

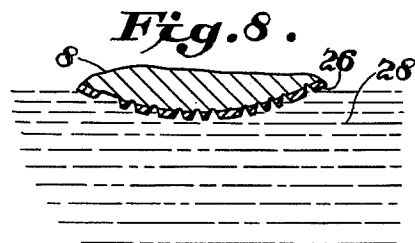
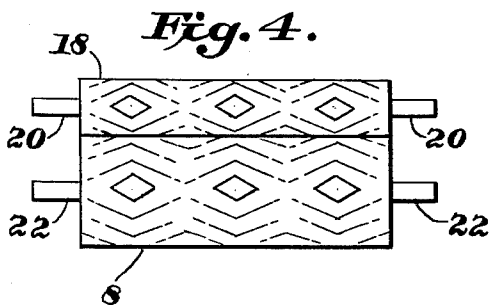
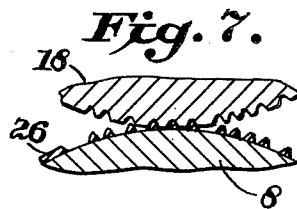
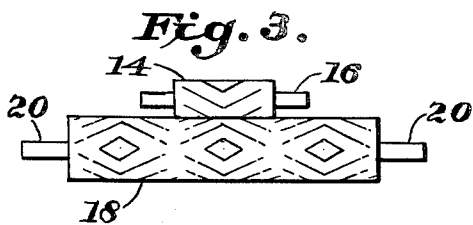
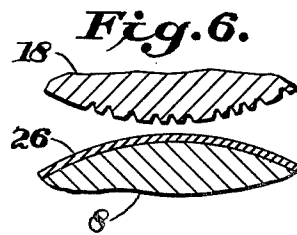
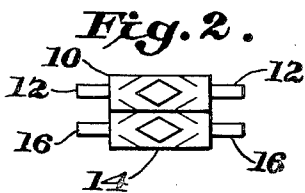
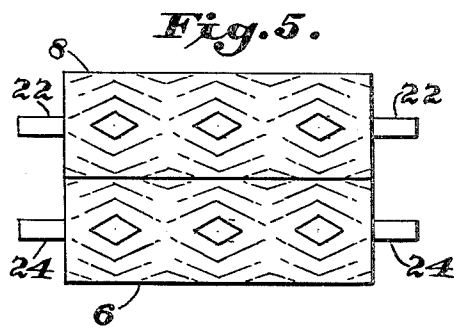
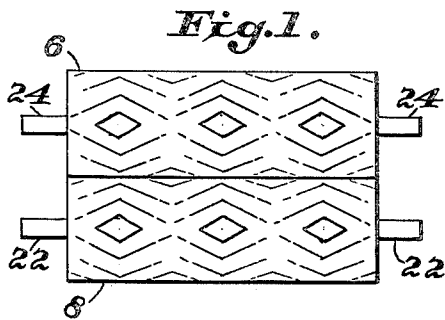
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3,048,512

METHOD OF MAKING MATCHED EMBOSSING ROLLS

Filed June 27, 1957



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3,048,512

METHOD OF MAKING MATCHED EMBOSSING ROLLS

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1 Claim. (Cl. 156—14)

This invention relates to matched embossing rolls of the type particularly adapted to emboss sheet metal. More specifically, it relates to a method of producing such matched embossing rolls.

In a conventional and well-known process for producing mated or matched metallic embossing rolls, such as steel rolls, the desired pattern is first formed on a small cylindrical die and transferred to a mill of similar size and shape by conventional procedures, such as engraving or etching. This small mill, which now has the pattern thereon, is then hardened and rolled under great pressure in contact with a first large roll of soft metal, thereby engraving the latter roll. This engraved roll is then hardened and its pattern or design transferred to a second roll by rolling the first roll in contact with an acid resist coating on the second roll. Portions of the coating on the second roll are removed by this procedure, after which the second roll is etched to remove the metal in the exposed areas thereby producing a pair of embossing rolls of mated or matched design. Such a process is disclosed in Patent No. 2,662,002.

