

United States Patent

Broderick

[15] 3,668,030

[45] June 6, 1972

[54] METHOD OF MAKING MATING MALE EMBOSSING ROLLS

[72] Inventor: Frank W. Broderick, 52 Pittsford Way,
New Providence, N.J. 07974

[22] Filed: Sept. 8, 1970

[21] Appl. No.: 70,434

[52] U.S. Cl. 156/14, 156/345

[51] Int. Cl. B44n 3/02

[58] Field of Search 156/14, 345

[56] References Cited

UNITED STATES PATENTS

2,662,002 12/1953 Sunderhauf et al. 156/14
3,268,378 8/1966 Broderick 156/14

Primary Examiner—Jacob H. Steinberg
Attorney—James & Franklin

[57] ABSTRACT

A method for manufacture of a male embossing roll which registers exactly with another male embossing roll, which comprises forming in the second roll a mating female pattern, filling the female pattern depressions with resist, and then etching, thereby to produce a male design corresponding to the female design. The filling of the preliminarily formed female design by a resist comprising chrome plating is a preferred embodiment, the entire roll being chrome plated after the formation of the female design, the chrome plate then being removed from the surface of the roll except in those areas corresponding to the depressions in the female pattern previously formed therein.

20 Claims, 14 Drawing Figures

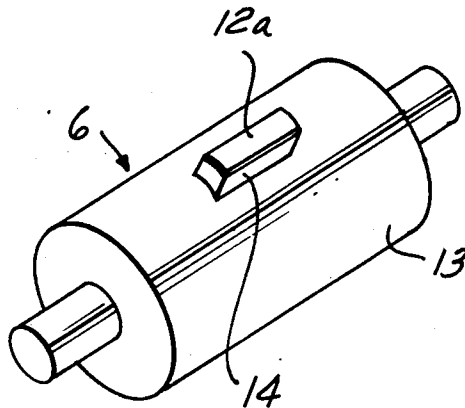


FIG. 1

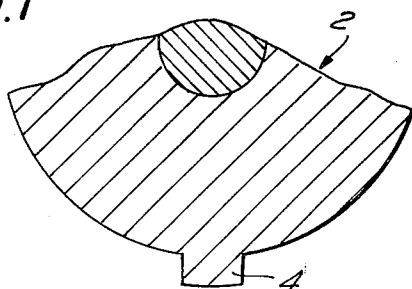


FIG. 2

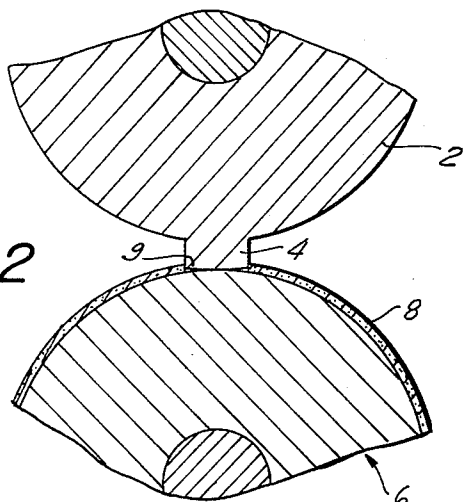


FIG. 3

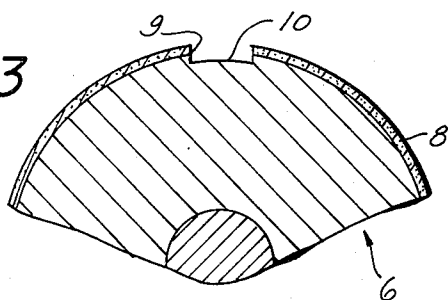


FIG. 4

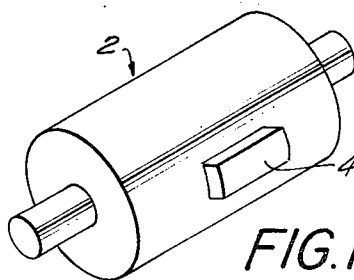
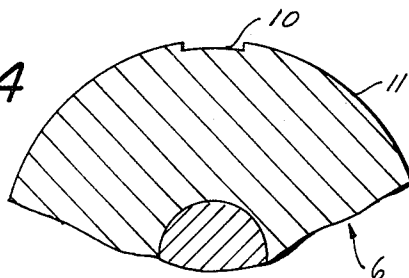


