

March 26, 1940.

R. P. PALMER

2,195,256

METHOD OF MAKING AND REPAIRING ROLLS FOR METAL ROLLING MILLS

Filed July 28, 1938

2 Sheets-Sheet 1

Fig. 1.

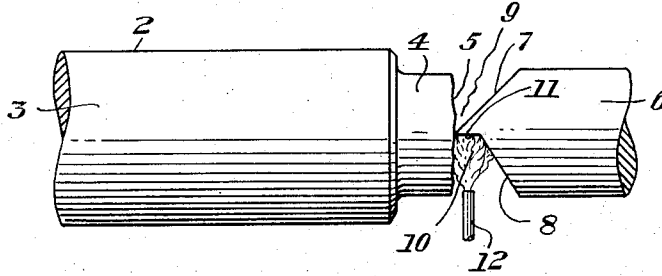


Fig. 2.

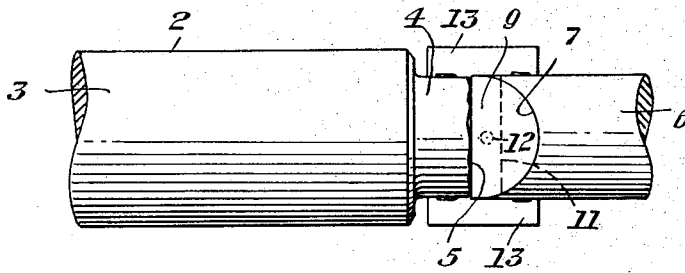


Fig. 3.

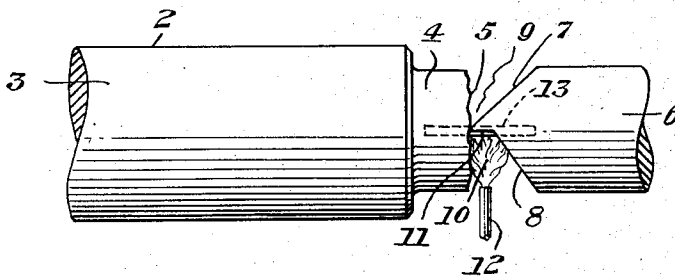
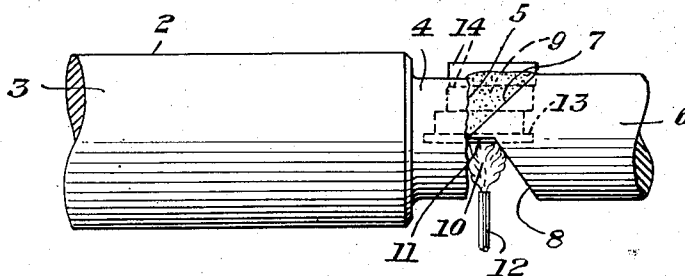


Fig. 4.



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2 Sheets-Sheet 2

Fig. 5.

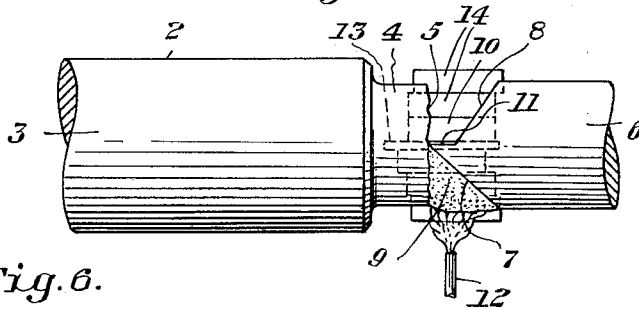


Fig. 6.

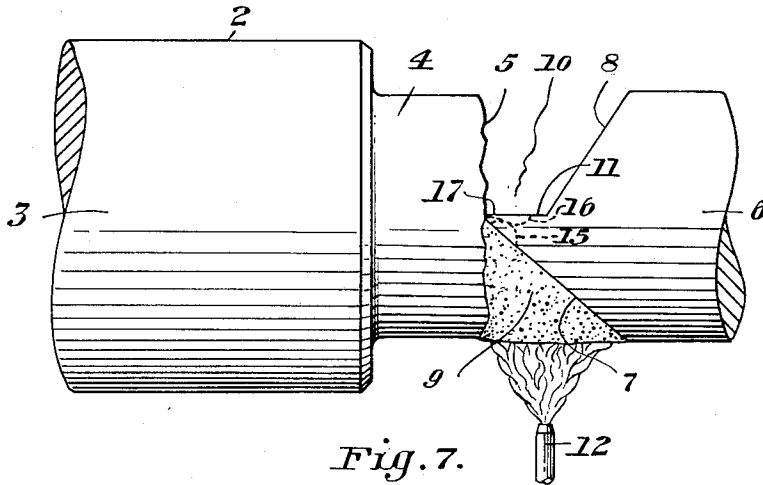


Fig. 7.

