March 9, 1965 F. WEISS 3,172,358

SUCTION STENCILLING APPARATUS

Original Filed April 11, 1962

FIG. 1

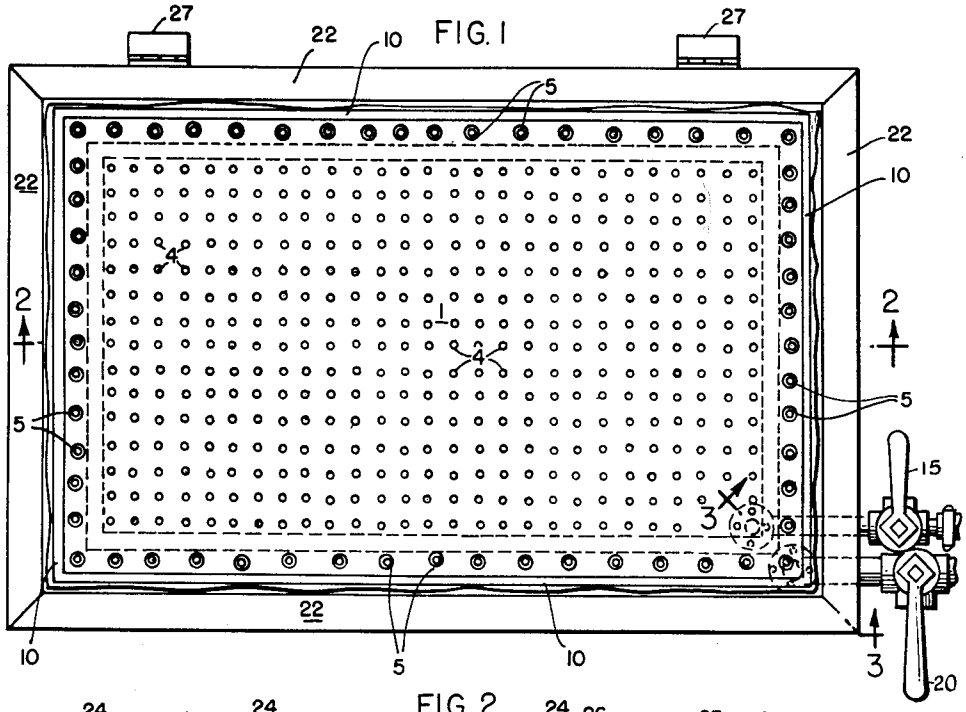


FIG. 2

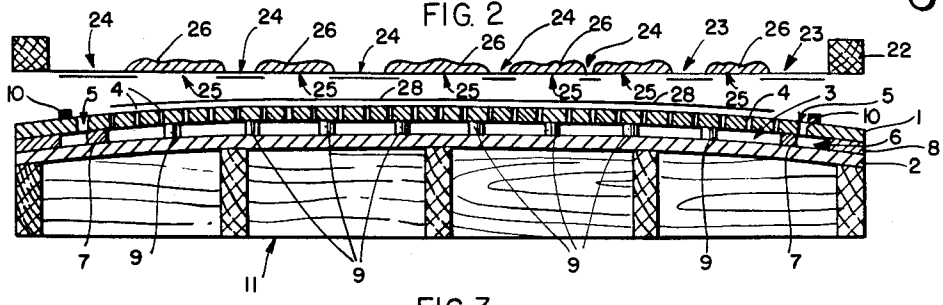
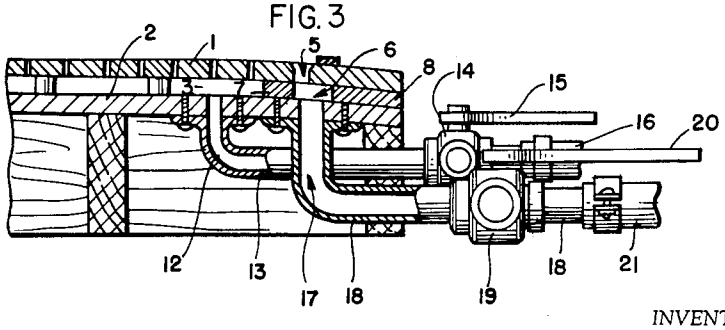


FIG. 3



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SUCTION STENCILING APPARATUS

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Original application Apr. 11, 1962, Ser. No. 186,773. Divided and this application May 27, 1963, Ser. No. 283,294

3 Claims. (Cl. 101—126)

This invention relates to a printing apparatus and process and more particularly to a printing apparatus and process especially suited for multi-color printing.

