plug is effectively cooled until it is set on the mandrel at the next rolling step. As the plug can be easily set to the mandrel, the entire mandrel handling operation is simple and rapid. Thus the disadvantage of the prior art is removed.

BRIEF DESCRIPTION OF DRAWING

The foregoing and other features, objects, and advantages of the invention will be apparent with reference to the following detailed description of the embodiment taken together with the drawing, in which:

FIG. **1** is a side view, partially in section, depicting an embodiment of the apparatus of the invention;

FIG. **2** is a sectional view depicting a plug disposed at the end of a mandrel bar;

FIG. **3** is a side view, partially in section, depicting a joint of a cooling pipe and rod cap;

FIG. **4** is a sectional view, taken along the IV — IV of the embodiment of FIG. **3**;

FIG. **5** is a sectional view depicting a feed-water mechanism;

FIG. **6** is a side view, partially in section, depicting an air cylinder portion;

FIG. **7** is a perspective view depicting a plug recovery mechanism; and

FIG. **8** is a disassembled perspective view of the embodiment of FIG. **7**.

DETAILED DESCRIPTION OF INVENTION

There is shown in FIG. **1** an apparatus comprising a pair of rolling rolls **1, 1**; back-stop mechanism **2** located in back of the rolls **1, 1**; mandrel bar **3** located between the rolls **1, 1** and the back-stop mechanism **2**; water-feed mechanism **4** positioned behind the back-stop mechanism **2**; air-cylinder mechanism **5** placed further behind; and plug recovery mechanism **6** located in front of the rolling rolls **1, 1.**

The rolling rolls **1 1** are each provided with plural roll kalibers **11** which slant at an angle from the peripheries of the rolls.

The back-stop mechanism **2** comprises main body **27** fixed on a suitable supporting base **26** of concrete or the like; a back stop plate **28**; a rear plate **28***a* between which is a support cylinder **25** into which a cooling pipe **12** may be thrust. In front of back stop plate **28**, support cylinder **25** is fixed or attached to main body **27**

with a bar sleeve 24 screwed to the front end of the support 25. The support cylinder 25 is also fixed or attached by a nut 29 screwed to the back of rear plate 28*a*. The base end of the mandrel bar 3 is fixed or attached, such as by welding, fasteners, etc., to the front end of bar sleeve 24. The back-stop mechanism 2 is used for holding the mandrel bar 3, as depicted.

The mandrel bar's intermediate portion is not shown in FIG. 1. Its length is sufficiently long to cover the length of steel pipe produced through the rolling process and it is generally more than 15m, sometimes over 20m. The cooling pipe 12 is positioned inside the mandrel bar 3.

FIGS. 3 and 4 depict the relation between this cooling pipe 12 and the mandrel bar 3. At or near the middle or at a more forward part of the cooling pipe 12, guide blades 13 are arranged in different axial positions but in the same angular relation radially to the axial direction of the pipe 12 as depicted. Even when the cooling pipe 12 is longer than 15m, it is so moved as to be located within the mandrel and parallel to the center line of the mandrel bar 3. The base end of the cooling pipe 12 extends to the rear of back-stop mechanism 2, and joins water-feed mechanism 4 through a joint member 14 as shown in FIG. 1. In order to couple this joint member 14 a screw or threads 15 are formed on the base end of cooling pipe 12.

As depicted in FIG. 5, pipe 12 is screwed into joint member 14 by means of screw 15; the joint member 14 is connected to another joint member 43, which is depicted at the end of shaft cylinder 41 of water-feed mechanism 4 opposite joint member 14. Joint members 14 and 43 are coupled together with a tightening device 43*a*.

Returning again to FIG. 3, rod cap 30 is depicted at the front end of cooling pipe 12. The base end of rod cap 30 is inserted into the inner hole of cooling pipe 12 and attached thereto by welded portion 31; the front end of cooling pipe 12 is, thus, closed by the rod cap 30. Small holes 16 are bored in cooling pipe 12 near the rod cap portion. As described hereinafter, cooling water which is supplied from water-feed mechanism 4, is jetted into the mandrel bar 3. The rod cap 30 can be also incorporated into the mandrel bar 3.

