Nov. 19, 1968 H. K. SILER 3,411,973

APPARATUS FOR ETCHING A CELLULOSIC PRINTING PLATE

Filed April 26, 1965 2 Sheets-Sheet 1

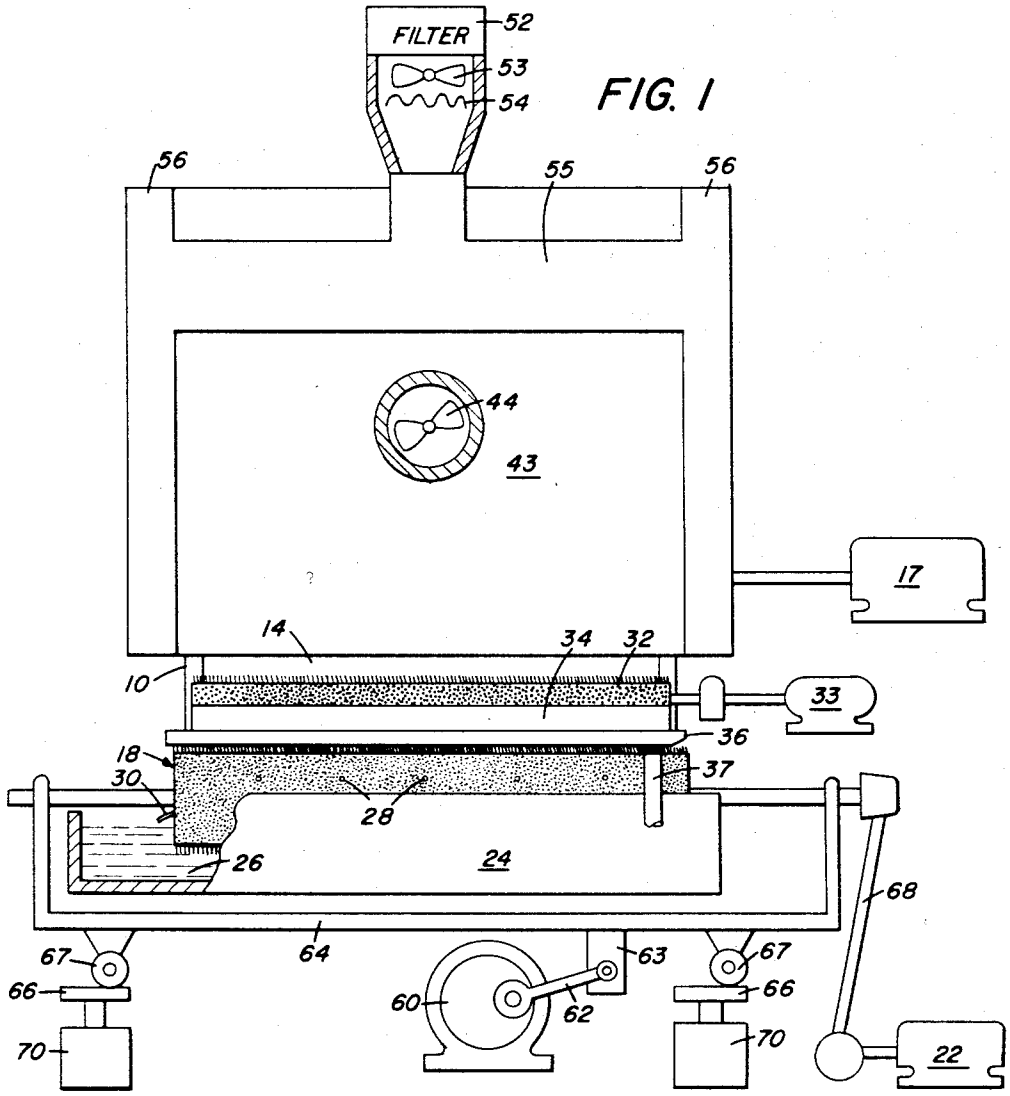

FIG. 1

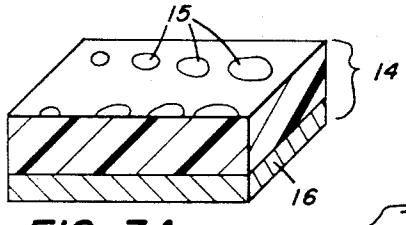

FIG. 3A

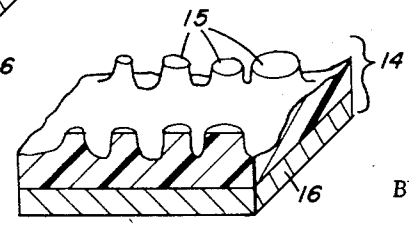

FIG. 3B

HOWARD K. SILER
INVENTOR.