This application is a division of my copending application Serial No. 186,773 filed April 11, 1962.

Many difficulties have heretofore been encountered in the multi-color printing of signs and advertising displays and the results obtained in such printing have left much to be desired because of the time required, the expense of the operation, and the quality of the product.

One of the objects of the present invention is to provide a new and improved process and apparatus for printing which is especially adapted to multi-color printing.

Another object of the invention is to provide a process and apparatus for printing in which several colors can be printed at the same time.

Still a further object of the invention is to provide a process and apparatus for printing in which high quality prints can be obtained in a relatively short period of time and with a minimum of expense.

An additional object of the invention is to provide a process and apparatus for printing in which the steps involved are simple and the apparatus required is relatively inexpensive.

Other objects and advantages of the invention will appear from the following description in conjunction with the accompanying drawing in which

FIGURE 1 is a plan view with parts broken away of a printing apparatus provided in accordance with the invention;

FIGURE 2 is a cross section taken along the line 2—2 of FIGURE 1; and

FIGURE 3 is a partial cross section taken along the line 3—3 of FIGURE 1.

In accordance with the invention a printing apparatus is provided which contains the following essential elements: (*a*) supporting means for supporting a porous sheet material; (*b*) a stencil screen frame; (*c*) a stencil screen having pervious portions extending across said frame; (*d*) means to form a fluid-tight space between said stencil screen and said porous sheet material when said stencil screen and said porous sheet material are brought into proximity to one another; (*e*) a coloring composition disposed on the pervious portions of said stencil screen on the side remote from said porous sheet material; (*f*) means to apply reduced pressure to the side of said porous sheet material remote from said screen, and (*g*) means to apply additional reduced pressure to the space between said stencil screen and said porous sheet material when said stencil screen and said porous sheet material are in such proximity as to provide a fluid-tight space.

The supporting means is preferably generally convex in shape and has a series of holes therein communicating with a vacuum pump through a conduit controlled by a valve or other suitable means. When a porous sheet material is placed on the supporting means and the valve to the vacuum pump is opened, the sheet material is held in place by the reduced pressure created on its underside. Another series of holes is provided in the supporting means beyond the margins of the porous sheet material and connected separately from the first series of holes through a pipe, conduit or the like, controlled by a valve or other suitable means to a source of reduced pressure

which may be the same vacuum pump used in applying reduced pressure to the underside of the porous sheet material. When the first valve is opened after the porous sheet material has been applied to the supporting means, air is drawn through the porous sheet material. When the second valve is opened after the stencil screen is brought into proximity to the porous sheet material, air is withdrawn from the fluid-tight space between the stencil screen and the porous sheet material and the reduced pressure causes a coloring composition disposed on the pervious portions of the stencil screen on the side remote from the porous sheet material to be drawn through the pervious portions of the stencil screen and printing on the porous sheet material. It is highly desirable in carrying out this process to support the porous sheet material on a convex surface so that air pockets cannot form in the space between the stencil screen and the porous sheet material as the reduced pressure causes the stencil screen to be drawn into contact with the porous sheet material. Inasmuch as the stencil screen is stretched rather tightly in a horizontal plane, the central part will tend to contact the central part of the porous sheet material first and then gradually and uniformly contact the remainder of the porous sheet material.

In practicing the process the preferred procedure involves placing the porous sheet material on the supporting means, then applying suction from a vacuum pump, or other suitable source, through holes directly beneath the porous sheet material, and applying to the porous sheet material by spraying, brushing, or in any other suitable manner, a liquid material in which a predetermined coloring composition or printing ink is at least partially soluble. The liquid or solvent is pulled through the porous sheet material so that it is no longer visible. In the meantime, the stencil screen has been previously prepared having pervious portions corresponding in shape to a predetermined colored configuration which it is desired to print on the porous sheet materal and a predetermined supply of coloring composition is applied to the side of the stencil screen remote from the sheet material. This coloring composition can be any well known heavy concentrated, non-flowing printing ink which is sufficiently viscous to remain on top of the stencil screen under normal atmospheric conditions but which will flow through the openings in the pervious portions of the stencil screen when the pressure on the opposite side of the stencil screen is reduced. The stencil screen containing this coloring composition or printing ink is then brought into proximity to the porous sheet material and a confined space is formed between the stencil screen and the porous sheet material. A portion of this space extends beyond the edges of the porous sheet material, and in this portion of the space, openings are provided which are connected to a suitable means for reducing the pressure, such as a vacuum pump. Additional suction or reduced pressure is applied through these openings to the space between the porous sheet material and the stencil screen, thereby causing the coloring composition or printing ink on the remote side of the stencil screen to be pulled through the openings in the pervious portions of the stencil screen onto the porous sheet material. The applied vacuum also pulls the stencil screen into contact throughout the porous sheet material and produces a uniform print on the porous sheet material corresponidng to the colors of the color composition on the stencil screen. The suction in the area between the stencil screen and the porous sheet material is then discontinued and the pressure allowed to return to normal atmospheric pressure. The stencil screen is thereafter removed from the porous sheet material and the suction is discontinued on the underside of the porous sheet material so that the printed material can be removed from the supporting means.

