April 24, 1951 E. C. V. OLDOFREDI 2,549,847

METHOD OF AND MEANS FOR PRODUCING DECORATED MATERIAL

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Fig. 1.

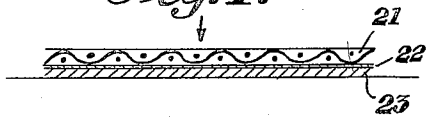


Fig. 2.

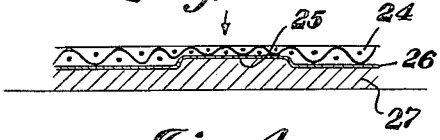


Fig. 3.

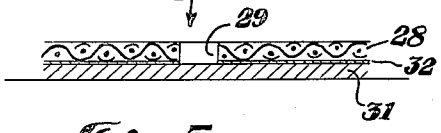


Fig. 4.



Fig. 5.

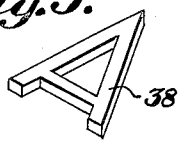


Fig. 6.

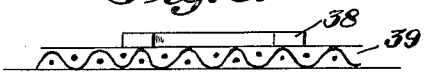


Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

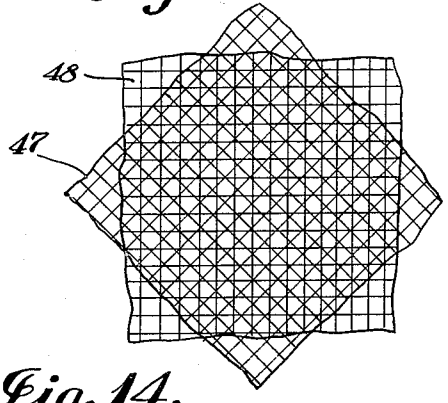


Fig. 11.

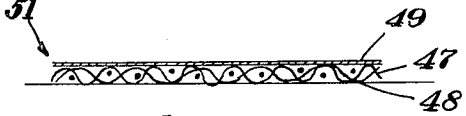


Fig. 12.

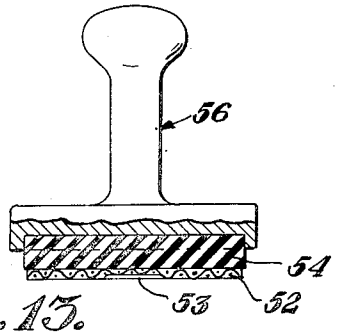


Fig. 14.

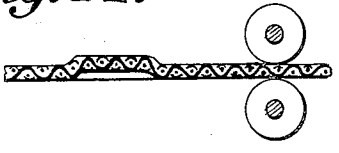
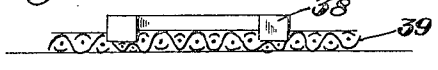


Fig. 15.



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Fig. 15.

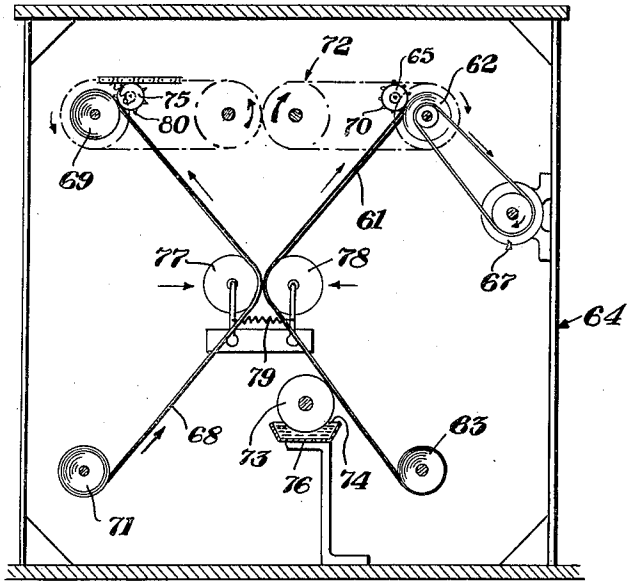


Fig. 16.

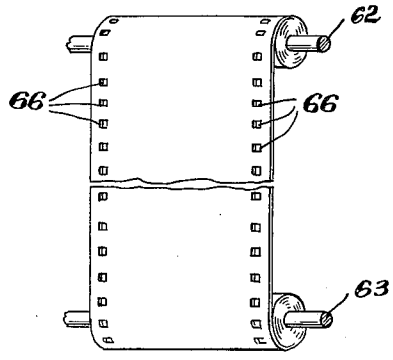
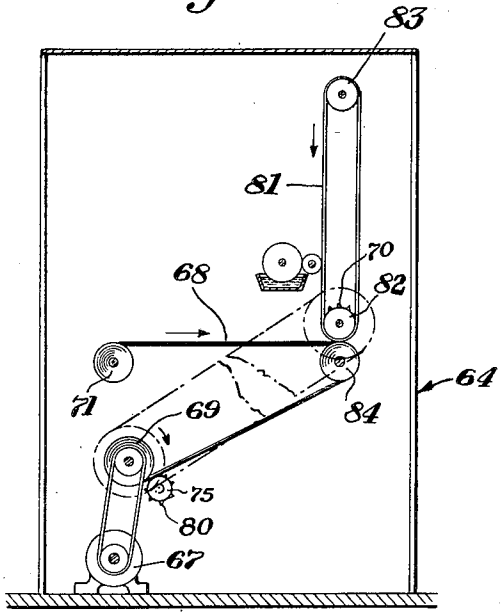


Fig. 17.