BY R. Frank Smith
David P. Ogle

ATTORNEYS

Nov. 19, 1968 H. K. SILER 3,411,973

APPARATUS FOR ETCHING A CELLULOSIC PRINTING PLATE

Filed April 26, 1965 2 Sheets-Sheet 2

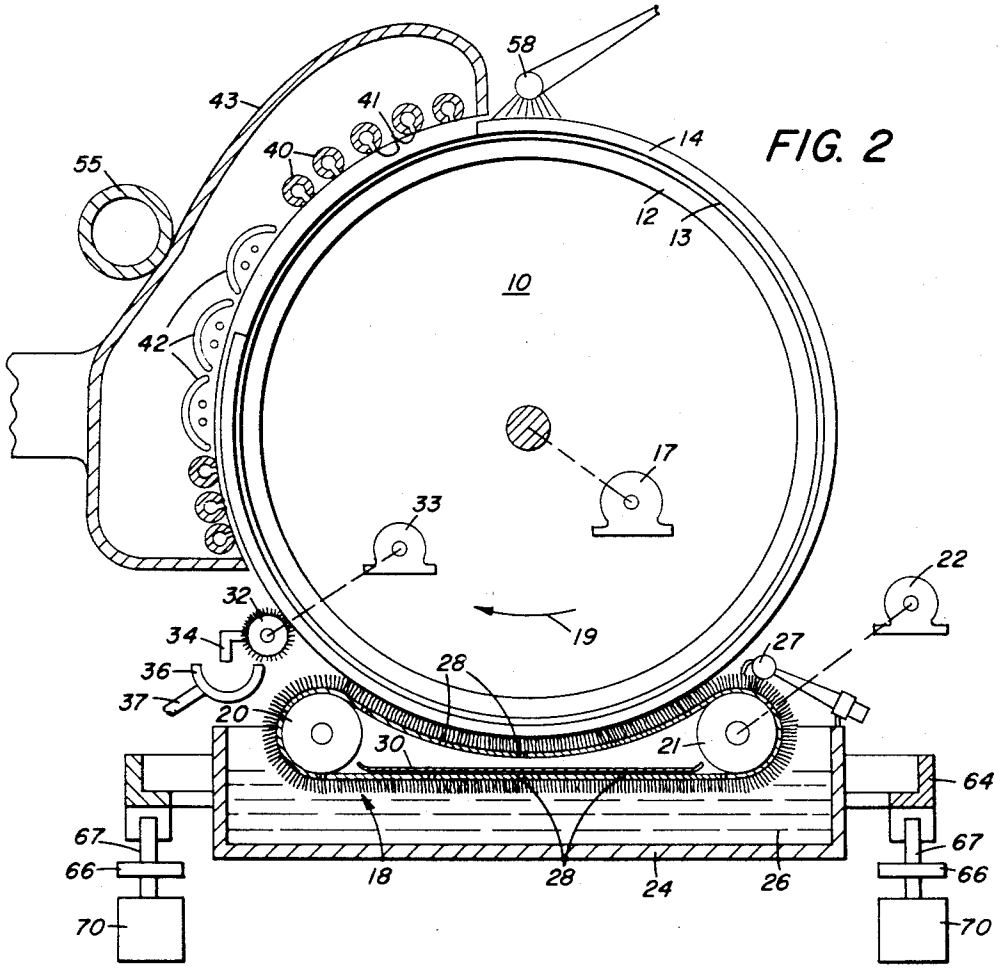

FIG. 2

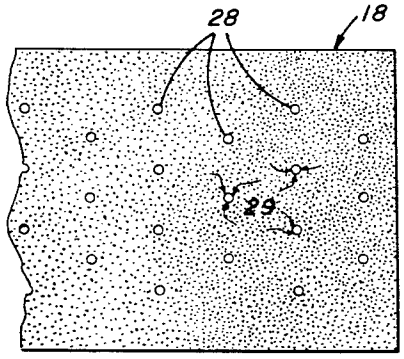

FIG. 4

HOWARD K. SILER
INVENTOR.

