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APPARATUS FOR DECORATING

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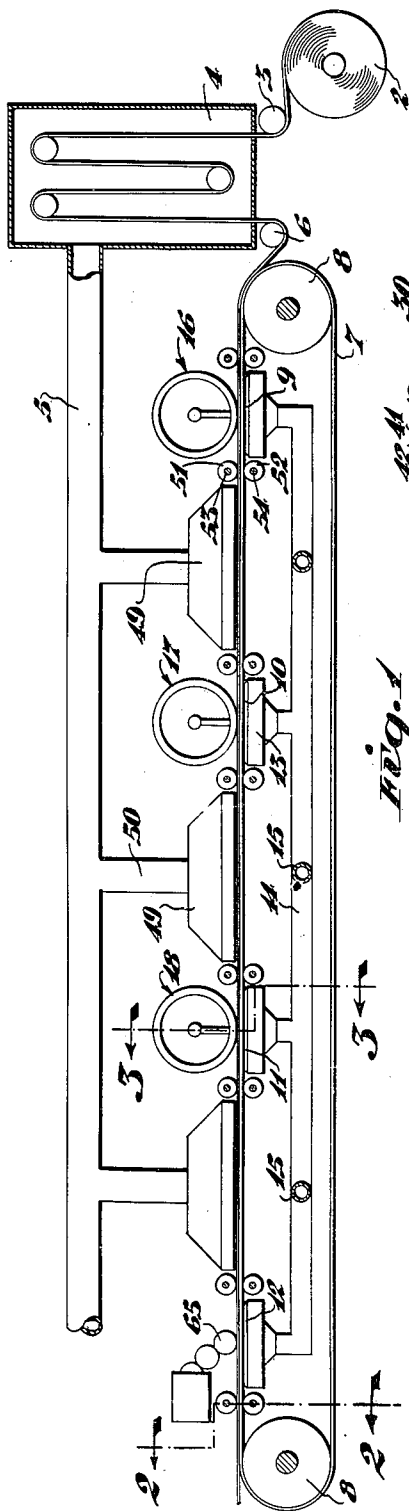


Fig. 1

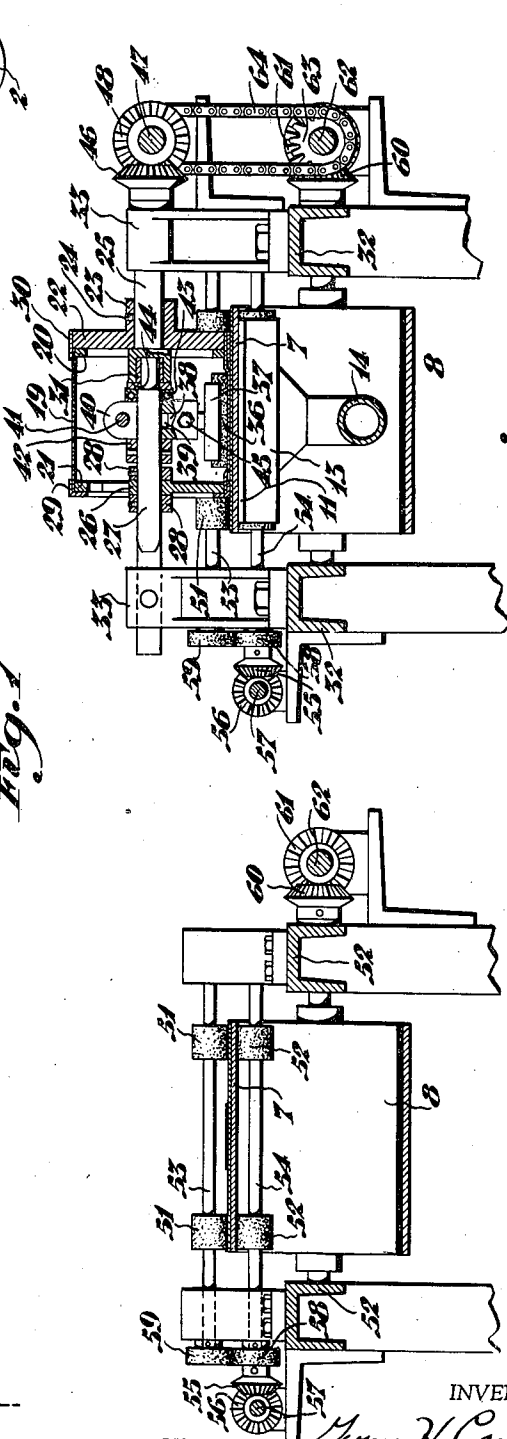


Fig. 2

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APPARATUS FOR DECORATING

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2 Claims. (Cl. 101—115)

This invention relates to the decoration of ceramic surfaces and is directed particularly to a process for applying designs to them. The invention has particular utility in the manufacture of chinaware, glassware, pottery and other ceramic articles upon the surface of which it is desirable to apply and fuse a design either before or after glazing. The invention also is adapted to be used in the application of cold colors to non-vitreous surfaces.

