May 28, 1940. D. A. MARSHALL 2,202,295

METHOD OF FORMING ORNAMENTAL STRIP METAL

Original Filed July 22, 1937 3 Sheets-Sheet 1

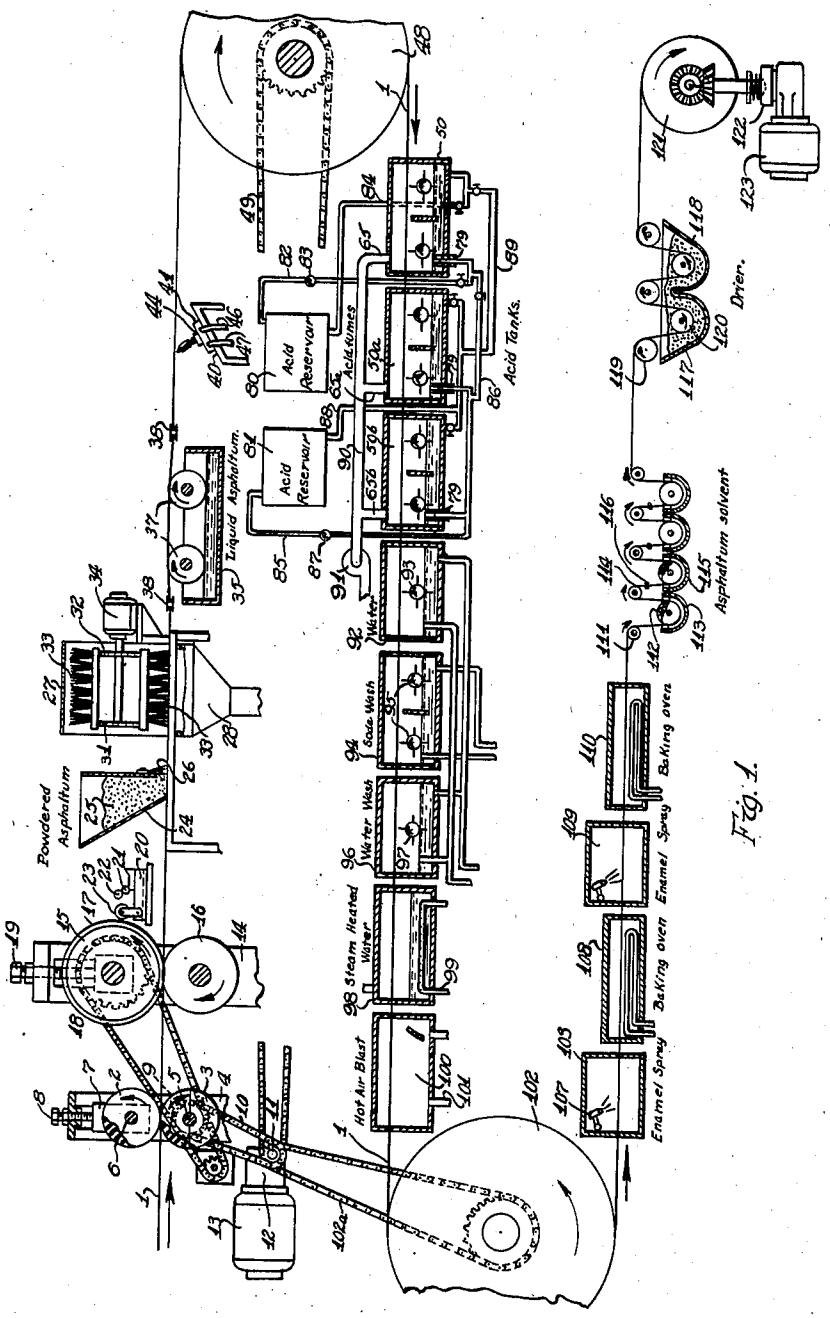


Fig. 1.

