

Aug. 23, 1960

P. G. CLONIS ET AL
SCREEN PRINTING APPARATUS

2,949,847

Filed Oct. 24, 1956

4 Sheets-Sheet 1

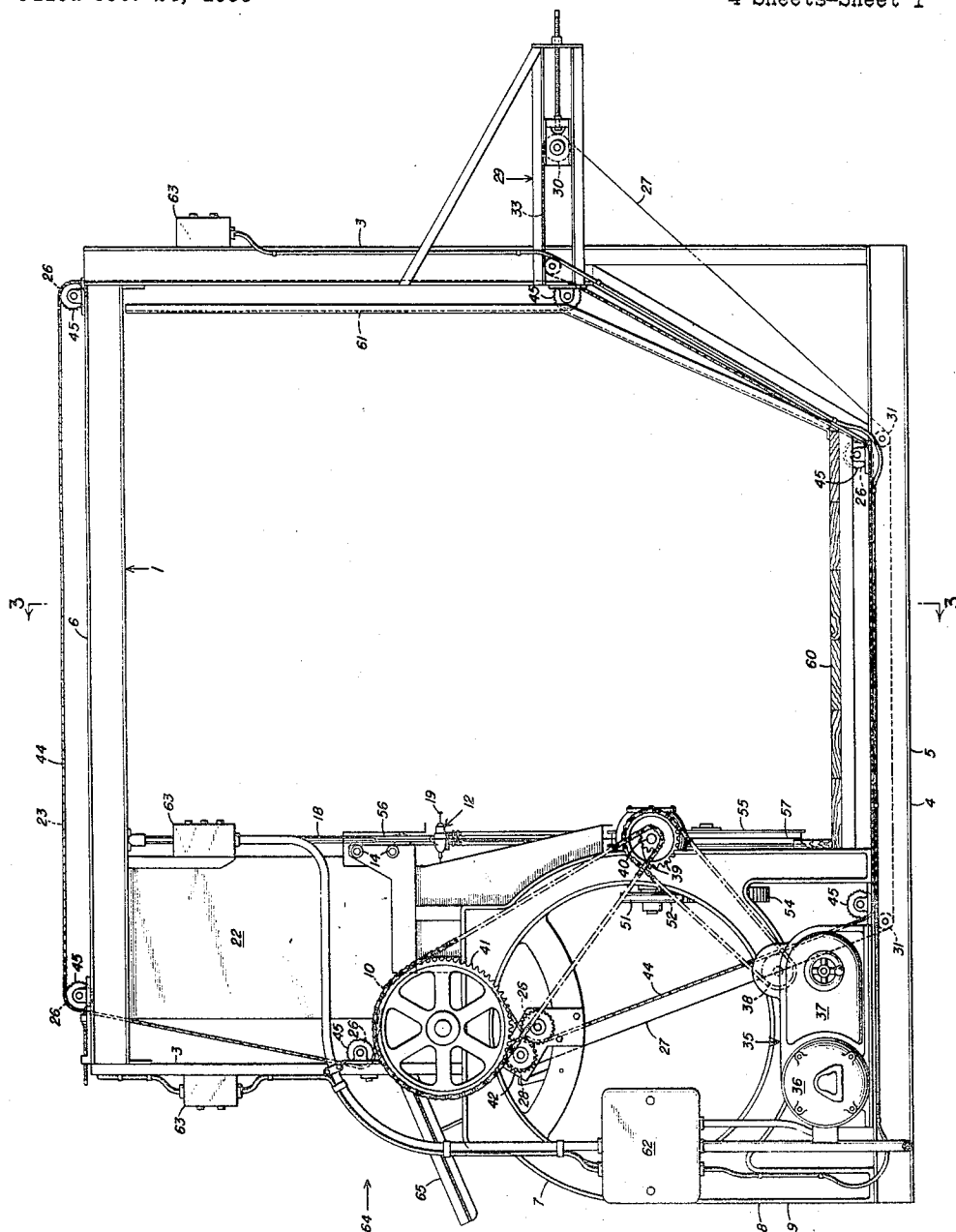


FIG. 1