FIG. 1A

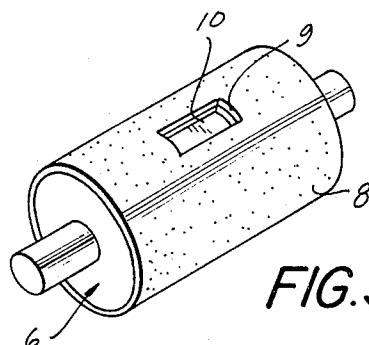


FIG. 3A

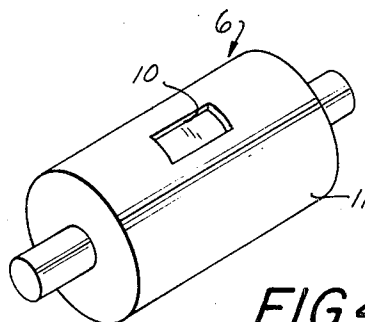
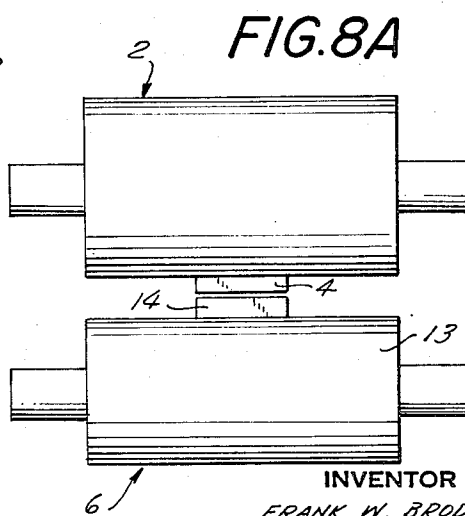
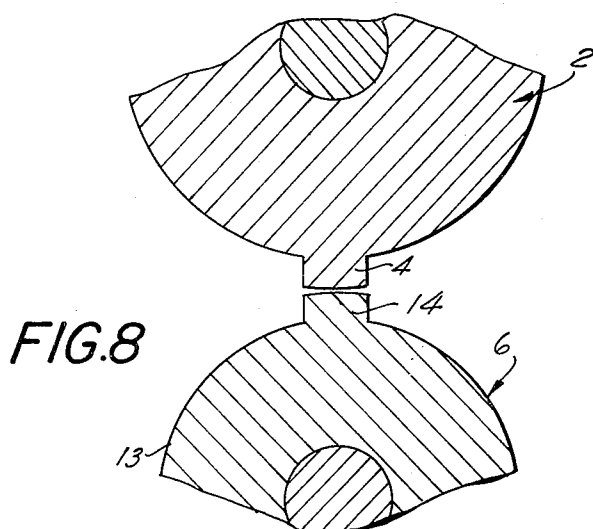
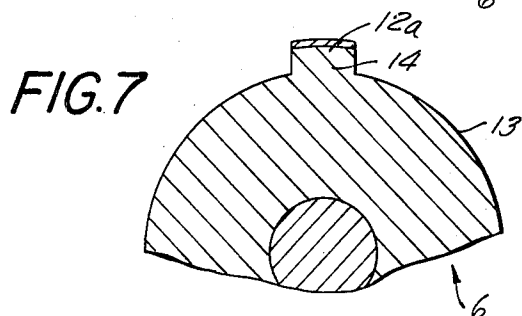
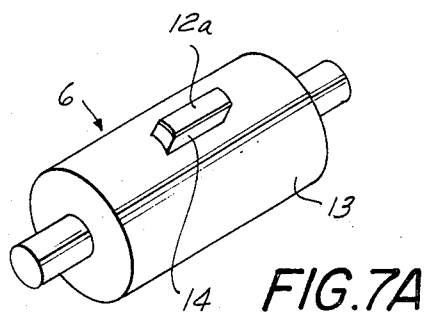
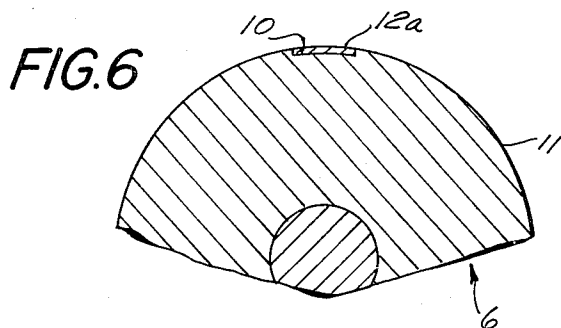
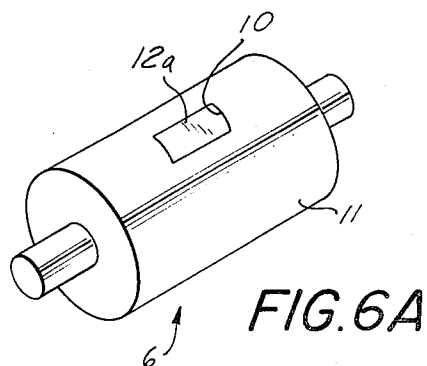
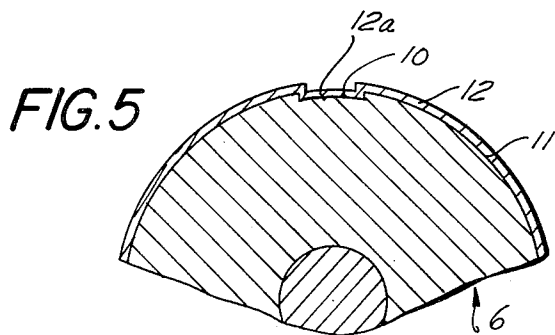