The principal object of the present invention has been to provide an improvement in the transfer tissue process of decoration. In this process, as it is practiced conventionally, ceramic coloring material in the form of a stiff and sticky ink-like substance is applied to thin transfer tissue by means of a printing roller. The tissue having a decoration applied to it is then placed face down upon the surface to be decorated, the ink or decorative material remaining sufficiently sticky to adhere firmly to the surface of the ware. Later on the tissue ware is soaked in a water bath and the tissue is stripped off leaving the decoration on the surface. After drying the ware is ready to be fired.

The chief difficulty with this process has been the tremendous expense involved in preparing suitable printing rollers. These must be engraved by hand and the preparation of one roll often takes from three to four months and sometimes as long as six months. Obviously, so much is invested in one roll that decoration designs or motifs cannot be changed very often and frequently a given design continues to be reproduced upon the ware even though it has long become outmoded. Moreover, only single color decorations can be applied by this process.

More recently decalcomanias containing ceramic coloring material have been proposed but the cost of printing these is considerably greater than the cost of printing upon tissue from a printing roll, discounting the original cost of the roll itself. Multicolor decals have not been satisfactory on the whole, the principal difficulty residing in obtaining registration and freedom from the formation of blisters in firing. Moreover, decals which have been stored for some time before being used are dried out and become so brittle that it is very difficult to work with them.

I have discovered that multicolor designs having good decorative value can be produced quickly and inexpensively by applying these designs upon tissue, not through a printing roll or by a printing process but by forcing the colors

through a screen stencil one after another. The screen stencil is a membrane made of silk, tulle, bolting cloth or wire screening in which the openings are very small. The non-design areas of the screen are rendered impervious either by attaching a non-porous membrane to the screen or by filling the portion with material such as shellac or lacquer, gelatin or other suitable washing materials. The color which is of fluid, and preferably of a stiff or pasty consistency, is deposited upon the screen and forced through the openings thereof in the design areas onto the tissue. For producing multicolor designs screens corresponding to the designs of each color are utilized.

I have discovered, more specifically, that the nature of the decoration deposited from a screen upon a piece of tissue or transfer paper is of such character that these colors may be superimposed or registered without difficulty, provided the tissue or transfer paper be held firmly upon a surface while being stencilled upon through the screen. Heretofore, moreover, one principal difficulty in applying multicolor designs upon transfer tissue has been in obtaining registration or alignment of the different colors constituting a design. Tissue of the type ordinarily employed in the transfer process is very susceptible to humidity conditions; it is so thin that the least variation in the moisture content of the air is reflected in a change in the dimensions of the paper. If the tissue be laid aside for a period of an hour or so after the first color has been applied and before the second is applied, the change in atmospheric humidity conditions may and usually is sufficient to cause the paper either to shrink or to expand appreciably. However, in accordance with the process of the present invention the tissue is conditioned and reconditioned before each color is applied and therefore is of given dimensions throughout the decorating period.

More specifically, it has been discovered that transfer tissue and the transfer papers of the type ordinarily employed are so thin that they all respond quickly to any heat to which they may be subjected, and that the moisture content of papers so heated under controlled conditions will be uniform substantially regardless of atmospheric humidity. Otherwise expressed, the moisture content and thus the dimensions of a given unit area of the paper are brought to a given value prior to the application of the first color, and these dimensions are maintained by reconditioning the paper in similar manner

so often as is necessary as, for example, by heating the paper after each color has been applied to it.