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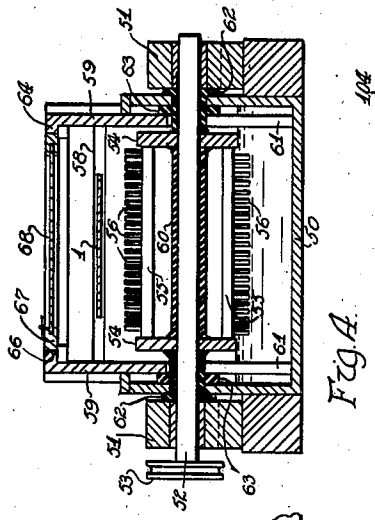


Fig. 4.

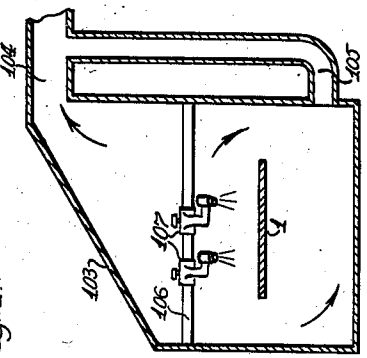


Fig. 5.

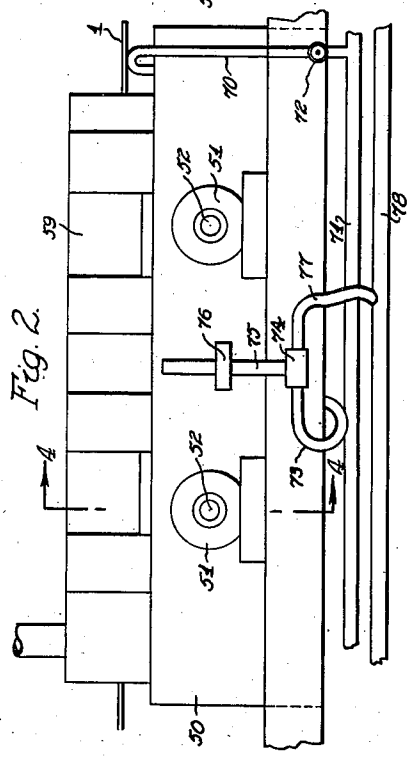


Fig. 2.

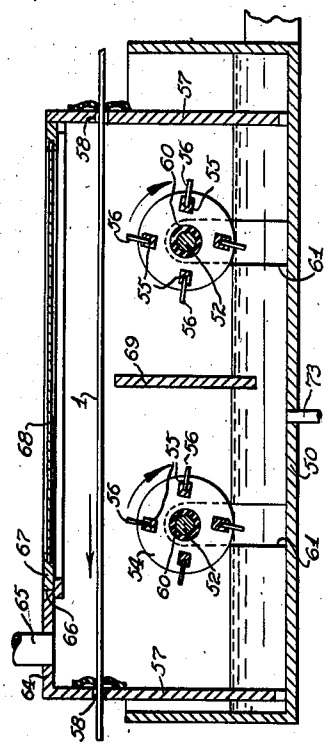


Fig. 3.

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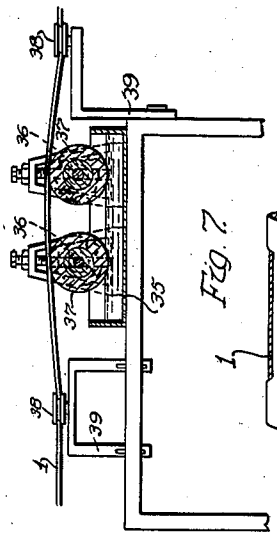


Fig. 7.

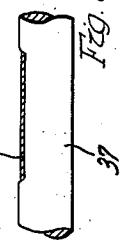


Fig. 8.