BY R. Franck Smith
David P. Ogden

ATTORNEYS

United States Patent Office 3,411,973
Patented Nov. 19, 1968

3,411,973

APPARATUS FOR ETCHING A CELLULOSIC PRINTING PLATE

Howard K. Siler, Dayton, Ohio, assignor, by mesne assignments, to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey

Filed Apr. 26, 1965, Ser. No. 450,971
5 Claims. (Cl. 156—345)

ABSTRACT OF THE DISCLOSURE

A perforated plush belt for scrubbing the surface of a printing plate to etch the surface thereof wherein the perforations permit the removal of etchant and entrained cellulosic materials from the surface of the belt to prevent accumulation thereof in the pile.

This invention relates to halftone printing and particularly to an arrangement for solvent etching a relief halftone in a cellulosic sheet protected by a suitable resist stencil such as a photographically produced wash-off gelatin image.

Relief plates of cellulose nitrate or of cellulose esters such as cellulose acetate are known, and solvent etching of such plates is described in the co-pending patent application Ser. No. 300,977 filed Aug. 9, 1963 by H. G. Staehle et al. and assigned to the assignee of the present invention, now U.S. Patent No. 3,271,226, issued Sept. 2, 1966.

While the removal of material between the dots of a relief printing plate is normally referred to as etching, the actual operation is a softening of the cellulosic sheet by the solvent or etchant accompanied by a brushing to remove the softened areas. With hundred-line per inch halftones or finer, the hairs of the brush must be quite small to operate between the dots, even in the highlight regions where the dots are small, and particularly in the shadow regions where the dots merge and the cellulosic material to be removed leaves only a small hole. The combined etchant and removed cellulosic material form what may be termed sludge. In the co-pending patent application mentioned above, a plush belt is disclosed for scrubbing the softened cellulosic sheet. However, it has been found that such a belt sometimes develops hard spots which tend to damage the plate. These hard spots are probably a result of hardened sludge causing several fibers of the plush belt to stick together.

The primary object of the present invention is to provide a reliable etching arrangement having an improved belt for producing a halftone printing plate with excellent dot quality.

It is a particular object of this invention to provide a perforated plush belt for use in an etching machine whereby sludge run-off occurs at many locations in addition to the edges of the belt.

The light-sensitive gelatin layer on the plate to be etched may be of any of the forms used for the production of stencils. It is not necessary for the residual gelatin image or stencil to be clear. Accordingly, it is preferable to use one of the more efficient types of recording systems, namely, that in which a silver salt is incorporated in the gelatin and in which a developer hardens the gelatin adjacent to the silver at the time the silver salt is reduced to silver. Such a cellulosic plate is exposed, for example, to a halftone negative. The exposed areas are developed with any of the standard hardening or tanning developers which reduce the silver salt to metallic silver and which harden the adjacent gelatin. The unexposed gelatin areas of the plate are then removed by washing in warm water, just

warm enough to remove the unhardened areas. All this is well known.

The environment of the present invention starts with an exposed, developed and washed-off plate consisting essentially of a cellulosic layer with a stencil thereon which is not soluble in the solvents to be used for softening the cellulosic layer. For simplicity, the developed and washed-off, but not etched, plate is hereinafter referred to as a cellulosic plate with a developed stencil thereon. The present invention works with such a cellulosic plate and stencil to provide an etched plate ready for inking and printing therefrom.

The machine using the invention includes a drivable drum having a cellulosic plate with developed stencil secured to its surface. The plate on the drum engages, throughout its lowest segment, a plush belt continuously moistened with an etchant. Since the particlar etchants used are relatively ineffective without scrubbing, the belt is driven at a speed different from and in a plurality of directions relative to that of the exposed plate surface so that the pile of fibers of the belt continuously rubs against a major surface of the plate to apply etchant thereto and to remove softened portions of the exposed cellulosic material between resistant nodules or dots of the developed and tanned stencil. As the drum continues to rotate, moving the plate past the plush belt, the plate is wiped to remove excess etchant, dried by auxiliary heaters, and cooled prior to a next engagement of the etchant applied by the plush belt.

In accordance with the present invention, the plush belt is provided with a plurality of apertures spaced over its outer surface to allow etchant and cellulosic materials to escape therefrom in the form of sludge. The plurality of escape routes for this sludge reduces the likelihood of collection of cellulosic material, as at the edge of the belt, to thereby form "hard spots" sometimes consisting of several bristles or fibers of plush pile secured together by undissolved cellulosic waste matter.

