United States Patent [19]

Van der Winden

[11] **3,892,176**

[45] **July 1, 1975**

[54] **ROTARY SCREEN TENSIONER FOR SINGLE SIDED DRIVE**

[75] Inventor: **Johannes Bernardus Van der Winden**, Amstelveen, Netherlands

[73] Assignee: **Konishiroku Photo Industry Co., Ltd.**, Tokyo, Japan

[22] Filed: **Sept. 5, 1973**

[21] Appl. No.: **394,645**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 108,394, Jan. 21, 1971, abandoned, which is a continuation of Ser. No. 608,438, Jan. 10, 1967, abandoned.

[30] **Foreign Application Priority Data**

Feb. 4, 1966 Netherlands 6601488

[52] **U.S. Cl.** **101/116**; 101/127.1; 101/128.1

[51] **Int. Cl.**[2] **B41F 15/38**

[58] **Field of Search** 101/127.1, 128.1, 127, 101/115, 116, 119, 120, 126

[56] **References Cited**

UNITED STATES PATENTS

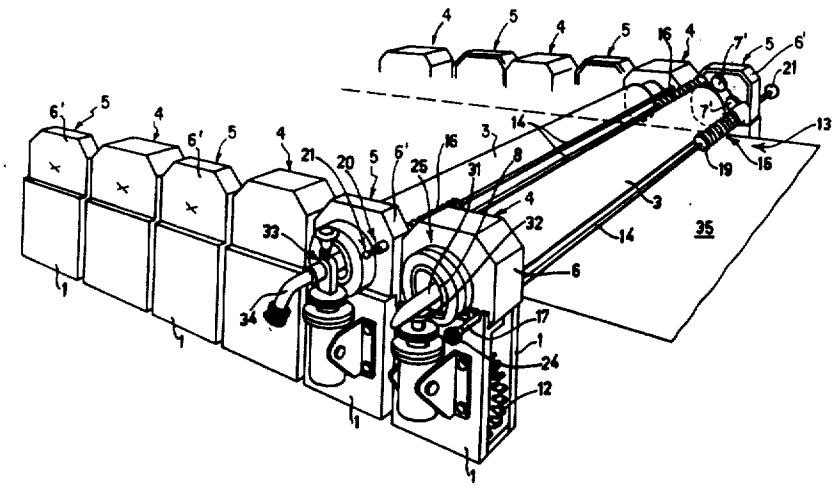
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[57] **ABSTRACT**

A rotary screen printing machine has a web to be printed upon while advancing from one end of the machine to the other. A plurality of cylindrical uninterrupted or seamless screens extend transversely of the direction of travel of the web and have relatively rigid hollow sleeves connected to the opposite ends thereof. Only one of the sleeves of each screen is driven, and means is provided for maintaining the screens under tension axially thereof while being driven. The screens may be mounted in two groups offset with respect to one another transversely of the direction of travel of the web. The doctor blade assembly within each screen can be mounted and dismounted through the sleeves mounted at opposite ends of the associated screen.