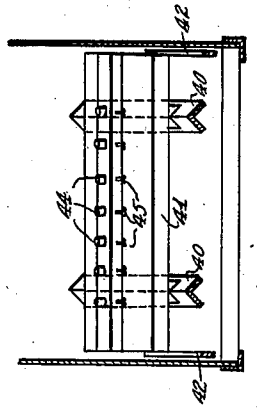


Fig. 10.

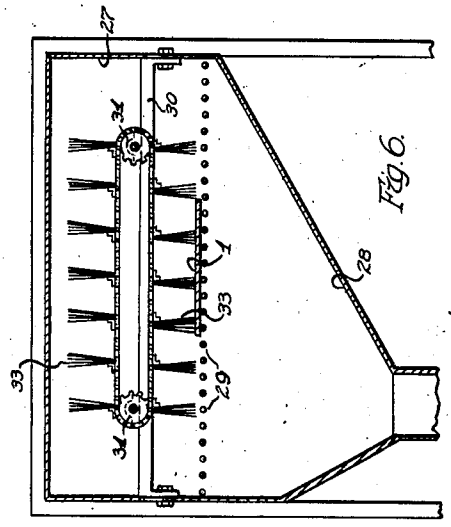


Fig. 6.

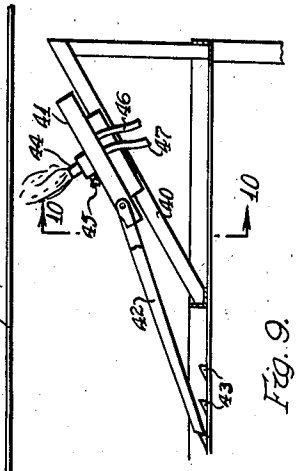


Fig. 9.

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METHOD OF FORMING ORNAMENTAL STRIP METAL

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Original application July 22, 1937, Serial No. 154,992. Divided and this application October 3, 1938, Serial No. 233,043

8 Claims. (Cl. 41—42)

This invention relates to the method of treating and etching a continuous metallic strip.

This application is a division of my co-pending application Serial No. 154,992 for Method of and means for forming ornamental strip metal, filed July 22, 1937.

It is an object of the present invention to provide a new and improved method of etching a continuous metallic strip in an efficient and commercially practical manner.

Other objects of the invention will become apparent from the following description taken in connection with the accompanying drawings in which—

Figure 1 is a diagrammatical view of apparatus for carrying out my method;

Fig. 2 is a side elevational view of an etching apparatus;

Fig. 3 is a sectional view of the etching apparatus;

Fig. 4 is a sectional view of the etching apparatus taken along the line and in the direction of the arrows 4—4 of Fig. 2;

Fig. 5 is a sectional view of spraying apparatus;

Fig. 6 is a view partly in elevation and partly in section of an apparatus for removing excess powdered acid resist from the metallic strip under treatment;

Fig. 7 is a view partly in elevation and partly in section of apparatus for applying a liquid acid resist to the metallic strip;

Fig. 8 is a detail view of a part of the apparatus of Fig. 7;

Fig. 9 is a view in side elevation of a heater and associated structure, and

Fig. 10 is an end view of the heater.

In the drawings, the numeral 1 designates a strip of metal, and in Fig. 1, the strip is shown extending between a pair of rolls 2 and 3. The two rolls 2 and 3 are formed of a resilient material, such as hard rubber, and are mounted for rotation about parallel axes. The roller 3 is supported in a frame structure 4 by a shaft 5 and the roller 2 is supported by a shaft 6 mounted in vertically adjustable elements 7, one of which is shown in Fig. 1. Screws, such as shown at 8 in Fig. 1, are provided for adjusting the sliding elements 7 vertically in order to insure firm contact between the rolls and strip. The roll 3 has a sprocket 9 connected thereto which is connected by a chain 10 to the sprocket 11 on a shaft operated through a gear reduction mechanism in the housing 12 by an electric motor 13.