FIG. 2 depicts one embodiment of the front end of mandrel bar 3 and plug 30. At the front end of mandrel bar 3, a bar cap 32 is fastened with a screw joint 37 with a packing material 33 therebetween. Between the base end of the bar cap 32 and the peripheral surface of the rod cap 30 there are located a sleeve 34, a cylindrical synthetic resin packing 36, and spring material 35, to provide a sealing mechanism for substantially perfect water tightness to the section between the bar cap 32 and the mandrel bar 3 or rod cap 30. A shaft lever 70 of a plug 7 is set into the inner hole 32*a* of the bar cap 32. The base end of this shaft lever 70 forms a bulging or larger diameter part 71 which makes a section substantially suitable to be positioned into the above inner hole 32*a*. In this mechanism, the plug 7 is held to the narrowed front end side by means of projection 72. Tail end 71*a* of the shaft lever 70 is located against the end 30*a* of the rod cap 30.

Turning to FIG. 5, there is depicted details of which comprises shaft cylinder 41 positioned n substantially the center of cylinder 42 held by mechanism base 42*a*. This shaft cylinder 41 is charged with packings 47 for end members 46 at the front and rear ends of cylinder 42, and is set with packing holder 48 and stopper 49. It is so set as to be movable in the axial direction. The inner hole 40 is formed from its top side with small holes 44 passing through said cylinder 42 at the base end thereof. The cylinder 42 has a water injection port 45 so that cooling water may be jetted in at specific pressures. Cooling water applied into cylinder 42 goes into the inner hole 40 through the small holes 44, and is fed into cooling pipe 12 (of FIG. 1). The cooling water, which reaches the front end of cooling pipe 12 is jetted into the mandrel bar 3 through small holes 16 as shown in FIG. 3 during the rolling stop, the mandrel bar 3 is thus cooled from the inside. Water cooling the inside of mandrel bar 3, flows backwards to the base end side of the mandrel bar 3, and is discharged from the base end of support cylinder 25 in the back stop mechanism 2 (of FIG. 1.). In spite of the high temperature during the rolling stop, the cooling water flowing from water-feed mechanism 4 always cools the mandrel bar 3, cooling pipe 12 and the plug 7 to prevent them from being deformed and damaged.

Returning again to FIG. 5, engaging part 50 formed on the base end of shaft cylinder 41 is coupled with sliding rod 52 (See FIG. 6) of an air cylinder 5 which is a reciprocating cylinder, through the joint 51 of FIG. 1.

Turning to FIG. 6, sliding rod 52 of air cylinder 5 is equipped with the piston 53 and sliding rod 52 is slid by compressed air from the inlet 54. In the ordinary air cylinder, when piston 53 goes forward, the air in cylinder chamber 55 is released into the atmosphere through a hole 56 located at its front end, to remove the air pressure of the back part of the piston 53. When the pressing force acts upon the plug the piston 53 suitably moves back. When piston 53 moves back, cylinder chamber 55 is charged with the air through said hole 56. In the invention, however, air cylinder 5 is not directly connected to a compressed air supply source. Instead, as shown in FIG. 1 an accumulator 58 is located adjacent or close to air cylinder 5, and is interconnected between the cylinder and a compressed air supply source. By suitably connecting and arranging the accumulator 58 the air pressure in this accumulator 58 also may act at the termination of the rolling operation, to produce rapid and exact piston action of air cylinder 5 by virtue of compressed air from the compressed air supply source positioned at a location considerably away from the cylinder.

The details of the plug recovery mechanism 6 before the rolling rolls 1, 1 is shown in FIGS. 1, 7 and 8. As depicted in FIG. 1 in front of rolling rolls 1, 1, a chute 63 is positioned through a plug receiving conduit 62. Turning then to FIG. 7, below this chute 63 there is placed a plug receiver 66 connected by an axle 65 to slide base 64. Piston rod 68 of the cylinder 67 is coupled with said slide base 64. By means of this cylinder 67 slide base 64 and plug receiver 66 may be moved along guide member 69 so that the plug may travel on a plug receiving base 84 located on substantially the same level as that of the above mandrel bar 3.

