United States Patent [19]

Zimmer

[11] **3,921,520**

[45] **Nov. 25, 1975**

[54] **INK APPLICATOR FOR SCREEN PRINTER**

[76] Inventor: **Peter Zimmer,** Untere Sparchen 54, A 6330 Kufstein, Austria

[22] Filed: **May 29, 1973**

[21] Appl. No.: **364,560**

[30] **Foreign Application Priority Data**

May 30, 1972 Austria 4676/72
Feb. 21, 1973 Austria 1509/73

[52] **U.S. Cl.** **101/120;** 101/123; 101/124; 118/406

[51] **Int. Cl.²** **B41F 15/44;** B05C 1/04

[58] **Field of Search** 101/114, 115, 116, 119, 101/120, 121, 122, 123, 124, 129; 118/406

[56] **References Cited**

UNITED STATES PATENTS

846,645	3/1907	Brooks	101/119 X
1,541,787	6/1925	Cadgene et al.	101/116 K
2,445,666	7/1948	Ellam	101/119
2,697,397	12/1954	Bailey	101/119
3,752,071	8/1973	McKay	101/125
3,799,053	3/1974	Rabelow	101/125

Primary Examiner—Clifford D. Crowder
Assistant Examiner—R. E. Suter
Attorney, Agent, or Firm—Ernest G. Montague; Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

A downwardly open ink receptacle, surrounded by a cylindrical masking screen, has a downwardly convex bottom member of elastic material forming a discharge slot for the ink, this slot being spanned by one or more substantially inextensible reinforcing elements leaving clearances in line with the slot in order to give passage to the ink. The slot may be bounded by a pair of low-friction strips bearing directly upon the inner screen surface under pressure of a pair of weighting bars flanking the slot. The reinforcement can be a perforated foil, an insert with an undulating wire, or a series of axially spaced bolts.