FIG. 4A

INVENTOR
FRANK W. BRODERICK
BY *James and Franklin*
ATTORNEY



INVENTOR
FRANK W. BRODERICK
BY *James M. Franklin*
ATTORNEY

METHOD OF MAKING MATING MALE EMBOSSING ROLLS

The present invention relates to the manufacture of a pair of perfectly mated male embossing rolls.

In embossing, as is well known, sheet material is passed between a pair of rolls, at least one of those rolls having a design formed thereon in relief, the pressure exerted by that roll on the sheet pressed thereagainst deforming the sheet, or at least the surface of the sheet, so as to produce thereon a corresponding pattern. In the usual procedure in embossing, both rolls are provided with designs which mate with one another, one roll being male and the other female, the sheet material being pressed by the protrusions on the male roll into the recesses in the female roll, thereby to be deformed into the surface pattern corresponding to the pattern on the rolls.

In some instances this type of male-female roll interaction is not desired. Moreover, in certain of such instances the provision of a forming pattern on only one roll does not result in proper or desired surfacing or deformation of the sheet under treatment. For example, if one of the rolls is smooth and hard and the other is provided with a pattern, that pattern will be formed only on that surface of the sheet material which is pressed against the patterned roll; that surface of the sheet material pressed against the smooth hard roll will not be embossed. Thus there is a demand for an embossing operation carried out by a pair of male rolls, each provided with mating projections which act simultaneously and similarly on opposite surfaces of the sheet under treatment as that sheet passes between the rolls. It is essential, however, that the pattern of projections on both the upper and lower roll mate exactly. If that is not the case then not only will the patterns on the opposite surfaces of the sheet under treatment be somewhat different but, as the registration of the projections on the two rolls move out of accurate alignment, the sheet under treatment is apt to be distorted unduly and, indeed, even cut or torn.

The art is well aware of how to make a male roll with a desired pattern thereon. There are many available known procedures for doing this, and the choice of the given procedure for that purpose is determined by manufacturing availability, plant custom, the particular type of design or pattern involved, the nature of the material to be embossed, etc., all as is well known to those skilled in the art. Likewise various methods are known for producing from a male roll a female roll the pattern of which mates exactly with that of the male roll. This is conventional in embossing roll manufacture procedure. However, prior to the instant invention the art, so far as I am aware, has not known how to make from a patterned male roll an identically patterned second male roll. Because no practical way has been known heretofore for accomplishing this result, the use of a pair of opposed identical male rollers for embossing has been infrequent and, when tried, has suffered from drawbacks because of the lack of identity and accurate registration between the patterns on the two rolls.