A serious disadvantage of mated rolls produced by this process is that in some cases they do not satisfactorily withstand shocks and other forces, such as those produced thereon when metallic strips or sheets of uneven or irregular thickness are passed therebetween to be embossed. This disadvantage is due to the lack of sufficient depth of hardness in the embossing rolls. The solution to this problem would seem to be merely to harden the rolls to a greater depth. However, as indicated above, the first roll must be initially in a soft condition to permit engraving thereof by the small mill; so that the first opportunity presented to harden this first roll is after the pattern or design has been engraved thereon. At this time, any heat treating process for hardening purposes must be carefully controlled to prevent warpage or distortion of the pattern. And, even though such control is exercised, undesirable warpage and distortion may still result during the thermal expansion and contraction incident to heat treatment, particularly when it is attempted to harden the rolls to considerable depths. Consequently, the only hardening treatment found to be practical, economical and satisfactory in this process is flame hardening whereby the roll becomes hard only in the regions of its outer surface of "skin." As a result, the first roll of the matched pair suffers from the disadvantage noted above.

It is, therefore, an important object of the invention to provide an improved process or method of making hardened matched embossing rolls, of the type referred to heretofore, particularly adapted to satisfactorily withstand shocks and other forces produced thereon when uneven materials are passed therebetween.

Other disadvantages are involved in the conventional process of making matched embossing rolls, discussed above. For example, the step of engraving the first large roll of soft metal by the hard small mill is time consuming and exacting, especially when the design to be engraved is intricate and involved. Additionally, due to the large rolling contact pressures necessary to effect the desired engraving in this step, large quantities of heat are generated which must be dissipated, for example, by applying coolants to the mill and/or roll, or by periodic interruptions or stoppages in this step of the process. In any

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case, production considerations are thereby complicated, and if this heat is not dissipated at a sufficiently rapid rate, distortion of the pattern or design on the mill and/or roll may occur which obviously would prevent faithful reproduction of the desired pattern on the sheets or strips embossed by the matched rolls. As is understood, this separate step of engraving with the small mill and the inherent disadvantages thereof are involved every time a pair of matched embossing rolls is produced by this process.

Accordingly, it is another important object of the invention to provide an improved method facilitating production of matched steel rolls from an initially formed die by eliminating the necessity of engraving either of the rolls in the matched pair.

A further object resides in the provision of a convenient and inexpensive method enabling matched steel embossing rolls to be produced having any desired depth of hardness without danger of warping or distorting the pattern or design thereon.

Further objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

The novel features of the invention may be best made clear from the following description and accompanying drawings in which:

FIGURE 1 is a front elevational view of a pair of matched embossing rolls;

FIGURES 2-5 illustrate, schematically, several steps in the method of the invention for forming a pattern on the rolls of FIGURE 1;

FIGURE 6 is a fragmentary, vertical sectional view of one of the rolls of FIGURE 1 and the master pattern roller just prior to engagement thereof for performing the step illustrated in FIGURE 4;

FIGURE 7 is a fragmentary, vertical sectional view of the roll and roller of FIGURE 6 shown in their engaged position involved in the step illustrated in FIGURE 4; and

FIGURE 8 is a fragmentary, vertical sectional view of the roll of FIGURES 6 and 7 dipped into an etching bath.

The present invention contemplates making matched embossing rolls from a relatively small die. The basic design or pattern to be ultimately formed in the matched embossing rolls is formed on this die which is in the form of a small cylindrical roller, and the pattern is then transferred from the die to a small mill of the same size as the die. The mill now contains the basic pattern and in conventional processes, as noted heretofore, is then rolled under great pressures directly in contact with a large roll, the latter forming the first roll in the pair of matched embossing rolls to be produced. During this step of conventional process, the mill is in a hardened condition while the much larger roll must be in a soft condition to enable the engraving of this step to be performed.

An important aspect of the invention contemplates eliminating this last-named engraving step in producing each pair of matched rolls, and this is accomplished by transferring the basic pattern from the mill onto an intermediate or master pattern roller having the same axial length, i.e. face width, as the pair of matched rolls to be produced. Such master pattern roller, as will be explained hereinbelow, permits both rolls in the matched pair to be given the desired pattern without resorting to engraving so that both rolls can be fully hardened throughout their entire masses before the pattern or design is formed therein.

Referring now to the drawing, numerals 6, 8 in FIGURE 1 designate the rolls constituting the pair of matched embossing rolls produced by the invention. Numeral 10 in FIGURE 2 designates the small cylindrical die containing the basic desired pattern or design ultimately to be produced on rolls 6, 8 and this pattern may be formed in the die by any conventional procedure, as is well under-

stood in the art. Die 10 is shown to include trunnions 12 for jouralling it in conventional apparatus (not shown). Numeral 14 designates the mill, and as shown in FIGURE 2, this mill also includes trunnions 16 and is of the same size as the die 10 to facilitate accurate transfer of the pattern from the die thereto. Although such transfer may be effected in any conventional manner, as is well understood, it is preferred to engrave the pattern onto the mill. And when transferring the pattern between die 10 and mill 14 by engraving, the die as is understood will be in a hardened condition while the mill is soft, and they will be rolled in contact with each other (see FIGURE 2) in a suitable apparatus (not shown) under sufficient pressure to effect the desired transfer. Both die 10 and mill 14 are constructed of metal, and after the basic pattern has been formed on mill 14, it is hardened by any suitable treatment.