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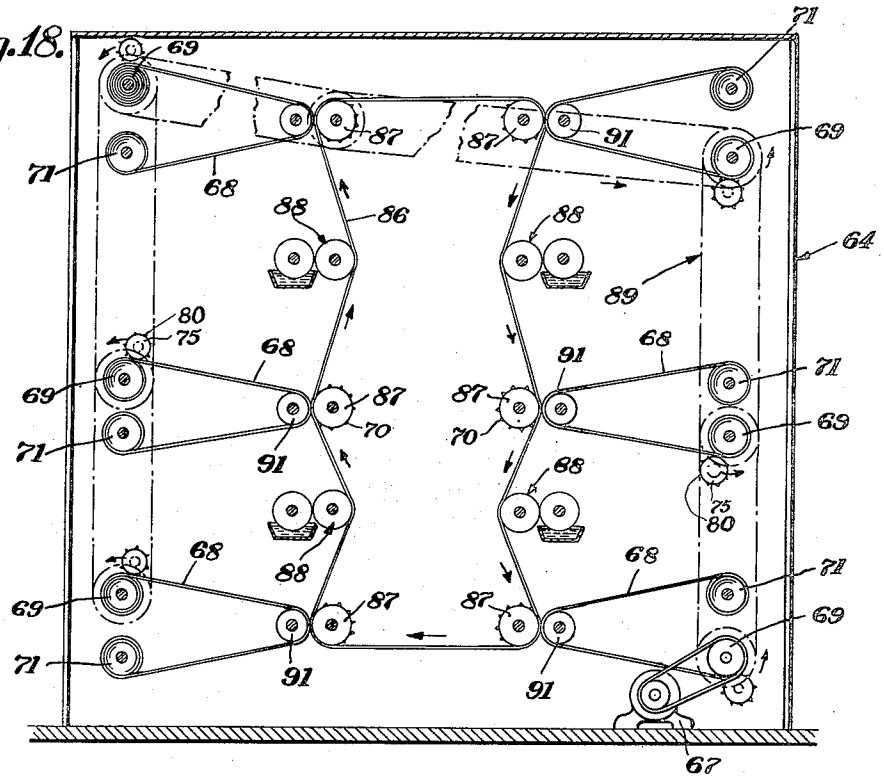
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METHOD OF AND MEANS FOR PRODUCING DECORATED MATERIAL

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Fig. 18.



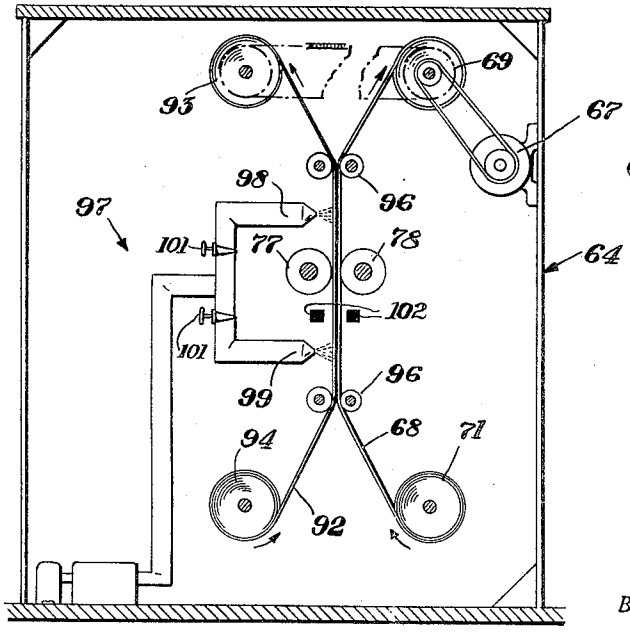


Fig. 19.

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UNITED STATES PATENT OFFICE

2,549,847

METHOD OF AND MEANS FOR PRODUCING DECORATED MATERIAL

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Application December 4, 1944, Serial No. 566,430

6 Claims. (Cl. 101—32)

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This invention relates to methods of, and means for, producing decorated materials and relates more particularly to methods of, and means for, decorating materials by printing with ink on the same or by reproducing a three-dimensional design thereon, such as produced by embossing, debossing, etc., or by combining printing with a three-dimensional design on materials.

This is a "continuation-in-part," reference being had to my pending application, Ser. No. 429,298, filed February 2, 1942, now U. S. Patent No. 2,370,186 dated February 27, 1945.

The principal object of my invention is to provide methods of, means for, and machines for, printing materials.

Another object is to provide methods of, means for, and machines for, combining the reproduction of a three-dimensional design onto a final material simultaneously with printing thereon.

Another object is to provide methods of, means for, and machines for, decorating material and simultaneously subjecting it to additional treatment, such as heating, cooling, dampening, spraying, etc.

Another object is to provide a printing machine with continuous run.

Another object is to provide a method of working a three-dimensional design onto a final material and producing thereby a novel effect in the appearance of said material.

Another object of my invention is to provide means for working a design into a final material.

A further object is to provide a method of producing a design which comprises the impressing of said design into a screen by depressing a portion of its surface, corresponding to the area and contour of the design, and thereafter reproducing said design therefrom onto a final material.