Adjacent the rolls 2 and 3, which are speed regulating rolls, is a frame structure 14 supporting a drum printing platen or cylinder 15, and a freely rotatable backing roll 16 which engages the bottom of the strip 1 to press it into contact with the printing cylinder. The printing cylinder preferably comprises a metal cylinder having a rubber printing plate 17 thereon, the rubber plate being cemented to the surface of the cylinder and having the desired design on its exposed surface. The printing cylinder is supported in vertically slidable, removable elements 18, one of which is shown in Fig. 1, and screws, such as the one shown at 19, are provided to adjust the elements 18 vertically.

In using the present apparatus to provide designs of different lengths it is necessary to change the printing cylinders and the invention provides for inking of the different sized cylinders. This apparatus comprises an ink tray 20 supported for horizontal movement. The rolls 21 and 22 receive ink from the tray 20 and from the roll 22 the ink may be transferred to the printing plate 17 by a movable roll 23.

The tackiness of the ink employed in some cases is sufficient to permit the printing cylinder 15 to be driven solely by contact with the strip 1. It has been found that the design transferred to the strip when the printing cylinder is so driven under certain circumstances is quite sharp and clear, whereas in other cases it is desirable to drive the printing cylinder positively in synchronism with the movement of the strip, as here shown. Further, such contact drive for the printing cylinder permits interchange of cylinders of various diameters without the necessity of interchanging a driving mechanism therefor as well. However, in the present apparatus, it is desirable that the printing cylinder be driven from the rolls 2 and 3, in absolute synchronism with the movement of the strip 1.

The ink used in the present apparatus contains a quantity of animal fat, such as tallow, and will not dry. It remains in a wet, sticky condition and the powdered asphaltum, with which the strip is subsequently treated, readily adheres thereto.

The strip 1 extends from the printing apparatus, above described, beneath a hopper 24 containing powdered asphaltum 25. A vertically adjustable brush 26, preferably formed of camels' hair, contacts the strip 1 as it leaves the hopper 24 and prevents an excessive amount of asphaltum from escaping from the hopper. The strip 1 is then further brushed transversely in order to remove asphaltum from all portions thereof

except the inked portions which require the acid resist.

The brushing apparatus, as shown more particularly in Fig. 6, comprises a housing 27 having a sloped bottom for collecting the excess asphaltum. The strip 1 in passing through the housing 27 slides over a wire screen 29, and mounted above the screen 29, in vertically adjustable supports 30, are sprockets 31 having endless chains 32 thereon supporting the brushes 33. The brushes 33 are preferably formed of camels' hair and are propelled across the strip 1 when the chains are driven by the motor 34, shown only in Fig. 1.

After passing the brushing apparatus the strip 1 extends to the apparatus for coating the reverse side and the side edges with an acid resist. As shown more particularly in Fig. 7, this resist coating apparatus comprises a tank 35 containing a quantity of asphaltum held in solution by a solvent such as gasoline. Rotatably supported in vertically adjustable elements 36 are rolls 37, the rolls being so supported that they dip into the liquid asphaltum. The rolls 37 are formed of a comparatively soft fibrous material, such as felt, and peripherally grooved disks 38 are mounted by adjustable supports 39, on each side thereof. The disks 38 cause the strip 1 to imbed itself in the rolls 36, as shown in an exaggerated manner in Fig. 8, so that the side edges of the strip, as well as the bottom surface, receive a coating of liquid asphaltum.

After being treated with the acid resist, the strip is subjected to heat. The heating apparatus is shown more particularly in Figs. 9 and 10, and comprises inclined guides 40 having a gas burner 41 mounted thereon and held in positions of adjustments by engagement of the links 42 with rack teeth 43. The burner 41 has a plurality of nozzles 44 which may be controlled independently by valves 45. The burner is of the well known type embodying a pilot light, using compressed air, and a remote control for the gas fuel so that the flames of the several burners may be simultaneously controlled. That is, the burner may be adjusted by means of the valves 45 to place any desired number of nozzles in operation at one time and when once placed in operation the group of nozzles may be simultaneously controlled by regulating the gas supply from a remote point. The burner is supplied with compressed air through the pipe line 46 and with gas fuel through the pipe line 47.