16 Claims, 7 Drawing Figures



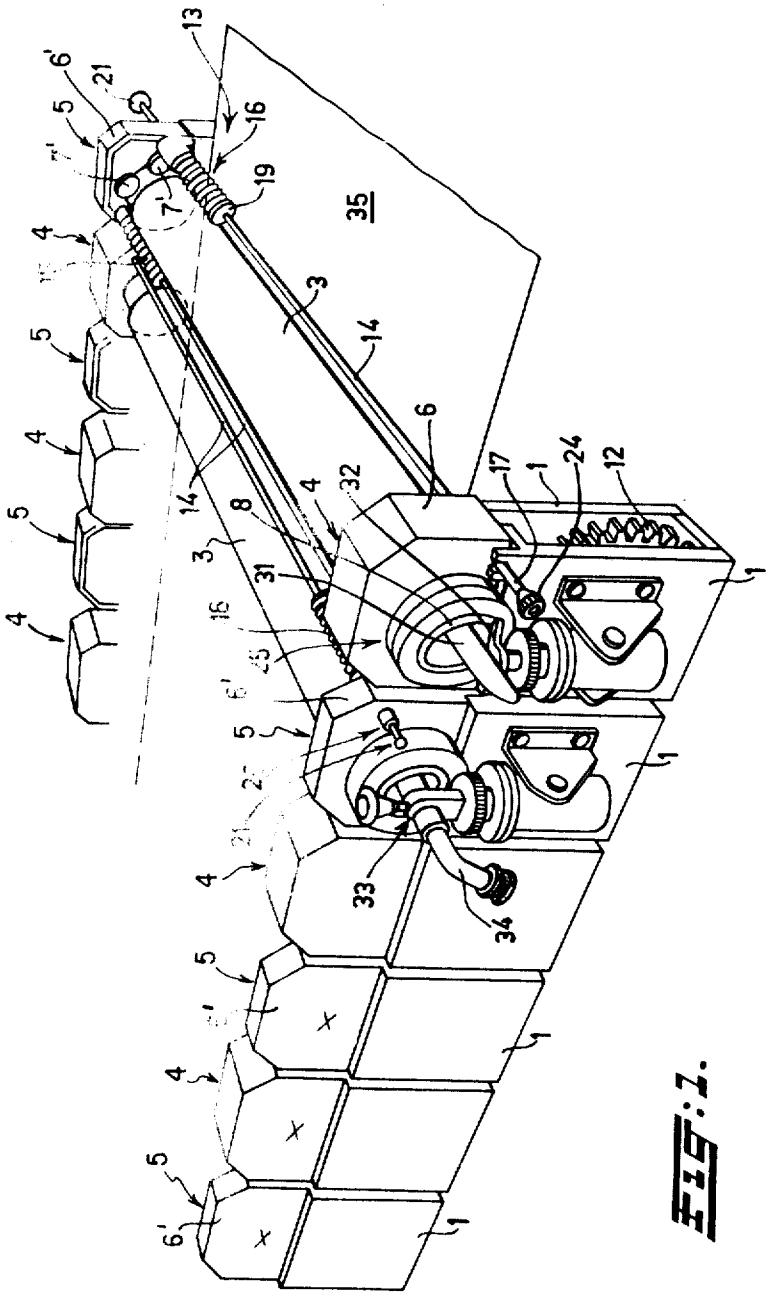


FIG. 1.

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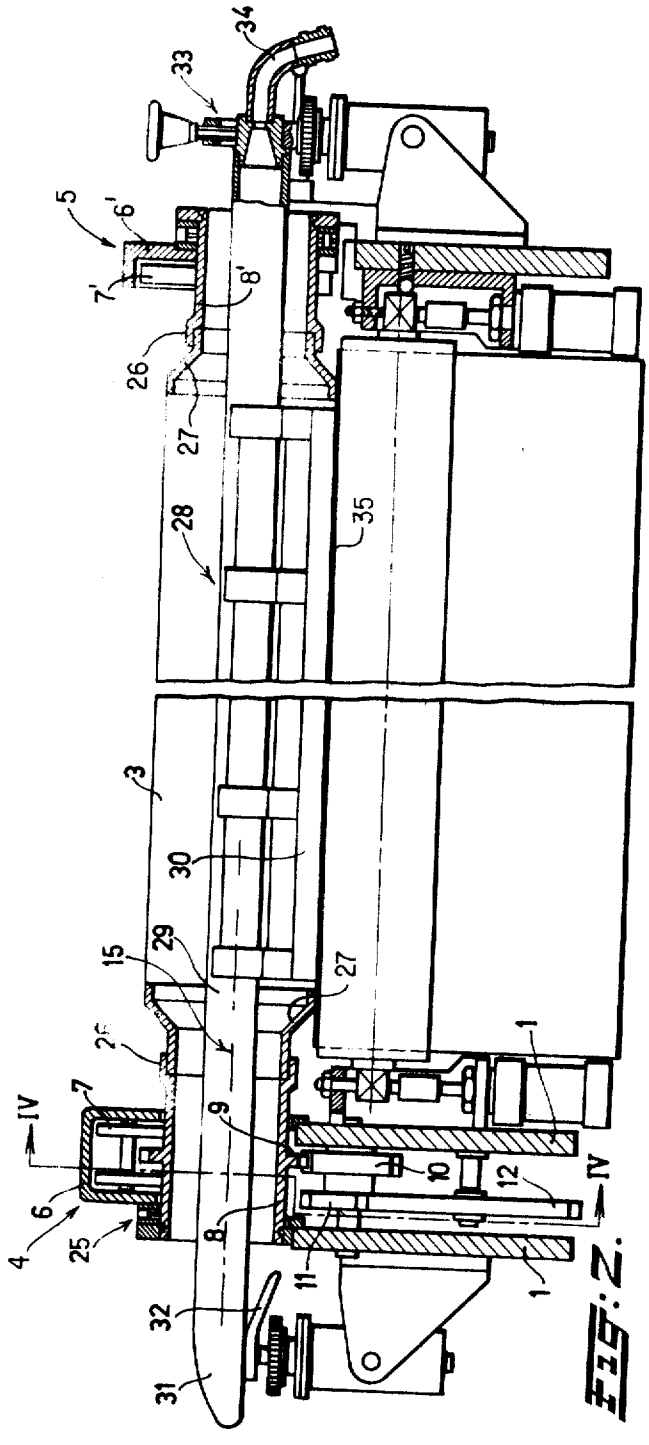


FIG. 2.

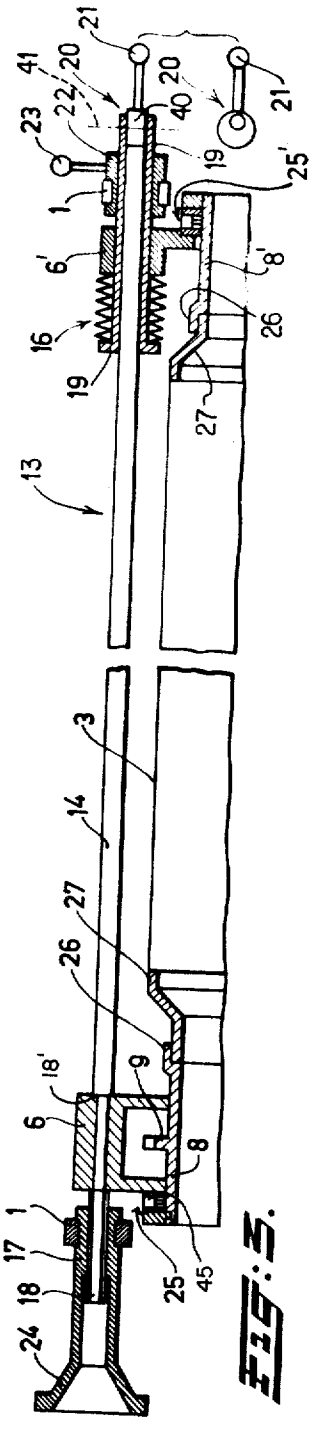


FIG. 3.