A further object is to provide an article for reproducing a design on a final material, said article being inexpensive and substantially indestructible.

A further object is to provide an article for reproducing a design on a final material, said article being light in weight and small in size.

A further object is to provide such an article, which will be easy to clean and to protect from corrosion.

A further object is to provide methods of producing a design, which comprises a succession of steps, each one of which may be made easily and speedily, and for each of which unskilled labor may be employed to carry out the same.

Still a further object is to provide an article into which a number of designs may be formed

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successively, and which may be utilized to reproduce all of the designs simultaneously on a material.

Further objects and advantages of the invention will be, in part, set forth in the following specification and, in part, will be obvious therefrom without being specifically pointed out.

The art of letterpress printing heretofore has utilized various kinds of solid metal dies for the reproduction of lettering and designs. Printing plates were made of zinc, copper, or special alloys; photo-mechanical and etching methods are used for their manufacture; electrotypes and stereotypes are employed for duplicating them, and, for rotary printing purpose, metal shells or metal cylinders are provided.

Since wood cuts, plastic and rubber plates are suitable for special applications only, the present art uses, almost exclusively, solid metal forms that are heavy and non-flexible; their manufacture is slow and expensive.

On the other hand, embossing, debossing, indenting and perforating, as well as any other three-dimensional marking, was done with brass or steel relief dies and corresponding female dies, both either in plate form for flat bed pressing or, for the use on steel rolls, the pattern or design being engraved or partly etched into the male die. Typecast types, photo-engravings, woodcuts, electrotypes, etc., have been used for light embossing on soft materials, but such substitutes do not insure satisfactory results on finer jobs due to the softness and deformability of finer lines. All such dies are not sufficiently rigid and strong; they soon wear out and cannot be re-engraved. Therefore, the commonly used method throughout the related arts consisted in applications of the Gaufrage process, using as male dies engraved steel cylinders working against a female or counter roll, which are usually made of papier-maché or cotton. The pattern has to be worked into the latter by an initial operation of dampening and rolling-in the male die. For heavy work, such as metal sheet rolling or high class work on other materials, a pair of engraved steel rolls is necessary. In light embossing or short runs, such as book covers, seals and similar paper work, brass types and brass dies are used. In most embossing, debossing and indenting work, heavy pressure is required, necessitating expensive machinery. Heat, dampening and other auxiliary methods are employed to facilitate the forming.

Softer metals, such as copper, brass and zinc, can be routed by hand-operated, motor-driven machine; such cylinders can only be used on

softer materials and finer parts have to be finished by hand.

Steel or other hard metal dies have to be engraved by hand or hand-operated apparatus or pre-etched and then finished by skilled labor.

Thus, in the present art, expensive material and work is required in making any kind of die for printing or for embossing, indenting or perforating. Considerable working time is required in preparing a more intricate pattern, as only one engraver at a time can work on each cylinder. These factors make it prohibitive to provide embossed patterns for short runs, and individualization and styling of the designs, as well as seasonal and fashionable changes, are rendered very difficult.

In the present invention, however, a mesh or fabric is used as a die for printing and for the purpose of reproducing a three-dimensional design. The mesh may be made of metal wires, or of plastic threads, or of threads of other material.

For some purposes, the fabric may be used as printing die without special preparation, for printing the surface of a material with a simple fabric pattern or such other screen or pattern as the weaving of the mesh may have inherent.

The mesh die, and particularly the type of mesh die made of threads of hard and resilient material, such as metal wire, or plastic, fibre, glass thread, or a combination thereof, may be subjected to the impression of a design by methods related further below, for providing a formed mesh die having a compacted design area.

With such a formed mesh die, decorating, e. g. printing, or three-dimensional reproduction of a design, may be performed, and results may be obtained at a low cost, compared to the great expense resulting from the use of methods and means known in the present art.

Printing with such a formed mesh die reproduces a light design on dark screen background.

With the above and other objects of the invention in view, the invention consists in the novel methods, construction, arrangements and combination of various elements, machines, devices, and parts, as set forth in the claims hereof, certain embodiments of the same being illustrated in the accompanying drawings and described in the specification.

In the accompanying drawings,

Fig. 1 is a sectional view of a mesh in its application as a printing die;

Fig. 2 is a sectional view similar to Fig. 1, showing a mesh die having a design formed therein, embossing and simultaneously printing a material;

Fig. 3 is a sectional view showing a printing mesh die, having an aperture corresponding to a design, applied to a material;

Fig. 4 is a sectional view showing a printing mesh die "sandwiched" between two materials to be decorated;

Fig. 5 shows the drawing of a design, the letter "A" having been selected for purpose of illustration;

Fig. 6 is a front elevation showing a mesh in cross section, having the same letter "A" placed on its top;

Fig. 7 is a front elevation similar to Fig. 6, with the letter "A" embedded in the fabric;

Fig. 8 is a sectional view similar to Fig. 6, but showing a coating on the surface;

Fig. 9 is a sectional view showing a formed mesh die having a compacted design area and a surface coating;

Fig. 10 is a top view showing two wire fabrics, at an angle of weaving to each other and closely entwined, with a coating of metal thereon;

Fig. 11 is a cross section taken along line 11—11 of Fig. 10;

Fig. 12 is an elevational view, partly in cross section, showing a stamp with a mesh die at the bottom;

Fig. 13 is a front elevation showing a mesh in cross section and the design "A" impressed thereon;

Fig. 14 discloses an embossed mesh die engaged by two flattening rollers;

Fig. 15 is a schematic illustration of a printing press for continuous printing, using a band of formed mesh as printing die (well known features of a printing press not being shown);

Fig. 16 is a perspective view showing a printing mesh die band with holes along its borders;

Fig. 17 is a schematic illustration of a printing press similar to Fig. 15, but showing an endless printing mesh die band;

Fig. 18 is a schematic illustration of a printing press for printing a plurality of materials simultaneously; and

Fig. 19 is a schematic illustration of a printing press similar to Fig. 15, additionally disclosing a spraying device and a heating element.