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4 Sheets-Sheet 2

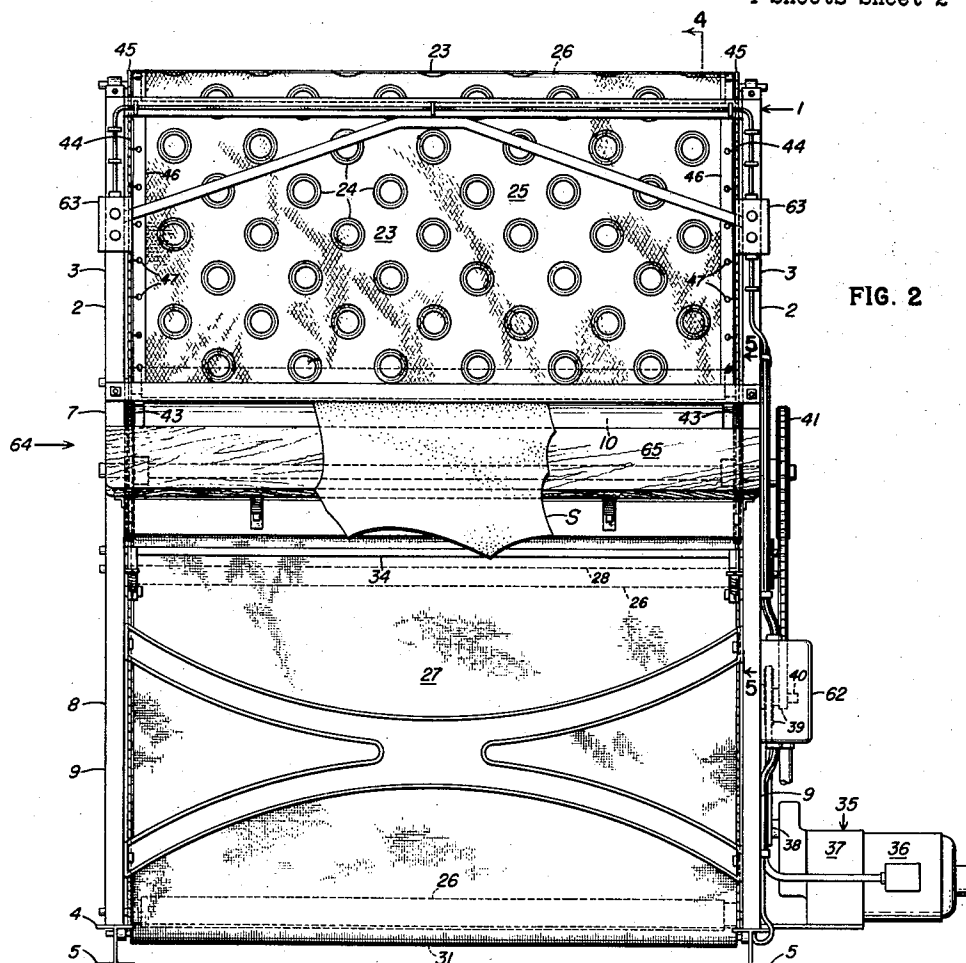


FIG. 2

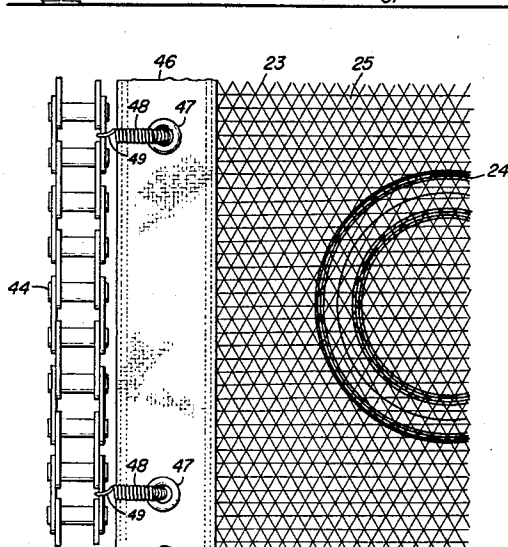


FIG. 6

