Sept. 18, 1973 G. W. REINKE 3,759,800

SEAMLESS ROTARY PRINTING SCREEN AND METHOD OF MAKING SAME

Filed Sept. 27, 1971

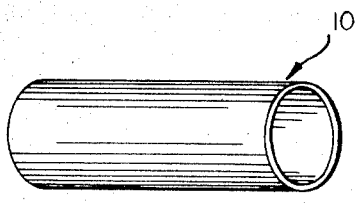


FIG.1

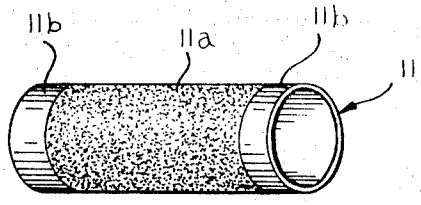


FIG.2

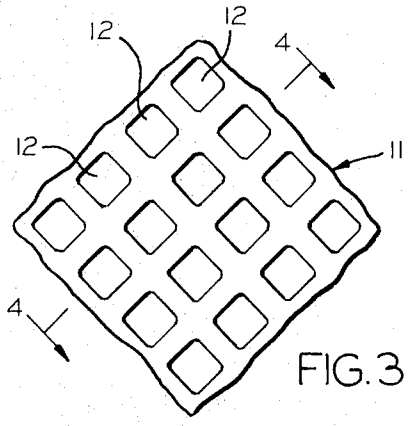


FIG.3

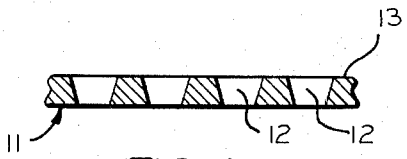


FIG.4

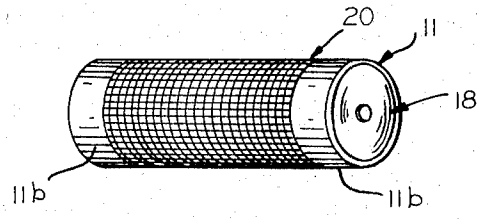


FIG.5

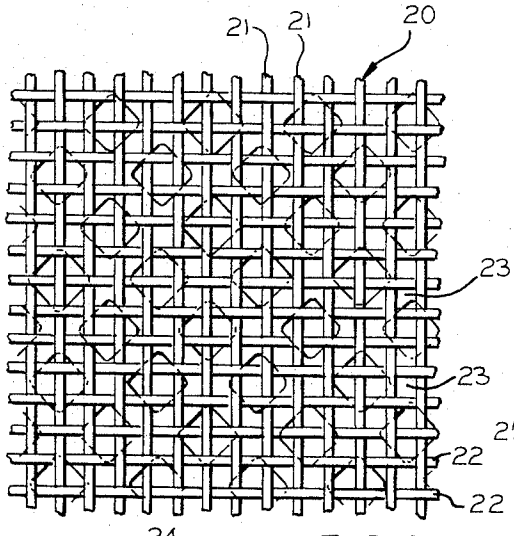


FIG.6

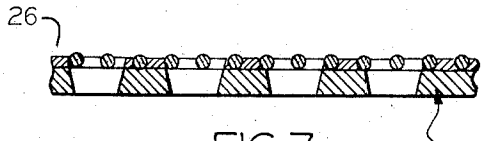


FIG.7

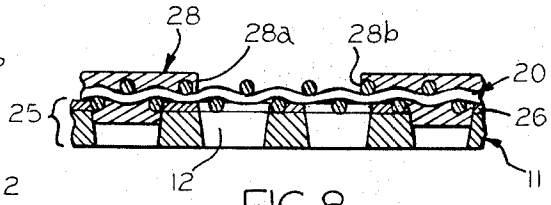


FIG.8

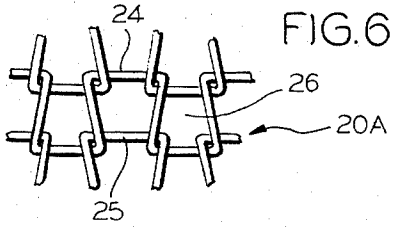


FIG.9

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# SEAMLESS ROTARY PRINTING SCREEN AND METHOD OF MAKING SAME

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U.S. Cl. 204—16 11 Claims

## ABSTRACT OF THE DISCLOSURE

A printing screen comprised of a metal base and a taffeta woven or knit fabric face in sleeve form where the base is defined by an electro-deposited sleeve having a pattern of holes chemically etched therein, and where the fabric face is stretched or heat-shrunk over the metal base and locked in place by a plating of metal onto the outer surface of the base.