As may be seen upon reference to Fig. 10, the burner 41 may be adjusted to positions nearer or more remote from the strip 1 by sliding it upon the guides 40, and as the strip passes over the burner it is heated, the powdered asphaltum is heated and the gasoline solvent of the liquid asphaltum is ignited and burned. In the event movement of the strip 1 stops for any reason the gas supply to the burners is immediately discontinued while the compressed air supply is continued. The strip is not, therefore, subjected to heat while it is stationary and the compressed air will blow out any flame resulting from combustion of the asphaltum solvent.

Reverting again to Fig. 1, the strip 1 passes from the burner, above described, and over a comparatively large roll 48 which is driven through a chain 49 by the motor 13. The strip thus begins its second run inverted, that is, with the face having the pattern of resist thereon on the bottom. During this second run of the strip it is treated by etching fluids contained in a plurality of etching tanks 50, 50*a* and 50*b*. There is no restriction as to the number of etching tanks, and although three tanks are here shown it will be understood that more than three or less than three may be used. In practice, it is found practical to employ more than three in most cases.

The acid tanks are identical in construction and one of the same is shown in detail in Figs. 2, 3 and 4, to which views reference is now had. Each acid tank comprises a receptacle 50, rectangular in form and open at the top. Rotatably supported in bearings 51, mounted externally of the receptacle 50, are shafts 52 having pulleys 53 on the ends thereof for the reception of a belt drive. Although the operating motors are not shown, it will be understood that the shafts 52 are driven in the direction of the arrows. Mounted upon each of the shafts 52 are two wood disks 54 united by rigid members 55 which support combs 56. As may be seen upon reference to Fig. 3, the combs 56, instead of being radially disposed, are tipped forwardly in the direction of travel of the shafts and disks.

The cover for the acid tank 50 comprises an inverted box-like structure, the end walls 57 of which have slots 58 therein permitting the inverted strip 1 to pass therethrough. The side walls 59 rest upon the bottom of the tank 50 to support the end walls slightly spaced above the same. The shafts 52 are encased in rubber, as designated at 60, and the openings in the side walls of the tank 50 through which the shafts 52 extend are provided with rubber seals 62 and 63. The seals 63 are interposed between the side walls of the tank 50 and the side walls 59 of the cover. The top wall 64 has an outlet pipe 65 for the acid fumes and an opening 66 with a hinged closure 67 having a transparency 68 therein. Centrally disposed between the shafts 52 is a baffle 69.

An acid supply pipe 70 is connected to the main supply conduit 71 and is equipped with a manual control valve 72. An acid outlet pipe 73 is mounted in the bottom of the tank 50 and comprises a flexible conduit. The conduit 73 is connected to a hollow-fitting 74 having a vent pipe 75 slidably received in a bracket 76 whereby it may be adjusted vertically. The fitting 74 is connected by a second flexible conduit 77 to a main conduit 78. In operation, the acid flows by gravity through the conduit 73, fitting 74 and conduit 77 to the main conduit 78, when the liquid level in the tank is higher than the fitting 74. By placing the fitting 74 in different positions of vertical adjustment the liquid level in the tank 50 may be regulated. The vent pipe 75 serves both as a support for the fitting 74 and also as a vacuum break to prevent syphoning.

The means for regulating the liquid level is diagrammatically shown in Fig. 1 and is generally designated by the numeral 79.