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4 Sheets-Sheet 3

FIG. 3

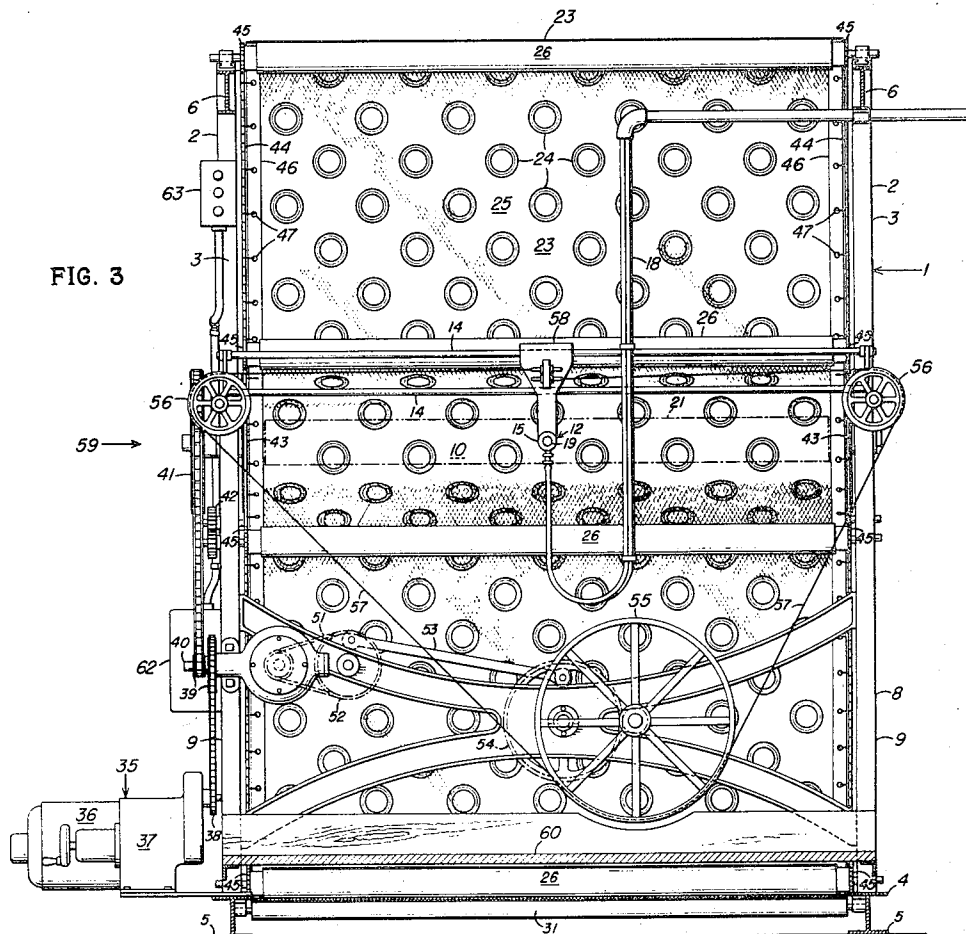
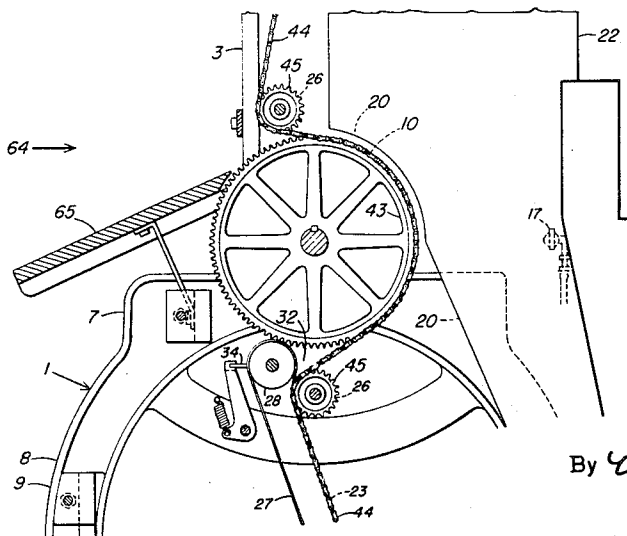