In the embodiment shown in the drawing the supporting means for the porous sheet material consists of an upper base **1** which is curved from side to side and also from front to rear to present a convex surface and a lower base **2** (FIGURE 2) which is also preferably curved in the same manner. These two supporting bases **1** and **2** are separated to provide an air space **3**. The bases **1** and **2** are preferably constructed of metal, such as aluminum, but can be made of any other suitable material including rigid plastic materials.

The upper base **1** is provided with a plurality of rather small holes **4** which are uniformly drilled over the entire supporting surface and are on the underside of the porous sheet material upon which a print or colored configuration is to be applied. Relatively large tapered vacuum holes **5** are provided around the area normally occupied by the porous sheet material. These are connected to a vacuum exhaust passageway **6**.

The air-tight separating wall **7** which is made of rubber or other suitable material forms one side of the passageway **6** and another air-tight seal **8** also formed of rubber or other suitable material defines the opposite side of the passageway **6**. The sealing walls **7** and **8** extend on all four sides of the printing apparatus. A number of spacers **9**, preferably formed of metal or other suitable rigid material, are provided between the two base plates **1** and **2** in order to keep them evenly spaced.

An air seal **10** made of rubber or other suitable material is mounted and sealed to the top of the upper base plate **1** on the outside of the holes **5** and extends upwardly a short distance above the base plate **1** to prevent lateral ingress of air to the space or vacuum chamber formed when the stencil screen is brought into position in proximity to the porous sheet material to be printed. The sealing wall or strip **10** is preferably formed from closed cell soft sponge rubber.

The lower base plate **2** is mounted on a strong wooden or metal under structure **11** which in turn is fastened to suitable legs or other supporting structure.

The space **3** between the upper base plate **1** and the lower base plate **2** and within the sealing wall **7** connects to a passageway **12** in a pipe or conduit **13** and the flow of fluid through this passageway is controlled by a valve **14** which is opened and closed by a handle **15** which can be operated automatically in any suitable way. The pipe **13** is connected to a hose or other suitable conduit **16** which in turn is connected to a vacuum pump, not shown.

The space **6** between the inner and outer sealing walls **7** and **8** connects to a passageway **17** in a pipe or conduit **18** controlled by means of a valve **19** operated by a handle **20** or connected to any other suitable operating mechanism, not shown. A hose **21**, or other suitable conduit, is connected to the pipe **18** and to a suitable pressure reducing means, such as a vacuum pump. The conduits **16** and **21** may be connected to the same or different vacuum sources. A stencil screen frame **22**, which is generally rectangular in shape, supports a stencil screen **23** which is fastened to the frame at the edges and is stretched between the frame in a substantially flat plane as shown. The stencil or printing pattern is applied to the under side of the screen **23** to produce certain areas **24** which are impervious and other areas **25** which are pervious. The color composition **26** to be applied to the porous sheet material is placed over the pervious portions of the stencil screen.

The frame **22** is preferably hinged to a suitable supporting surface by hinges **27** in order to maintain a relatively fixed position between the stencil screen and the porous sheet material to be printed. It will be understood, however, that the frame containing the stencil screen may be placed by hand over the porous sheet material to be printed.