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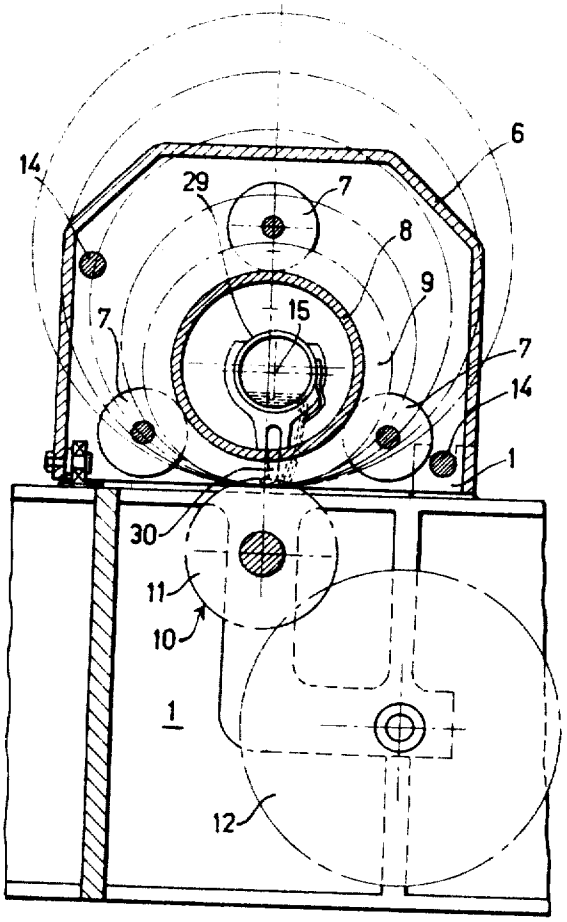


FIG. 4.

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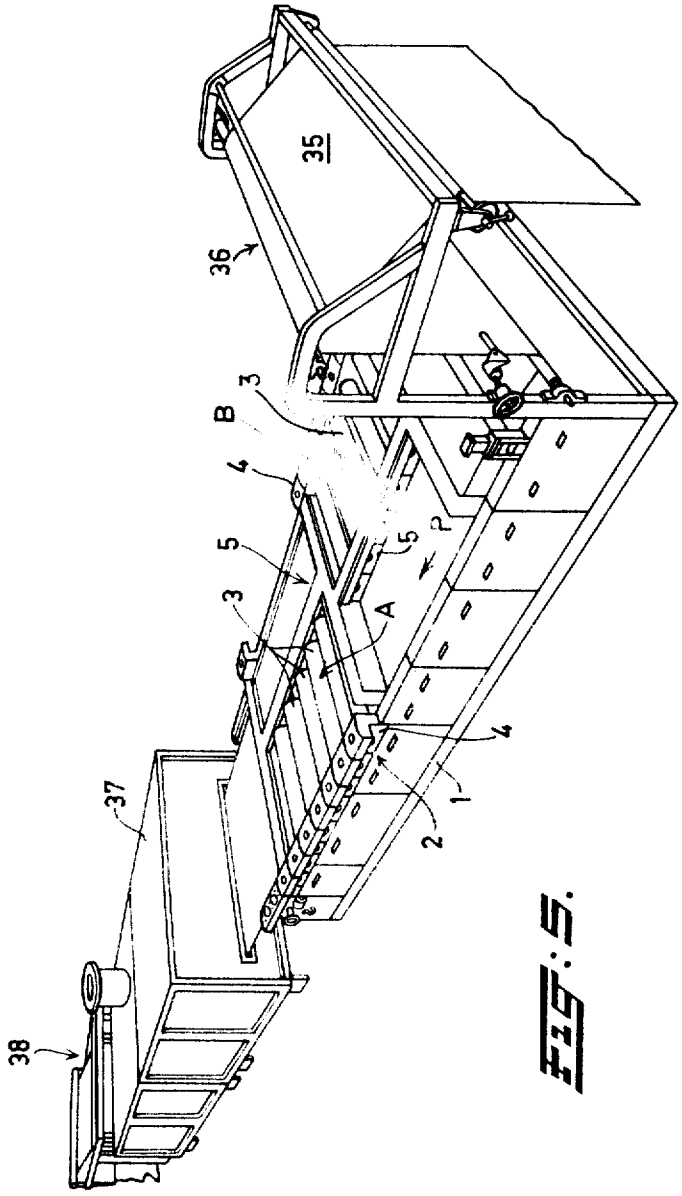