As shown in FIGS. 7 and 8, a guide member 69 is provided at a suitable position and a plug receiver 84 is fastened at its top. A support seat 83 of this plug receiver 84 is supported by such a support frame 82 as shown in FIG. 1. Inside the holding seat 83 a contact 85 is protruded on both sides of guide member 69 as shown in FIGS. 7 and 8. Guide member 69 has placed thereon

a box-type slide base **64**. Hangers **74, 74** hanging down from both sides of the guide member **69** are equipped with spindle **75**, which have rollers **76, 76** as depicted. The rollers **76, 76** swivel respectively on ether side of the guide member **69**. Piston rod **68** of cylinder is connected to spindle **75** located in the rear side. On the rear upper surface of slide base **64** a push seat **73** is protruded in front of which, receiving end of hanger **77** is equipped with contacts **78**, which hang on both sides of plug receiver **66**, and is rotatably, by the pivot connection to upper part of slide base **64** with a pivot rod **65**. A receiving piece **81** is furnished on the receiving surface **80** to receive and stop plug **7** which may be received through the conduit **62** so that the shaft lever **70** would not be damaged. Advantageously, plug **7** is thus also correctly positioned on the plug receiver **66**.

OPERATION

The operation according to the invention is simple, rapid and efficient. Illustratively, a steel pipe may be sent to the outside of plug **7** positioned on the end of mandrel bar **3**, to be rolled between the rolling rolls **1, 1**. At the beginning of the steel pipe rolling, since compressed air is not yet supplied to air cylinder **5**, cooling pipe **12** and rod cap **30** return to their non-operated position due to the air pressure supplied from hole **56** of the cylinder **5**. Front end **30***a* of rod cap **30** takes a fully retreat position **30***a'* in FIG. **2**. Bulging part **71** of the shaft lever **70** of plug **7** is, as depicted in FIG. **2**, kept in the inner hole **32***a* of bar cap **32** to form a proper clearance between the end surface **71***a* and the end surface **30***a*. When the rolling work is started, and the compressed air is sent to the air cylinder **5**, the rod cap **30** is pushed forward to take the position of **30***a''* and brought into contact with the end surface **71***a*. In such a condition, the shaft lever **70** is held and the pipe, is rolled. During the rolling, cooling water is supplied into cooling pipe **12** from water-feed mechanism **4** at a pressure of from 1.5 to 2Kg/cm² (preferably from 1.6 to 1.8Kg/cm²) at a flow rate of from 20 to 35 1/min.

Cooling water, which reaches the top of cooling pipe **12** is jetted into mandrel bar **3** through small holes **16** and flows backward, and is discharged from the tail end of support cylinder **25** coupled with the base end of mandrel bar **3**. Thus the mandrel bar **3** is supplied with cooling water.

Immediately after the start of rolling, air cylinder **5** is supplied with the compressed air of from **4** to 8Kg/cm², (preferably around from 5.5 to 6Kg/cm²) to push forward rod cap **30**. When the rolling on a steel pipe, which may be as long as over 15m, is finished, the steel pipe located between the rolls **1, 1** and plug **7** is sent out. Constraining force, which has checked plug **7** between the rolling rolls **1, 1**, through the pipe, is released. Due to the pressure of compressed air, cooling pipe **12** and rod cap **30** instantly go forward to eject plug **7** into receiving conduit **62**. When air pressure is kept effective on air cylinder **15**, while steel pipe is being rolled, cooling pipe **12** and rod cap **30** are constantly subject to the forward projecting force. This force acts as a plug ejecting force at the moment when the steel pipe goes out. When the plug is ejected, compressed air is no longer supplied to air cylinder **5** and cooling pipe **12** is recovered. The ejecting force ejects normally plug **7** forward a suitable distance.

Therefore, the plug slides through the receiving conduit **62** and chute **63** to plug receiver **66**, where it is stopped by the receiving piece **81** at a suitable position. When it is thus received on the plug receiver **66**, air cylinder **67** begins operation to lift the slide base **64** along the guide member **69**. The plug receiver **66** on slide base **64** is lifted together with the plug. When it reaches substantially the upper end of guide member **69**, contact portion **78** formed below the hanging piece **77** of plug receiver **66**, is brought in to contact with the contact **85** which is depicted inside supporting seat **83**. This sets up the plug receiver **66** to be about 90° to the axis **65**. Consequently plug **7**, received on plug receiver **66**, is rotated into a plug receiving base **84**. The plug, which has moved to the plug receiving base **84** is suitably air-cooled or water-cooled in preparation for the next use. As shown in FIG. **1**, plug receiving base **84** is at almost the same level as the mandrel bar **3**, and can be easily set on to the end of mandrel bar **3** mechanically or manually.