In the description of the drawings in which similar numerals designate similar parts throughout, 21 indicates a printing mesh die made of metal wire or of threads of other material covered on one of its surfaces with a printing ink 22 and in contact with a material 23 to be decorated. This type mesh will only be used as die where the printing of an ornamental pattern is desired, as the mesh die 21 was left unprocessed and only its inherent weaving pattern may be reproduced.

For decorating a material with a three-dimensional design, such as embossing, debossing, etc., or a combination of printing with embossing, etc., a formed mesh die made of metal wire or of threads of other hard and resilient material has to be used. The mesh die has to be processed before being applied for reproduction. A design has to be worked or impressed into the mesh, which may be done by a number of methods, some of which are outlined below.

Impressing a design into the mesh may be accomplished in various ways according to the intricacy of the design involved and its dimensions. The following discloses a few of the numerous methods which have been found effective, and it is understood that similar results may be reached in many other ways without departing from the spirit of the present invention within the scope of the appended claims.

Designs consisting of plain outlines, signatures, etc., may be worked by hand directly into the fabric. This can be done by using carving tools, chisels, or by a power-driven router, an abrasive mounted wheel, or a rotary file.

Plain letters, signatures, simple trade-marks, etc., are cut out from plywood, cardboard, fibre or sheet metal, and used as masters for a subsequent reproduction into the mesh (see Fig. 13). These masters are applied as a punch for pressing into the fabric by any suitable means, such as a roller press apparatus, or the like. Thus, the design is reproduced into the fabric with all its details.

For the reproduction of ornaments even simpler means are available. Any suitable article of metal, such as a straight rule, a circle, square, etc.,

may be used as a master for pressing an ornament into the fabric.

It is possible to provide large size formed mesh dies at an amazingly low cost by repeatedly impressing the same master into the mesh. This is considered an important advantage of this process.

By preparing a set of letters, any combination of lettering may be composed and thereafter reproduced into the mesh. Such master alphabets may be used repeatedly, thus providing an inexpensive means of simple reproduction.

Another simple way of producing a formed mesh die consists in hand-composing the required copy or in providing a typecast master by machine typesetting. This master is then impressed into the fabric and the same composition may be used over and over again for making any desired number of printing mesh dies or for impressing one fabric all over. Stock cuts, foundry borders, or machine borders, may be used in the same way.

Designs may be incorporated directly into a brass or copper fabric by applying photo-mechanical methods, following the usual procedure of related arts. Sensitizing the surface of a dense fabric and etching the same may be accomplished in the way a line-cut is photo-engraved, a method which is well known to those skilled in the art. The resulting etched mesh die will not show any compacted design area, but will show a design recess which will reproduce said design.

When lettering only is required, the easy impressability of the fabric renders possible the use of a lettering device similar to an electric typewriter. The flexibility of the fabric permits its insertion into the machne in the same way a sheet of paper is inserted into a typewriter. Instead of a rubber roll, a non-resilient fibre or metal carrier is necessary as a backing, and its length will have to be equivalent to the width of the fabric to be impressed. A holding fixture will facilitate the insertion of long sheets and the rolling up after processing.

In addition, any of the usual embossing methods may be used to impress a design into the mesh die and for imparting a design area therein.

While the above methods refer to special cases, it will be practical, for general purposes, to provide as master a zinc-etching which is prepared in the usual way. Light etching only is required and the cut does not have to be routed or blocked. This master is put face to face with the fabric and the whole subjected to pressure.

In Fig. 2, a fabric **24** is shown having a design **25** formed therein by one of the hereinabove mentioned or by similar processes, and covered with an ink **26**; a material **27** is shown to which the three-dimensional design reproduction as well as the printing reproduction is being applied.

Instead of depressing the surface of a wire fabric or providing a recess therein for the purpose of printing, a design may be cut out therefrom leaving a fabric **28**, as shown in Fig. 3, having an aperture **29** corresponding to a design area. When contacting a material **31**, to be printed with an ink **32**, only the mesh surrounding the design will appear in a printed pattern, the design area itself, however, will be left blank.

In Fig. 4, a mesh die **33** is shown having design-depressions symmetrical to and opposite each other, the die being inked on both surfaces and "sandwiched" between on upper and lower piece of material **34** and **36**, respectively; an ink is designated **37**.

The ink is applied by means of rollers or others inking means to the surface of the mesh die; subsequently, the inked mesh die is put in contact with the material to be printed and the whole is subjected to pressure.