9 Claims, 15 Drawing Figures

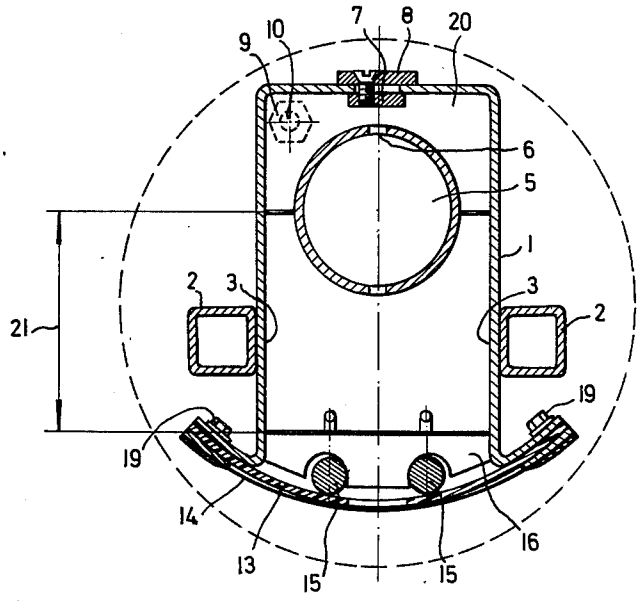


FIG. 1

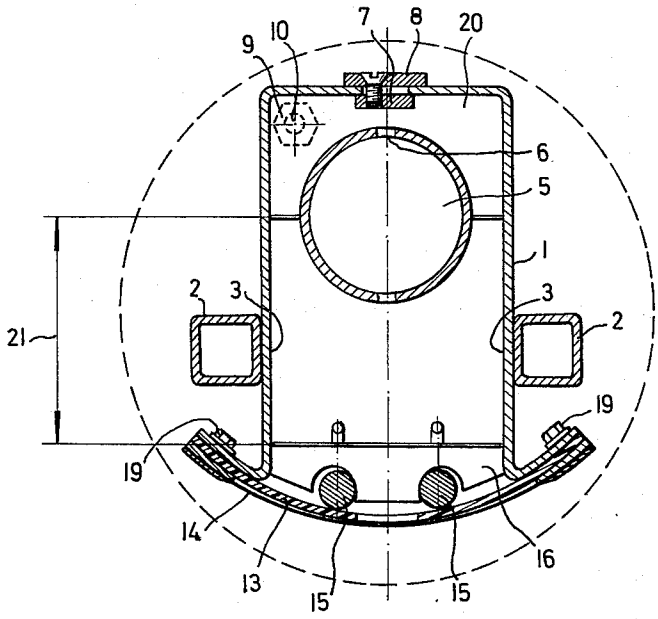


FIG.2

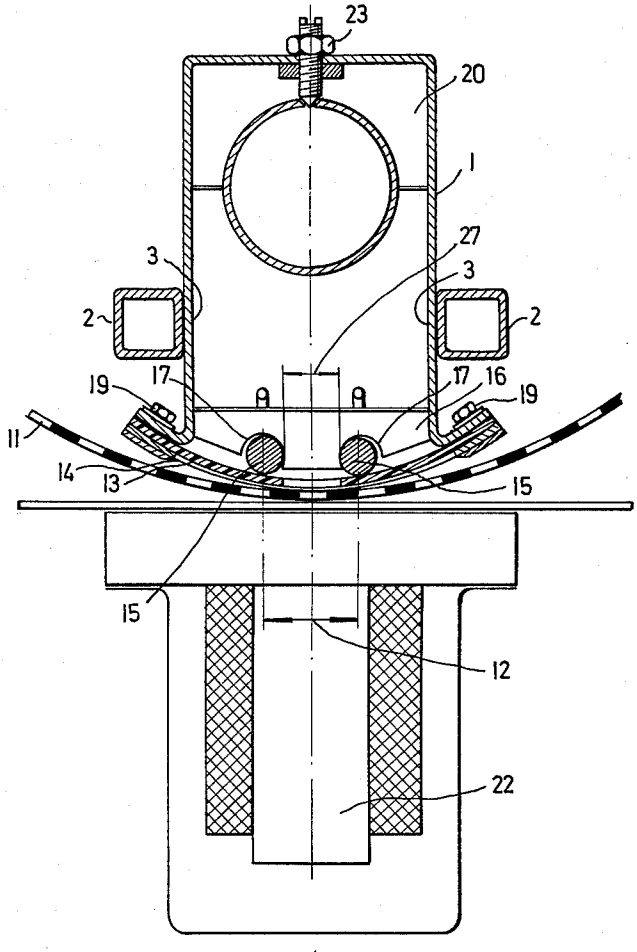


FIG. 3

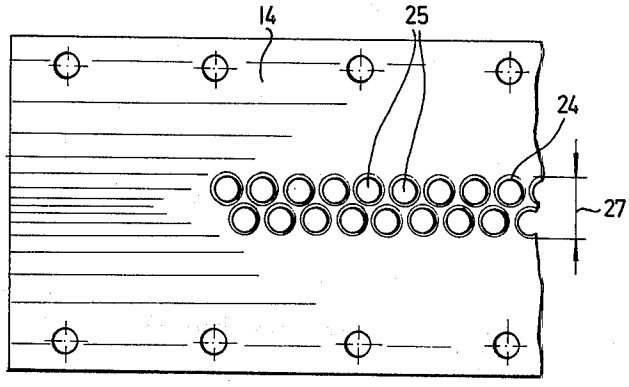
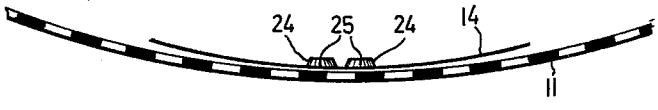