According to the invention as described above, while the steel pipe is being rolled, air pressure, by means of air cylinder, is kept acting upon the plug by virtue of the cooling pipe in the center of sliding mandrel bar, whereby at the moment when the rolling is finished, the plug can be ejected out quickly and substantially immediately by the air pressure. Operation is easy, simple, reliable, safe and requires no special operation. The plug is always ejected out exactly and precisely and simply in a short period.

The foregoing is only intended to be illustrative of the principles of the invention; modifications and extension thereof embodying the principles of the invention would be evident to those skilled in the art and would be properly considered to be within the spirit and scope of the invention.

What is claimed is:

1. Method of ejecting a plug from a pipe rolling mill comprising the steps of placing said plug on one end of a mandrel, applying a force originated by pressurized gas through said mandrel and against said plug during rolling of said pipe whereby upon completion of said rolling said force causes rapid ejection of said plug from said mandrel.

2. Method of claim **1**, wherein said force is applied by means of a gas stored in an accumulator, said accumulator being connected to a cylinder, thereby to enable said piston to produce said force to thereby cause rapid and exact ejection of said plug at substantially the exact moment rolling is completed.

3. Method of claim **2**, wherein the gaseous pressure at said cylinder is from 4 to 8 Kg/cm².

4. Method of claim **3**, wherein said gaseous pressure at said cylinder is from 5.5 to 6 Kg/cm².

5. Method of claim **1**, further comprising the step of applying a cooling liquid into said mandrel during said rolling operation.

6. Method of claim **5**, wherein said force is developed by gaseous pressure of from 4 to 8 Kg/cm² at a drive means and said liquid is at a pressure of from 1.5 to 2 Kg/cm² at a water feeding means used to supply said liquid to said mandrel.

7. Apparatus for ejecting a plug from a pipe rolling mill, comprising a mandrel means, said plug being disposed at one end of said mandrel means with said pipe being attached to said plug, slidable means disposed within said mandrel, gas operated drive means positioned to be contact with said slidable means and

means contactable to said slidable means and movable against said pipe.

8. Apparatus of claim **7**, further comprising accumulator means connectable between said drive means and a supply of gas.

9. Apparatus of claim **7**, further comprising a liquid feeding means disposed between said drive means and said mandrel means and wherein said slidable means has holes therein through which liquid can travel and further comprising means connectable between said liquid feeding means and said slidable means for supplying said liquid to said mandrel through said holes of said slidable means thereby to cool said mandrel means.

10 Apparatus of claim **9**, wherein said liquid feeding means comprises a cylinder and a shaft disposed therein.

11. Apparatus of claim **7**, wherein said slidable means is disposed to have thereon guide means to position said slidable means substantially within the center of said mandrel means.

12. Apparatus of claim **11**, wherein said guide means are disposed in substantially the same radial direction to the center line of the said mandrel means, and spaced from each other in the axial direction of said mandrel means.

13. Apparatus of claim **7**, further comprising cap means disposed at one end of said slidable means to seal said slidable means, said cap means being positioned adjacent to said plug.

14. Apparatus of claim **7**, further comprising second cap means disposed at one end of said mandrel means and means for plugging the area between said mandrel means and said slidable means.

15. Apparatus to claim **7**, further comprising plug recovery means disposed to receive ejected plugs.

16. Apparatus of claim **15**, wherein said plug recovery means comprises guide means, movable carriage means movably positioned on said guide means, platform means located at the same horizontal level as said mandrel means, and drive means for moving said carriage means from a recovery position to said platform means position.

17. Apparatus of claim **16**, wherein said carriage means comprises a recovery station for receiving said ejected plug and rotatable means for moving said receiving station to a position such as to place said ejected plug on said platform means.

18. Method of claim **1**, wherein said force is applied by a piston rod and wherein cooling means is supplied to said piston rod.

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