The subject matter which is regarded as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as to its organization and operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings in which:

FIG. 1 is an elevation view partially in section of an etching arrangement using the present invention;

FIG. 2 is a cross-sectional view taken along the line 2—2 of FIG. 1;

FIGS. 3A and B are magnified perspective views of a halftone plate unetched and etched respectively; and

FIG. 4 is a detail view of the surface construction of the plush belt shown in FIGS. 1 and 2.

Referring now to the drawings wherein like numbers refer to similar parts, I have shown in FIGS. 1 and 2 a main drum **10** having a composite outer surface **12** and **13** for supporting a cellulosic plate **14** with a developed stencil thereon. The stencil on the plate **14** consists of dots **15** (shown magnified in FIG. 3A) of hardened gelatin and the cellulosic layer is supported on a base material **16** such as metal. The size of the dots **15** depends upon the relative halftone exposure of a particular area. After etching is completed, the plate takes the form shown in FIG. 3B. In the overall construction illustrated, one side of the drum **10** is exposed to the exterior of the machine to facilitate placing the plate **14** thereon and observation of the plate during etching.

The drum **10** with the plate **14** supported thereon is driven in a clockwise direction (FIG. 2) as indicated by an arrow **19** by a driving means such as a motor **17**. Throughout the surface region of its lower segment, the

plate 14 is contacted by a plush belt 18 supported by a pair of rollers 20 and 21. The roller 21 is driven by a reversible motor 22 so that the surface of the plush belt 18 may be wiped in both directions across the lower surface of the cellulosic plate 14. The rollers 20 and 21 and the plush belt 18 lie partially within a pan 24 having therein an etchant or solvent 26 somewhat like that used for thinning lacquer. The etchant is replenished periodically by fresh etchant being applied directly to the belt 18 from a distributor pipe 27.

In accordance with my invention, in order to prevent buildup of sludge saturated with cellulosic material on the belt 18, I have provided what might be termed relief valves in the form of holes 28 through the belt 18. As shown more clearly in FIG. 4, the plush belt is provided with a plurality of such holes or apertures 28 in a staggered or diamond pattern, which holes allow escape of sludge as indicated by arrows 29. According to one embodiment of my invention, I prefer to provide about fifty to seventy-five such apertures or about four to six per square foot of belt. The sludge dropping through the holes 28 falls onto a run-off pan 30. Holes of one-fourth inch diameter work satisfactorily.

This added drainage substantially increases the periods between cleanings without serious danger of "hard spots" developing due to the undissolved cellulosic matter scrubbed from the plate 14 by the belt 18. Also, this results in a reduced solvent fluid pressure on the plate 14. Such fluid pressure tends to be unpredictable in magnitude and influential in the softening of the cellulosic material. Therefore, the relief of this pressure results in more uniform etching.

Because of the softening effect of the etchant on the cellulosic plastic below each halftone dot 15, it is not practicable to complete the etching step during a single pass, whereby the etchant would soften all of the plastic. If such were to occur, the hardened areas, as well as the plastic therearound, would be wiped away by the bristles of the plush belt 18. Usually, when providing fine relief printing plates, only .001" may be removed per pass without damage or loss of some of the smallest dots. When operating at room temperature, the drum 10 is driven at a speed such as ¼ r.p.m. or about 2 ft./min. for etching halftone plates of 120 lines per inch, which is substantially faster than that which would be necessary to remove the full depth of the etching required for printing purposes during a single pass over the plush belt 18.

During the etching process, the surface of the belt 18 travels at about 120 feet per minute and is reversed about 30 times per minute. As the successive portions of the plate 14 leave the region of the plush belt 18, they are wiped by a plush roller 32 to remove susbtantially all of the sludge remaining thereon. As it is rotated in a clockwise direction by a driving motor 33, the plush roller 32 is wiped clean by a rigid wiper 34. Used etchant and cellulosic matter (sludge) are removed from the plate 14 by the roller 32 and collected on the wiper 34, flows into a trough 36 and from there to a waste material collection receptacle. When using the perforated belt of my invention, this wiped-off sludge is of a thin enough consistency to flow through a waste pipe 37 without serious danger of clogging it.