A letter "A," having been selected for purpose of illustration of a design and shown in Fig. 5 in perspective, may be secured to one surface of a fabric, as shown in Fig. 6. As disclosed in this figure, a material, such as a letter "A," designated **38**, may be secured to a mesh die **39**, by soldering it thereon if the mesh be made of metal wire, or mounted thereon by other suitable means. However, the mesh die **39** may also have a design connected to its surface by means of sewing or embroidering the same directly thereon, using a thread of wire, or other suitable material harder than the mesh. Such sewing or embroidering may be done by hand or by means of a suitable machine; for embroidering, a Bonnaz machine can be used with excellent results. In a subsequent operation, the design **38** is thereafter pressed into the mesh **39** as shown in Fig. 7, by running it through pressure rollers, until the outline of the design **38** is substantially flush with the surface of the mesh **39**.

In the following decorating process the design **38** will leave an impression on the material which differs from the screen impression created by the surrounding fabric **39**. If ink is applied to the surface of the die, the amount, continuity and shading of the ink deposited by the surface of the design **38** will be distinctly different from that of the fabric **39**.

Various methods are applicable for rendering these mesh dies more resistant to wear and tear so that they may be used for a long period.

If steel wire mesh is used, the finished printing mesh die may easily be hardened and tempered by ordinary heat treating. Printing mesh dies of softer metals, such as copper, brass, etc., can be prepared for long runs by various coating methods, thereby providing a mesh die having a coating.

The well known metal spraying or metallizing process provides a practical means for coating the printing mesh die by spraying it with suitable liquid metal, either by using for spraying a wire of the same metal the mesh consists of, or by employing wire of a harder metal.

Electroplating is another simple and inexpensive means for coating either the entire fabric surface or, for protecting the design area only, by covering the rest of the mesh with wax or stop-off lacquer.

Furthermore, the mesh die may also be coated by dipping it into a liquid metal bath after applying flux.

Still further forms of coating the printing mesh die consist in laminating or spraying with an acetate or plastic coating.

Any of these hardening, coating or covering methods will provide additional toughness and wear resistance for heavy duty without impairing the flexibility of the mesh. At the same time, they will improve the reproduction by protecting the fabric against distortion that may occur in long runs.

The thickness of deposit in plating can be controlled according to the requirements of the job. A heavy deposit will cover up the screen pattern on a finer mesh, resulting in a solid background effect. On the other hand, on a coarse fabric a heavier screen design is created corresponding to the mesh and the thickness of deposit.

Since the basic mesh used for these formed

mesh dies may be selected from a wide variety of standard grades ranging from finest to coarse, the reproduction will show any desired screen. This process, therefore, offers an inexpensive way for reproducing a screen pattern in combination with any design or lettering, replacing the Ben Day or similar shading mediums.

Such coating with metal or other hard surface may readily be applied to a fabric 41 carrying the design 38 connected thereto, as shown in Fig. 8, covered all over by a thin, hard spray-coating 42. A coating of this type may be applied before or after the embedding of the design into the fabric, and in either phase the die may be used for printing or other decorating. In Fig. 9, a coating 43 of the above type is shown on a formed mesh die 44 having a design depression 46.

An entirely different type of printing die may be made by placing a wire fabric 47 on top of another wire fabric 48, at an angle of weaving, and subsequently pressing the same into each other until they are closely entwined, and thereafter subjecting this composite die to a coating of metal 49.

A die 51 of this character (see also Fig. 11) may thereafter be subjected to design impressions by one of the methods hereinabove described for incorporating a design, resulting in a formed die for reproducing an appealing watered silk (moiré) pattern and many novel patterns. The characteristics of this pattern change according to the angle of weaving of both fabrics.

If more than two fabrics are employed in this way, the resulting fancy pattern will be even more intricate and appealing in appearance.

An infinite number of patterns are made available by this method, because any two or more of the multitude of different standard meshes may be combined with each other. This unlimited range of available combinations of patterns makes this simple method particularly suitable for application to imprints on blanks for safety papers, documents, etc., as a means of protection against duplication, alteration or counterfeiting.

If a formed mesh die is used as top mesh, its combination with such a plain mesh will result in a reproduction showing the design on an ornamental background of watered silk or other fancy pattern. An unlimited variety of such backgrounds being made available, the combination of a design, trade-mark or lettering with a unique background is afforded which offers an excellent means of individualization and identification.

For best results, it will be practical to use different grades of mesh for each layer and to provide as backing or bottom mesh a fabric made of a softer metal than the top wire fabric. In a three-layer-arrangement, for instance, the bottom may be copper wire mesh, the in-between-layer brass or aluminum fabric, and the top layer phosphor-bronze or Monel wire mesh. The compacting of such layer-arrangement of fabrics in different degrees of metal hardness may be done in any suitable manner by a separate operation, such as running it through pressure rollers. Thus, the layers will be pressed together according to the hardness of their basic metal and grade of mesh. A compacted sheet which can be easily handled is thus created.

A printing stamp in the nature of a "rubber stamp" may also be made by utilizing the present invention. As shown in Fig. 12, a fabric 52 having a compacted design area 53 is secured to an elastic base 54, such as rubber, and connected to a holding device 56 including a handle, in a usual suitable manner. The advantages of this printing stamp over a rubber stamp are manifold, such as increased resistance against wear and decreased printing distortion.