It is the prime object of the present invention to provide a method for making from a pre-patterned male embossing roll a second male embossing roll which is perfectly mated to the first roll.

It is another object of the present invention to devise such a method in which the various steps can be carried out accurately and effectively with existing plant equipment.

It is yet another object of the present invention to devise such a procedure the steps of which are such as are more or less familiar, individually considered, to those working in the art, so that the procedure can be carried out by plant personnel with normal existing skills.

It is yet another object of the present invention to devise such a process in which the number of steps required and the time involved to produce in the second roll a male pattern projecting out to a desired degree are greatly minimized.

It is a still further object of the present invention to devise such a method in which the male pattern formed in the second

roll not only registers with the pattern formed in the first roll, but also accurately conforms to the latter in size, shape and configuration.

To these ends, a first roll is formed with a desired male pattern in accordance with known procedures. A second roll, on which the mating female pattern is to be formed, is first provided with a shallow female pattern corresponding to the male pattern on the first roll. This may be done in any conventional manner. At this point the second roll will have in it a series of indentations or recesses which accurately register with and conform in shape and size to the projections on the male roll. These indentations are then filled with an etch resist material, but the remainder of the surface of the second roll is not thus resist-coated. The second roll is then subjected to an etching step, and all of those portions of the second roll not covered by etch resist are etched away until the portions covered by the etch resist - the areas which formerly were the bottoms of the female recesses - project above the surface of the roll after etching. These upwardly projecting parts define male projections which are accurately positioned and shaped in accordance with the position and shape of the projections on the first roll, and they therefore constitute a male pattern on the second roll which perfectly mates and registers with the male pattern on the first roll. Thereafter the etch resist is removed from the upper surfaces of those projecting portions defining the male pattern on the second roll, and that male pattern is then deepened in any appropriate manner in order to provide projections of desired height.

In a preferred embodiment, the etch resist which is used is chrome plating. After the second roll has been treated to form the mating female pattern in its outer surface, the roll is subjected to a chrome plating treatment whereby its entire outer surface is chrome-plated. Thereafter the roll is very carefully ground and the chrome plating removed from the outer surface thereof without removing the chrome plating from inside the recesses defining the female pattern. Thereafter, when the roll with the chrome plating in the female recesses is subjected to an etching operation, that operation may be carried on for an extended period of time and may in a single step produce a male projecting pattern of much greater height than can be produced when ordinary etch resists are used. This very materially cuts down the overall time to form a male pattern of desired projecting height, and thus reduces the cost of manufacture of the roll by a substantial factor, and at the same time it produces a sharper and more accurate pattern that does the use of conventional etch resists under ordinary circumstances and operational procedures.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the manufacture of a pair of mated male embossing rolls, as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

FIG. 1 is a fragmentary cross sectional view of an idealized embodiment of the first embossing roll with a male pattern formed thereon;

FIG. 1A is a three-quarter perspective view of the roll of FIG. 1;

FIG. 2 is a fragmentary cross sectional view showing one way in which the male embossing roll of FIG. 1 may be used to form a mating pattern in a resist layer on the surface of a second embossing roll;

FIG. 3 is a fragmentary cross sectional view of the second embossing roll, after it has been subjected to the operation shown in FIG. 2 and to an etching step, thereby to form therein a female pattern corresponding to the male pattern on the roll of FIG. 1;

FIG. 3A is a three-quarter perspective view of the roll of FIG. 3;

FIG. 4 is a view similar to FIG. 3 but showing the etch resist layer removed from the roll;

FIG. 4A is a three-quarter perspective view of the roll of FIG. 4;

FIG. 5 is a view similar to FIG. 4 but showing the roll with a layer of resist in the form of chrome plating formed thereover;

FIG. 6 is a view similar to FIG. 5 but showing the roll after the resist layer has been removed from all surfaces thereof except those in the recesses defining the female pattern;

FIG. 6A is a three-quarter perspective view of the roll of FIG. 6;

FIG. 7 is a fragmentary cross sectional view of the roll of FIG. 6 after the latter has been subjected to an etching step;

FIG. 7A is a three-quarter perspective view of the roll of FIG. 7;

FIG. 8 is a fragmentary cross sectional view of the rolls of FIGS. 1 and 7 in the relationship which they will assume during an embossing operation, the chrome plating having been removed from the tips of the projections defining the male pattern and the pattern having been deepened; and

FIG. 8A is a front elevational view, in idealized form, of the upper and lower rolls of FIG. 8 in operative relationship.