FIG. 5

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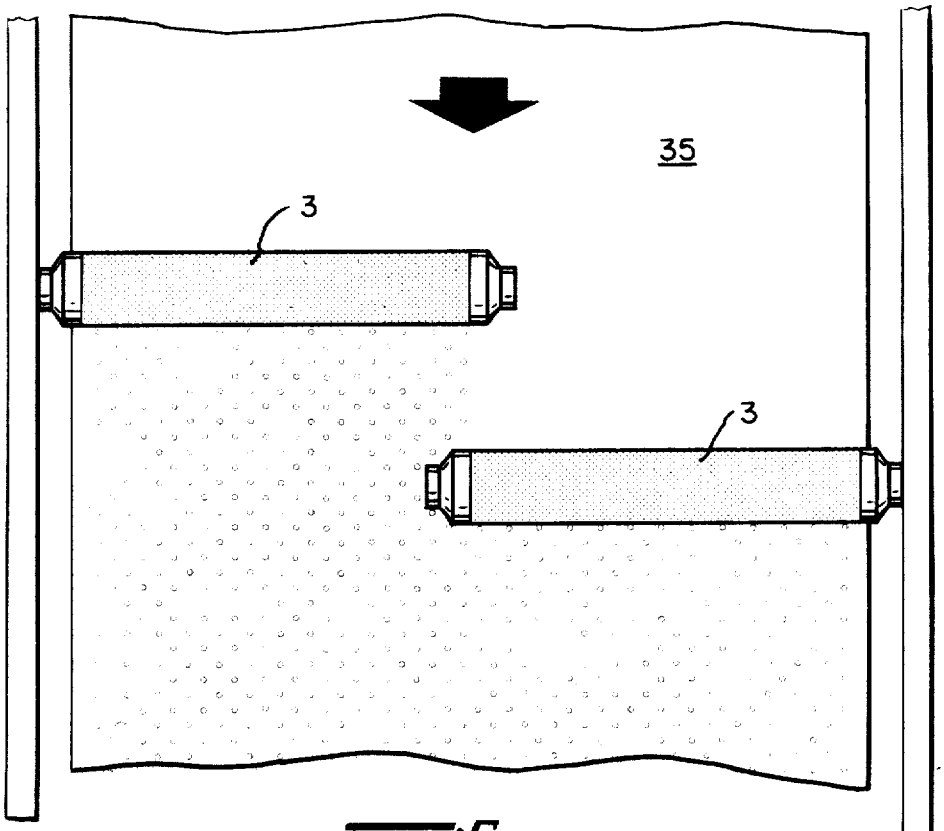


FIG: 6.

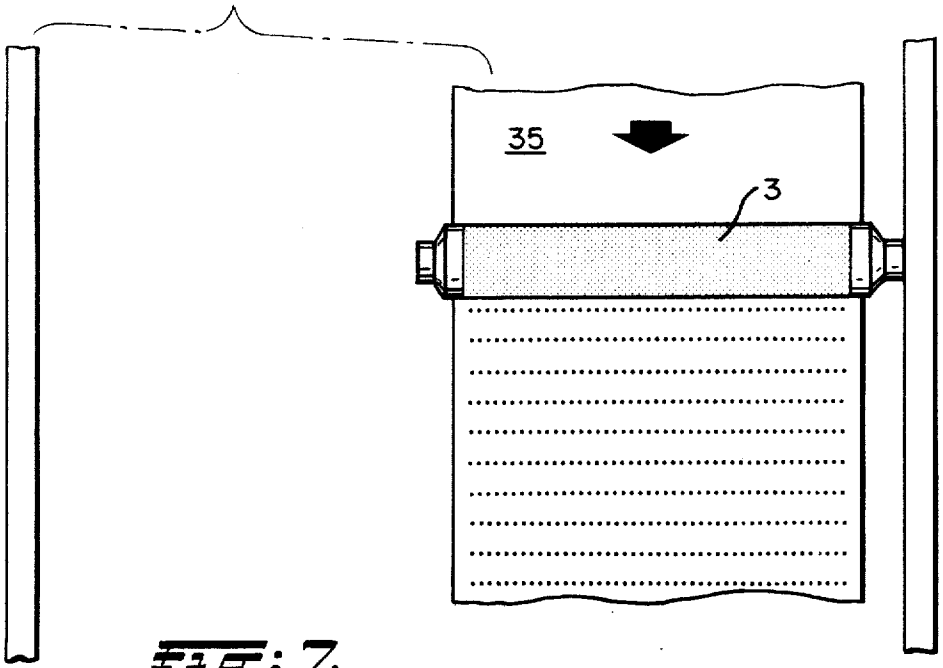


FIG: 7.

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ROTARY SCREEN TENSIONER FOR SINGLE SIDED DRIVE

RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. Pat. application Ser. No. 108 394, filed Jan. 21, 1971, now abandoned and the latter application was a continuation of U.S. Pat. application Ser. No. 608,438 filed Jan. 10, 1967, and abandoned.

The present invention relates to a rotary screen printing machine wherein a rotating screen is employed for printing on a web in contact therewith. These screens extend transversely of the direction of travel of the web and are connected with relatively rigid members at the opposite ends thereof. In the prior art, when employing uninterrupted screens which are disposed in continuous printing contact with the associated web, this type of screen is always driven from both ends thereof since the screens are not sufficiently rigid to withstand the torsional stresses of a single end drive.

On the other hand, when it is desired in the prior art to provide a single end drive, screens of a different construction have been employed including a rigid framework or other type of reinforcing construction which requires periodic and cyclic lifting of the screen out of printing relationship with the web.

In addition, the construction of prior art machines of this type is such that it is relatively difficult and time consuming procedure to mount and dismount the doctor blade assemblies with respect to the screens and to change the screens when required.