This invention relates in general to printing screens, and more particularly to rotary printing screens, and still more particularly to a seamless rotary screen and method of making same.

In order for a rotary printing screen to be practical and usable in commercial processes, it must have a given degree of rigidity and inherent strength. Most electro-deposited screens heretofore made do not have sufficient rigidity and strength. The one exception is in a sleeve known as a Stork screen which is only usable to print textile materials, since it can only be made in coarse meshes. When it is made in meshes having more than 100 holes to the inch it tends to be too fragile for practical use. The typical opening of the Stork sleeve is from 4 to 7 percent of the total area, which is inadequate for detail printing, since the space between the openings is so great that when an image is placed on the screen it results in an irregular printing edge, commonly referred to as a "saw tooth" edge. On textiles the flow of the dye on the threads of the fabric dissipates the visible effect of this "saw tooth," and it is entirely acceptable for much printing of that type.

The objections of known prior art rotary screens are overcome by the present invention wherein a rotary screen is provided having high stability and toughness while giving a sharp printing effect for detail printing on paper and like materials. The screen of the invention includes a metal base in the form of a sleeve that has been made by electro-depositing metal onto a cylindrical mandrel. Holes are etched in the base by a suitable photo-chemical process to provide approximately 40 to 150 holes per inch. Thereafter, while supporting the metal base on a mandrel of suitable non-conducting material, a woven or knit sleeve of fibers, such as polyester or nylon, is either stretched or heat-shrunk onto the base. The combination is then subjected to an electro-plating operation wherein plating is applied to the outer surface of the metal sleeve of a thickness substantially less than the thickness of the threads of the fabric sleeve but of sufficient thickness to effectively lock the threads in place on the base. Because the fabric sleeve is non-conducting, it will not be coated with the metal during the electro-plating process. Thereafter, a suitable image design can be applied to the fabric face. The mesh of the fabric sleeve is 150 to 200 threads per inch, and in any case finer than the metal sleeve, wherein the holes in the fabric mesh are substantially smaller than the holes in the metal base to enhance the production of detail printing operations. Accordingly, this printing screen embodies the strength characteristics of a metal screen and the printing characteristics of a fiber screen. The great number of threads available anchor images more firmly than on a typical Stork sleeve, and they



permit the flow of ink through the larger holes in the metal base to the edge of the image, around the threads, which make contact with the printed object only at the highest point of their curved surfaces, enhancing the flow of the ink to the image forming edge.

It is therefore an object of the present invention to provide a new and improved seamless rotary printing screen and a method of making same.

Another object of this invention is in the provision of a seamless rotary printing screen having the strength of a metal screen and the fine mesh of a fabric screen to provide detail printing operations.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheet of drawing, wherein like reference numerals refer to like parts, in which:

FIG. 1 is a perspective view of an electro-deposited metal sleeve utilized in the present invention;

FIG. 2 is a view of the sleeve of FIG. 1 after it has been etched to provide a pattern of holes;

FIG. 3 is a greatly enlarged fragmentary plan view of the etched screen of FIG. 2;

FIG. 4 is also an enlarged cross-sectional view of the etched screen taken substantially along line 4—4 of FIG. 3;

FIG. 5 is a perspective view of the etched metal sleeve mounted on a mandrel of non-conducting material such as an inflatable rubber mandrel, and illustrating the woven fabric sleeve heat-shrunk onto the metal sleeve;

FIG. 6 is a greatly enlarged fragmentary detail plan view of the combination metal and fabric sleeves in FIG. 5, illustrating the relationship between the holes in the metal sleeve and the holes in the fabric sleeve;

FIG. 7 is a greatly enlarged detail and fragmentary cross-sectional view taken through the completed screen of the invention, illustrating the plating which locks the threads of the fiber sleeve in place, and omitting the second row of fiber threads for purposes of clarity;

FIG. 8 is a view similar to FIG. 7, but illustrating the additional rows of fibers, together with an image pattern formed onto the fabric face; and

FIG. 9 is a plan view of a piece of knitted fabric.

The seamless rotary printing screen of the invention is particularly useful in printing operations needing a considerable amount of detail printing capable of being accomplished on a rotary printing press, especially in the printing of web paper. It is especially important to have a rotary seamless printing screen which has not been heretofore possible that has a given degree of rigidity and strength, which may be reused for a number of jobs while also providing sufficient detail printing characteristics for printinng on paper. Heretofore the metal Stork type of sleeve has been inadequate for most screen printing of the type referred to, since the opening was only 4 to 7 percent and such developed the "sawtooth" printed edge.