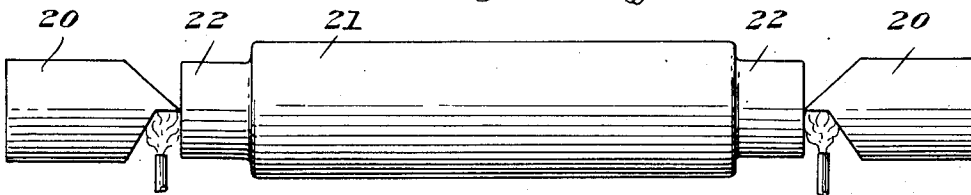
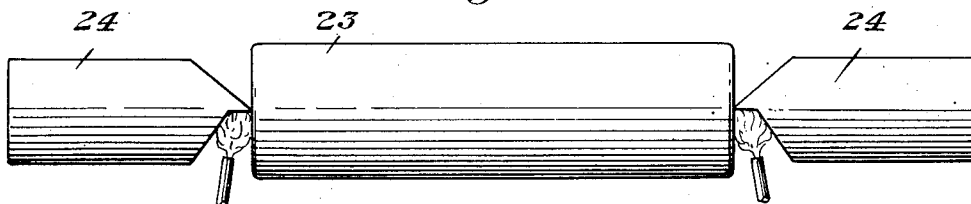


Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING AND REPAIRING
ROLLS FOR METAL ROLLING MILLS

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Application July 28, 1938, Serial No. 221,756

6 Claims. (Cl. 29—148.4)

This invention relates to a method of making or repairing rolls for metal rolling mills and the present application is a continuation-in-part of my application, Serial No. 180,529, filed December 18, 1937.

It is known that rolls for metal rolling mills are subjected to severe stresses and shocks during their use. For example, in rolling hot strip in a 4-high continuous mill, although every effort is made to prevent the strip from cobbling in the mill, nevertheless it does occur at times. When this happens, the result is frequently a broken roll neck.

Various attempts have been made in the past to produce rolls for metal rolling mills which would withstand the severe strains and shocks to which they are subjected but these have not been wholly successful. An inherent difficulty is that the roll body requires different characteristics from the roll neck. One of the principal desired characteristics of a roll body is that it should be hard, so as not to be excessively marred or worn in use. For this reason, the roll is generally made of chilled cast iron usually containing alloying elements which increase the hardness of the roll body. The roll necks, on the other hand, are used for transmitting the driving force and, therefore, should be tough in order to withstand the stresses. Furthermore, it is necessary to form keyways on the necks for cooperation with the driving connections for the rolls. Where the whole roll—that is, the body and necks—are all cast as a single casting and of a composition hard enough so that the roll body will not become easily marred in use, the roll necks are so hard that the keyways for driving connections have to be ground rather than machined. It is estimated that the cost of grinding the keyways when contrasted with machining them is approximately two hundred dollars (\$200.00) or more per roll. The greatest disadvantage, however, of making the roll body and neck of a hard composition is that the necks are not tough enough to withstand the shocks during use and oftentimes break off.

In accordance with the present invention, I make new rolls or repair broken rolls, the necks of which have been broken in service, by assembling in end to end relation a hard unmachinable roll body and a tough machinable stub adapted to form at least a portion of the roll neck and weld the assembled parts together in the manner hereinafter more particularly described. In the repair of broken rolls, the repaired roll is

superior to the original roll, because the repaired roll has necks which are of tough material adapted to withstand the driving force without breaking. The savings effected by repairing broken roll necks in accordance with my invention are very great. A cast iron roll having a body 60" long and 21" in diameter and necks each 36" long weighs in the neighborhood of 3½ tons and costs approximately \$1200 to \$1500. The savings effected by reclaiming the roll by welding on a new neck portion, in accordance with my invention, are approximately one-half the original cost of the roll, although this naturally will vary according to how long the roll has been in use when the break occurred. Furthermore, the rolls are used in pairs and when one roll of a pair breaks, it is necessary to replace it with a new roll, which may not be of the same diameter as its mate; and it is, therefore, necessary to grind the mate to the diameter of the new roll. The ability to repair broken roll necks eliminates a large part of the number of spare rolls which it is necessary to keep on hand, since the repair may be made and the roll returned to use in a few days' time, as contrasted with a period of months sometimes necessary in obtaining a new roll.