FIG. 5



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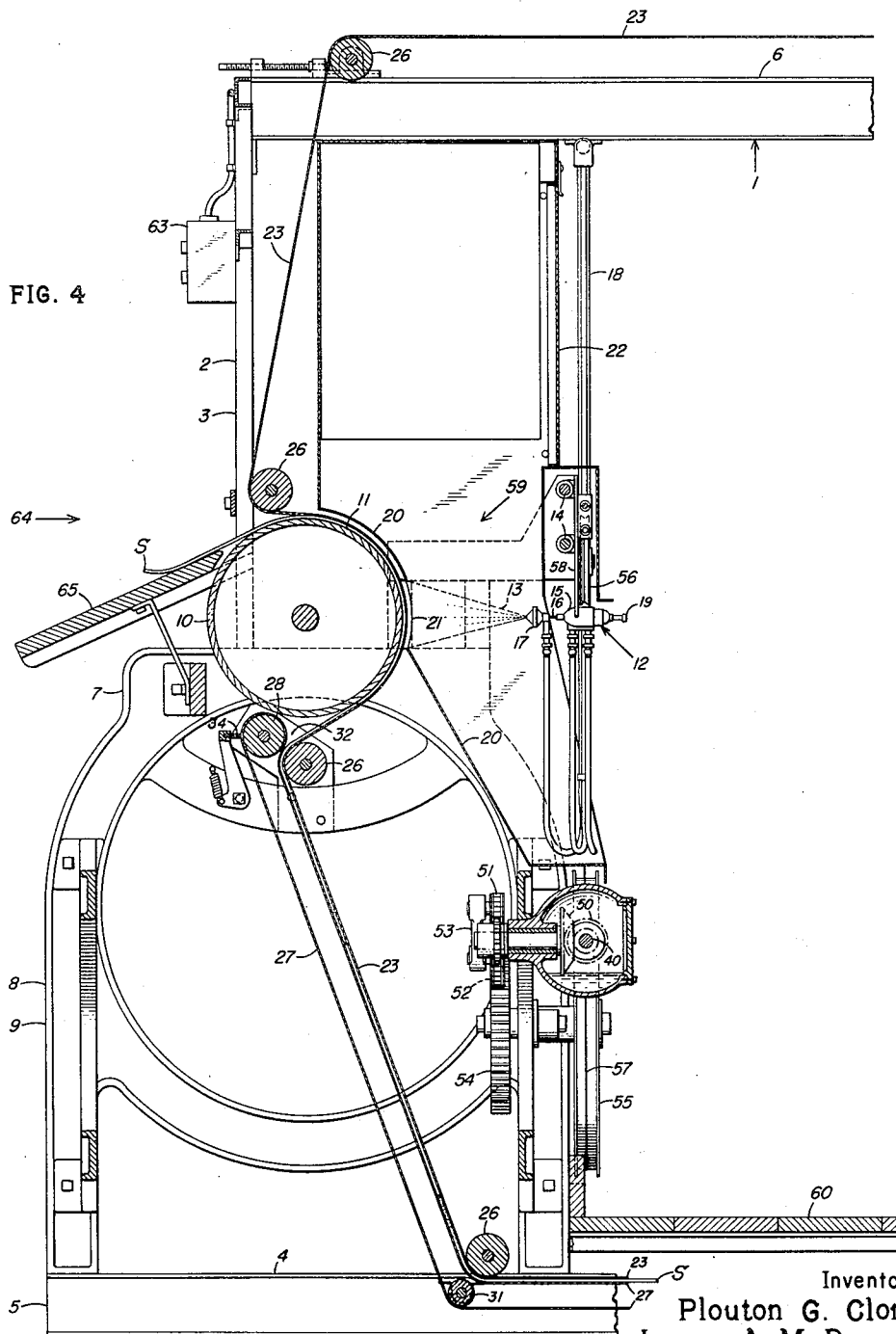
P. G. CLONIS ET AL
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4 Sheets-Sheet 4

FIG. 4



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2,949,847

SCREEN PRINTING APPARATUS

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Filed Oct. 24, 1956, Ser. No. 618,042

10 Claims. (Cl. 101—122)

This invention relates to apparatus for printing on sheet material and has for its primary object to provide apparatus for practicing, on a continuous basis, the screen printing process of Plouton G. Clonis application Serial No. 592,525, filed June 20, 1956, now abandoned, wherein a printing medium is sprayed directly through a screen bearing a design onto the surface to be printed.

Another object of the invention is to provide apparatus for printing on sheet material wherein the printing medium is sprayed through an endless screen bearing a design and of sufficiently open mesh to pass the printing medium directly to the surface to be printed and the sheet material is supported and travels with the screen during the stage in which its surface is presented for printing, whereby the apparatus is enabled to print on material in either individual or continuous sheet form.

A further object of the invention is to provide apparatus of the character described wherein the screen bearing the design is of such construction and so arranged relative to the back-up roll or similar device by which the sheet material is presented for printing as to hold the material firmly thereon during printing.

An additional object of the invention is to provide apparatus of the character described wherein the material to be printed is supported during the printing stage on a back-up roll and thereafter supported between an associated endless belt conveyor and the continuous screen substantially to the point of discharge, thus enabling the apparatus to print on skins or other individual sheets of material, as well as on material in continuous sheet form, fed in sequence into the machine.

Another object of the invention is to provide apparatus of the character described wherein the spraying device is reciprocated axially of the back-up roll and its reciprocation and the linear speeds of the back-up roll and design bearing screen are so synchronized as to ensure uniformity of printing upon the surface of the sheet material presented for printing.