Another method of preparing a formed mesh die is as follows:

A design is embossed into a mesh by any suitable embossing operation; thereafter, a second operation follows for flattening the now raised design area into the fabric (see Fig. 14). This is easily done by pressing the fabric in a flat bed press or any roller press appliance, and the design area is thus pressed down practically to the same surface level as the rest of the mesh.

It was discovered that a mesh die prepared by this sequence of operations has practically no compacted design area, but, at the same time, has a design area which differs in its structure of mesh from the surrounding area and which is suitable for reproduction onto a material. Said design area is characterized by a weaving dislocation brought about by the initial embossing operation, which subjected the respective portion of the structure of the mesh to a shifting, or dislocation and distortion.

The formed wire mesh die or fabric die, created and finished in any one of the disclosed methods, can be used for printing in a number of ways according to the equipment available, or the special machinery provided. If the printing mesh die is of smaller size and is to be used in an ordinary letterpress, it may simply be nailed to a wood block of standard type height and beveled as in photo-engraving, thus providing type height, or, by sweating on a standard metal base.

The printing mesh die is flexible and may easily be affixed to any rotary or cylinder press; it also lends itself to the designing and building of special machinery, such as will be described later on. For short runs or individual markings the mesh die can be used as a printing stamp, as described hereinabove, for inking by stamp pad, or in combination with an inked ribbon, e. g. for marking machines. Large size fabrics are inexpensive, and, by the various methods disclosed, may be converted so easily and quickly into printing mesh dies, that they will open up economical and timesaving uses for many purposes where at present stencils or hand stamps are used.

Stencils are limited as to their over-all size by the necessity of making them from rigid material; their lettering consists of primitively cut-out larger letters and figures, since no part can be disconnected from the stencil body. The formed mesh die, on the other hand, permits the reproduction of intricate trade-marks, true in every detail to the original. The most intricate lettering even of the smallest size and the finest work of art may be reproduced. Its over-all dimensions are not limited, since wire fabrics can be made in any size and the formed mesh die can be rolled up after use and easily stored or shipped.

For hand applications, the mesh die can be mounted on any suitable backing, according to its dimensions and the requirements of a particular job, as on flexible cloth, leather, sheet rubber, or, for smaller sizes, on a rigid material, such as cardboard, plywood, etc. By inserting a resilient material, such as rubber, between the print-

ing mesh die and a rigid backing, uniformity of the reproduction will be assured.

The inking of a printing mesh die for hand application can be provided by an inked pad, by inking roller, or by spraying or brushing on the ink or paint.

The inked printing mesh die is pressed by hand against the surface to be decorated; for larger surfaces a hand roller is rolled over its back. Wide surfaces will be decorated, successively, in strips, one part of the fabric being unrolled, inked and reproduced after the previous part has been finished and rolled up.

This applicating by hand will prove particularly useful for decorating walls and ceilings with any pattern or individual design, for reproducing advertising messages or pictures on any extended surface, and on large and fixed objects, such as tents, awnings, stage decorations, or factory walls, etc.

Another advantage for the hand application of the present invention is due to the inherent flexibility of the formed mesh die. When used as die for ink-marking, it can be placed around steps, applied to unlevel, shaped, curved or formed surfaces, and also mounted on a permanent backing of any such odd form. Therefore, this method of marking may be applied to formed signs and containers, crates and cases, barrels, drums, etc. If an acid-resistant mesh is used, it may be inked with etching ink and used to reproduce trade-marks, letterings and designs for show windows of any size and shape.

The simplicity of this method of converting fabrics to an efficient printing form, in combination with the light weight and low cost of the basic material, makes it possible to use very large sizes of mesh for converting the same into printing mesh dies at a comparatively small cost.

These inexpensive, light and flexible printing mesh dies open the way for many new applications of very large sizes in the graphic arts, both for use in standard machinery and in combination with the construction of special and novel machinery. The light weight and flexibility of such a large printing form makes possible the construction of much lighter machinery than has been in use up to now in the graphic arts. Large size printing will be useful in printing of textiles, coated fabrics, wallpapers and decorative papers, wrapping papers, posters, acetate and cellophane printing, etc., and also for the manufacture of simulated veneer plates, decorated board, plywood and masonite and other materials where over-all patterns or designs are desired.

The flexibility and light weight of these printing mesh dies as well as their availability in any size at reasonable cost makes it possible to provide entire rolls of considerable length.

Such a roll of great length of mesh, rolled up on a lightweight core does not exceed the weight or the cost of making of a solid stereotype roll of small circumference.

It is clear that so large a printing surface as provided by this method is suitable for reproducing a complete book in one run. An entire roll of textile fabrics or wallpaper can be printed with a complete variety of patterns, by using a printing mesh die of corresponding length. Since the present art, using stereotypes or a Gaufrage roll, necessitates the repeating of a design all over again in short intervals due to the necessarily limited circumference of the metal roll, this printing mesh die provided by the herein disclosed new processes constitutes a notable advancement over the present state of the art.

A mesh die made of a flexible fabric lends itself to constructing novel printing equipment and opens up an entirely new field of printing methods, particularly for rotary printing and for printing of material in rolls.