FIG. 3a



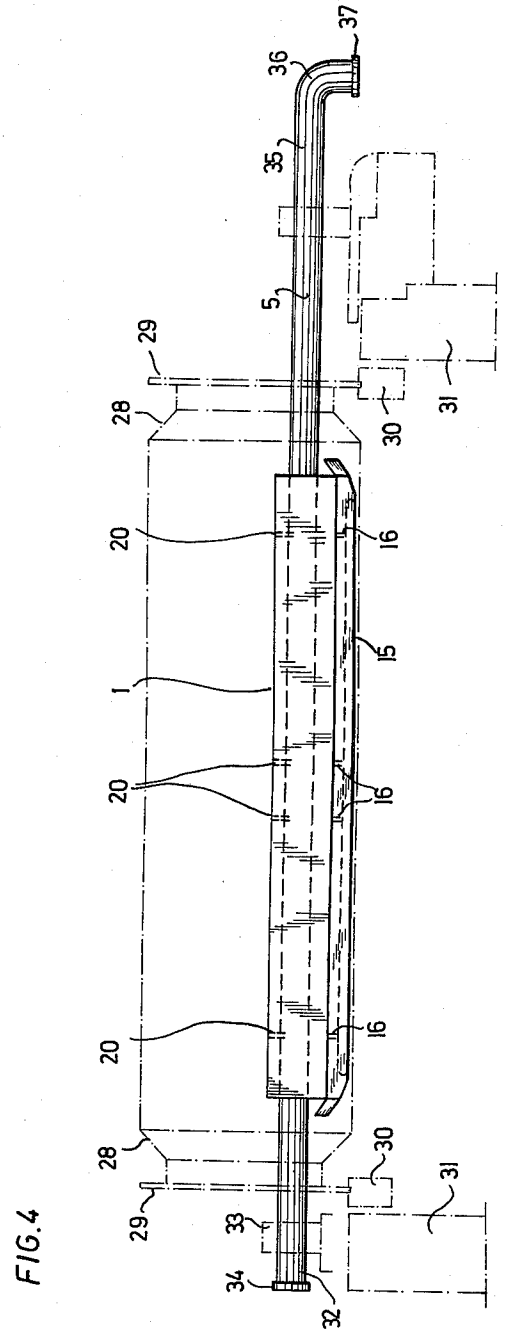


FIG. 4

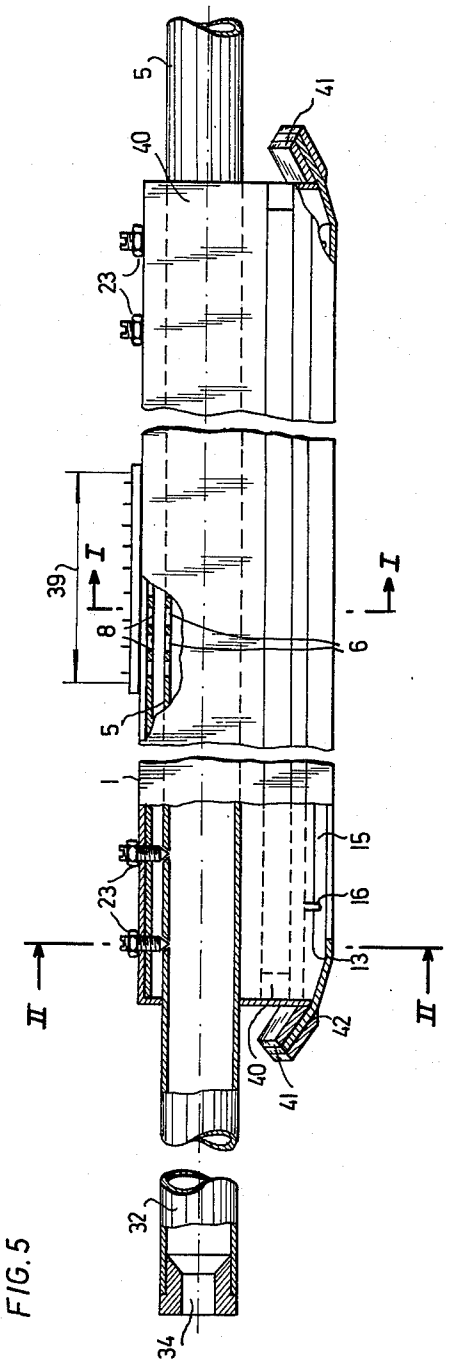


FIG. 5

FIG. 6

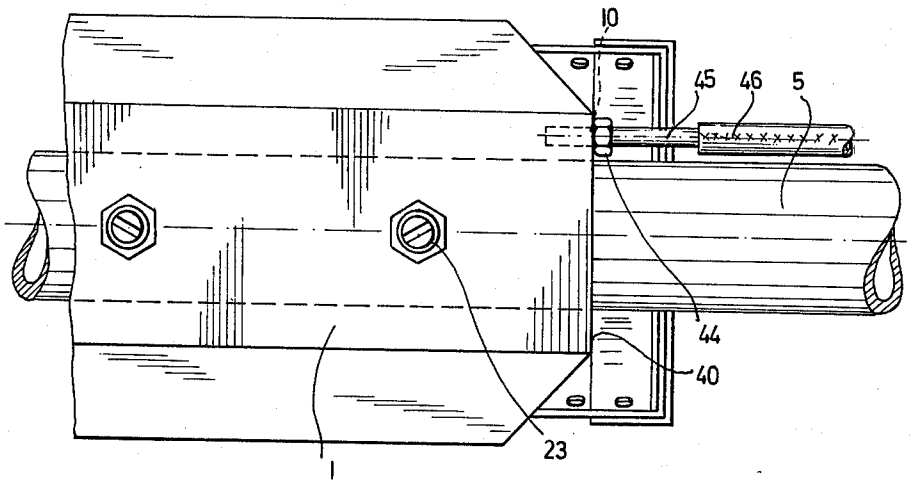


FIG. 7

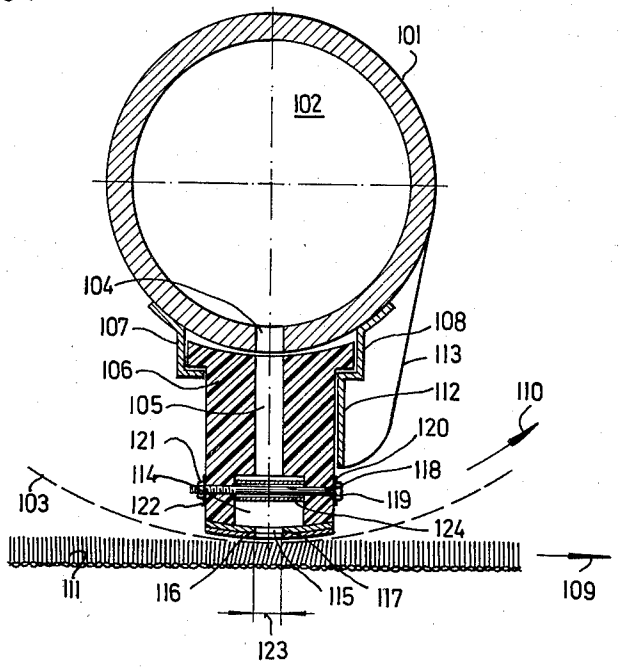

101
102
104
107
108
113
106
112
110
105
120
121
118
114
119
103
122
124
111
116
115
117
109
123