It is therefore an object of the present invention to provide a rotary screen printing machine having a plurality of cylindrical perforated screens wherein each screen, which is normally incapable of transmitting torsional forces, can be driven from one end while the other end is freely journalled.

In the present invention, means is provided for advancing a web to be printed from one end of the machine to the other. A plurality of cylindrical seamless or uninterrupted screens extend transversely of the direction of travel of the web and relatively rigid hollow sleeves are connected to opposite ends of each of the screens. Bearing means support the sleeves and the screens for rotation so that the screens bear in continuous printing relation upon the web and it is not necessary to periodically lift the screens away from the printing web.

The screens are continuously driven by driving the sleeve at only one end of each of the screens while the sleeve at the opposite end of each of the screens is freely rotatable. Means is provided for maintaining the screens under tension axially thereof while being driven whereby the sleeve at the opposite freely rotatable end of each screen is rotated by a driving torque transmitted solely through the associated screen. In this manner, a cylindrical seamless screen may be driven from only one end thereof.

A doctor blade assembly is supported within each of the screens and includes a support member extending beyond the sleeves at opposite ends of the associated screen. The sleeves are of such a size relative to the doctor blade assembly that the doctor blade assembly can be mounted and dismounted with respect to the screen through the ends of the sleeves connected to the screen. There are no members or elements within the screen either for tensioning or supporting the screen so that after the doctor blade assembly is removed the screen is entirely empty and can be easily dismounted for changing screens thereby reducing any downtime periods.

The bearing means for supporting each of the screens comprises a pair of aligned bearing assemblies, one of which is freely rotatable and the other one of which receives the drive for the associated screen. The drive is transmitted from the driven bearing assembly solely through the uninterrupted screen to the opposite freely rotatable or non-driven bearing assembly. This enables the screens to be divided into a plurality of groups wherein each group can receive its own drive.

Two or more groups of screens may have different diameters and each group can be driven at its own particular speed in such a way that the circumferential speed in the printing area of all the screens will be substantially identical.

The construction of the present invention also enables the screens to be so arranged that the screens of one group may alternate with the screens of another group with the screens of one group being driven from one end thereof and the screens of the other group being driven from the opposite end thereof.

The means for maintaining the screens under tension axially thereof in order to enable a drive from only one end of the screens also provides additional functions such as adjustment of each screen transversely of the direction of movement of the web and further enables at least one end of each screen to be adjusted longitudinally of the direction of travel of the web so that the screen is positioned substantially perpendicular to the direction of travel of the web.

Due to the fact that the screens are driven from only one end thereof, the length of the screens is limited. The screens may be divided into two groups which are offset with respect to one another transversely of the direction of travel of the web so that the screens are adapted to print a web having a width twice as great as the effective length of each screen. When the two groups of screens are employed, an additional amount of work is involved in replacing the various screens, and accordingly the construction which permits the screens to be more readily replaced is an important feature of the present invention.

Other objects and advantages of the invention will be apparent upon reference to the accompanying description when taken in conjunction with the following drawings, which are exemplary, wherein;

FIG. 1 is a top perspective view partly broken away of a first embodiment of the invention;

FIG. 2 is a longitudinal section through one of the screens and the associated supporting structure shown in FIG. 1;

FIG. 3 is a section through a portion of the structure shown in FIG. 2 illustrating the tensioning means of the machine;

FIG. 4 is a sectional view on an enlarged scale taken substantially along line IV—IV of FIG. 2 looking in the direction of the arrows;

FIG. 5 is a top perspective view of a modified form of the invention;

FIG. 6 is a schematic view of a web printed by a machine as shown in FIGS. 1–4 inclusive; and,

FIG. 7 is a schematic view of a web printed by a machine as shown in FIG. 5 of the drawings.

Referring now to the drawings wherein like reference symbols designate corresponding parts throughout the several views, the machine as shown in FIGS. 1–4 includes a frame 1 supporting a plurality of bearing means for a series of screens or stencils 3. Each bearing means comprises a pair of spaced aligned bearing assemblies 4 and 5 in which the opposite ends of a corresponding cylindrical screen are supported. The machine further comprises means for supporting, guiding and advancing the web of material 35 to be printed upon. This portion of the machine of the present invention is of conventional construction as, for example, disclosed in U.S. Pat. Nos. 3,291,044; 3,304,860; 3,313,232; 3,420,167; and in U.S. Patent application Ser. No. 17,136 now abandoned which is a continuation application of U.S. Patent application Ser. No. 395,764, now abandoned.

However, in the present invention, each screen as supported in its bearing assemblies 4 and 5 is driven from only one end of the screen. In the drawings, drive means is associated with each bearing assembly 4 whereas each screen 3 is supported for free rotation at each bearing assembly 5.

Each bearing assembly 4 includes a casing 6 within which are disposed three spaced supporting rollers 7. Each bearing assembly 5 includes a casing 6' within which are disposed three spaced supporting rollers 7'. A sleeve 8 is rotatably supported by rollers 7 and a sleeve 8' is rotatably supported by rollers 7' such that both sleeves 8 and 8' are axially movable thereon. Each screen 3 comprises a cylindrical seamless screen as disclosed in the aforesaid patents and patent application which is normally incapable of withstanding any substantial torsional loading. Such screens are generally made of pure nickel and the wall is very thin, generally of the order of 0.08–0.19 mm. The cylinder is regularly perforated over its entire surface and is therefore incapable of withstanding the torsional stresses of being driven from one end thereof.