Another object of the invention is to provide apparatus of the character described wherein the means through which the endless screen is driven are availed of to enable the screen to be tensioned transversely and with longitudinal tensioning means, serve to maintain the screen in register with the surface being printed.

Other objects and advantages of the invention will appear hereinafter in the detailed description, be particularly pointed out in the appended claims and be illustrated in the accompanying drawings, in which:

Figure 1 is a side elevational view of a preferred form of the screen printing apparatus of the present invention;

Figure 2 is a front elevational view of the apparatus of Figure 1;

Figure 3 is a vertical sectional view taken along the lines 3—3 of Figure 1 with the hood removed and only its outline indicated in dot-and-dash line to more clearly illustrate certain of the details of construction;

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Figure 4 is an enlarged fragmentary vertical sectional view taken along the lines 4—4 of Figure 2;

Figure 5 is a fragmentary vertical sectional view on the scale of Figure 4 taken along the lines 5—5 of Figure 2; and

Figure 6 is a fragmentary view of an end portion of the screen and associated driving chain on a sufficient scale to indicate the openness of the weave of the printing areas on the screen.

Referring now in detail to the drawings, in which like reference characters designate like parts, the improved screen printing apparatus of the present invention is adapted for printing on sheet material, whether available only in individual form, such as skins, or in either individual sheet or continuous strip form, such as paper, fabric or flexible plastic or metal sheeting, and to apply to such material a design of practically any desired degree of detail and repetitive for any given length of the material. It thus is suited equally for printing electrical circuits for use in the electronics industry, at one extreme, and for applying designs to dress fabrics or wallpaper, at the other.

The screen printing apparatus of the present invention comprises basically a frame carrying a back-up device for supporting and progressively presenting for printing a surface of a skin or other sheet material, a spraying device directed at the back-up device for spraying an atomized printing medium on the surface to be printed and a continuous or endless screen bearing a design and passing in part of its travel about the frame between the spraying and back-up devices, together with the driving mechanism and other components needed to coordinate the operation upon the sheet material and to feed the material into and remove it from the apparatus, the particular details depending on whether the apparatus is to handle individual or continuous sheets or both. The several basic components are all contained in the disclosed embodiment which, while particularly designed for handling individual sheets, such as skins, will also handle continuous sheets of material. The disclosed apparatus is comprised of a preferably parallel-sided frame 1 having at either of its sides 2 longitudinally spaced uprights 3 which surmount a base 4, desirably in the form of a pair of transversely spaced bottom rails 5, and are connected at or adjacent their upper extremities by transversely spaced longitudinally extending top rails 6, the frame 1 conveniently being made of structural shapes of appropriate size and shape welded or otherwise connected together and its sides 2 being suitably cross-braced to rigidify the structure. At one, here the infeed, end 7 of the frame 1, there preferably is provided a subframe or stand 8 of cast, welded or other construction sufficiently rugged to support the principal operating parts of the apparatus, its sides 9 forming the lower part of the uprights 3 at that end of the frame.

Surmounting and supported on the subframe 8 for rotation about a horizontal axis extending transversely of the frame 1 is a back-up or work-supporting drum, roll or equivalent backing or supporting device 10 for presenting a surface of a skin S or other sheet material for printing. For applying ink or another of the printing media described in the above-mentioned Clonis application which may be appropriate for the particular sheet material and design to be printed, there confronts the periphery 11 of the drum 10 a spraying device in the form of one or more air guns or brushes 12, reciprocable axially of the drum and so disposed as to direct a jet 13 of atomized fluid substantially radially of the back-up drum and mounted to cover a segment or portion of the drum surface from end to end during a given interval in the rotation of the drum. For the illustrated single

air gun, this entails so mounting the gun as to enable it to reciprocate between the sides 2 of the frame, and is accomplished in the disclosed embodiment by mounting the gun 12 on a pair of guide rails or rods 14 anchored at opposite ends in the sides of the frame and reciprocally driving it in the manner hereinafter to be described.

Since the illustrated gun 12 is conventional and its details form no part of the present invention, it suffices to point out that it is composed of an oval body 15 from the front end of which projects, radially of the drum 10, a tube or pipe 16 to the end of which is connected a spray head or nozzle 17. The gun 12 is connected by flexible hose or tubing 18 to suitable sources of supply (not shown) of air and liquid printing medium. Of the three tubes leading to the illustrated gun, one, that immediately behind the nozzle 17, supplies the atomizing air while the other two supply, respectively, liquid printing medium and air under pressure, the latter by controlling the position of a spring-pressed piston (not shown) within the body 15, opening or closing the body to the printing medium. As usual in such guns, there is, in addition, a handle 19 for operating a needle valve (not shown) to regulate the richness of the mixture emitted from the nozzle.