Referring now to Fig. 1, numerals 80 and 81, designate, respectively, acid reservoirs which are placed in a plane above the tanks 50, 50*a*, and 50*b* so that the acids may flow by gravity from the reservoirs to the tanks. The liquid level regulating outlet means 79 of the tank 50 is connected to the acid reservoir 80 by a main conduit 82 having a pump therein for causing movement of the liquid from the tank 50 to the reservoir. A main conduit 84 conveys liquid from the reservoir, by gravity flow, to the tank 50. The reservoir 81 is connected by a main conduit 85 to the outlets 79 of both tanks 50*a* and 50*b*, and through a valve controlled pipe line 86 to the outlet 79 of the tank 50. A pump 87 is provided in the conduit 85. A conduit 88 is connected with the reservoir 81 and

with the acid tanks 50a and 50b, and through a valve controlled by-pass 89 to the inlet of the acid tank 50.

The above described system of conduits makes it possible to place all of the tanks 50, 50a and 50b in communication with either reservoir, or to place the reservoir 80 in communication with the tank 50 and the reservoir 81 in communication with the tanks 50a and 50b. In the latter instance the reservoirs would contain different acids, for example, the reservoir 80 might contain an acid which provides a very efficient etching action on a new surface while the tanks 50a and 50b, through which the strips subsequently pass, might contain acids which provide a more efficient etching apparatus once the surface layer of metal has been penetrated.

With the apparatus in operation, the shafts 52 are rotated continuously and the combs 56 successively dip into the acid and throw a fine spray against the strip 1. This function permits an overchanging action in the contact of the acid with the strip with a highly efficient, rapid etching action resulting.

The level of the liquid within the tank 50, which is controlled by the hereinbefore described liquid level regulator indicated generally in Fig. 1 at 79, determines the depth to which the combs 56 dip into the liquid during rotation of the shafts 52 on which they are mounted, and thus determines the density of the acid spray thrown against the strip 1. The chemical reaction between the acid and the metal of strip 1 results in a rise in temperature of the acid on the strip. I have found the temperature to which the acid is raised on its contact with strip 1 is higher when a low density, fine particle, spray is used than when a similar spray of greater density is employed and that under these circumstances the etching effect of the acid is faster with a low density spray than with a higher density spray. It is, of course, well known that the etching speed of acid on metals increases with rising temperature and it is my present belief that the more rapid etching action secured in my machine with a low density spray is the result of the high temperature obtained by the small quantity of acid in contact with the strip and that by increasing the spray density a greater cooling effect is produced by the greater quantity of acid thrown onto the strip. The continuous circulation of the acid from the tank to the reservoirs and from the latter by gravity to the tank tends to retard a decrease in the etching efficiency of the acid contained within the tank.

The acid fumes are conveyed to a point of disposal by a main conduit 90 having a blower 91, the conduit 90 being connected to the tank 50 by the outlet pipe 65, and to the tanks 50a and 50b by similar pipes 65a and 65b respectively.

After having passed the acid tanks as above described, the strip 1 passes through a tank 92 containing water and having a rotatable element 93 therein for throwing a spray against the strip. A major portion of the etching acids are removed by this water spray and the strip then passes through a tank 94 containing a soda solution. In the tank 94 are mounted rotatable elements 95 which, upon rotation thereof, dip into the soda solution and throw a spray against the strip. Any acids remaining after the first washing function are neutralized by the soda. The strip then passes through a tank 96 and is again washed by a water spray created by the rotatable element 97 therein.

The strip, in continuing its movement from the washing tank 96, passes through a housing 98 containing a quantity of water. Submerged in the water in the tank 98 is a steam pipe 99 having outlets for discharging steam through the water into the housing 98. In this housing the temperature of the strip is raised and it then passes into the housing 100 to which a hot air blast is supplied through the conduit 101. The hot air blast thoroughly dries the strip.