The seamless rotary printing screen of the invention is made by first producing an electro-deposited metal sleeve **10** having a thickness of about .003 to .005 inch or 3 to 5 mils. Such a sleeve can be made in any desired fashion, such as by immersing a cylindrical mandrel having a smooth outer surface into an electrolyte such as nickel sulphamate and inserting nickel electrodes in the bath about the cylinder to function as anodes while the cylindrical mandrel functions as a cathode. Application of a given amount of potential to the electrodes for a given time results in producing the electro-deposited sleeve of a given thickness, which may then be stripped from the mandrel for further processing.

The sleeve **10** is then subjected to a suitable photo-chemical process in the usual manner, wherein the sleeve has applied thereto a photo resist which is exposed to a

photocopy of a hole pattern wherein subjecting the sleeve to an acid etch results in producing a pattern of holes in accordance with the exposed photocopy. The sleeve holes etched therein are shown in FIG. 2 and designated **11**, wherein the central portion **11***a* includes the holes, a small or large section thereof of which is shown in FIG. 3, while solid bands **11***b* are provided at opposite ends, the latter of which further enhance the strength of the sleeve and also facilitate further processing in an electrolyte. The etched holes are identified by the numeral **12** in FIGS. 3 and 4, while the outer face of the sleeve is identified by the numeral **13**. The pattern of the holes defines a mesh-like opening, and the holes are about 80 per inch, but can be varied greatly to achieve specific printing results, as low as 40 per inch and as much as 150 per inch. The holes are rectangular, and essentially square having a width of from .007 to .009, while the distance between the centers of adjacent holes is about .012. This provides a hole pattern giving 35 to 50 percent open area, thereby facilitating a greater passage of ink. As noted particularly in FIG. 4, the direction of etching is done toward the outer face **13** wherein the undercutting renders the holes slightly larger at the face **13** or at the side from which the etching is conducted.

The etched metal sleeve **11** is then mounted onto an electrical non-conducting mandrel **18**, such as an inflatable rubber mandrel. Next, a woven or knit fabric mesh sleeve **20** or **20A** is mounted on the metal sleeve **11** and heat-shrunk or stretched in order to place the fiber threads of the sleeve into intimate contact with the outer surface **13** of the etched sleeve **11**. The woven sleeve would be heat-shrunk onto the metal sleeve, while the knit sleeve would be stretched onto the metal sleeve. The fabric sleeve which can be woven or knit in sleeve form and be seamless may be any fabric material, but usually is either nylon or polyester, and of about 150 to 200 mesh. As seen in FIG. 6, the fabric sleeve **20** includes threads **21** and threads **22** woven together to define rectangular and essentially square-shaped openings **23**, which are of a size substantially smaller than the openings in the etched sleeve **11**. Similarly, the fabric sleeve **20A** includes threads **24** and **25** knitted together to define essentially square-shaped openings **26**.

After the fabric sleeve has been applied to the etched sleeve **11** and pre-shrunk or stretched into tight-fitting relation, the entire unit on the mandrel is immersed in a suitable electrolyte for a further plating operation to plate a thickness onto the metal sleeve about two-thirds the thickness of those fabric threads in intimate contact with the metal sleeve. In this case it is again preferable to use an electrolyte of nickel sulphamate with anode electrodes of nickel, wherein the sleeve **11** would be connected as a cathode. The nickel in the nickel sulphamate bath provides the greatest amount of stability so as to provide a uniform plating throughout the surface of the sleeve. Since the fiber sleeve is electrically non-conductive, it will not receive a coating of metal in the electroplating process. The solid end sections **11***b* of the sleeve **11** will be connected to the source of potential to carry the current, to therefore eliminate as much side growth in the holes **12** as possible. As an alternative, the holes could first be filled with an electrical non-conductive type of material before the plating operation, such as a viscous lacquer, which would be allowed to dry, and which would later have to be removed following the plating operation. The plating thickness of about .001 or 1 mil is provided, but which will vary with the type of fabric used. The plating thickness must be sufficient to cover about two-thirds of the thread areas which are in intimate contact with the etched metal sleeve. This plating area which is indicated by the numeral **26** in FIGS. 7 and 8, which serves to lock the threads **21** and **22** of the fabric sleeve **20** in place on the metal sleeve **11**. The holes **12** formed in the metal sleeve **11** are angulated relative the holes in the fiber sleeve so that upon application of the fabric sleeve **20**, the axes of the square holes in the fabric sleeve **20** are displaced about 45 degrees from the axes of the holes in the metal sleeve **11**, as particularly illustrated in FIG. 6.