Rotary printing in the present art is done by stereotyped rollers or half rolls the circumference of which is limited by cost and weight. The printing mesh dies, however, may be used in practically unlimited lengths. For incorporating a mesh die of the present invention in a printing machine for continuous printing, the mesh die is made into a long band and over the entire length of one surface thereof the design is incorporated. In Fig. 15, shown in a schematic way (in which all parts have been left out which have no direct bearing on the present invention), a printing mesh die band **61** having designs incorporated over the entire length of one of its surfaces, is carried by two rollers **62** and **63**, respectively. These rollers are secured with relation to a frame **64** of the printing machine; a power driven sprocket wheel **65** is provided carrying sprockets **70** for ensuring positive rolling connection of the die band **61**, by coacting with holes **66** along the borders of said die band **61** (see Fig. 16). The upper roller **62** is driven by means of a motor **67** which is connected to the frame **64**, and a belt and pulley drive therebetween. The sprocket wheel **65** is geared to the upper roller **62** and driven thereby.

A band of material **68** to be printed is carried by two rollers, **69** and **71**, respectively, supported by the frame **64** and oppositely arranged to the die band rollers **62** and **63**. A multiple chain drive **72** is provided between the driving roll **62** of the die band and the driving roll **69** of the band of material **68**. The band of material **68** is also in positive engagement with its rollers **69** and **71** by means of perforations and a power driven sprocket wheel **75**, carrying sprockets **80** for engaging the same.

An ink roll **73**, in frictional engagement with the printing surface of the die band **61**, is partly immersed into an ink bath **74** contained in an ink basin **76**, which is supported by the frame **64**.

A pair of pressure rollers is provided and secured with relation to the frame **64**, one of which, **77**, bears from the rear against the band of material **68**, the other one of which, **78**, bears from the rear against the die band **61** exerting pressure in opposite direction to one another.

A spring **79** is arranged between the two pressure rollers **77** and **78**, for providing continuous printing contact between the die band **61** and the band of material **68** on their path therebetween.

When the driving mechanism is set in motion, each of the driving rollers will reel the band attached to it and a continuous printing from the die band onto the band of material will result at the position between the two pressure rollers.

Another important feature of this invention is the possibility of using an endless band of printing mesh die of great length between two rolls and to print in this way, in one run, much larger sizes than is presently possible. The design on this endless fabric roll repeats itself after a full revolution. This method is usable for continuous printing of wallpaper, wrapping paper, textile fabrics, ribbons, cellophane and other wrapping materials for subprints on safety papers, checks, policies, bonds, stocks, etc. A printing

machine for utilizing an endless printing mesh die band is schematically shown in Fig. 17 in which all parts not directly bearing upon the present invention have been left out.

An endless printing mesh die band 81 is held under tension between a driving roller 82 provided with sprockets 70 and a driven roller 83. The band of material 68 is carried by the driving roller 69, sprocket wheel 75, and the driven roller 71 in a similar way as shown in Fig. 15, and above described. The die belt as well as the belt of material have holes for sprocket engagement, and a chain drive is again provided as well as a motor belt and pulley drive. An inking device for distributing printing ink on the outer surface of the endless die band is also shown, and it is believed that no repetition of description of these features is necessary. A single pressure roller 84 is secured in the frame 64, pressing against the driving roller 82 for providing a printing contact between said endless band 81 and said roll of material 68 for continuous printing of said material when the power driven rollers reel said material and move said endless band and cause successive portions thereof to pass through said pressure position.

The length of printing mesh dies supplied by this method for making endless bands is practically unlimited, and machinery may be used which provides a plurality of printing positions with a single mesh die band, as disclosed in Fig. 18. An endless printing mesh die band 86 engages a plurality of rollers 87 and also a plurality of ink distributing devices 88; a plurality of bands of material 68, each carried by a driving roller and a driven roller, 69 and 71, respectively, are provided. One of the rollers 87 as well as all the driving rollers 69 are rotated by a multiple chain drive 89 (partly broken off, the reversing of direction of rotation not being shown), insuring simultaneous rotation of equal speed. Adjacent each band of material a pressure roller 91 is provided coacting with its respective sprocket carrying counter part roller 87 of the endless band 86, for providing a printing contact at each printing position.

The advantages of such a multiple printing arrangement are obvious. A machine with a single endless printing band can achieve several times the production volume of any similar machine in use at the present time. One of the principal advantages of such a die band, besides economical production, is believed to be the providing, on very short notice, of a printing band having any required design in contrast to the slow production of equivalent quantities of printing plates. The new method permits speedily to put on the market new patterns of printed material, paper or textile fabric.

A still further use of such a printing mesh die is its application for multi-color printing in one run, in a basically new and inexpensive process.

During the printing with these printing mesh dies, a spraying device can be employed to spray a second color through the openings of the woven fabric; in this way one color is printed by the printing mesh die itself, and the second color sprayed through it, the resulting effect being novel and different. If two or more spray guns are used with different inks, an inexpensive multi-color effect can be applied in a single run.

In Fig. 19 a schematic illustration of a printing machine is shown. A printing mesh die band 92 is disclosed therein, carried by a driving roller 93, and a driven roller 94, in similar arrangement to that shown in Fig. 15, the material band 68 is shown carried by the driving roller 69 and the driven roller 71, respectively. Each band is in sprocket engagement (not shown) to insure positive rolling. A pair of pressure rollers is arranged acting similar to the pressure rollers shown in Fig. 15. In addition thereto, two pairs of guide rollers 96 are provided spaced in opposite direction from the pressure rollers for providing a short straight run of both bands.