From the second run of the strip, which is completed with the hot air blast, the strip passes over a roller 102, of comparatively large diameter, and enters the third and final run. Both rolls 48 and 102 may be idling rolls, that is, with no motive force applied to them other than the friction of the strip as it passes over their peripheral surfaces. These rolls are constructed of a relatively large size for the purpose of reversing the direction of movement of the strip without subjecting it to one or more turns of short radius which would be apt to crack the resist thereon and to otherwise damage the metal. In the present apparatus, however, the rolls 48 and 102 act as driving rolls for the strip and, as illustrated in Fig. 1, are provided with suitable sprockets and are driven through the chains 49 and 102a respectively, sprocket 11 and gear reduction 12 by the electric motor 13. It will be understood that with such driving means, the rate of rotation of the rolls 48 and 102 is synchronized with the normal speed of the strip. During the third run, the strip has its etched surface uppermost, and it passes through a spray booth 103. The spray booth is shown more particularly in Fig. 5, and as there shown has outlets 104 and 105 at top and bottom thereof. Although it is not here shown, it will be understood that the usual air circulating means will be provided to withdraw the spray fumes from the booth through these outlets. Mounted in the booth 103 is a support 106 upon which are mounted spray guns 107, the guns as shown, being of the adjustable type known to the art and available on the market.

As the strip 1 passes through the booth 103 its entire upper surface, that is, the etched surface and the resist treated surface, is coated with enamel of any desired color. The strip then passes through the drying oven 108 and is provided with a second coating of lacquer in the spray booth 109 through which it subsequently passes. The second lacquer enamel coating is dried in the oven 110.

The next step performed by the apparatus is that of removing the resist from the strip. In removing the asphaltum resist, the strip is passed over a roller 111 and downwardly under a roller 112 in a tank containing gasoline or other solvent for the resist. The roller 112 is formed with a surface of soft fibrous material, such as felt, and as it rotates in a direction opposite to the movement of the strip in contact therewith, it submerges the strip in the solvent in tank 113. The strip 1 then passes upwardly and over a roller 114 from which it again extends downwardly to a second gasoline tank 115 and felt roller 116. In its run between the roller 113 and the roller 114 the strip passes between scrapers 116, formed of a bone-like material. An alternative form of scraper which has been found successful comprises a plurality of parallel horizontally arranged cylinder steel bars mounted vertically

one above the other in the path of movement of the strip from the roller 114 to the second roller 112, the strip passing on opposite sides of successive bars and in contact therewith. The strip is, in this manner, treated successively by immersion in gasoline, rubbing with a soft, gasoline saturated roller, and scraped, and after a succession of such treatments, shown by way of example as four, the resist is entirely removed from the unetched surfaces of the strip and such unetched surfaces are exposed in their natural condition. The strip is then dried and polished.

The drying and polishing means comprises receptacles 117 and 118 containing loose sawdust and the strip 1 passes over rollers 119 and under rollers 120 to contact with the sawdust. The strip is finally wound upon a spool or drum 121 which is rotated through a frictional driving connection 122 by a motor 123. The frictional driving connection permits slippage between the motor and drum to compensate for the variation in speed which ordinarily would result from increasing the diameter of the roll of strip while rotating the drum at a constant speed.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various changes may be made within the scope of the appended claims without departing from the spirit of the invention, and such changes are contemplated.

What I claim is:

1. The process of producing an etched metallic strip of greatly extended length which comprises moving a continuous strip of metal in a longitudinal direction and in the course of the movement repeatedly applying an ink design to one side of the strip, applying to said ink design a powdered material capable of forming an acid resist when heated, applying a resist coating on the other side of the strip, applying a resist coating to the longitudinal edges of the strip, heating the strip, all of said steps being performed during movement of the strip, and subsequently subjecting the strip to an acid etching treatment.

2. A method of producing an etched metallic strip of greatly extended length which comprises, moving a continuous strip of metal in a longitudinal direction and in the course of such movement repeatedly applying designs in liquid to one side of the strip, applying to said designs a powdered material capable of fusing and forming a resist when heated, removing excess powdered material from the strip, applying an acid resist coating to the other side of the strip, heating the strip, subjecting the strip to an acid etching treatment, subjecting the strip to a cooling fluid, subjecting the strip to a saline solution to clean the strip, and then subjecting the strip to a water spray to remove the saline solution, all of said steps being performed during movement of the strip.