For limiting the area of the drum 10 to which the atomized printing medium may have access to that directly in front of the gun 12 so as to ensure clarity of printing, the surface 11 of the drum is shielded or protected from the spray by a shield 20 extending across the frame 1 above and below the level of the gun and interrupted over that level by a substantially rectangular slot 21 extending the length of the drum and of a width sufficient to include the spread of the jet 13 from the gun. The shield in turn is part of a hood 22 which, about and below the level of the spray gun, may be enclosed at either side and, above that level, preferably is fully enclosed to contain the excess atomized medium and, if desired, exhaust it through a suitable exhaust fan and duct (not shown).

Partly wrapping the drum 10 over a portion of its circumference, including that exposed through the slot 21 to the jet from the spray gun 12, is a continuous or endless flexible screen 23. Woven in the same manner and of any of the materials described in the Clonis application and having its design 24, of which that disclosed is merely exemplary, applied in any of the ways therein described which is suitable for the particular design to be printed, the screen 23 will have its printing areas 25 of such open mesh as to pass the printing medium directly from the spray gun 12 to the surface to be printed. As will be noted, the screen 23 in its path or travel follows roughly the perimeter of the frame 1, traveling thereabout on guide rollers or pulleys 26 having their axes disposed substantially parallel to that of the drum 10, the consequent length of its run or travel ensuring maximum opportunity for air drying in case the printing medium employed is relatively slow-drying.

Guided over the drum 10 during printing by the screen 23, the sheet material, if in continuous strip or sheet form, readily could be guided over a portion of the path of the screen by some of the guide rollers 26 until it had reached a convenient point for discharge from the apparatus. However, in dealing with individual sheets of material, such as the disclosed skins S, provision must be made for conveying the material to a discharge point. This is here accomplished by the provision of an endless belt conveyor 27 running over a drive roller or pulley 28 positioned below the drum 10 and thereafter in its forward travel running on the related of the guide rollers 26 of the screen 23 until it reaches a discharge station 29 at the rear end of the frame 1, whence, after passing over a take-up roller 30, it runs on its own set of idler pulleys 31 back to the drive pulley.

With the faces of the screen 23 and conveyor 27 parallel and, in the absence of sheet material, pressing against

or engaging each other as they run to the discharge station, the leading edge of a skin or other individual sheet of material, as it leaves the drum 10, will drop into the trough-like opening 32 provided between the screen and the conveyor immediately below the drum and be conveyed or conducted by the screen and conveyor together to the discharge station 29. As will be noted, the screen and conveyor, in their common path, travel first downwardly and finally upwardly so as to clear the central portion of the frame for the purpose hereinafter described and in the downward and upward portions of their common path are inclined, this to facilitate their holding the material flat as it is carried to the discharge point. Too, the conveyor, in the last portion of the forward path beyond the point at which it separates from the screen, desirably projects substantially horizontally outwardly of the rear end of the frame to provide a run-out or horizontal leg 33 for discharging the sheet material for further handling. Since the conveyor 27 may pick up printing medium from the screen 23 as well as matter from the underside of the sheet material, it sometimes will be desirable to remove any excess matter from the conveyor in advance of its point of contact with the sheet material. A spring-pressed rubber scraper or scraper blade 34, mounted to bear against the surface of the conveyor as it rounds its drive roller 28, has been found adequate for this purpose.

Since, to prevent blurring of the printing, either while the sheet material is being printed or thereafter as it is conducted to the discharge point, it is necessary to avoid slippage between the material and the screen, an important feature of the present invention is the driving mechanism, designated generally as 35, for driving the drum 10 and screen 23 in synchronism or concert and with the partial wrap of the drum by the screen and the sheet material ensuring intimate contact between and registry of the screen and the sheet material during printing. This driving mechanism may have its electric motor or other power means 36 mounted at one side of the frame 1 and preferably has a vari-pulley or other speed adjusting device 37 interposed between it and the other driven components of the device.

For positiveness of drive, chain and sprocket connections are provided between the take-off 38 of the speed changing device and the driven components, the take-off being connected directly to reduction gearing 39 mounted on a common shaft 40 and therethrough drivably connected to a sprocket wheel 41 on the drum 10.