A spraying device 97 is provided having outlets in a pair of nozzles 98 and 99, respectively, for spraying liquid or a gaseous substance from the rear of the die band 92 through the same and onto the surface to be decorated of the band of material 68.

The gaseous substance may be steam for heating or dampening the decorated material, hot air for drying or cool air for cooling the same. A valve 101 is attached to each nozzle making it possible selectively to spray before or after the printing process or simultaneously at both positions.

A spraying operation may also be employed with a mesh die for three-dimensional decorating, for treating the material simultaneously while decorating it.

In addition to the foregoing, heat may be conducted into the printing mesh die and projected therefrom onto the material to be printed, simultaneously with the printing process. A heating element 102 shown in Fig. 19, may be provided located near the pressure rollers; the heating element may also be placed at a different position for causing the heat to be applied after the material has passed through the pressure rollers. Such an element may be an electronic heater inducing high temperature into the fabric if it be made of metal, or an electric current may be directly led into the fabric if it has metal wires woven therein. The current must have sufficient amperage to induce the desired heat. If current is directed into the fabric, the latter must be insulated against the rollers carrying it. The heat can be controlled according to the requirements of each job, and by using a timing device, the heating can be adjusted according to the speed of the press. Heat may also be conducted into the wire fabric by any other suitable method.

The present art is limited to the use of type metals made of alloys containing lead, antimony and other metals having a comparatively low melting point. The necessarily solid and heavy character of such printing forms makes it difficult to conduct heat since most of it is lost before it reaches the surface. The mesh dies, however, can be made of any metal or alloy with high melting point, such as chrome, bronze, Monel, nickel, etc., or high speed steel. This makes it possible directly to heat the fabric to the desired degree without danger of softening. It is even possible to use such fabric of high speed steel in red hot state.

Such a heated printing mesh die provides new methods for reproducing designs onto various materials, by burning them in without the use of ink. Wood, leather, book covers, fabrics, fibre and various plastics can be decorated by burning-in the designs in the above described manner.

This may be done either in printing machines for long runs, and for short runs, by applying the printing mesh die to hand-stamps; the latter will be utilized for burning of leather, cases,

cattle, meat, and other identification and marking purposes, for which at present heavy burning irons are used that are hand engraved and require much more heat. This type of direct heat printing also may make possible economical laminating by bonding acetate strips or sheets to any material in a printing machine.

The application of heat to printed material itself is likewise an important factor for many printing operations, particularly for quick drying of printed matter.

Many methods are known for that purpose, such as leading the freshly printed sheet in the press itself over a row of gas flames, etc. However, the present art does not provide any printing plate that in itself conveys heat readily. The present invention provides a printing form of inherent open structure all through and thereby permits the direct application of heat in many ways. The openings in the mesh permit also application of a blowing device for a continuous flow of heated air to the paper or material being printed, thus providing an effective means for quick drying.

This possibility of controlled direct heating lends itself to application to the printing of slow-drying, non-porous materials, such as foils, waxed and parchment paper, cellophane, sheet acetate, etc.

It will be understood from what has been said hereinabove that the same mesh die that is used for printing can also be employed as die for embossing or other three-dimensional design reproduction, if the inking is omitted. And furthermore, the embossing effect can be combined with printing, if the printing mesh is inked.

Simultaneous printing and embossing has numerous applications, such as, for instance, for covers, wallpaper, greeting cards, many types of textile printing, etc.

Although dies and cuts are commonly used for printing and embossing, this printing mesh die opens up a new field of such combined runs as its cost is only a fraction of the cost of any heretofore used printing and embossing die.

Metal wire mesh was found best suitable for the purpose described, since it is inexpensive, manufactured and stocked all over the world. It is available in a wide variety of standard sizes, grades and types; it is tough, but flexible, pliable and conducts heat easily.

However, it was also found that a mesh woven of vinylite and other plastic wires can be compacted, cut out or formed by the methods disclosed and that wires and threads of many other materials can be woven into fabrics usable for this process. Metal wire may also be interwoven into a mesh of non-metallic material to reinforce the same and to convert it into a conductor of electric current or heat.

The above means and methods may also be applied for producing a design on a transfer-material to be used, in turn, for reproducing the design onto a final material.

I do not limit myself to the particular details of methods and construction set forth in the foregoing specification and illustrated in the accompanying drawings, as the same refer to and set forth only certain embodiments of the invention, and it is obvious that the same may be modified, within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described my invention, what I claim as new and desire to be secured by Letters Patent is as follows:

1. A method of forming a printing wire mesh die comprising the steps of first embossing a design thereinto and thereafter subjecting the embossed area to a flattening operation, for providing a die having a design area differing in its structure from the surrounding area.

2. In a method of imparting to a wire mesh a design area structurally differing from surrounding areas, the steps comprising embossing a design in the mesh and subsequently flattening the embossed design.

3. In a method of forming a wire mesh die, the steps comprising, embossing a design thereinto and subsequently flattening the embossed design.

4. In a method of decorating material, the steps comprising pressing said material with a wire mesh die having a design area formed therein by embossing and subsequent flattening.

5. In a method of printing material, the steps comprising pressing said material with an inked wire mesh die having a design area formed therein by embossing and subsequent flattening.

6. A die designed for imparting under pressure a design onto a material, comprising a wire mesh having a design area formed therein by embossing and subsequent flattening.

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