At this time, the invention contemplates transfer of the pattern from the mill 14 to an intermediate or master pattern roller or mill 18. Roller 18, as seen in FIGURE 3, is larger than the mill 14, and the pattern preferably is transferred thereto by engraving. That is to say, the hardened mill 14 is rolled under pressure in contact with the face of the roller 18, which roller is in an unhardened or soft state during this operation. This engraving step (see FIGURE 3) is carried out in conventional apparatus (not shown). Roller 18 is formed with projecting trunnions 20 thereon for mounting purposes. The mill 14 is fed axially across roller 18, during the engraving thereof, to form the desired pattern in the entire face thereof. As will be evident, the ratio of the diameter of the roller 18 to the mill 14 will be a whole integer, such as 2 for example, so that the basic pattern on the mill 14 will be repeated an even number of times around the circumference of the roller 18 thereby preventing imperfections or irregularities in the pattern engraved on the roller.

The roller 18, after being engraved, is hardened and now constitutes a master pattern roller to be utilized in forming matched embossing rolls as will be described hereinafter.

Before receiving the pattern from the roller 18, both rolls 6 and 8 are hardened by any suitable process and then ground to a smooth external surface. The rolls may then be polished, if desired. In any event, this hardening of the rolls 6, 8 can extend to any desired radial depth. As a matter of fact, the rolls may be hardened throughout their entire metallic mass, and inasmuch as no problems will be encountered with possible distortion of a pattern thereon since the rolls have smooth external surfaces at this time, the hardening operation may be carried out conveniently and inexpensively in any desirable manner.

The invention now contemplates the step of transferring the pattern from roller 18 to one of the rolls 6, 8. The first roll of the pair to receive the pattern, for example lower roll 8, is first given an acid resist coating 26 over its entire cylindrical surface as indicated in FIGURE 6. This coating may be of any suitable waxy composition, such as an asphalt latex composition, and applied in any conventional manner, as by a brush or applicator rolls (not shown). The now coated roll 8 and the roller 18 are jouralled in conventional apparatus (not shown) in the position shown in FIGURE 4, as by means of the trunnions 20 on roller 18 and trunnions 22 on roll 8. In such apparatus, the roller 18 is aligned with roll 8 so they will be in complete longitudinal or axial contact as shown. In this regard, the axial length of the patterned cylindrical surface of the roller 18 is equal to the axial length of the cylindrical surface on the rolls 6, 8, as seen in the drawing. With the roller 18 and roll 8 in this position, power is supplied to drive them into rolling engagement with each other to cause removal of portions of the coating 26 on roll 8 thereby exposing the outer surface of the roll 8 in regions predetermined by the particular pattern on the roller 18 as is well understood in the art and indicated fragmentarily in FIGURE 7. The ratio of the

diameter of the pattern roller 18 to the diameter of roll 8 is a whole number so that no irregularities will occur in the coating on roll 8. In other words, the pattern on roller 18 will repeat on roll 8 an odd or even whole number of times, but not a fractional or improper fractional number of times.

After the coating on the roll 8 has been removed in these predetermined regions, the roll 8 is then etched as by dipping and rolling it in an etching fluid indicated at 28 in FIGURE 8, thereby causing the metal, only in the uncoated or exposed predetermined regions, to be eaten away. The etching fluid may be of any suitable composition including, for example, nitric acid or nitric acid and acetic acid. These steps of applying an acid resist coating 26 to the roll 8, rolling it in contact with the roller 18 to remove portions thereof corresponding to the pattern on roller 18, and then etching the exposed or uncoated regions of the roll 8 may be repeated as often as necessary and desired, to produce a pattern or design of desired depth in the roll 8 complementary to the pattern on the roller 18. It will be understood that the coating 26 on the roll 8 and any acid film are removed therefrom by a conventional washing or rinsing operation after the roll is etched.