FIG. 8

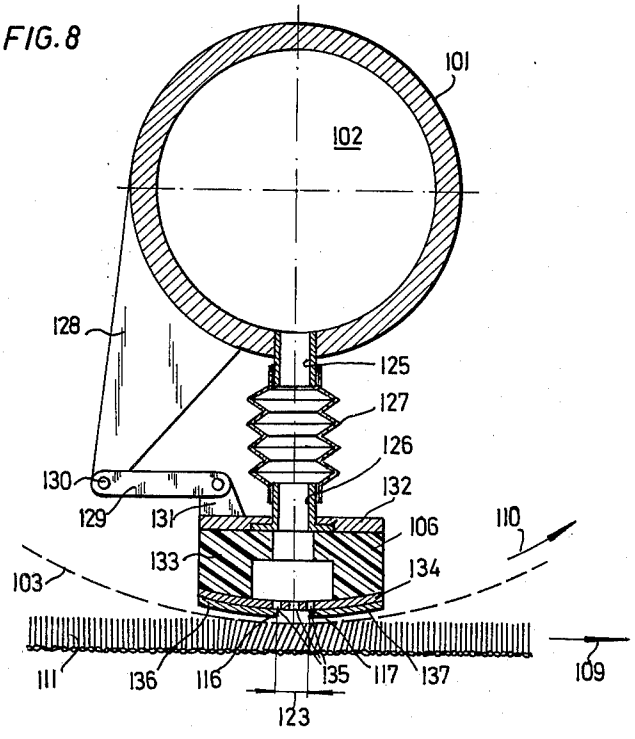

101
102
128
125
127
126
130
132
129
131
106
110
133
134
103
111
136
116
135
117
137
109
123