In the accompanying drawings, which illustrate in a somewhat diagrammatic manner several embodiments of my invention,

Fig. 1 is a front elevation of an assembly of a portion of a roll element including a roll body and a portion of a roll neck, and a stub adapted to form a roll neck when welded to the broken roll element.

Fig. 2 is a plan view of the assembly shown in Fig. 1.

Figs. 3, 4 and 5 illustrate in front elevation progressive stages of the welding of the stub to the element including the roll body.

Fig. 6 is a view similar to Fig. 5 but on an enlarged scale, the means for restraining molten welding material from running out of the notches being omitted for clearness of illustration.

Fig. 7 is a front elevation of an assembly of a roll body and two stubs each adapted to form a portion of a neck of the roll, this figure illustrating the invention as applied to the production of a new roll instead of the repair of a broken roll; and

Fig. 8 is a front elevation of an assembly of a roll body and two stub portions, each adapted to form a roll neck, the stub portions adapted to be welded directly to the roll body in the production of a new roll.

Referring more particularly to the accompanying drawings, there is shown in Figs. 1 and 2 an assembly of elements which are to be welded together. The element 2 includes a roll body 3 and a portion 4 of a roll neck, the roll neck having been broken off in use along the line 5. The element 2 is of chilled cast iron and is, therefore, very hard and unmachinable. One such composition which is representative of the chilled cast iron element 2 is as follows:

Carbon	2.60
Manganese	.55
Silicon	1.05
Sulphur	.08
Chromium	1.22
Nickel	4.68
Molybdenum	.120

The element 2 is assembled in end to end relation with a stub 6 which also is of cast iron but is unchilled and is of a composition such that it may be readily machined to form the keyways (not shown) for the driving connections. The stub is of slightly larger diameter than the diameter of the neck portion 4, in order that after the parts have been welded together the neck may be machined to the proper size—that is, to the same size as the diameter of the neck portion 4. A typical example of the composition of the stub 6 is as follows:

Carbon	2.90
Manganese	1.25
Silicon	1.25
Sulphur	.05
Phosphorus	.15

It will be noted that in the compositions given the element 2 is a cast iron containing chromium, nickel and molybdenum, which impart the desired hardness and other properties required for a roll body. The stub 6 is also of cast iron but of a different composition from the element 2. Its manganese content is considerably higher than that of the element 2, in order to provide toughness, and the alloying elements chromium, nickel and molybdenum are omitted. It will be understood that these compositions are given by way of example only and that the invention contemplates utilizing for the element 2 any composition which is relatively hard and relatively unmachinable as contrasted with the stub, and for the stub any relatively tough and machinable material. The stub might, for example, be made of steel.

The end of the stub 6 which is to be welded to the element 2 is beveled, the beveled surfaces 7 and 8 forming with the end 5 of the element 2 an upper notch 9 and a lower notch 10. It will be noted that the beveled surface 8 which forms the lower notch is offset with respect to the beveled surface 7, in order to provide a bottom notch 10 which is wider than the upper notch 9. The surface 8 at its upper end joins a ledge or shelf 11, which extends in a substantially horizontal direction, when the parts are in their assembled position. The provision of the ledge 11 also serves another important function in the welding operation, as well be described more in detail later.

In preparing the parts for welding after they have been assembled in end to end relationship, as shown in Fig. 1, the adjoining ends of the parts are brought up to a visible red heat, say in the neighborhood of 1,000° F. This may be done by enclosing the parts in a sheet metal enclosure which forms in effect a heating furnace and inserting a burner 12 into the enclosure. After the

parts have been preheated to raise them to a temperature suitable for welding, a bar 13 (Fig. 2) is "tacked" to the stub 6 and element 2 at the front and rear of the assembly, which bars are used during the welding operation for supporting bricks placed along each side of the notches 9 and 10, in order to restrain the molten welding material from running out of the notches.