The heating of the paper besides controlling its moisture content serves the additional purpose of accelerating drying of the decorative material to such a degree that the decoration may be applied from stencils to an advancing web of sheet material, the stencilling apparatus for the application of the respective colors being driven in unison for registration of one color with the next. Following each stencilling step the color applied by that step is dried sufficiently to enable the next successive color to be applied. The heat to which the paper is subjected is effective in expelling any volatile solvents present in the decorative material and also to restore the paper or the tissue to its original moisture condition. The warm surface of the paper causes the ink to become warmed and therefore a more even application of ink upon the paper is obtained. This result also enables printing materials which are of a relatively tacky consistency to be used satisfactorily; the heat enables the tacky screening material to release itself from the screen very easily.

At this point the difference between the silk screen process and hand printing process of decoration is made most apparent. In a printing process it is requisite that the first color be substantially completely dried before the next can be deposited, otherwise smearing and blurring occur and some of the colors are dislodged and picked up by the printing roller because of the pressure exerted upon it by the tissue. With the screen process of decoration, however, the applied decoration may be in an almost tacky condition without encountering any of these difficulties by virtue of the fact that the screen is a porous member, and the screen is yieldable so that it does not exert a positive squeezing pressure on the decoration previously applied. The porous nature of the screen relieves the pressure and prevents the squeezing action. As many colors as desirable are applied by this process, for example, three or four. Thus, while the process conforms in some respects to the conventional tissue method of decoration, it differs in that it enables multicolor designs to be applied to ware and registration of the colors to be easily obtained. It is also to be observed that the screen process enables a thick layer of color to be deposited in the design areas. In order to effect this result by lithographic methods or by printing from a plate, it will be necessary to print the color several times to get the proper depth.

The cost of preparing screens is but a fraction of the cost of preparing printing rolls or printing plates or stones of the type used in printing decalcomanias.

A typical apparatus adapted for the practice of the process on a commercial scale is shown in the drawings and, from the foregoing description of the principles upon which the invention is predicated and from the detailed description which follows, those skilled in the art readily will comprehend the modifications to which the process is susceptible.

In the drawing, Figure 1 is an elevation showing a typical apparatus.

Figure 2 is a sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a sectional view taken on the line 3—3 of Figure 1.

As shown in Figure 1 paper is supplied from a

roll 2. This paper may be of conventional tissue type which is thin, fragile and almost transparent, or it may be paper of the type used in the preparation of decals, or it may be so-called duplex decalcomania paper comprised of two laminations, one being adapted to be stripped from the other when the design is to be applied.

Paper from this supply roll passes over the guide roll 3 into a heated chamber 4 wherein it is preferably festooned. The chamber 4 is provided with suitable heating elements such as electric coils or steam tubes and provision preferably is made so as to hold the temperature within this cabinet as uniform as possible and at a degree sufficiently high to substantially reduce the normal moisture content of the paper. The temperature depends upon the rate at which the tissue is passed through the cabinet, the humidity conditions ordinarily encountered in the vicinity of the machine, and the nature of the paper. The paper preferably enters and emerges from the cabinet through relatively narrow slits and it has been found desirable to maintain a negative pressure on the cabinet as through the suction manifold 5.

Upon emerging from the cabinet 4 the paper passes over a guide roll 6 and onto an endless belt 7 carried by rolls 8—9, one at each end of the machine. The belt 7 is made of a porous material or may contain apertures throughout its surface so arranged that a suction applied at one side of the belt is manifest at the other side. It is also desirable that the outer surface of the belt upon which the paper rides be relatively smooth.

The belt travels across a plurality of platens 9, 10, 11 and preferably 12. Each of these platens corresponds to a station at which decoration is applied upon the paper. The platens 9 to 12 are flat surfaces and these also are preferably constructed of a porous material such as fine mesh porous screen, perforated metal or the like, and they are supported upon hollow tables designated 13 with a manifold 14 interconnecting all of the hollow tables. When vacuum is applied upon the manifold as, for example, through the ducts 15, which may be led therefrom at suitable intervals and connected to a suitable vacuum source, negative pressure occurs at the surfaces of the platens so that the belt 7 is held upon the surfaces. The vacuum manifest at the outer surface of the belt 7 holds the paper on the belt by suction and, with a relatively slight tension applied upon the paper passing over the guide roller 6, the paper remains in smooth flat condition, free of wrinkles during its conveyance by the belt past the respective decorating stations.

The decorating stations are indicated generally at 16, 17 and 18, one corresponding to each color to be applied. As many such stations as may be necessary to enable completion of the application of the decoration on the tissue are provided. Each station may correspond to a given color or in certain instances the same color applied at one station may later be applied at another part of the design at a following station.