FIG. 9

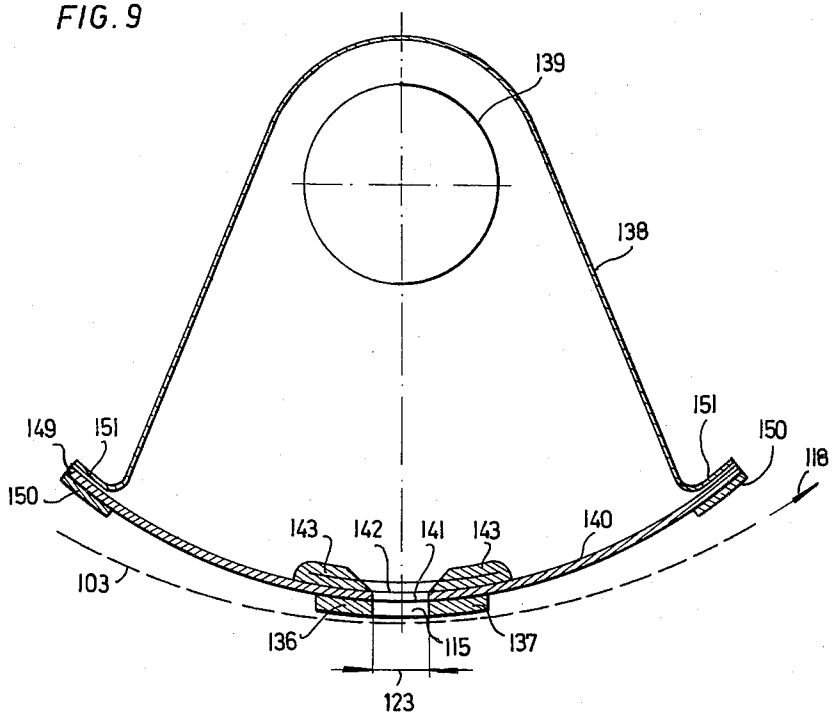


FIG. 10

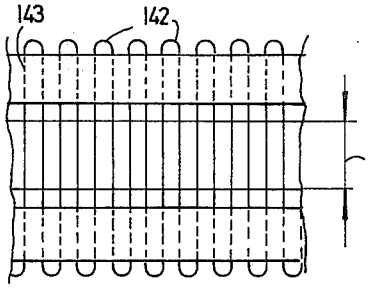


FIG. 11

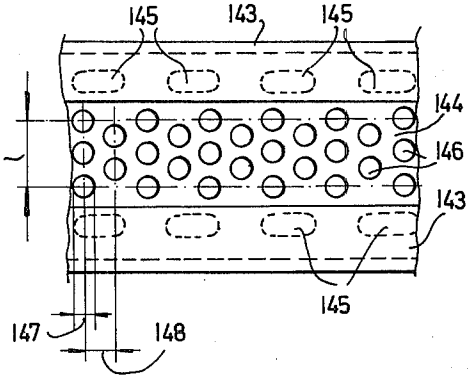


FIG. 12

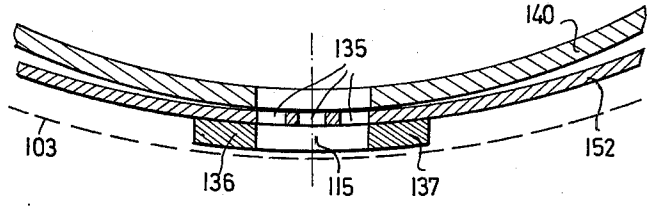


FIG. 13

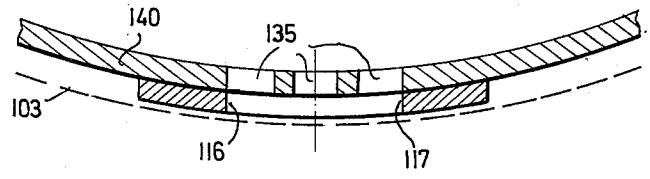
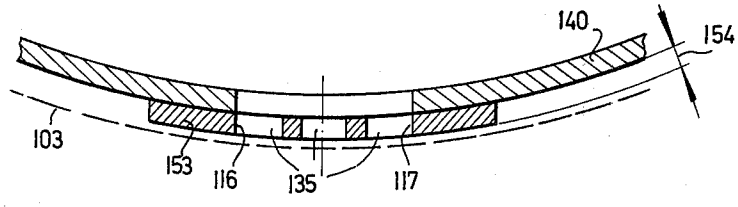


FIG. 14



INK APPLICATOR FOR SCREEN PRINTER

CROSS-REFERENCE TO RELATED APPLICATION

This application relates to subject matter disclosed in my copending application Ser. No. 320,739 filed 3 Jan. 1973.

FIELD OF THE INVENTION

My present invention relates to a dyestuff applicator for a printing machine of the type wherein a perforated cylindrical screen is rotatable about a horizontal axis and surrounds a housing forming an axially extending gap just above the nadir of the screen for the controlled discharge of printing liquid (referred to hereinafter as ink) through the perforations of the screen onto a substrate for imprinting the latter in accordance with a predetermined pattern.

BACKGROUND OF THE INVENTION

In may above-identified copending application I have disclosed an applicator of this type wherein two sealing strips are weighted down by two parallel rods which flank the discharge gap and are attracted downwardly by a magnetic force.

In this type of applicator, in which no positive connection exists between the two strips forming the discharge gap, there arises the problem of maintaining the width of that gap essentially constant against the stresses which tend to vary that width during operation.

OBJECT OF THE INVENTION

The object of my present invention, therefore, is to provide means for stabilizing the gap width while effectively preventing outward leakage of the printing liquid from the region of the gap onto adjoining portions of the inner screen surface.

SUMMARY OF THE INVENTION

I realize this object, in accordance with my present invention, by providing a receptacle for the printing liquid with a cylindrically curved downwardly convey bottom member of elastic material forming a discharge slot or gap parallel to the cylinder axis, the underside of this bottom member being closely spaced from the surrounding apertured masking screen, and securing substantially inextensible reinforcing means to that bottom member, the reinforcing means spanning the discharge slot for preventing its enlargement while leaving clearances for the passage of printing liquid from the receptacle through that slot.

BRIEF DESCRIPTION OF THE DRAWING

The above and other features of my invention will now be described in detail with reference to the accompanying drawing in which:

FIGS. **1** and **2** are cross-sectional views, taken respectively on the lines I — I and II — II of FIG. **5**, of an ink applicator embodying my present invention;

FIG. **3** is a plan view of a perforated reinforcing foil partially closing a discharge slot at the bottom of the applicator housing of FIGS. **1** and **2**;

FIG. **3***a* is a fragmentary cross-sectional view drawn to a large scale and showing details of the foil of FIG. **3**;

FIG. **4** is a side-elevational view of the applicator of FIGS. **1** and **2**;

FIG. **5** is a view similar to FIG. **4**, drawn to a larger scale and with parts broken away;

FIG. **6** is a top view of the right-hand end of the applicator, drawn to a still larger scale;

FIG. **7** is a cross-sectional view of another applicator according to my invention;

FIG. **8** is a view similar to FIG. **7**, illustrating a modification;

FIG. **9** is a further cross-sectional view illustrating, somewhat schematically, an alternate embodiment;

FIGS. **10** and **11** are plan views similar to FIG. **3**, showing modified reinforcements for the bottom of the applicator;

FIGS. **12** – **14** are fragmentary cross-sectional views of the applicator bottom, illustrating further modifications.