3. A method of producing an etched metallic strip of greatly extended length which comprises, moving a continuous strip of metal in a longitudinal direction and in the course of such movement repeatedly aplying designs in liquid to one side of the strip, applying to said designs a powdered material capable of fusing and forming a resist when heated, removing excess powdered material from the strip, applying an acid resist coating to the other side of the strip, heating the strip, subjecting the strip to an acid etching treatment, subjecting the strip to a cooling fluid, subjecting the strip to a saline solution to clean the strip, then subjecting the strip to a water spray to remove the saline solution, subjecting the strip to a heated liquid, and then subjecting the strip to an air blast to dry the same, all of said steps being performed during movement of the strip.

4. A method of producing an etched metallic strip of greatly extended length which comprises, moving a continuous strip of metal in a longitudinal direction and in the course of such movement repeatedly applying designs in liquid to one side of the strip, applying to said designs a powdered material capable of fusing and forming a resist when heated, removing excess powdered material from the strip, applying an acid resist coating to the other side of the strip, heating the strip, subjecting the strip to an acid etching treatment, subjecting the strip to a cooling fluid, subjecting the strip to a saline solution to clean the strip, subjecting the strip to a water spray to remove the saline solution, subjecting the strip to a heated liquid, subjecting the strip to an air blast to dry the same, spraying enamel on the strip and then heating the strip to rapidly dry the enamel, all of said steps being performed during movement of the strip.

5. A method of producing an etched metallic strip of greatly extended length which comprises, moving a continuous strip of metal in a longitudinal direction and in the course of such movement repeatedly applying designs in liquid to one side of the strip, applying to said designs a powdered material capable of fusing and forming a resist when heated, removing excess powdered material from the strip, applying an acid resist coating to the other side of the strip, heating the strip, subjecting the strip to an acid etching treatment, subjecting the strip to a cooling fluid, subjecting the strip to a saline solution to clean the strip, subjecting the strip to a water spray to remove the saline solution, subjecting the strip to a heated liquid, subjecting the strip to an air blast to dry the same, spraying enamel on the strip, heating the strip to rapidly dry the enamel, subjecting the strip to a lacquer spray, and then heating the strip to rapidly dry the lacquer, all of said steps being performed during movement of the strip.

6. The method of providing strip metal with ornamental designs or indicia which consists in providing a pattern on the strip with a material having affinity for powdered acid resist, dusting a fusible acid resist of powdered form on the patterned portions of said strip, coating the rear and side edges of the strip with an acid resist held by a combustible solvent, and subjecting the strip to a flame to ignite aid solvent whereby combustion thereof supplies at least a part of the heat for fusing the powdered acid resist.

7. A method of producing an etched metallic strip which comprises, moving a continuous strip of metal longitudinally thereof and during such movement repeatedly by applying designs in liquid to one side of the strip, applying to said liquid designs a powdered material capable of fusing with the liquid when heated to provide a resist to etching liquid, heating the strip to fuse the powdered material and liquid into a resist, subjecting the strip to an etching liquid, cooling the strip, cleaning the strip with a cleaning substance, and then removing the cleaning substance from the strip, all of said steps being performed during movement of the strip.

8. A method of producing a continuous etched strip which comprises moving the strip longitudinally thereof and during such movement re-

peatedly applying designs in liquid on one side of the strip, applying to said liquid designs a powdered material adapted to fuse with the liquid when heated to form an etching acid resist, removing excess powdered material from the metallic strip, applying an etching acid resist to the other side of the metallic strip and simultaneously therewith applying acid resist to the longitudinal edges of the strip, heating the strip, passing the strip through an etching acid bath, passing the strip through a cooling liquid bath, passing the strip through a cleansing liquid bath, passing the strip through a heated liquid bath, subjecting the strip to a hot air blast, enameling the strip, baking the enamel into the strip, applying asphaltum solvent to the strip and finally drying the strip.

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