Each of the decoration devices 16, 17 and 18 is constituted by a stencil membrane which is pervious in a predetermined portion of the design, and a squeegee for forcing coloring material applied upon the stencil membrane therethrough onto the paper carried by the belt. These stencilling units are preferably driven in unison and are so arranged with respect to one another that a portion of the design applied at the second sta-

tion or third will register with a portion of the design previously applied respectively at the first or second station provided no change takes place in the paper dimensions. One suitable arrangement for preventing such change is described at a later point in the specification.

In the preferred embodiment the stencil membranes are of circular contour or of drum-like configuration and are indicated at 19, the stencils being appropriately supported on spiders 20 and 21. The spider 20 is carried from a disc 22 having its hub 23 mounted on a rotatable shaft 25, while the spider 21 has its hub 26 rotatably journaled upon a stationary shaft 27, with collars 28—28 located at each side of the hub 26 to maintain the proper tautness in the stencil membrane 19. The stencil membrane is held upon the outer peripheries of the spiders 20 and 21 by means of a flange 29 and a plate 30 respectively. This arrangement by which the drum is driven from one side is suitable where the width of the stencil membrane is not very great. For the application of very wide designs it may be desirable to drive the drum from both sides to avoid any tendency of the undriven end of the drum to drag with respect to the driven side. In place of the drum type stencils which have been disclosed in the drawings, the apparatus may embody flat stencils if desirable.

As shown in Figure 3 the peripheral stencil fastening members 29 and 30 track upon the surface of the tissue which, in turn, is carried by the endless belt 7. The shaft 27 is a stationary shaft having its end counterturned to reside in a sleeve bearing 31 which, in turn, is housed within an enlarged portion at the inner end of the shaft 25. At each side of the machine upon longitudinal frame members 32 support blocks 33 are provided, the shaft 27 being mounted stationarily in one of these and the shaft 25 being rotatably journaled in the other.

A squeegee 36 is stationarily supported from shaft 27 with its lower edge positioned to press upon the surface of the stencil membrane along a line of contact so as to force color material through the openings in the design area of the stencil membrane onto the paper. In the preferred structure squeegee 36, which preferably is a stiff Celluloid or spring steel member, is carried within a groove in a bar 37 which, in turn, has a shank 38 extending upwardly from its central portion into a slot 39 provided in a split collar 40. A bolt 41 passes through the split portion of the collar so that it readily may be clamped to the stationary shaft 27. A collar 42 is located at the one side of the split collar 40 and a thrust bearing 43 is carried at the other side for abutment against a plate 44 which, in turn, is in abutment with the inward end of the enlarged portion of the rotatable shaft 25. It will be seen that by unloosening bolt 45 the position of the squeegee with respect to the stencil membrane may readily be adjusted. It is desirable that the stencil membrane be pressed beyond its normal peripheral path in passing the squeegee. In this manner the stencil is stripped from the decoration as soon as the color material has been applied upon the paper.

The rotatable shafts 25 of each stencilling unit carry bevel gears 46 beyond the respective journal blocks 33 and a drive shaft 47 extending along the stencilling apparatuses 16, 17 and 18 is provided with gears 48 for mating with the respective gears 46 so that all stencil drums are

driven in unison. Set screws 24 in the hub 23 enable the stencilling drums to be adjusted, rotatably, for alignment of the designs applied from the stencils which they carry.

Intermediate each of the stencilling membranes the belt and the paper carried by it pass beneath heated hoods 49. The heat provided by these hoods reconditions the paper so as to restore it to its original condition. The hoods are heated by steam, electrical coils or other means and the temperature maintained therein is so adjusted, with respect to the temperature and humidity to which the paper originally was subjected, as to bring the paper to the same moisture humidity and dimension conditions which it had during the period the preceding stencilling design was applied to it. It is desirable that a negative pressure be maintained upon these hoods so as to facilitate the removal of any vapors driven from the decorating material, and for this purpose each hood is provided with an exhaust manifold 50 which may be interconnected with the exhaust manifold 5 from the conditioning oven 4.