SPECIFIC DESCRIPTION

In FIGS. **1** and **2** I have shown a printing-ink applicator according to my present invention whose housing **1** is reinforced by two profiled tubes **2** to minimize deformation of the lateral housing walls **3** as a result of the static pressure of the printing liquid or ink within the housing. The ink flows through a supply tube **5** and openings **6** into the applicator housing. In FIG. **1** the ink-supply openings **6** are shown overlain by ports **7** in the housing **1** which are covered by strips **8.** If necessary, the clogged ink openings **6** can be cleaned through the ports **7.** A screw **9** opens a throttled passage through a vent hole **10** during the entire operation of the applicator, the hole **10** having a diameter of about 4 mm. Normally a small quantity of ink flows out of the applicator through this vent hole. Since the printing ink may carry air bubbles along with it, it might happen after a sufficiently long period of operation that the applicator is filled to a large extent with air, which always accumulates in the upper part of the housing **1.** This entrained air exits through the vent hole **10,** so that the operation of the applicator will not be impeded by accumulating air. The applicator is surrounded by a cylindrical masking screen **11** which it closely approaches in the region of its nadir **12.** The bottom of the applicator housing above the screen **11** comprises a plate **13** of para rubber bearing upon a nickel foil **14** which in turn rests on the screen **11** in the contact area **12.** In order to intensify the contact pressure, round bars **15** of magnetizable material are disposed on the elastic plate **13** and are held in a predetermined relative position by straps **16** having recesses **17.** The nickel foil **14** and the plate **13** are fastened by screws **19** to the bottom of housing **1.** The housing **1** is furthermore so stiffened by the straps **16** and reinforcing segments **20** that it cannot be deformed. An intermediate region between straps **16** and segments **20** is unobstructed so that a free flow of the ink in the longitudinal direction of the applicator housing is facilitated. The illustrated mounting of plate **13** and foil **14** permits a tight, resilient application of the nickel foil **14** to the screen **11.** Of course this foil **14** could also be made of some other material, as for instance a sheet of tombak, copper-beryllium bronze, or the like. The round bars **15** are pressed against the stack formed by plate **13,** foil **14** and screen **11** by an electromagnet **22** located below the screen **11.** The contact pressure of the foil **14** against the screen **11** and thus the lateral sealing of a discharge gap **27,** flanked by the bars **17,** is thus jointly produced by the natural elasticity of the resilient metal

foil **14** and the rubber plate **13**, by the weight of the bars **17** supplemented by the magnetic force, and by the hydrostatic pressure of the ink within the housing. Gap **27** allows the ink to pass through pattern-forming apertures in masking screen **11** to an underlying substrate to be imprinted.

The ink-emitting holes **6** located near the ends of screen **11**, one of which is visible in FIG. **2**, are controlled by associated throttle screws **23**. These holes **6** can be opened by a slight turning of the screws **23** which, as will be explained later on in connection with FIG. **3**, serve to regulate the outflow of the printing ink.

As shown in FIG. **3**, the nickel foil **14** has coarse perforations **25** in the region of the discharge gap **27**, which is narrower than the contact area **12**. These perforations are preferably produced by punching, the nickel foil **14** being so mounted that the deformation or burr **24** due to the punching of the holes **25** faces upwardly, as shown in FIG. **3***a*. This prevents the clipping of small hairs of the substrate to be imprinted which extend through the perforations **25** into the rotating screen **11** and which, when cut, would dirty the inner wall surface of the screen. Foil **14**, spanning the gap **27** defined by the downwardly convex bottom member **13** of the applicator housing **1**, serves as a substantially inextensible reinforcing means which prevents the gap from spreading.

In FIGS. **4** and **5**, where the same reference numbers are used as in the preceding Figures, the screen **11** is shown provided at opposite ends with heads **28** which are placed in rotation by means of gears **29** and **30**. The driving torque comes from a power shaft (not shown) within gear boxes **31**. The left end **32** of the ink tube **5**, journaled in a bearing **33**, is accessible for cleaning upon removal of a plug **34**. The right end **35** has an elbow **36** with threads **37** for attachment to a feed line not shown.

The ink openings **6** are arranged in the center of the housing **7** within a narrow region **39**, so that identical flow paths are present for the ink at opposite ends **40** of the housing.

The rubber plate **13** is fastened to flanges **41** at the housing ends **40** by means of strips **42** and screws **43**. As can also be noted from FIG. **5**, throttle screws **23** are disposed in the end regions of the applicator housing **1** so that any drop of pressure in either of these regions can be counteracted by slightly retracting these screws **23** to increase the controlled flow of the ink toward that end of tube **5**.

FIG. **6** is a plan view of the right-hand end **40** of the housing, showing the vent hole **10** formed in a nipple **44** which is screwed into that end of the housing **1**. A tubular connection **45** links the nipple **44** with a thin guide hose **46** which returns the ink emerging from the throttled vent hole **10** together with any entrained air to the ink reservoir.

In the embodiment of FIG. **7**, printing ink is supplied via the interior **102** of a tube **101** under a hydrostatic pressure which is produced by a pressure accumulator, an elevated ink container, a pump or the like, located outisde of a surrounding printing screen **103**. The ink passes via apertures **104** of supply tube **101** into bores **105** of an elastic base **106** consisting, for instance, of rubber. This base **106**, forming part of a downwardly convex bottom member, is held by guides **107** and **108** to the ink tube **101** serving as a liquid receptacle. The guide **108** is constructed as a lateral reinforcement preventing excessive bending of the base **106** in the direction of the arrow **109**, i.e. the direction of the transport of a substrate **111** to be imprinted. The screen **103**, during the printing operation, turns counterclockwise as indicated by an arrow **110** and moves synchronously over the surface of the advancing substrate **111**. Tangential bending forces exerted on the base **106** as a result of friction are resisted by an extension **112** of the guide **108**. Stiffening plates **113** take up the not insignificant forces occurring there and transmit them via the ink tube **101** to the bearing structure lying outside the screen **103**.