The operation of the process in terms of the specific apparatus previously described is as follows: A porous sheet material **28** is placed over the small holes **4** on the supporting base **1**. The valve **15** is turned in order to apply suction or vacuum to the passageway **3** thereby holding the sheet material **28** in place and drawing air through it. Before or after turning the valve **15** a liquid which is at least a partial solvent for the coloring material, such as, for example, naphtha, mineral spirits, xylene, toluene or benzene, is applied to the upper surface of the porous sheet material **28** by means of a brush, sponge, spray, or in any other suitable manner. The suction removes any excess liquid from the sheet. The stencil screen **24** is brought down upon the strip air seal **10** which prevents outside air from entering the printing space. The printing vacuum is then applied by turning handle **20** of large valve **19** and after a very short period of time, for example, one-half to one second, the valve is turned off again which permits the lifting of the stencil screen. The printed sheet **28** is still held by the suction from passageway **12**. When the stencil screen is completely removed from the printed sheet **28** valve handle **15** is turned in order to close valve **14** and thereby discontinue the suction from the under side of the printed sheet. The printed sheet can then be removed from the supporting surface **1**. The moisture and solvents in the porous sheet material have been removed under vacuum suction and enough ink or coloring composition has been applied to give a strong printed impression of superior quality.

The coloring compositions **26** may be different and the pervious portions **25** may consist of different designs, letters or other indicia so that the final printed sheet material can be a multi-colored print produced in a single operation. Successive prints can be made in the same manner without replenishing the supply of coloring material carried by the stencil screen.

Any suitable type of porous sheet material can be used, such as an eighty pound sized paper. In general, it is preferable not to use clay filled papers or other papers which are adversely affected by the application of a solvent. Any conventional heavy printing ink can be employed but the ink should preferably be one which does not dry readily in bulk but dries fast in thin layers from a solvent-treated porous material. Oil base inks can be used in which case the solvent employed to pretreat the porous sheet material would be a solvent such as naphtha, mineral spirits, xylene, toluene or benzene. It will be recognized that the type of solvent may vary depending upon the type of printing ink. For example, with a zein an alcohol solvent would be used. The ink should preferably be one which does not readily oxidize in the air. Various combinations of inks can be used. Heat setting inks can be employed. The pigments employed can be any of the conventional pigments including the well known fluorescent pigments. The printed design can be over-printed with successive screens using different stencils but otherwise applying the same general principles.

It will be seen from the drawing (FIGURE 3) that the passageway **12** leading to the small holes on the under side of the porous sheet material is smaller than the passageway **17** leading to the holes around the perimeter of the sheet material. In general, the amount of suction applied per unit area to the under side of the porous sheet material is less than the amount of suction applied to the printing space between the porous sheet material and the stencil screen. Ordinarily approximately twice as much suction is applied to the printing space. This is made possible by the differential in the size of the conduits **13** and **18**. Ordinarily, the conduits **16** and **21** are connected to the same vacuum pump. A vacuum of 20 to 28 inches of mercury is usually sufficient. It is desirable that the suction applied to the under side of the porous sheet should be just strong enough to hold the sheet in place and not strong enough to exhaust all of the solvent from the sheet. On the other hand, the suction applied to the printing space should be stronger because of the greater pressure required to pull the printing composition through the pervious stencil screen.

The printing colors which are placed on top of the stencil screen over the pervious portions can, if desired, be enclosed in a boundary wall made of rubber, metal, or other suitable material, in order to confine them to a predetermined area. This is not always necessary.

The invention is hereby claimed as follows:

1. A printing apparatus comprising

(*a*) supporting means for supporting a porous sheet material in operative position,

(*b*) a stencil screen frame,

(*c*) a stencil screen having pervious portions extending across said frame,

(*d*) means to form a vacuum chamber between said stencil screen and said supporting means when said porous sheet material is so supported in said operative position and said stencil screen and said porous sheet material are brought into proximity to one another,

(*e*) a coloring composition disposed on the pervious portions of said stencil screen on the side remote from said porous sheet material when the latter is disposed in said operative position,

(*f*) means to apply reduced pressure to the side of said porous sheet material remote from said screen, and

(*g*) means to apply additional reduced pressure which is lower than said first mentioned reduced pressure to the space between said stencil screen and said porous sheet material when said stencil screen and said porous sheet material are in said proximity to one another.

2. A printing apparatus as claimed in claim 1 in which the supporting means is convex in shape.

3. A printing apparatus as claimed in claim 1 in which said supporting means contains a plurality of holes beneath said porous sheet material connected to a source of reduced pressure and another plurality of holes outside of said first mentioned holes independently connected to a source of reduced pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,323,620	Deleeuw	Dec. 2, 1919
1,680,500	Cotes	Aug. 14, 1928
2,237,179	Gromm	Apr. 1, 1941
2,419,695	Shuttleworth et al.	Apr. 29, 1947
2,663,251	Baumrucker	Dec. 22, 1953
2,729,162	Edgelberg et al.	Jan. 3, 1956