At the entrance and approach to each stencilling apparatus sets of rolls are provided to hold the paper firmly in contact with the conveyor belt 7. The rolls indicated at 51 and 52 are positioned adjacent the edgewise portions of the paper and are carried on shafts 53 and 54 respectively. The shafts 54 are positioned beneath the endless belt 7 in such manner that the peripheries of the rolls carried thereby are in substantially the same plane as the surfaces of the platens 9. The shafts 54 are rotatably journaled in the blocks at opposite sides of the machine, each shaft at one side carrying a bevel gear 55 for engagement with a mating bevel gear 56 carried by a shaft 57 extending longitudinally of the machine so that all of the rolls may be driven in unison. Each of the shafts 54 inwardly of the bevel gears 55 carries a friction drive roller 58 and this drive roller, which may be of rubber or the like, frictionally drives a corresponding drive roller 59 attached to shaft 53. The friction drive permits paper to move slidably upon the roll during the application of coloring material thereto or during reconditioning of the paper. Each edgewise roller 8 on which the endless belt is carried is provided with a bevel gear 60 which is in contact with the mating bevel gear 61 carried on a shaft 62. The shaft 62 is provided with a sprocket 63 which, in turn, is driven through a chain 64 from the shaft 47, the drive being such as to move the belt at a rate of speed corresponding to the rate of rotation of the stencil membrane.

After the application of color at each decorating station the paper is reconditioned and the heat to which it is subjected effects drying of the applied decorating material. The rate of movement of the paper through the apparatus is so adjusted that the time elapsed from the application of one color until the application of the next is sufficient in accordance with the temperature maintained at the conditioning hoods to dry the coloring material to such a degree that the next successive color may be applied to it without smearing or blurring. This condition need not be a condition of bone dryness as heretofore requisite. By virtue of the porosity and nature of the stencil membrane and by virtue of the line contact of the stencil membrane with the applied film of decoration the

film may be in a somewhat tacky condition without causing smudging of the color previously applied.

In some instances it is desirable to apply a decalcomania varnish over the decoration so that the decorated tissue can be cut into sections and the designs applied to ceramic ware in the form of decalcomanias. For this purpose conventional roller coater apparatus 65 may be located following the last heating station. This apparatus is shown diagrammatically and may be of any sort suitable for applying a thin film of varnish over the paper and over the decoration thereon. It is desirable also to provide a platen beneath the traveling belt to support the belt and to hold the belt on the paper during application of the varnish.

In this event it is desirable that the temperature in the last hood be held at a somewhat higher degree than the preceding hoods to facilitate drying of the applied decoration. In the alternative, the application of varnish may be omitted and the temperature condition in the last hood so adjusted as to leave the decoration in a tacky state so that the decorated tissue can be severed into sections and the decorations thereon applied directly to the ware by virtue of the tackiness of the decoration. In either case the conventional procedure is followed, that is, the decoration is placed upon the ware and the tissue is separated by soaking it off with water.

Having described my invention, I claim:

1. Apparatus for applying designs in multi-color upon transfer material, comprising a plurality of platens each corresponding to a color to be applied, apparatus including a stencil membrane and a squeegee passing decorative material therethrough located above each platen, means for maintaining a negative pressure at the surface of each platen, a belt arranged to travel over the surface of each of the platens beneath the stencilling apparatus thereabove for conveying

transfer material to the respective stencil apparatuses, the said belt having openings therein whereby the negative pressure maintained at the platen surfaces is exerted upon the paper disposed on said belt to hold said belt in position during stencilling, means for conditioning the paper to establish predetermined dimensions for a given unit area thereof, said means being located prior to the first stencilling apparatus and means intermediate the other stencilling apparatus for reconditioning the paper by heating it to reestablish the predetermined dimensions of such given unit area of the paper carried on the belt.

2. Apparatus for applying designs in multi-color upon transfer material, comprising a plurality of platens each corresponding to a color to be applied, apparatus including a stencil membrane and a squeegee passing decorative material therethrough located above each platen, means for maintaining a negative pressure at the surface of each platen, a belt arranged to travel over the surface of each of the platens beneath the stencilling apparatus thereabove for conveying transfer material to the respective stencil apparatuses, the said belt having openings therein whereby the negative pressure maintained at the platen surfaces is exerted upon the paper disposed on said belt to hold said belt in position during stencilling, means for conditioning the paper to establish predetermined dimensions for a given unit area thereof, said means being located prior to the first stencilling apparatus and means intermediate the other stencilling apparatus for reconditioning the paper by heating it to reestablish the predetermined dimensions of such given unit area of the paper carried on the belt, with the said stencilling apparatus being driven in unison for registration of the coloring materials applied to the paper through the stencil membranes thereof of the stencilling apparatus.

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