From the bores **105** the printing ink passes into a distributing channel **114** in which the equalization of liquid pressure takes place before the ink flows via a discharge gap **115** through the screen **103** into the underlying substrate **111**. The gap **115** is a slot bounded by two edges **116** and **117** of a pair of low-friction strips **136, 137** (see also FIG. **8**) which are held together by reinforcing bolts **118** disposed thereabove. These bolts are of relatively small diameter and have heads **119** which, through the intermediary of a washer **120**, bears upon the right-hand side of the inverted-U-shaped lower part of base **106** while a nut **121**, acting through another washer **122**, engages the left-hand side of that part. Over the entire length of the applicator there are provided a series of such bolts, spaced along the screen axis, which together insure the maintenance of a practically constant width **123** of the slot **115**. Within the ink-distributing channel **114** the bolts **118** are received in spacing sleeves **124** which keep the two walls of that channel a predetermined distance apart. The bolts **118** and their spacing sleeves **124** are advantageously made of an acid-resistant, stainless high-grade steel. However, they can also be made of a relatively nonextensible, thermoplastic or thermosetting resin; for example, polyamide or polyacetal is well suited for this purpose.

In FIG. **8** the same reference numbers are used as in FIG. **7**. The flexible base **106** of this embodiment is limitedly movable in vertical direction with respect to the ink tube **101**. The conduits **105** of FIG. **7** have been replaced by aligned nipples **126** and **125** interconnected by a length of corrugated and therefore flexible tube **127** which may consist of rubber, high-grade steel or plastic defining a fluidtight feed channel between the ink tube **101** and the base **106**. Brackets **128** and **131**, articulated to each other by a link **129** and pivot pins **130**, hold the base **106** in place upon rotation of the screen in the counterclockwise direction indicated by the arrow **110**. The nipples **126** are fastened to the base **106** by means of a cover strip **132** which has flexural elasticity. The rubber body **133** of the base **106** can be bonded to the covering strip **132** by vulcanization or cementing. In its lower region the base **106** has a nonextensible reinforcing foil **134** provided with a perforated zone **135** at its center. This foil can be a strip of, for instance, galvanized or noble sheet metal or of a substantially nonextensible plastic material in which the holes **135** are produced by punching. This foil **134** is fastened to the rubber body **133** by bonding or vulcanization. Bonded to the underside of sheet **134** are the two aforementioned low-friction strips **136** and **137** whose separation defines the width **123** of the slot **115**, the foil **134** being sandwiched between these strips and the arms of the inverted "U" formed by base **133**. The two slot edges **116** and **117** are in this case held apart by the foil **134** at an invariable distance so that the slot

width **123** cannot be changed by the frictional forces occurring between the rotating screen **103** and the slide coverings **136** and **137.** Pressure tests carried out with such devices have established a remarkable uniformity of the depth of color and penetration of the substrate printed in this manner. The perforations **135,** if suitably distributed, do not impair that uniformity, particularly if the discharge gap **115** is disposed below them.

The applicator of FIG. **8,** of course, also be modified as, for instance, by providing the ink tube **101** with a guide in which the base **106** is vertically displaceable.

FIG. **9** shows another embodiment in which a fluid-tight container **138** is filled with printing liquid via ink-inlet openings **139** provided at its ends. In its lower region the container **138** is closed by an elastically flexible sheet **140** preventing the outflow of liquid from this container downward through the screen **103** into a region other than that of the slot **115.** The sheet **140** preferably consists of a synthetic rubber so as to be yieldable in vertical direction in case of unevenness of the substrate. This elastic sheet material, however, also causes a certain extensibility in tangential direction tending to change the width of the discharge slot **115** by reason of the unavoidable frictional forces between the screen **103** and the slide coverings **136** and **137,** cemented onto the foil **140,** the slot **115** registering with a continuous slit **141** formed in that foil. I therefore reinforce the bottom of receptacle **138** by inserting a sinusoidally bent steel or plastic wire **142** above the foil **140** in the region of the slot **115** and the slit **141,** the wire being fastened to the foil **140** by means of an elastic polymer **143.** The undulating wire insert **142** is so arranged, as best seen in FIG. **10,** that its individual turns point in the direction of rotation of the screen. The frictional forces exerted in the same direction on the slide coverings **136** and **137,** transmitted to the foil **140,** can then no longer change the width **123** of the slot **115** since this width is maintained constant under all conditions by the substantially inextensible wire insert **142.** That insert could also be replaced by a coarse-mesh fabric.