Fig. 3 illustrates the beginning of the welding operation and shows the support 13 spot welded to the stub 6 and element 2. Flux and pieces of cast iron welding rod are placed in the notch 9 and the pieces are fused by oxy-acetylene torches. In carrying out the operation, 2 or 3 welders, preferably, work together and the blow torches are played on the welding material and the adjacent edges of the element 2 and stub 6, so as to melt the pieces of weld rod and form a pool of molten welding metal in the notch. This pool is of a depth of about ½ to 1" and is maintained during the progressive filling of the notches. From time to time, as additional pieces of weld rod and flux are placed in the notch 9 and fused, additional bricks 14 are placed on top of each other on each side of the assembly to restrain the molten welding material from running out of the notch. During the operation of filling the upper notch 9 with welding material, the burner 12 is in operation, in order to prevent the deposited metal from cooling and thereby contracting and warping the element 2 and stub 6 out of alignment with each other. Fig. 4 illustrates the process at the stage where the top notch 9 has been completely filled with welding material.

Pieces of welding rod of the following composition may be used in welding the parts together, when the element 2 and stub 6 are of the compositions previously given:

Carbon	3.28
Manganese	.58
Silicon	2.83
Sulphur	.064
Phosphorus	.668

During the filling of the notch 9 with welding material, it is advisable to heat the element 2 only at and adjacent its end 5 and not to allow the heat to be transmitted to too great an extent throughout the body of the element, as otherwise this element being made of chilled cast iron is likely to crack. It is, therefore advantageous to have the end 5 of the element 2 substantially flat rather than being beveled, as is the case with the stub 6. Also too great heat application on the element 2 might reduce its hardness which was imparted to it by chilling.

After the top notch 9 has been filled with welding material, the element 2 and stub 6 are rolled over until the lower notch 10 is in the upper position, as illustrated in Fig. 5. Welding material and flux are then added progressively to the notch 10 and the welding material fused so as to progressively fill up the notch and during this time the molten welding material is prevented from running out of the sides of the notch by adding bricks on the supports 13. Also during the filling of the notch 10, the burner 12 is used to heat the weld material which has already been deposited in the notch 9.

Fig. 6, which is on a larger scale than Fig. 5, illustrates the advantages of providing the ledge 11 on the stub. As shown in this figure, the notch 9 has been filled with welding material, the elements rotated 180 degrees from starting

position and the notch 10 is about to be filled. As has been pointed out previously, the ledge 11 provides a notch 10, which is wider than the notch 9, and, therefore, gives more room for playing the oxy-acetylene blow torch flame into the notch. The blow torch has a tendency to backfire and blow itself out, if it becomes too hot at the tip end. The wider notch prevents or decreases the tendency of the tip end to get so hot as to backfire. The provision of a ledge also has another distinct advantage. In building up the weld in the notch 9, when that notch was in the uppermost position, the operator plays the blow torch on the beveled surface 7 at a point close to where that surface contacts with the end 5 of the element 2. This is for the purpose of washing away a certain amount of metal of the stub and in carrying out this operation the metal is washed away as indicated by the dotted line 15 in Fig. 6. It will be understood that this washing away as indicated by the line 15 is actually done when the notch 9 is in the uppermost position. After the notch 9 has been filled with welding material and the parts are in the position shown in Fig. 6, the operator then washes away a portion of the ledge 11 along the dotted line 16, so that the welding material deposited in the notches 9 and 10 actually contact with each other and the beveled edge 17 of the stub is actually fused, so as to allow the welding material in each notch to contact with the other.

After the weld is finished, the portion adjacent the weld is heated to approximately 1100° F., held at this temperature for about four hours to remove strains and then cooled slowly. The welded roll is then machined and ground to the desired finish.

Although it is preferred to provide the ledge 11 on the stub by machining or other operation before assembling the parts to be welded, the ledge may be formed after the notch 9 is filled or partly filled with welding material. In this case, the parts instead of being rotated a half turn from the position shown in Fig. 4, in order to bring the notch 10 into upper position as shown in Fig. 5, are rotated only a quarter turn. This brings the beveled edge 17 of the stub into vertical position, in which position the beveled surface may be washed with the blow torch to form the ledge. The parts are then rotated a quarter turn further to the position shown in Fig. 5 and the method carried out as previously described.

Fig. 7 illustrates the invention as applied to the production of a new roll rather than to the repair of a broken roll neck. In this case, a stub 20 is welded to each end of the roll body 21. The body is preferably cast, so that it has neck portions 22 to which the stubs 20 are welded in the manner previously described.