The opposite ends of each of screens 3 are provided with known coupling or adaptor rings 27 which are connected at 26 to sleeves 8 and 8' respectively to permit rapid mounting and removing of the screens. The sleeves as well as the coupling rings are formed of a suitable relatively rigid substance such as metal so as to be able to impart driving torque to the screens which normally would be incapable of transmitting drive therethrough. Both the sleeves and the coupling rings are hollow and of a suitable dimension for a purpose hereinafter described.

A hollow cylinder of a thin and flexible material such as the perforated screens of the present invention, will become shortened in length when subjected to torsional forces. The application of torsional forces will cause a twisting of the cylinder so that creases and buckles will occur therein and the length of the cylinder will decrease. Since it is necessary during printing that the screen be as rigid as possible, it is desirable to maintain the screen in its cylindrical form as near as possible. In order to maintain the original length and form of the cylindrical screen even when subjected to torsional forces an axial force is applied to the screen so as to place the screen under tensile stress. Therefore, the application of axial force will maintain the length of the screen constant under the influence of torsion and the screen can be driven from one end. The amount of tensile stress which must be applied to such a cylindrical screen can be calculated through known mathematical procedures.

In an actual test, an 80 mesh cylindrical screen having a wall thickness of about 0.0003 inches was subjected to torsional forces both under tension and without any tension. The screen with tension withstood a torque of 9.5 foot-pounds before buckling at a deflection of 0.008 inches, while the cylinder without tension could withstand only 6.5 foot-pounds before deflecting the same amount and buckling. The deflection is measured at the end of the cylinder and indicates the amount that one end of a longitudinal line drawn on the surface of the cylinder deflects from its original position.

As seen in FIG. 2, each of sleeves 8 is provided with a gear 9 having a pitch diameter corresponding to the diameter of the associated screen 3. It will be appreciated that screens of different diameters may be employed as illustrated in phantom lines in Flg. 4. Different sizes of enclosure casings 6 with correspondingly sized sleeves 8 are thus used for different sizes of screens and different sizes of stencils can be used. Conventionally, five different sizes are available.

The main drive wheel 12 for each screen is in mesh with gear 11 of the gear train 10, 11 which, similar to gear 12, is rotatably supported by frame 1. Gear 9 is in mesh with gear 10 whereby each screen is driven at one end thereof from an associated main drive gear 12.

As seen in FIG. 1, the first screen on the right side of the figure is driven at its near end while the next screen is driven at its far end. This alternating arrangement is continued from right to left in the figure so as to provide two groups of alternate screens which are driven from opposite sides of the machine. Each bearing assembly 4 is at the driven end of the screen while each bearing assembly 5 is at the freely rotating or non-driven end of the associated screen. For adjustment purposes, the two gears 10 and 11 of the gear train are mounted so as to allow for slight relative angular displacement or adjustment therebetween as known in the art.

Referring to FIGS. 1, 3 and 4, tensioning means for each screen is indicated generally at 13 and includes a pair of rods 14 disposed diametrically opposite to one another with respect to the center line 15 of bearing assemblies 4 and 5 as seen in FIGS. 2 and 4 and when three or more rods 14 are used they are spaced equal arc distances from each other on a generatrix of a cylinder concentric to center line 15. Each of rods 14 has operatively associated therewith a sleeve 17, a sleeve 19, a resilient member 16, and eccentric mounting bushing 22 and a tension cam 20. Each sleeve 17 has a hand wheel portion 24 and is provided with a circumferential groove by means of which it is rotatably supported in the frame 1 but held against axial movement with respect thereto. The end 18 of the associated rod 14 is threadedly engaged with the sleeve 17 so that when the latter is rotated in the frame the rod is shifted axially with respect to the frame.

The end 18 of the rod 14 also has a shoulder 18' spaced therefrom for engaging casing assembly 6 so that when hand wheel 24 is rotated to shift the rod 14 axially to the left in FIG. 3, casing assemblies 6 and 6' are likewise so shifted. A thrust bearing 25 is interposed between casing 6 and a shoulder 45 formed on sleeve 8. Accordingly, when casing 6 is shifted to the left, sleeve 8 and the screen secured thereto together

with casing 6' and sleeve 8' are also shifted to the left. This permits transverse adjustment of the screen with respect to the web.

At the opposite end of each rod **14**, a sleeve **19** is slidably mounted on rod **14**. The sleeve **19** has mounted therein a cam **20** having an eccentric **40** pivotable around axis **41** and provided with an operating handle **21**. A resilient member or compression spring **16** is disposed between a shoulder on the sleeve **19** and casing assembly 6'. Sleeve **19** may be shifted to the right as seen in FIG. 3 by manipulating cam **20** to the position shown in FIG. **3**. The cam reacts against the fixed end face of rod **14** and thus shifts the sleeve **19** to the right.

When the sleeve **19** is shifted to the right, spring **16** is compressed and exerts a greater force against casing assembly 6' which, in turn, exerts a force to the right against an axial thrust bearing 25' disposed between casing assembly 6' and a shoulder formed on sleeve 8'. Accordingly, applying a greater axial force on casing assembly 6' to the right urges the associated end of the screen to the right to effect the desired axial tensioning of the screen.