FIG. **11** shows an alternate arrangement wherein the reinforcement **142** has been replaced by a perforated metal strip **144** fastened at the same place as the wire insert **142** to the foil **140,** again with the aid of a polymer or vulcanizate **143.** For better adherence of this polymer, which is applied in liquid condition to the metal strip and the foil **140** located below it, the metal strip **144** is provided in its lateral regions with oblong perforations **145.** In order to assure a distribution of the ink which is as uniform as possible, the diameter **147** of each individual hole **146** of the perforated central strip zone bears a predetermined ratio to the center-to-center distance **148** between these holes. That ratio advantageously has the approximate value of $1{:}2\cos 30° = 1{:}\sqrt{3}$. The center points of the holes then neatly fill a network of lines of a hexagonal raster. If the physical webs remaining between the holes are not larger than **10** to **20** percent of the hole diameter, very uniform ink-passage conditions result.

As shown in FIG. **9,** the elastic foil **140** is fastened tightly to the container edges **149** between clamping strips **150** and flanges **151.**

FIG. **12** shows another modification wherein the elastic foil **140** is urged by the ink pressure or other means against a thin metal diaphragm **152,** located below it, which has a perforated zone **135** approximately conforming to the pattern of holes **146** shown in FIG. **11.** This metal diaphragm **152** bears the two slide strips **136** and **137** which assure low-friction contact between the screen **103** and the convex bottom of the applicator and which again form an ink-distribution channel — here very narrow — in the region of the slot **115.** This ink-distribution channel is, however, entirely sufficient, with a very small mesh size of the perforations **135,** to distribute the printing ink uniformly.

FIG. **13** shows that it is also possible to provide the perforated zone **135,** located between the two slot edges **116** and **117,** in the foil **140** itself. With this arrangement, also, very good results can be obtained although the uniformity of color is not as high as in the case of a diaphragm of metal or thermosetting plastic bridging the two slot edges **116** and **117** as shown in FIG. **12.**

FIG. **14,** finally, shows an embodiment in which the elastic foil **140** is provided with a single low-friction strip **153** provided with the perforated zone **135.** Since the strip **153** generally consists of a readily slidable but not very extensible material which has a certain flexibility only by virtue of its small thickness, a quite satisfactory connection of the two slot edges **116** and **117** is assured; upon prolonged operation, however, a certain impairment occurs since the slide covering **153,** of course, wears so that the reinforcement spanning the two edges **116** and **117** becomes weaker while the effective stresses remain the same. Eventually, there is reached a condition of wear in which the remaining thickness **154** of the slide covering **153** is no longer sufficient to withstand the frictional forces.

The present invention is not limited to the embodiments described and illustrated. Thus, the variants shown in FIGS. **12** to **14** can be used also in connection with the types of applicator shown in FIGS. **7** and **8.** The foil **140** is then replaced by the rubber body **133** of the base **106.** It is also possible to cover the bottom of the applicator housing contacting the substrate, such as the arms of the bodies **106** and **133** in FIGS. **7** and **8,** with a rigid sheath, e.g. steel plates interconnected via a tubular body which encloses the ink tube. In this way the slot width is also kept constant.

Another possibility of keeping the slot width constant consists in providing slits interrupted at intervals by webs either in a covering sheet or else in the bodies **106** and **133.** The bottom member defining the discharge gap can be integral with the webs in that case. A grate could be disposed both inside and outside the outlet proper.

It is also advantageous if the entire applicator can be swung around the axis of the ink tube, preferably by 180°, when the machine is stopped so that the substrate is not dirtied and the ink can be practically completely drained from the applicator housing.

Another advantage of the applicator construction in accordance with my invention is that inks with readily volatile solvents can also be used without any danger of thickening since the liquid receptacle is closed on all sides.

I claim:

1. In a printing machine, in combination:

a receptacle for printing liquid provided with a cylindrically curved, downwardly convex bottom member of elastic material forming a discharge slot for said liquid parallel to the cylinder axis;

an apertured masking screen underneath said receptacle substantially concentric with and closely spaced from the underside of said bottom member; and

substantially inextensible reinforcing means secured to said bottom member and spanning said slot for preventing its enlargment, said reinforcing means leaving clearances for the passage of said liquid from said receptacle through said slot.

2. The combination defined in claim **1** wherein said reinforcing means comprises a flexible perforated foil overlying said slot.

3. The combination defined in claim **1** wherein said members further comprises an insert of undulating wire extending predominantly in a direction perpendicular to said slot.

4. The combination defined in claim **1** wherein said reinforcing means comprises a series of axially spaced bolts.

5. The combination defined in claim **1** wherein said receptacle has a generally cylindrical body and said member forms a base underlying said body with freedom of limited relative motion, said base being provided with conduit means for supplying said printing liquid, said conduit means extending from said slot to the interior of said body.

6. The combination defined in claim **5** wherein said conduit means comprises resilient tubing.

7. The combination defined in claim **5** wherein said base has a cross-section substantially of inverted-U shape transverse to said axis, said reinforcing means spanning the arms of the U.

8. The combination defined in claim **7** wherein said reinforcing means comprises a flexible perforated foil secured to said arms, said member further including a pair of low-friction strips underlying said arms with confronting edges bounding said slot.

9. The combination defined in claim **8** wherein said foil is sandwiched between said arms and said strips.

* * * * *