Fig. 8 illustrates a modified embodiment of the invention as applied to the production of a new roll. In this embodiment, the roll body 23 is of the same diameter throughout its entire extent rather than having neck portions 22 cast integral with the body, as is the case in Fig. 7. The stubs 24 are welded directly to the body 23 in the manner previously described. In making new rolls, the embodiment illustrated in Fig. 7 is preferred, since the finishing of the roll after welding is somewhat simplified, due to the location of the weld.

By using neck portions of suitable composition, material economies may be effected in finishing

the composite new rolls, or in repairing old rolls. The necks of a unitary chilled roll must generally be finished by grinding alone, at great expense. The necks of rolls made or repaired by my method may be machined and finish-ground. There are also great economies in casting.

The present invention provides a method of making a roll in which the roll body and roll neck may be made of different compositions, so that each part is best adapted to perform its special function. Broken rolls which formerly had to be scrapped may be repaired for a small fraction of the cost of making a new roll.

I have illustrated and described in detail the preferred embodiment of my invention and have given certain modifications. It is to be understood, however, that the invention may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation with an element including the whole roll body, said element being relatively hard as compared with said stub, said stub being relatively tough as compared with said element, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, depositing welding material in the upper notch until it is substantially filled and while filling the upper notch applying heat to the lower notch, turning said element and stub to bring the lower notch into upper position, depositing welding material in the unfilled notch until it is substantially filled while applying heat to the under side of the assembly, and during filling of the notches maintaining a pool of welding material of substantial depth while restraining molten welding material from running out of the notches.

2. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation with an element including the whole roll body, said element being made of chilled cast iron, said stub being made of unchilled cast iron, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, depositing welding material in the upper notch until it is substantially filled and while filling the upper notch applying heat to the lower notch, turning said element and stub to bring the lower notch into upper position, depositing welding material in the unfilled notch until it is substantially filled while applying heat to the under side of the assembly, and during filling of the notches maintaining a pool of welding material of substantial depth while restraining molten welding material from running out of the notches.

3. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation

- with an element including the whole roll body, said element being relatively hard as compared with said stub, said stub being relatively tough as compared with said element, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, the bevel at the bottom being offset with respect to the bevel at the top to provide a wider bottom notch than the top notch, and depositing welding material in the notches to unite the assembled parts while restraining the welding material from running out of the notches.
4. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation with an element including the whole roll body, said element being relatively hard as compared with said stub, said stub being relatively tough as compared with said element, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, the bevel at the bottom being offset with respect to the bevel at the top to provide a wider bottom notch than the top notch, depositing welding material in the narrower top notch, turning the assembly to bring the wider notch into upper position, depositing welding material in the wider notch, and during filling of the notches maintaining a pool of welding material of substantial depth while restraining molten welded material from running out of the notches.
5. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation with an

element including the whole roll body, said element being of chilled cast iron, said stub being made of unchilled cast iron, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, the bevel at the bottom being offset with respect to the bevel at the top to provide a wider bottom notch than the top notch, depositing welding material in the narrower top notch, turning the assembly to bring the wider notch into upper position depositing welding material in the wider notch, and during filling of the notches maintaining a pool of welding material of substantial depth while restraining molten welded material from running out of the notches.

6. The method of making or repairing rolls for metal rolling mills, which comprises providing a beveled edge on a stub adapted to form at least a portion of a roll neck, said beveled edge extending substantially across its diameter, assembling the stub in end to end abutting relation with an element including the whole roll body, said element being relatively hard as compared with said stub, said stub being relatively tough as compared with said element, the beveled edge of the stub when assembled with said element extending generally in a horizontal plane, the stub and element forming a notch open at the top and a notch open at the bottom of the assembly, placing pieces of weld rod and flux in the upper notch and melting them until it is substantially filled and while filling the upper notch applying heat to the lower notch, turning said element and stub to bring the lower notch into upper position, placing pieces of weld rod and flux in the unfilled notch and melting them until it is substantially filled while applying heat to the under side of the assembly, and during filling of the notches maintaining a pool of welding material of substantial depth while restraining molten welding material from running out of the notches.

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CERTIFICATE OF CORRECTION.

Patent No. 2,195,256.

March 26, 1940.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 40, for "maching" read machining; line 41, strike out the word "or"; page 2, first column, line 67, for "well" read will; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of April, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.