When the formation of the pattern of desired depth on the roll 8 is completed and the roll has been washed, the roll 6 is then given an acid resist coating similar to that given the ultimate lower roll 8, and it is then rolled in aligned and intimate contact with the now embossed and completely uncoated lower roll 8 (see FIGURE 5). Although roll 8 is shown in upper position in FIGURE 5 for this step, it will be understood that it may be in the lower position beneath roll 6, if desired. As is evident, this step effects removal of portions of the coating on the roll 6 corresponding to the unetched portions of the roll 8 in the same manner as that illustrated in FIGURE 7. These uncoated or exposed portions of the ultimate upper roll 6 are then etched in the same manner as that described above for producing the design on the lower roll 8. That is, the coated roll 6 may be dipped and rolled in an etching bath, such as 28, until the desired depth of pattern is realized thereon.

Thus, it will be seen that the rolls 6, 8, so formed, now constitute a pair of matched or mated embossing rolls which have previously been hardened and consequently need not be subjected to possibly detrimental heat treatment after the patterns or designs have been formed thereon.

It will be understood that helical driving gears (not shown) may be drivingly and coaxially connected to the trunnions 22, 24 on the rolls 8, 6 respectively, for facilitating the step of FIGURE 5 and also for accurately forming the complementary designs in the rolls 6, 8. Such gears and a preferred apparatus for using them are shown in the aforementioned patent, 2,662,002. As indicated in this patent, these gears also enable the embossed rolls 6, 8 to be perfectly aligned during use.

In an exemplary embodiment of the invention, the pattern roller 18 is constructed of approximately a 1055 steel while the matched rolls 6, 8 are both constructed of an alloy steel roll known as approximately composition 4485, which is a chrome moly alloy. The rolls 6, 8 are of substantially the same diameter and the ratio of their diameter to the diameter of the pattern roller 18 is 2.

It has been found desirable in some cases, such as when heavy gauge material is to be embossed by the pair of rolls 6, 8, to provide a clearance between the pattern indentations on the female roll of the pair and the corresponding pattern projections on the male roll. This may be accomplished by etching roll 6 to a sufficient depth after the step shown in FIGURE 5 is performed. Although the diameters of the rolls 6, 8 were described hereinabove as being the same, it has been found in actual practice that it is desirable to have the bottom

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roll 8 of a slightly larger diameter than the top roll 6, for example, 0.020" larger. Some compensation is therefore initially provided in the rolls for wear or subsequent re-etching of the lower roll, if necessary, to maintain the clearance referred to above.

As will be appreciated, the present invention enables matched steel embossing rolls to be produced which are fully hardened and therefore eminently suitable for resisting shocks and other forces produced thereon, such as when the rolls are embossing sheet metal or other strong material having irregularities or non-uniformities in its thickness. This advantage can be realized since the process of the invention does not require any engraving of the matched rolls ultimately to be produced, yet the invention preserves the advantages of convenient, inexpensive, and economical production incident to processes utilizing dies and mills. Additionally, the steps of the invention involved in forming the patterns on rolls 6, 8 greatly minimize the time involved in similar steps of previous processes since the same master pattern roller 18 can be used in forming the pattern on each first roll of each pair produced. Thus, the step of engraving the first roll of each pair and its inherent disadvantages noted heretofore are omitted.

It will be evident that the pattern roller 18 may be utilized to initially form the pattern in the upper roll 6, instead of lower roll 8, by the steps described above in connection with roll 8, after which the pattern on the upper roll 6 will be transferred to the lower roll 8 in a similar manner to that described in connection with the step illustrated in FIGURE 5.

It will thus be seen that the objects of this invention have been fully and effectively accomplished. It will

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be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of the invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the appended claim.

I claim:

In the method of producing hardened, matched metallic embossing rolls, the steps comprising; hardening a pair of coextensive rolls throughout substantially the entire metallic mass thereof, applying an acid resist coating to the entire cylindrical exterior surface of the first of said rolls, rolling a master pattern roller of the same axial length as said rolls and of a diameter related by a whole member to the diameter of said first roll in contact with the acid resist coating of said first roll to remove portions of said coating in regions predetermined by the pattern on said roller, etching the first roll to remove metal therefrom in said regions, removing the acid resist coating from the first roll, applying an acid resist coating to the entire external cylindrical surface of the second of said rolls, rolling the now embossed first roll in contact with the coating on said second roll to remove portions of said coating in predetermined regions, and etching the second roll to remove metal therefrom in said regions.

References Cited in the file of this patent

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2,662,002	Sunderhauf et al. ----- Dec. 8, 1953
2,684,291	Wilson et al. ----- July 20, 1954