During further rotation, in order to assure drying of the partially etched plate 14, the plate surface is heated by suitable means to remove all etchant and dry the cellulosic layer so that a next pass may be taken by the plush belt 18 without loss of any detail. The particular drying apparatus shown in FIG. 2 is a combination hot air and radiant heater system. The hot air portion utilizes a plurality of parallel pipes 40 having inwardly opening apertures 41 which direct air, heated to temperatures of the order of 200° F., against the surfaces of the plate 14. Several radiant heaters 42 may be added. These heaters 42 must be operated at temperatures below the ignition temperatures, such as 700° F., of the various chemicals being used.

Because of the fact that the etchant and other chemicals present tend to create noxious and inflammable fumes, there is provided exhaust means substantially surrounding the pipes 40 and the heaters 42 in the form of an exhaust hood 43 with a fan 44 (FIG. 1) for removing the heated air containing the volatile solvents. Usually, this contaminated air is removed both from the region of the subject etching arrangement and from the building housing the equipment.

As shown more clearly in FIG. 1, the inlet to the hot air pipes 40 comprises a filter 52, a fan 53, a heater 54 and duct means 55 which conveys the heated air to both ends of the hood 43 wherein plenum chamber distributors 56 convey air to both of the ends of each of the pipes 40. In order to assure removal of noxious fumes, the capacity of the fan 44 is made larger than that of the fan 53.

As a final stage, during each cycle or etch operation, the plate 14 is cooled to near room temperature prior to the next cycle. Auxiliary cooling means such as cool air impingment is obtained from a distributor pipe 58 to assure suitable cooling. Depending on the travel time between the heater system and the plush belt 18, additional or no cooling means may be employed.

During etching, simply scrubbing the surface of the developed plate 14 with a continuous straight wiping action prevents obtaining of useful etched plates. Therefore, in addition to the motor drive 22, a lateral drive of the plush belt 18 is preferably accomplished by an eccentric drive motor 60 connected by a lever 62 to a drive arm 63 of a support frame 64 for the rollers 20 and 21. A speed of 60 r.p.m. is suitable for the eccentric drive motor 60 when the length of its stroke is of the order of one inch. Thus the platform 66 supporting the pan support rollers 67 must be at least this large. Obviously, with such motion of the support frame 64, the motor 22 will be most effective if it is mounted on the support frame 64 or provided with a universal drive linkage 68, as shown in FIG. 1.

An additional control feature enhances the attaining of quality plates, and that is regulation of the pressure between the plush belt 18 and the drum 10. Both the total pressure and the distributed pressure are important. The total pressure is regulated by upward force developed by the support platforms 66. Pneumatic means such as air cylinders 70 will provide this force. The distributed pressure is a function of the sag of the plush belt 18 between the rollers 20 and 21.

While I have shown and described particular embodiments of the present invention, other modifications may occur to those skilled in this art. For instance, when using etchants of greater viscosity, the holes 28 may be of larger size. I intend, therefore, to have the appended claims cover all modifications which fall within the true spirit and scope of my invention.

I claim:

1. In an apparatus for etching the exposed areas of a cellulosic plate having a stencil on a surface thereof to form a relief printing plate, the apparatus including a rotatable drum for supporting the plate with the stencil surface thereof engaged by a plush belt which scrubs the surface, the plush belt having a flexible backing faced with a pile on the scrubbing surface thereof which is wet during scrubbing of the plate with an etchant to soften only the exposed areas of the cellulosic layer, the belt being driven at surface velocities different from that of the plate on the drum and in a plurality of directions relative to the surface of the plate so that the softened portions are scrubbed away, the improvement wherein:

the plush belt is provided at locations remote from the edges thereof with a plurality of holes through the flexible backing to remove etchant and entrained cellulosic materials from the scrubbing surface of said belt to reduce the accumulation thereof in said pile.

2. The invention as in claim 1 wherein the holes in said belt are at least about one-fourth inch diameter and are spaced about six holes per square foot of belt area.

3. The invention as in claim 2 wherein the holes are in a staggered pattern.

4. The invention as in claim 1 wherein there is also provided a run-off pan under the region of the scrubbing area of the belt to catch sludge passing through the plurality of holes in the belt.

5. The invention according to claim 1 wherein the portion of the belt in contact with the plate is disposed substantially horizontally below the stencil surface whereby the etchant and entrained cellulosic materials are removed from the surface of the belt by gravity.

References Cited

UNITED STATES PATENTS

3,271,226	9/1966	Staehle et al.	156—345
3,266,196	8/1966	Barcaro	134—9 X

JACOB H. STEINBERG, *Primary Examiner.*