Both the screen 23 and conveyor 27 are driven off the drum 10 to coordinate their linear or peripheral speeds, the conveyor through a gear 42 fixed to its drive roller 28 and intermeshing with a gear of the same size fixed to the adjoining of the guide rollers 26 of the screen. For a dual purpose, one to drive the screen 23, the drum 10 has fixed to its shaft 40, in addition to its drive wheel 41, a pair of sprocket wheels 43, one toward either end. All three of these wheels are of the same size and over each of the pair 43 runs, at either side of the frame 1, a sprocket chain 44 which follows the path of the screen 23 and runs over a sprocket wheel 45 fixed to each of the screen's guide rollers 26.

While ordinarily it would suffice to drive the screen through but one of its guide rollers 26, the pair of sprocket chains 44 at either side of the screen serve a very useful purpose in the apparatus. Flexible vertically but relatively stiff against lateral displacement, these chains afford lateral anchorages through which the screen can be tautened or tensioned transversely, as by reinforcing the screen at either side by edge tapes 46 and piercing each of the tapes by eyelets or grommets 47 for resiliently connecting the screen at spaced points to the bounding chains 44. The resilient connection in the illustrated embodiment is obtained by coil springs 48, one looped through each of the grommets 47, and having its ends connected to an adjoining of the links 49 of the chains 44. Any

linear slack in the screen and associated chains may be taken up by constructing one or more of the guide rollers 26 as a take-up roller. Thus tautened or tensioned both linearly and transversely, the screen serves to hold the sheet material being printed in tight engagement with the supporting periphery 11 of the drum 10 and itself and the sheet material in register during printing.

It has been mentioned that the driving connection between the power take-off 38 and the drum 10 is through intervening reduction gearing 39. It is the latter that is here employed to reciprocate the spray gun 12 across the slot 21 in synchronization with the linear or peripheral speed of the drum so as to ensure that the exposed surface of the sheet material has been printed completely when it leaves the printing station. Conversion of the rotary movement of the driven shaft 40 of the reduction gearing 39 to reciprocable movement of the spray gun parallel to the axis of that shaft is here obtained by a pair of bevel gears 50, one fixed to the shaft 40 and the other drivably connected by a sprocket chain 51 to a gear 52 which, through an eccentric linkage 53, causes a larger gear 54 to oscillate. The latter, in turn, drives a pulley 55 about which and a pair of idler pulleys 56 of parallel axis, one at either end of the guide rails 14, runs a wire or cable 57, the ends of which are anchored to the base plate on which the spray gun is carried. With this arrangement and slippage of the cable 57 over its driving pulley 55 inhibited by an entire friction mounting of the base plate 58 of the guide rails 14, it is a simple matter to synchronize the speed of reciprocation of the spray gun relative to the linear speed of the screen and, since the drives are inter-connected, this relation will obtain regardless of the speed at which the drum 10 and screen 23 are driven.

To permit access to the interior of the apparatus and particularly to permit observance of the printing as it proceeds, the frame 1 is open between its rear end and the printing station, designated as 59, at which the sheet material is printed, and has a platform 60 extending from side to side on which an operator can stand and beneath which run the screen 23 and conveyor 27 in their forward travel. To prevent accidental damage to the screen by such an operator, its inner face as it passes up the rear end of the frame preferably is covered by a grill 61 extending substantially to the top rails 6. The main control box 62, containing both on and off controls for starting and stopping the power means 36, is positioned above the printing station so as to be accessible to an operator standing on the platform 60 and supplemental control boxes 63 for permitting the power means to be cut off in the case of an emergency are provided at both the discharge station 29 and the feed station 64 at the infeed end 7 of the frame 1.

To direct sheet material onto the drum 10, particularly if the apparatus is to be fed manually, rather than automatically, there preferably is provided at the feed station a shelf 65 which is mounted on the subframe 8 and directed substantially tangential to the periphery 11 of the drum. This shelf, in the case of skins, not only facilitates feeding of the individual sheets of material, but affords opportunity for smoothing the sheets as they enter onto the drum. At the discharge station, the run-out or horizontal leg 33 of the belt conveyor 27, onto which the sheet material passes as the conveyor and screen separate, serves effectively to discharge the material from the apparatus for further handling elsewhere. If the printing is to be multi-color, the material, after it leaves the first printing station, may be conducted through a sequence of printing stations, each having substantially the same basic components and synchronized in drive with the first, and the screens of the several stations being matched for applying a different color at each.

From the above detailed description, it will be apparent that there has been provided improved screen printing apparatus which, while comparable in the quality of its product with the silk screen process, unlike that process

as now practiced is adapted for continuous printing on sheet material, whether in individual or continuous sheet form. It should be understood that the described and disclosed embodiment is merely exemplary of the invention and that all modifications are intended to be included which do not depart from either the spirit of the invention or the scope of the appended claims.

Having described our invention, we claim:

1. Screen printing apparatus comprising a frame, a back-up drum rotatably mounted on said frame, an endless flexible screen separate from said drum and mounted on said frame for movement in a substantially fixed path, said screen in a portion of its path partially wrapping said drum and intimately contacting sheet material supporting thereon, and spray means mounted on said frame and reciprocable axially of said drum for directing printing medium at said screen in the portion of the path thereof of partially wrapping said drum, said screen bearing a design and having its printing areas of open mesh to pass printing medium from said spraying means directly onto a surface to be printed of said sheet material.

2. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, a spray gun directed at and mounted on said frame for reciprocation axially of said drum, an endless flexible screen separate from and partially wrapping said drum and intimately contacting work supported thereon, said screen bearing a design and having printing areas of open mesh to pass printing medium directly from said gun to a presented surface of said work, and means for driving said drum and screen and reciprocating said gun in synchronism.

3. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, a flexible screen separate from said drum and mounted on said frame for travel about a path including a segment of the periphery of said drum, said screen over said segment registering with an intimately contacting work supported on said drum, spray means for directing a printing medium at said included segment of said periphery, said screen bearing a design and having printing areas of open mesh to pass said printing medium directly to a presented surface of said work, and an endless conveyor facially engaging said screen for gripping work therebetween as it leaves said drum and conveying said work therefrom to a discharge point.

4. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, a flexible screen separate from said drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, spray means mounted on said frame and reciprocable axially of said drum for directing a spray of printing medium at said included segment of said periphery, said screen bearing a design and having printing areas of open mesh to pass said printing medium directly to a presented surface of said work, chain means at opposite sides of and corresponding in path of travel to said screen for drivably connecting said screen to said drum, said chain means being substantially rigid against transverse deflection, and means resiliently connecting said screen to said chain means for transversely tensioning said screen.

5. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, and endless flexible screen separate from the drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, spray means mounted on said frame and reciprocable axially of said drum for directing a spray of printing medium at said included seg-

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ment of said periphery, said screen bearing a design and having printing areas of open mesh to pass said printing medium directly to a presented surface of said work, sprocket chains at opposite sides of said screen and substantially conforming in path of travel thereto for drivably connecting said screen to said drum, and spring means spaced linearly of said screen and connecting sides thereof to said sprocket chains for transversely tensioning said screen.

6. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, an endless flexible screen separate from said drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, spray means mounted on said frame and reciprocable axially of said drum for directing a spray of printing medium at said included segment of said periphery, said screen bearing a design and having printing areas of open mesh to pass said printing medium directly to a presented surface of said work, and a shield overlying said included segment of said periphery and partially enclosing said spray means, said shield having a slot extending lengthwise of said drum and opening from said spray means onto part of said included segment for limiting thereto the surface of said work presented at a given time to said spray means.

7. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, an endless flexible screen separated from said drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, said screen bearing a design and having printing areas of open mesh, and said screen being drivably connected to and driven off of said drum, spray means mounted on said frame for directing a spray of printing medium through said open mesh printing areas of said screen directly onto the presented surface of said work, and means drivably connected to said driving means for reciprocating said spray means axially of said drum in synchronism with rotation of said drum.

8. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, an endless flexible screen separate from said drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, said screen bearing a design and having printing areas of open mesh, spray means mounted on said frame for directing a spray of printing medium

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through said open mesh printing areas of said screen directly onto the presented surface of said work, and an endless conveyor facially engaging said screen over a portion of the travel thereof and cooperating with said screen for conveying work from said drum to a discharge point, said screen and conveyor being driven off of and synchronized in drive with said drum.

9. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, an endless flexible screen separate from said drum and mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen over said segment registering with and intimately contacting work supported on said drum, said screen bearing a design and having printing areas of open mesh, spray means mounted on said frame for directing a spray of printing medium through said open mesh printing areas of said screen directly onto the presented surface of said work, and means drivably connecting said spray means to said driving means for reciprocation thereof axially and in synchronism with rotation of said drum.

10. Screen printing apparatus comprising a frame, a work-supporting drum rotatably mounted on said frame, driving means for rotating said drum, an endless screen mounted on said frame for travel in a path including a segment of the periphery of said drum, said screen bearing a design and having printing areas of open mesh, spray means mounted on said frame for directing a spray of printing medium through said open mesh printing areas of said screen directly onto the presented surface of work supported on said drum, and drive means for reciprocating said spray means axially of said drum.

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