This arrangement provides the maximum ink passage and spread as ink is forced through the holes **12** from the back side of the screen to the side having the face of fabric mesh. Following the plating to lock the threads of the fabric sleeve in place, the printing screen now shown as **25** in FIG. 8 may be removed from the inflatable mandrel **18** and be ready for use. At this point it can be appreciated, that utilizing an etched metal screen as a base with about 80 holes per linear inch, sufficient stability has been achieved with the fineness of the fabric mesh on the surface to support a design image and give sharp straight printing edges, and where the total thickness of a fabric sleeve and a metal sleeve is only about 50 percent more than the fabric sleeve itself. The overall thickness of the printing screen has been increased over the thickness of the base sleeve by the thickness of the fabric sleeve. The plating for locking down the threads of the fabric sleeve has further increased the rigidity and strength of the overall screen.

The application of a printing image is illustrated in FIG. 8 wherein the printing image **28** provides edges **28***a* and **28***b*, and as seen, the openings **12** which are much larger than the openings in the fabric sleeve **20**, permit more ink to pass through the metal base, which then is forced through the openings in the fabric sleeve of a smaller size to give finer detail in the printing operation. The combination of fabric and metal base must be as thin as possible, while maintaining rigidity and stability, to achieve fine quality printing results. Other attempts where a coarse perforated metal base onto which a fabric sleeve is stretched, are unsuccessful, in that they do not develop fine quality, properly deposited ink layers, acceptable in commercial trade. The image may be provided in a conventional manner, processed, used, removed and re-applied for several successive uses of the same screen on different jobs. This minimizes the cost of the screen for each use.

From the foregoing, it can be appreciated that a seamless rotary printing screen constructed of both fabric and metal will provide the rigidity of a metal screen and the fine detail printing capabilities of a fabric screen, and which may be re-used several times. Further, the ink has a depth of surfaces between the metal sleeve and the printed product to spread outward to the image forming edge. Moreover, the fabric threads give more area for the image forming material to adhere to, and thus create a stronger screen and allow for finer detail. The fact that the image edge is .001 or .002 inch above the metal defines the printing properties that are so desirable.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention, but it is understood that this application is to be limited only by the scope of the appended claims.

The invention is hereby claimed as follows:

**1.** A combination metal and fabric seamless rotary printing screen comprising, a metal base and a fabric face, said base including an electro-deposited sleeve having an etched pattern of substantially rectangular holes, said face including an electrically non-conductive woven or knit mesh fabric sleeve fitted tightly over the base, said fabric sleeve defining a pattern of substantially rectangular holes, the holes in the fabric sleeve being smaller than and angularly displaced from the holes in the base, and a layer of plating on the base having a thickness about two-thirds the height of the fabric sleeve engaging and coupling the fabric sleeve to the base.

**2.** The combination of claim **1**, wherein the pattern of holes in the base is in the range of 40 to 150 per inch, and the pattern of holes in the fabric sleeve is finer.

**3.** The combination of claim **2**, wherein the base holes present a 35 to 50 percent open area in the base.

4. The combination of claim 3, wherein the base is about .003 to .005 inch thick, and the plating is about .001 to .002 inch thick.

5. The combination of claim 1, wherein the diagonal axes of the fabric sleeve holes are displaced about 45° from the diagonal axes of the base holes.

6. The method of making of making a seamless rotary screen having a metal base and fabric face comprising the steps of forming an electro-deposited metal sleeve, photochemically producing a pattern of substantially rectangular holes in the metal sleeve, and mounting and coupling onto the metal sleeve an electrically non-conductive woven fabric sleeve having substantially rectangular holes of a size substantially smaller than the holes in the metal sleeve so that the diagonal axes of the holes of one sleeve are offset from the diagonal axes of the other sleeve.

7. The method of claim 6, wherein the step of mounting the fabric sleeve onto the metal sleeve includes arranging the relative diagonal axes offset 45°.

8. The method of claim 7, wherein said mounting step includes mounting said metal sleeve onto an electrical non-conductive inflatable, expandable, or other type of mandrel and then heat-shrinking said fabric sleeve onto the metal sleeve to obtain a tight intimate fit between the sleeves.

9. The method of claim 7, wherein said mounting step includes mounting said metal sleeve onto an electrical non-conductive inflatable, expandable, or other type of mandrel and then stretching said fabric sleeve onto the metal sleeve to obatin a tight intimate fit.



10. The method of claim 8, wherein said mounting step includes further plating said metal sleeve with the fabric sleeve in place to a thickness of about two-thirds the thickness of the fabric, sleeve to lock the fabric sleeve against shifting on the metal sleeve.

11. The method of claim 9, wherein said mounting step includes further plating said metal sleeve with the fabric sleeve in place to a thickness of about two-thirds the thickness of the fabric sleeve to lock the fabric sleeve against shifting on the metal sleeve.


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U.S. Cl. X.R.

101—127, 128.4; 204—11