Since the pattern which may be formed on the rolls in question may vary widely, from one design or letter or series of letters to an overall surface texture design, no attempt has been here made to show any particular design or configuration of the pattern. Instead, the pattern is here shown in stylized form as a single rectangular projection. This is done in part for ease of explanation, in part because comprehension of the method steps will, it is thought, be easier under that situation, and in part because of the great variety of patterns and designs which can be employed. Moreover, in the illustrations no attempt has been made to conform to actual dimensions or to relative dimensions from one view to another, in part because in actual practice these dimensions may be very small and in part because exaggerating the dimensions makes for easier understanding of the explanation. It should be borne in mind, however, that in making this stylized showing the problems involved in achieving accurate registration are to some extent masked. When it is considered that the male patterning on the rolls may comprise literally thousands of individual projections in a few square inches of surface, and that every one of those thousands of projections on a given roll must accurately mate with correspondingly shaped projections on the second and cooperating roll, the problems involved in achieving proper registration and mating will be appreciated. Thus the simplicity of the illustrations here used belies the complexity of the problem actually presented to one in the art to whom the task of making two accurately mating male embossing rolls is presented.

In accordance with the present invention, and as shown in FIGS. 1 and 1A, the upper male roll, generally designated 2, (the terms "upper" and "lower" are here used interchangeably) is formed first, and a male pattern, defined by a projection or projections 4 (only one is shown, for simplicity of illustration), is formed on its periphery in any appropriate manner. Two such conventional methods are the mill and die method and the photoengraving process. For a given application the projections 4 defining the male pattern must project out from the body of the roll 2 by a predetermined distance. A typical such distance is 0.04 inch. The top roll 2 is then ground so that the outer end surfaces of the projections 4 lie on an imaginary cylinder true and concentric with the axis of the roll 2.

It might be thought that a second male roll identical to the roll 2 could be made merely by following the same procedures that were employed in the manufacture of the roll 2, particularly if those procedures involved photoengraving. However, that is not the case. A second roll produced in such a fashion would be, if great care were taken, a close approximation to the first roll, but as a practical matter it is impossible to make in that fashion a second roll which will, over its entire surface area, mate exactly with the pattern on the first roll.

I have found that an accurately registering second male roll can be produced in the following fashion: First, as illustrated in FIGS. 2-4, the second roll 6 is provided with a shallow female pattern which matches that of the male pattern 4. The

way in which this can be accomplished is also well known to the art. One known method, as illustrated in FIGS. 2-4 is to coat the second roll 6, after it has been ground so that its outer surface defines a cylinder true and concentric with the axis of roll 6, with a layer 8 of etch resist of any suitable composition and then to rotate the roll 6 in synchronism with the previously formed male roll 2 so that the protrusions 4 defining that male pattern press into the layer of etch resist 8, squeezing that material out from those areas corresponding to the projections 4, as illustrated in FIG. 2. Thereafter the roll 6, now with a pattern formed in the etch resist 8, that pattern corresponding exactly to the pattern of the male projections 4 on the roll 2, is subjected to an etching step, thereby to produce, as shown in FIG. 3, shallow recesses 10 in the body of the roll 6 immediately beneath the openings 9 formed in the etch resist layer 8. Thereafter, as shown in FIG. 4, the etch resist layer 8 is removed, thus leaving the roll 6 with a shallow female pattern formed by recesses or indentations 10 which corresponds exactly with the male pattern defined by the projections 4 on the roll 2.

The next step is to deposit etch resist only in the indentations or recesses 10 on the roll 6, while leaving the surfaces of that roll which are not indented free of resist material. This may be done in various ways, and various types of etch resist material may be used. For example, as illustrated in FIG. 5, the roll of FIG. 4, containing the female pattern defined by the indentations 10, may be covered completely with a layer 12 of etch resist, after which, as shown in FIG. 6, that etch resist is removed from the outwardly projecting surfaces 11 of the roll 6, while leaving the resist material 12 within the recesses 10.