An eccentric bushing **22** is fixed axially with respect to the frame **1** but is rotatable relative thereto. This bushing supports sleeve **19** within a bore thereof so that rotation of the bushing by means of handle **23** allows sleeve **19** and casing 6' to be shifted longitudinally with respect to the direction of travel of the web. In this manner, one end of the screen may be shifted longitudinally so as to enable each screen to be properly positioned in the transverse direction and to be aligned so that its axis is exactly perpendicular to the direction of travel of the web being printed.

Casing **6** and 6' of the two bearing assemblies **4** and **5** for each screen rest upon the machine frame with the stencil tensioning means fixing these casings in place both longitudinally and transversely with respect to the frame. Each casing **6** because of threaded sleeve **17** cannot shift longitudinally with respect to the direction of travel of the web. However, rotation of threaded member **17** by means of knob **24** shifts rod **14** together with the two casings **6** and 6' secured thereon transversely with respect to the direction of travel of the web. The screen **3** carried by these casings is also displaced so that each screen can thus be precisely positioned in the direction transverse to the web.

As a result, both casings **6** and 6' may be shifted transversely while casing 6' at the non-driven end of each screen may also be shifted longitudinally.

The tension adjustment for each screen is effected by moving casing 6' toward or away from casing **6**. As shown in FIG. **3**, manipulation of handle **21** causes cam element **40** to rotate about axis **41** and shifts sleeve **19** axially on shaft **14**. Spring **16** is thereby compressed or relaxed, as the case may be, to thereby modify the tension on screen **3**. Tensioning and proper positioning of the screens may accordingly be easily and quickly effected.

Disposed within each screen **3** and the associated sleeves **8** and 8' is a doctor assembly **28**. The doctor assembly comprises a supporting member **29** of tubular construction having a longitudinally extending bore therewithin, and doctor blade **30** is supported by this supporting member. Supporting member **29** has a tapered finder nose **31** at one end thereof cooperating with a support including an upwardly slanting supporting face **32**. The doctor blade assembly is inserted upside down into the screen through sleeve 8' and moved until the finder nose runs up along surface **32**. When the doctor blade assembly is in the final position, it is rotated a half turn and secured against displacement by means of a fastening member **33** of known type such as a threaded clamp which engages the supporting member **29**.

The doctor blade assembly and the internal diameter of sleeves **8** and 8' are of such dimension that the doctor blade assembly can be readily mounted and dismounted with respect to the screen through the sleeves at opposite ends of the screen.

Printing liquid is supplied through a tube **34** to the longitudinally extending bore provided within supporting member **29**. As seen in FIG. **4**, the printing liquid is adapted to flow downwardly as shown in dotted lines through suitable outlets provided in supporting member **29** into the interior of the screen and rearwardly of the doctor blade **30**.

Both the driving and the tensioning members are arranged entirely outside of the screens so that these members do not interfere with removing and replacing the doctor assemblies. The doctor assembly can be readily removed through one of the sleeves connected to the screen whereupon the screen can be replaced in a quick and efficient manner.

Since a number of successive screens are employed, it is important to provide a means for adjusting their positions relatively to one another so that the prints of the successive stencils correctly overlap one another on the material to be printed. The adjustment for varying the rotational or angular relationship between gears **10** and **11** of the gear train previously described enables rotational adjustment of the screens so as to provide the proper overlap.

FIG. **1** discloses a construction wherein each of the screens is driven from only one end thereof and wherein the driven ends of adjacent screens are at opposite ends of the machine. On the other hand, it is also possible to provide a construction wherein all of the driven ends of the screens may be disposed at one side of the machine and all of the freely rotatable ends of the screens may be disposed at the opposite side of the machine.

Referring now to FIG. **5**, a modified form of the invention is illustrated wherein two groups A and B of cylindrical screens **3** are provided and are supported by bearing means **2** disposed on a frame **1**. A web **35** is fed from one end of the machine to the other in the direction of arrow P by a conventional feeder mechanism **36**. The web passes from the printing machine into a treatment installation **37** and a collector **38**.

Bearing means **2** includes a first plurality of bearing assemblies **4** which are driven bearing assemblies and second bearing assemblies **5** which are freely rotatable or non-driven.

The two groups of screens A and B are offset with respect to one another transversely of the direction of travel of the web, the freely rotatable bearing assemblies **5** of the two groups being situated in a central area of the path of web **35** to that the inner ends of the screens of the two groups of screens are substantially in longitudinal alignment with respect to the direction of travel of the web. With this construction, the screens are adapted to print over a width of a web which is twice the length of an individual screen.