It is preferred, for reasons which will be explained hereinafter, to utilize chrome plating as the etch resist material for the layer 12. The rolls 6 are generally made of metal, and a layer of chrome plating can be applied completely thereover in accordance with the standard manufacturing chrome plating procedures, thus resulting in the structure shown in FIG. 5. That chrome plating, when deposited, will conform to the contour of the outer surface of the roll 6, forming itself in uniform thickness both on the outer exposed surface 11 of the roll 6 and on the exposed surfaces of the recesses 10. Thereafter the roll can be machined so as to accurately remove the chrome plating 12 from the outwardly projecting portion 11 of the roll 6, thereby leaving the chrome plating 12a within the recess or indentation 10, as shown in FIG. 6. The machining off of the chrome plating 12 can readily be accomplished by an accurate grinding operation.

Next the roll of FIG. 6 is subjected to a conventional etching operation. At that time those surfaces 11 of the roll 6 which are not covered by the resist layer 12 will be eaten away, but the portion of the roll 6 beneath the resist layer 12 will not be eaten away. Hence there will be produced on the roll 6 by this etching step, as shown in FIG. 7, protrusions 14 extending radially outwardly from the etch-exposed roll surface 13, the shape of which protrusions conforms accurately to the shape of the resist layer 12, and thus conforms accurately to the shape of the indentations 10 defining the shallow female pattern originally formed in the roll 6. Since that female pattern accurately corresponded to the male pattern defined by the projections 4 on the roll 2, the projections 14 on the roll 6 will be seen to be accurately mating and corresponding in all respects (except, at this point, possibly as to depth or extent of protrusion) to the projections 4 defining the male pattern on roll 2.

Thereafter the male projections 14 on the roll 6 may be deepened in any desired manner, usually after the etch resist layer 12a is removed, in order to produce male projections 14 of desired extent of protrusion, and then the roll 6 may be used with the roll 2 for an embossing step, as schematically shown in FIG. 8, with the sheet to be embossed being passed between those rolls 2 and 6, the upper and lower surfaces of that sheet being deformed by the male projections 4 and 14 on the rolls 2 and 6 respectively. Those projections 11 and 14 are shown slightly separated in FIGS. 8 and 8A to provide space for the sheet to be debossed to pass therebetween.

With conventional etch resist materials of the type usually employed in forming a female pattern in a roll as shown in FIGS. 2-4 (e.g. asphaltum) there is a practical limit to the depth to which etching can be carried out before the etch resist material becomes sufficiently weakened by the etching operation as no longer to function reliably as a resist. Etching to a depth of 0.004 to 0.006 inch is usual when such conventional resists are employed; etching to any further depth is generally considered undesirable. Thus the greater the depth of etching, the less reliable is the etching procedure. Accordingly, in forming the recesses or indentations 10 defining the female pattern initially formed in the roll 6, etching is carried out to produce indentations preferably to a depth of 0.0015 to 0.002 inch, in order to insure extremely accurate correspondence of the indentations 10 to the male pattern protrusions 4.

If such a conventional resist is used as the resist 12 in connection with the formation of the protrusions 14 such as those disclosed in FIG. 7, then the depth to which the etching can be carried out in any given step, and particularly in the first step, must likewise be limited to 0.004 to 0.006 inch. However, it is usually desired that the projections 14 on the roll 6 have the same height or projecting distance as the projections 4 on the roll 2, to wit, a depth or height of 0.040 inch. To increase the depth to desired value calls for additional steps, such as the covering of the roll with a resist layer newly applied, the use of a mill to remove that resist layer from places other than the projections 14, and a subsequent etching step, with each etching step having to be terminated at a time such as to permit the resist used to continue reliably to function as a resist. Other deepening procedures are known and may be used, e.g. machine engraving.

These additional time consuming and costly etch stages can be minimized when, as has been described above as the preferred embodiment, the resist used is constituted by a metal plating such as chrome plating. The chrome plating, in functioning as an etch resist, is much longer lived in its etch-resist action than more conventional etch resists. When chrome plating is used as the resist, a single etching step can be carried out to produce projections 14 having a height or projecting distance of 0.008 to 0.012 inch. Subjecting the roll to the etchant for a period of time of about 20 minutes will produce a 0.010 inch depth without any appreciable loss of accuracy in the configuration of the pattern formed. It will be apparent that the procedures required to lengthen the projections 14 from a distance of 0.012 inch to a distance of 0.040 inch are far less rigorous, time consuming and difficult than those required when one must start with projections having a height of only 0.004 inch. Thus the use of the chrome plating as the resist 12 has many advantages when compared with the use of conventional resists in this connection.

It will be apparent from the above that the procedure here involved produces a roll 6 having a male pattern 14 which is an accurately mating reproduction of the male pattern 4 on the roll 2, and that the roll 6 is produced by procedures (application of resist layers, removal of resist from desired areas, and etching) which in and of themselves are not only known to the art but conventionally used in plants of the type making embossing rollers. Hence the carrying out of the present method involves little or no additional investment, and available skilled and semi-skilled personnel will have the know-how to carry out these steps without requiring special training. Thus the method is particularly well adapted for use in existing plants making embossing rollers. The method not only produces accurately mating pairs of male embossing rollers, but does so by means of an inexpensive and thoroughly reliable procedure.

While but a single embodiment of the present invention has been here specifically disclosed, it will be apparent that many variations may be made therein, all within the scope of the instant invention as defined in the following claims.

I CLAIM:

1. A method of making a pair of mating male embossing rolls comprising the steps of:

1. Forming on one roll a desired male pattern;
2. Forming in the second roll a female pattern comprising one or more shallow recesses mating with said male pattern on said one roll;
3. Providing etch resist material in said recesses so as to cover the bottom surface thereof; and
4. Subjecting said second roll to etching until said resist-covered bottom surfaces project out from the rest of said second roll, thereby to define a male pattern on said second roll mating with that on said first roll.

2. The method of Claim 1, in which Step 4 comprises a substantially continuous etching operation carried on for a period of time sufficient to cause said resist-covered surfaces to project out from the rest of said roll for a distance of at least about five times the depth of said shallow recesses.

3. The method of claim 2, in which said male pattern on said one roll comprises portions extending out from said roll a given distance, said shallow recess of said female pattern after Step 2 have a depth no more than one-tenth of said given distance, and said resist-covered surfaces project out from the rest of said second roll after Step 4 by a distance of at least about one-quarter of said given distance.

4. The method of claim 3, in which, in Step 3, said etch resist substantially fills said recesses.

5. The method of claim 3, in which said roll is metal and said etch resist comprises a layer of plated metal on said roll.

6. The method of claim 5, in which said roll is plated with chromium.

7. The method of claim 5, in which Step 3 comprises metal plating the recesses and the roll surface around said recesses, followed by removing said metal plating from the roll surface around said recesses while leaving said plating in said recesses.

8. The method of claim 7, in which said roll is plated with chromium.

9. The method of claim 1, in which said male pattern on said one roll comprises portions extending out from said roll a given distance, said shallow recess of said female pattern after Step 2 having a depth no more than one-tenth of said given distance, and said resist-covered surfaces project out from the rest of said second roll after Step 4 by a distance of at least about one-quarter of said given distance.

10. The method of claim 9, in which, in Step 3, said etch resist substantially fills said recesses.

11. The method of claim 9, in which said roll is metal and said etch resist comprises a layer of plated metal on said roll.

12. The method of claim 11, in which said roll is plated with chromium.

13. The method of claim 9, in which Step 3 comprises metal plating the recesses and the roll surface around said recesses, followed by removing said metal plating from the roll surface around said recesses while leaving said plating in said recesses.

14. The method of claim 13, in which said roll is plated with chromium.

15. The method of claim 1, in which, in Step 3, said etch resist substantially fills said recesses.

16. The method of claim 1, in which said roll is metal and said etch resist comprises a layer of plated metal on said roll.

17. The method of claim 16, in which said roll is plated with chromium.

18. The method of claim 1, in which Step 3 comprises metal plating the recesses and the roll surface around said recesses, followed by removing said metal plating from the roll surface around said recesses while leaving said plating in said recesses.

19. The method of claim 18, in which said roll is plated with chromium.

20. The method of claim 1, in which said roll is metal and said etch resist comprises a layer of plated metal on said roll.

* * * * *