Referring now to FIG. 7, a top view is schematically illustrated of a web 35 having a pattern printed thereon by means of a machine as constructed in accordance with FIGS. 1–4 inclusive and employing a single group of aligned screens. FIG. 6 is a top view schematically illustrating a web 35 having a pattern printed thereon by means of a machine as constructed in accordance with FIG. 5 employing two groups of screens which are offset with respect to one another transversely of the direction of travel of the web. It is apparent that when utilizing the same size screens, the arrangement shown in FIG. 6 enables the printing of a desired pattern of twice the width of the pattern printed with the construction shown in FIG. 7 and accordingly a web may be printed on with the construction shown in FIG. 7.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. A rotating screen printing machine comprising a frame, means on said frame for supporting a web to be printed while advancing from one end of the machine to the other, a cylindrical seamless perforated screen of a thin, flexible material extending transversely of the direction of travel of the web, a rigid hollow sleeve connected to each of the opposite ends of said screen, a pair of spaced aligned bearing assemblies on said frame supporting said sleeves and said screen for rotation so that the screen bears in continuous printing relation upon the web during printing, a doctor blade within said screen and bearing against the inner side of the associated screen in opposed relationship to the web, means for introducing printing liquid within said screen behind the associated doctor blade with respect to the direction of movement of the screen past the blade, means for positively and rotatably driving a said sleeve at only one end of said screen while the sleeve at the opposite end of the screen is freely rotatably supported, and means for maintaining said screen under tension axially thereof while being driven whereby the sleeve at the said opposite end of said screen is rotated by a positive driving torque transmitted through the screen.

2. A printing machine as claimed in claim 1 wherein said machine comprises a plurality of said screens each positioned transversely of the direction of travel of said web.

3. A printing machine as claimed in claim 2, and means for adjusting the position of the non-driven bearing assembly of each screen both transversely and longitudinally of the direction of travel of the web.

4. A printing machine as claimed in claim 2, wherein said adjusting means includes first means for shifting each pair of bearing assemblies together with the associated screen transversely of the direction of travel of the web, and second means for shifting only that bearing assembly associated with the non-driven end of each screen longitudinally of the direction of travel of the web.

5. A printing machine as claimed in claim 2 including a plurality of groups of screens, the driven sleeve associated with each screen of a first group of screens being disposed at one side of said frame and the driven sleeve of each screen of a second group of screens being disposed at the opposite side of said frame.

6. A printing machine as claimed in claim 5 wherein said first and second groups of screens are offset with respect to one another transversely of the direction of travel of the web.

7. A printing machine as claimed in claim 6 including rotatable support means, the non-driven ends of said screens being journaled in said rotatable support means and being disposed substantially in longitudinal alignment with respect to the direction of travel of the web, the screens of said two groups extending in opposite directions with respect to each other from the non-driven ends thereof.

8. A printing machine as claimed in claim 2, wherein said means for maintaining said screens under tension comprising at least two rods extending between each pair of bearing assemblies, the rods between each pair of bearing assemblies being disposed adjacent diametrically opposite portions of the associated screen, each end of said rods being secured to one of the associated bearing assemblies, and spring means for resiliently acting between each rod and the other of the associated bearing assemblies, one of the rods associated with each pair of bearing assemblies being interconnected with said frame.

9. A printing machine as claimed in claim 8, wherein the interconnection of each one of said rods with said frame comprises a threaded member mounted for rotation by the frame and held against axial movement with respect thereto, each of said rods being threaded into one of said threaded members.

10. A printing machine as claimed in claim 8, wherein said spring means includes a member slidably supported on the associated rod, a movable cam face engageable with said rod and a resilient member disposed between said slidable member and the adjacent bearing assembly.

11. A printing machine as claimed in claim 10, wherein said spring means includes a member which is a supporting block having an eccentric bore receiving said rod and which is rotatably mounted in said frame.

12. A printing machine as claimed in claim 2 including an elongated supporting member supporting said doctor blade within each screen, each supporting member having the opposite ends thereof projecting beyond the corresponding ends of the associated screen and sleeves, and support structure means for supporting the opposite ends of said supporting member.

13. A printing machine as claimed in claim 12, wherein said supporting member includes a tapered finder nose at one end thereof, said support structure means having an upwardly slanting supporting face cooperating with said finder nose when the doctor blade is inserted in inverted position, and fastening means engaging the opposite end of said supporting member to hold the supporting member in operative position.

14. A printing machine as claimed in claim 2 and comprising a supporting member for each of said doctor blades, said each one doctor blade and said supporting member therefor define a doctor blade assembly, said doctor blade assembly being supported independently of the associated screen and said sleeves having a dimension such that said doctor blade assembly can be mounted and dismounted endwise through said sleeves.

15. In a rotating screen printing machine comprising a frame, means on said frame for supporting a web to be printed while advancing from one end of the ma-

chine to the other, a cylindrical seamless perforated screen of a thin flexible material extending transversely of the direction of travel of the web, relatively rigid hollow sleeves connected to opposite ends of said screen, a pair of spaced aligned bearing assemblies on said frame supporting said sleeves and said screen for rotation so that the screen bears in continuous printing relation upon the web during printing, means for positively and rotatably driving one of said sleeves at only one end of said screen while the sleeve at the opposite end of the screen is freely rotatably supported, and means for maintaining said screen under tension axially thereof while being driven whereby the sleeve at the said opposite end of the screen is rotated by a positive driving torque transmitted through the screen.

16. In a printing machine as claimed in claim **15** and said tension maintaining means comprising a rod between said pair of bearing assemblies and one end of said rod being secured to one of the bearing assemblies, and spring means for resiliently acting between the other end of said rod and the other of the bearing assemblies.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3 892 176

DATED : July 1, 1975

INVENTOR(S) : Johannes Bernardus Van der Winden

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

(73) Assignee: Stork-Amsterdam N.V.
Amstelveen, the Netherlands

Signed and Sealed this

sixteenth Day of *March 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks