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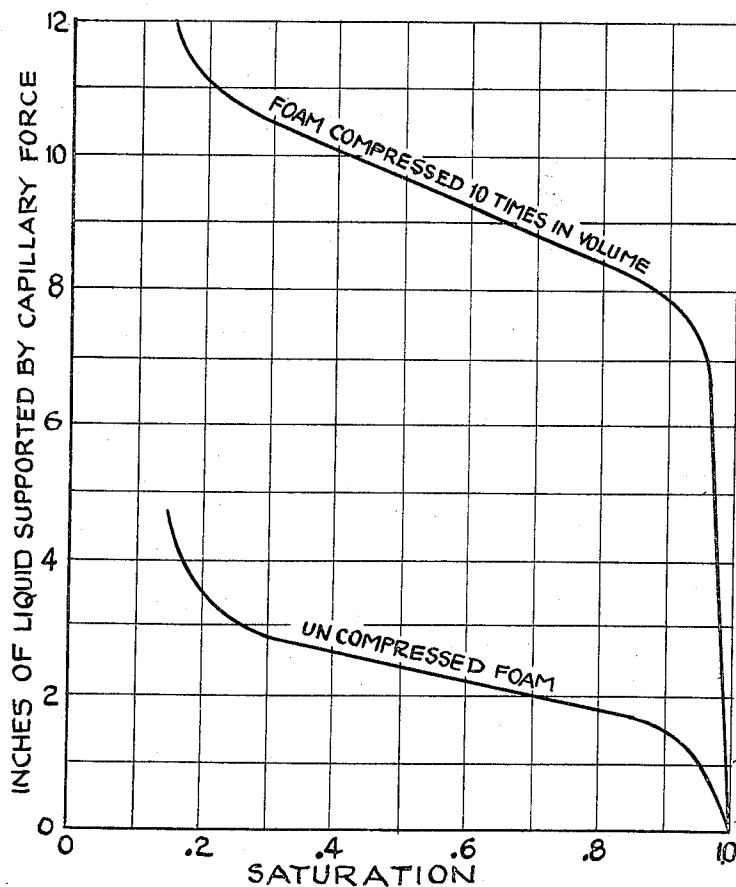
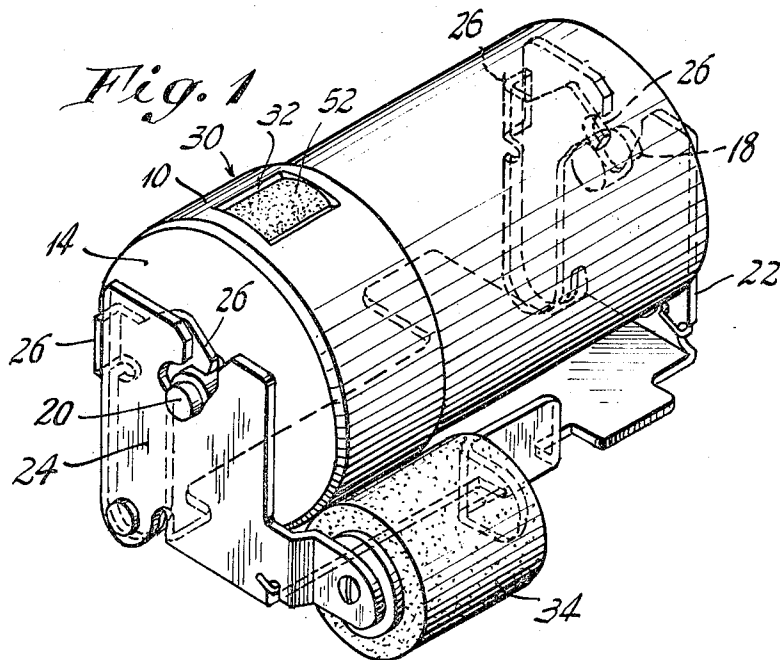
H. TRAMPOSCH

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ROTATABLE INK STORAGE AND METERING CARTRIDGE

Filed May 24, 1967

2 Sheets-Sheet 1



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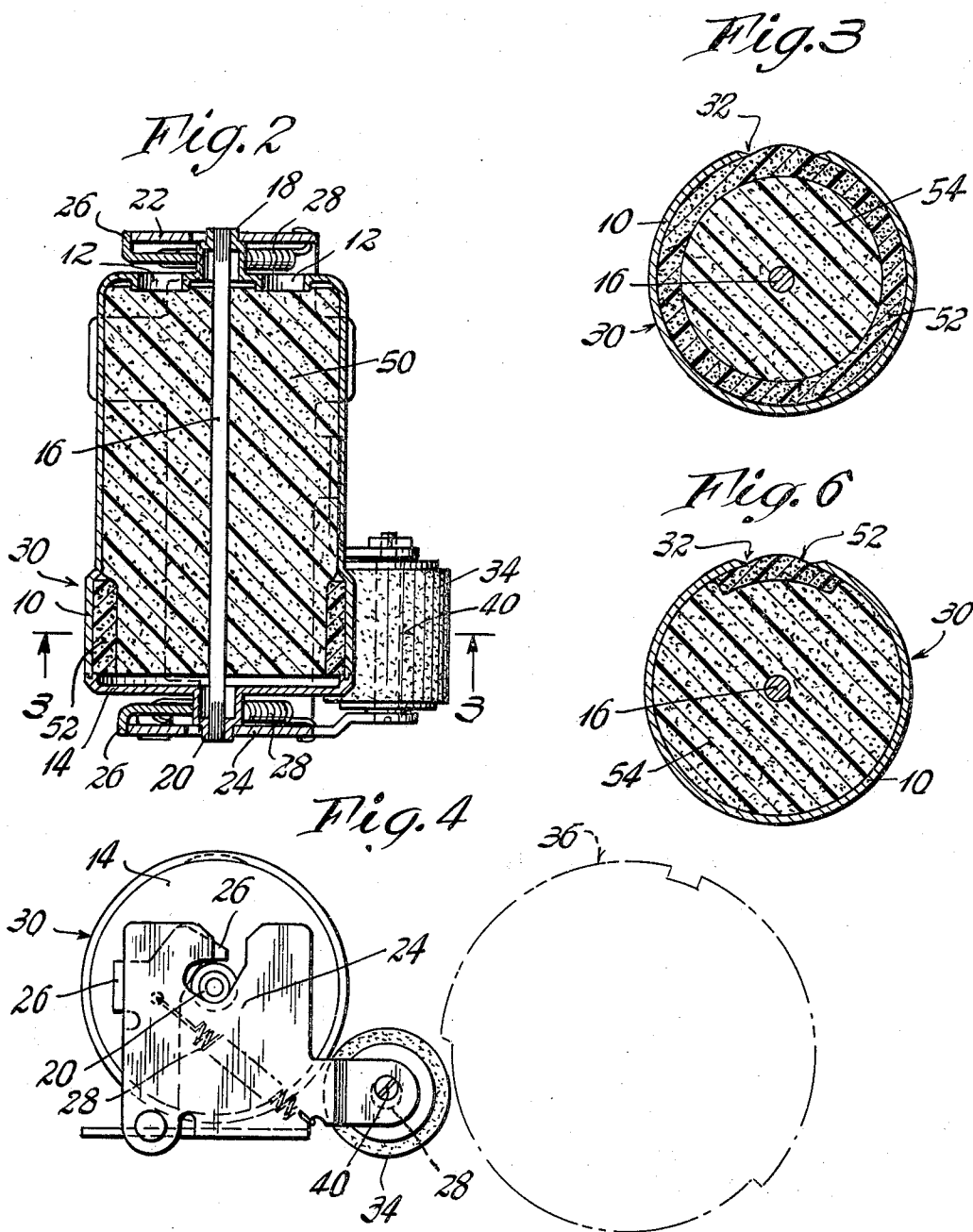
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ROTATABLE INK STORAGE AND
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7 Claims

ABSTRACT OF THE DISCLOSURE

An ink dispensing cartridge composed of a first foam material with large pores constituting an ink reservoir and a second foam material with smaller pores positioned in contact with the first foam and exposed to a portion of the exterior of the cartridge to provide ink to an applicator roller.

This invention relates in general to a printing apparatus and in particular to apparatus for containing ink and for applying ink to a printing roller or the like.

More specifically the invention is concerned with a cartridge adapted to contain a supply of ink and to meter the ink to an intermediate or applicator roller in quantities which maintain the applicator roller at a uniform saturation level sufficient to adequately apply ink to a printing drum or indicia and yet insufficient to bleed or drip ink from the surface of the applicator. This invention is also specifically concerned with apparatus which prevents the ink supply from dripping, leaking or over feeding the intermediate roller when not in use.

Conventional inking devices are of two types, one wherein a reservoir of ink is connected to the applicator roller by a wick which through capillary action provides a continuous quantity of ink to the applicator roller. The second type of inking device is one in which an absorbent member such as felt is pre-saturated with a quantity of ink and which through contact with an applicator roller provides a continuous though diminishing amount of ink to the applicator. The first type has the advantage of having a large quantity of ink available for the applicator however it also has the disadvantages of having a body of free ink which upon movement will tend to overload the wick member and produce bleeding or dripping. This disadvantage of the felt rollers has been the inability to provide a constant or uniform ink supply over the life of the roller. When the applicator is new the felt tends to be saturated and produce a bleeding or dripping situation and as ink is depleted the percentage of the saturation at the outside of the felt continually diminishes in proportion to the ink used. The present invention combines the best features of both prior art devices in that it provides a large supply or reservoir of ink and advantages of the felt type of applicator without the problems of bleeding and rapid diminishing of surface saturation over the life of the applicator.

It is also a problem in conventional inking devices that the ink provided to the applicator roller and to the printing member usually diminish slightly for each print that is made and thus it is not readily discernible when the applicator is low on ink or should be replaced. The present invention provides a means to maintain the inking characteristics nearly constant throughout the useful life and then a comparatively rapid drop off in inking characteristics when the supply of ink has been diminished to the point where the ink cartridge should be replaced. Thus an operator becomes immediately aware that his ink supply is low and must be replenished.

Additionally the conventional inking devices are in continuous contact with the applicator roller and tend

2

to supply ink to the applicator during the periods when the printing apparatus is not in use. This type of arrangement tends to oversaturate the applicator roller and produce either bleeding or excessive inking during the first few cycles of operation after prolonged shutdown. The present invention provides a simple and effective disengagement device to prevent the possibility of the applicator roller and the ink supply from being in ink transferring contact during the shutdown periods of the apparatus. The only time the applicator roller is in contact with the ink supply is during the operation of the device.

The degree of surface saturation of the intermediate or applicator roller which applies ink to the printing member is critical to the amount of ink that is deposited on the printing member in each cycle of operation. It is important to maintain the surface saturation at the controlled level. The level of saturation of the applicator roller is controlled by the surface saturation level of the ink supply member which contacts or supplies ink to the applicator roller and the length of time the applicator roller is in contact with the supply member. The saturation level of the surface of the ink supply must be higher than the saturation level of the surface of the applicator roller so that ink flows from the ink supply member to the applicator member. Also the contact between the member must be sufficient to allow the amount of ink used on each printing cycle to be replaced.

It is an object of this invention to improve inking cartridges used in printing apparatus to provide an ink supply with a uniform surface saturation over an extended period of use.

It is also an object of this invention to increase the useful life of inking cartridges and to provide a large supply of ink in an easily handled form.

It is also an object of this invention to control the surface saturation characteristics of inking devices used in printing apparatus.

It is also an object of this invention to provide an ink applicator cartridge which will hold large quantities of ink and maintain uniform surface saturation characteristics as the internal percentage of saturation decreases.

It is also an object of this invention to provide an ink cartridge which does not bleed or drip during inoperative periods.

It is also an object of this invention to provide apparatus which disengages an applicator roller from an ink supply when the printing apparatus is not in operation.

It is also an object of this invention to provide an ink cartridge for a printing apparatus having an increased ink capacity and surface characteristics which provide uniform inking during the effective life of the cartridge and a rapid fall off of the amount of ink transferred when the effective life of the cartridge has been exceeded.

BRIEF SUMMARY

These and other objects of this invention are obtained by means of an inking cartridge having an inner core of porous material such as polyurethane in the free and uncompressed or slightly compressed state to contain a large quantity of ink and a surrounding layer of the same or similar porous material compressed to about 10% of its free form to provide a high surface saturation. The cartridge completely encloses the porous member except for a small window which when the cartridge rotates, contacts a porous applicator roller. The applicator roller is mounted in a loose bearing which leaves the roller out of contact with the cartridge except during operation of the printing apparatus.

For a better understanding of the invention as well as other objects and further features thereof, reference is

had to the following detailed description of the invention to be read in connection with the accompanying drawing.

DESCRIPTION OF DRAWINGS

FIGURE 1 is an isometric view of an ink applicator embodying the present invention.

FIGURE 2 is a sectional view of the ink cartridge taken along lines 2—2 of FIGURE 1.

FIGURE 3 is a sectional view of the ink cartridge taken along lines 3—3 of FIGURE 2.

FIGURE 4 is a side view of the ink cartridge and applicator embodying the present invention.

FIGURE 5 is a graph showing the relationship between capillary forces and foam saturation.

FIGURE 6 is a sectional view of an ink cartridge showing an alternate embodiment of the invention.

DETAILED DESCRIPTION

Referring to the drawings, there is shown in FIGURE 1 an ink cartridge assembly embodying the present invention. FIGURES 2 and 3 show sectional views of the cartridge exposing the internal arrangement of foam like material adapted to contain printing ink. The outer shell 10 of the cartridge is constructed of plastic or some other suitably rigid, ink impervious material. The shell 10 is cylindrically shaped with one end closed and having one or more openings 12 located in the closed end. There is an enclosing cover 14 adapted to seal the open end of the cylinder. The shell 10 and the cover 14 have aligned/sized center holes to receive a center shaft 16. The shaft 16 has splined ends which are sized for a tight fit into the aligned holes in the shell and the cover so that when the shaft is forced into the opening in the shell 10 and the cover 14 is forced down over the shaft the entire assembly is held secured. The holes for the shaft are in a pair of bearing surfaces 18 and 20 in the shell 10 and cover 14 respectively. The bearing 18 is journaled in a slotted bearing plate 22 and the bearing 20 is journaled in a slotted bearing plate 24. The entire assembly is held in the bearings by means of a spring loaded clip member 26 biased against the bearing 20 by means of the tension spring 28.

The cartridge 10 is shaped so that the end adjacent the cover 14 is enlarged providing a raised surface or shoulder 30 around a portion of the circumference of the cartridge. As seen in FIGURE 1 there is an opening 32 in the surface 30. An applicator roller 34 is rotably supported from the bearing plate 24 in position for its surface to be in contact with the raised surface 30 of the cartridge 10 and to come into contact with the opening 32. The applicator roller 34 is constructed of a porous or foam material, for example polyurethane, which is suitable for holding and retaining liquids such as ink. The entire assembly including the cartridge 10 and the applicator roller 34 are positioned to be in contact with a printing drum or indicia 36 shown in dotted lines in FIG. 4. The printing drum 36 has raised metal letters on a curved portion of the surface thereof so that when the drum rotates the metal letters are in contact with the surface of the applicator roller 34. The remaining portion of the drum 36 is undercut so that the surface of the applicator roller is not in continual contact with the surface of the drum. Rotation of the drum 36 causes rotation of the applicator roller 34 and in turn forces the applicator roller against the surface 30 of the cartridge 10 and produces rotation of the cartridge.

The applicator roller 34 is mounted on a tube 38 which is journaled about a rod 40 mounted in the bearing plate 24. The tube 38 is oversized or larger than the rod 40 so that when the tube 38 rests on the rod 40 the applicator roller 34 is not in contact with the surface of the cartridge 10. However when the printing drum 36 rotates against the surface of the applicator roller 34 the roller is forced upward around the rod 40 into a position wherein the surface of the applicator roller 34 is in contact with the surface of the cartridge 10. The applicator roller 34 will re-

main in this upward position for the duration of the printing cycle of the drum 36. At the completion of the printing cycle the printing drum disengages from the applicator roller 34 allowing the roller 34, under the force of gravity to fall downward around the rod 40 and return to its original position out of contact with the surface of the cartridge 10. If the applicator roller 34 stopped in contact with the hole 32 then the ink would tend to flow from the cartridge to the applicator. After a period of time the saturation level of the applicator would increase to a point where overlinking would occur on the succeeding inking cycles. By removing the applicator roller from contact with the cartridge when it is not in use the possibility of the applicator being in contact with opening 32 is eliminated.

The inside of the cartridge 10 is completely filled with a porous foam material as for example polyurethane. Two different types or conditions of foam are used. The center portion or the bulk of the foam consists of foam material 50 which is referred to herein as uncompressed but which actually may be slightly compressed when it is placed in the cartridge and which is capable of holding large quantities of ink. The enlarged portion of the cartridge 10, that is the portion under the surface 30, contains a peripheral layer of compressed foam 52 as seen in FIGURES 2 and 3. The foam 52 may be of the same material as the foam 50 with the exception that the foam 52 is not in the free or uncompressed state but has been compressed to a portion of its original size. It is not necessary that the compressed foam extend completely around the periphery of the shell but only to the extent necessary to cover the opening 32. FIGURE 6 shows a cartridge with a smaller compressed foam section 52.

Since the foam 50 is in the uncompressed state the porous openings are larger than the openings in the compressed foam 52. That is the percentage or amount of void space in the uncompressed foam is larger than the percentage of the available void space in the compressed foam. Therefore, not only is the uncompressed foam capable of retaining a larger quantity of ink due to the larger mass of foam involved but it also is capable of retaining a larger volume of ink per unit volume of foam than the compressed foam. Inversely however, as explained below, the capillary action produced in the uncompressed foam is considerably less than the capillary action in the compressed foam. That is the percentage of ink saturation at the interface of the foams varies between the compressed and uncompressed foam as shown in the graph of FIGURE 5.

The purpose of the uncompressed foam 50 is to act as an ink reservoir and the purpose of the compressed foam 52 is to maintain a uniform saturation level at the surface of the foam, and thus a uniform saturation of the applicator roller 34 and uniform printing for each cycle of operation.

In relief printing wherein ink is applied to the surface of raised or relief characters and transferred from the characters to the printed surface, a very important feature is the uniformity of the application of ink to the surface on which the printing is to appear. In order to have a uniform density of printed characters on the final sheet it is necessary that the application of ink to the printing member be uniform. As shown herein a printing roller or drum 36 is coated with ink by an applicator roller 34 and then the ink is transferred in the form of printing to sheets of paper or the like. If the surface saturation of the applicator roller 34 is maintained at a uniform level then for each rotation of the printing member 36 a uniform amount of ink will be deposited from the applicator roller 34 onto the surface of raised characters on the printing drum 36. If the applicator roller 34 is not continually replenished with ink then each succeeding printing cycle will receive slightly less ink than the previous one and over an extended period of time would deplete the ink from the applicator roller 34. When it is deter-

mined what level of saturation the surface of the applicator roller 34 should be at in order to apply a uniform coating of ink onto the printing drum 36 in quantities sufficient to provide the desired ink density in the printing process, it is then possible to design an ink cartridge to maintain the surface saturation of the applicator roller 34 at the desired uniform level.

One means of controlling the amount of ink which is transferred from the ink cartridge to the applicator roller 34 is to control the amount of time that the applicator roller is in contact with the exposed portion of the foam in the cartridge. For example the opening 32 could be extended so that the applicator roller 34 is in contact with the foam for a longer period of time and thus more ink would be transferred to the applicator roller for each cycle of operation. If less ink were desired then the size of the opening 32 would be smaller. The opening 32 could be theoretically extend completely around the cartridge and the applicator roller would be constantly in contact with the ink applying foam during operation of the apparatus. In the embodiments shown herein it was determined that the amount of ink depleted by each printing cycle is essentially replaced by having the applicator roller in contact with the foam for the length of time permitted by an opening of the size indicated by opening 32.

The foam 50 in the ink cartridge consists of a cellular or porous material in which series of small cells or pores interconnect to form a sponge like material. When the foam material is partially immersed in a liquid the pores which are interconnected tend to act as thin tubes producing capillary action which draw fluid up into the foam against the action of gravity. The larger the cells or pores the smaller the capillary forces produced; in the same manner the smaller pores tend to produce larger capillary forces. The action of the capillary forces is not exactly the same as it would be in a tubular member since the cells or pores are not uniform in size, are not regularly interconnected and are more or less randomly dispersed throughout the foam. However the capillary forces that do exist have the same characteristics as those created in uniform tubular structures and for discussion purposes will be considered as essentially the same.

The curve labeled "Uncompressed Foam" in FIGURE 5 represents the relationship between the height liquid is held in the foam by capillary action and the amount of saturation of the liquid in the foam at that level. The curve was derived by placing a column of the uncompressed foam material, saturated with ink, in a reservoir of liquid ink and measuring the height at which the ink was held by capillary action and measuring the amount of saturation of ink at the various height levels. For example it can be seen at 0 inches above the fluid level, or where the foam is immersed in the fluid, the saturation is 100%; at a height of one inch above the liquid the foam is 96% saturated with ink. At a height of two inches above the ink the foam is 70% saturated with ink and the degree of saturation tends to fall off very rapidly from the one inch to the three inch level. At the 4.8 inch level the foam is approximately 15% saturated with ink. The second curve in FIGURE 5, entitled "Foam 10 Times Compressed in Volume" shows how the compression of the foam which produces smaller cellular structures, creates the higher capillary forces. It can be seen from the curve that the capillary forces will hold ink at a height of 12 inches above a liquid level and have a 15% saturation at the point. It can also be seen that the percentage of saturation remains very high in the compressed foam up to the height of 7 inches at which point it is 96% saturated. Between 7 and 12 inches the percentage of saturation falls off rapidly in the same manner as it did for the uncompressed foam.

When different types of foam or foams having different degrees of compression or cellular structure are placed in contact, the pressures produced by capillary action

at the boundaries of the two materials is the same. Thus for example if the surface of the uncompressed foam is 70% saturated that is it is operating at a capillary pressure sufficient to sustain 2 inches in height of ink, then compressed foam, in contact with the surface of the uncompressed foam, at that point, would also be at the same capillary pressure, however the percentage of ink saturation at that pressure is 99% for the compressed foam. This is shown on the graph by tracing across on the 2-inch line until the uncompressed foam curve is intersected then reading down at the bottom 70%; then continuing across on the 2-inch line until the compressed curve is intersected and reading 99% at the bottom.

It can be seen from the curves that as the ink is depleted from the uncompressed foam the degree of saturation falls off rapidly, however the compressed foam though undergoing the same pressure drop, maintains a relatively high or uniform degree of saturation.

For purposes of example, if the foam 50 is saturated to approximately 90% of its total capacity prior to use then the compressed foam receives ink from the uncompressed foam and maintains a surface saturation of approximately 99%. In printing operations, the compressed foam which appears in the opening 32 tends to be depleted of ink by the applicator roller 34 but because of the capillary forces draws ink from the uncompressed foam 50. The saturation of the uncompressed foam 50 drops according to the curve in FIGURE 5 and by tracing horizontally across to the uncompressed foam curve the saturation level of the compressed foam can be determined. It can be seen that the saturation level of the compressed foam is always going to be between 98 and 100% during the entire time that there is ink left in the uncompressed foam. Of course it is realized that due to the cellular nature of the foam material there are pockets of ink which will not be removed by capillary action and thus there will be ink remaining in the foam even though the percentage of saturation of the compressed foam has fallen below 98%. At the point that the uncompressed foam is essentially depleted of ink the compressed foam still is at the 98% saturation and will continue to provide ink at a fairly uniform rate. Since the compressed foam does not hold the quantity of ink that the uncompressed foam holds the number of cycles that can be operated based on amount of ink stored in the compressed foam is considerably less. However for a period of time the compressed foam will function with a surface saturation in excess of 96%. When the saturation of the compressed foam reaches the 96% point the fall off in ink supply or degradation in the printing is rather rapid, as seen by the top of the curve for the compressed foam. This rapid fall of foam from a maximum saturation to an unacceptable condition for printing is advantageous to the operator of the printing apparatus. In conventional printing devices the images deteriorate very slightly for each cycle and thus are not readily noticeable by the operator. According to the present invention the rapid fall off in the quantity of ink provided indicates to the operator that the cartridge must be replaced with a new supply of ink. In the embodiment shown in FIGURE 6 the amount of compressed foam is less thus the amount of ink available after the main supply has been depleted is less. In this case the drop in print quality is more rapid and more noticeable.

OPERATION

In the embodiment shown herein the compressed foam 52 is placed around a portion of the inner surface of the shell 10 in a position to cover the window or opening 32. It should be noted herein that the foam 52 may or may not be the same material as the foam 50. The basic requirement is that the foam 52 have a smaller cellular structure than the foam 50 and thus produce the higher saturation characteristics as seen by the curve in FIGURE 5. For example the material may be the same and may be compressed to one-tenth of its original size, as is the material

used to construct the curves shown in FIGURE 5. However if the material were only compressed to one-fifth the original size the characteristics would be similar but its saturation curve would fall between the two curves shown in FIGURE 5, and though the basic theory of operation would be the same, the degree of uniformity of the surface saturation of the material in the opening 32, throughout the effective operational life of the cartridge, would be less. If on the other hand a material was used with smaller pores or were more highly compressed than the foam used in the curve shown in FIGURE 5, then its saturation curve would be displaced upwards, thus the surface saturation would be more nearly uniform throughout the life of the cartridge. It has been found however for useful practical purposes the foam compressed to one-tenth of its uncompressed size can be easily manufactured and provides a degree of uniformity throughout the life of the cartridge which is very effective. It is however within the scope of this invention to vary the pore structure and size of the foam materials to provide the capillary characteristics desired.

In order to fill the cartridge with ink there are holes 12 located in the closed end of the cartridge. The cartridge may be placed in a supply of liquid ink with the holes submerged below the surface of the ink. A vacuum pulled on the open end of the cartridge will draw ink through the holes into the foam material up into the cartridge. The vacuum is held until the cartridge reaches 90% saturation. The cover 14 is then placed on the cartridge so that the shaft 16 lies in the opening and holds the cover secured on the cartridge. Obviously the cartridge may be filled by other means such as pouring ink into the foam or immersing the cartridge in ink. The holes 12 also provide vents so that the interior of the cartridge is always at atmospheric condition.

What is meant by the cartridge being 90% saturated is that the average ink content of the foam at rest within the cartridge when it is placed in the position in which it will operate within the printing machine is 90% or the maximum amount of ink the foam can hold. In this condition the bottom of the foam material is very nearly at 100% saturation. If this is the case then obviously the top of the foam is at a point less than saturation and the interior of the foam varies between the top to the bottom condition. The average saturation is approximately 90% and the increase due to the centrifugal force during operation does not exceed 100%. It should be noted that the optimum size of the cartridge is to have the diameter of the cartridge the same as the length. If the length exceeds the diameter then during shipping or at other times when the cartridge stands on end, the column of ink which is supported by capillary force is greater than that which is supported when it stands on its side in the machine. Therefore a portion of the cartridge will exceed the 100% saturation condition when stood on end and bleeding or dripping of ink will occur. If however the length and the diameter are the same then the same average condition exists through-out in all orientations of the cartridge.

When the cartridge is filled with ink and properly placed in a machine the applicator roller is in a position to receive ink through the opening 32 in the shell 10. The material from which the applicator roller is constructed is also a foam material and very probably the same foam as the compressed foam 52. The applicator roller 34 is inked to a saturation level sufficient to apply the proper amount of ink to the printing drum 36. As the printing drum 36 rotates the printing surface comes in contact with the applicator roller 34 forcing the roller up against the shell 10 rotating the cartridge. Ink is deposited from the applicator roller 34 onto the raised metal characters of printing drum 36 and at the same time receives approximately the same amount of ink from the compressed foam 52 in the opening 32 in the cartridge 10. If the surface saturation of the compressed foam 52 is maintained fairly uniform then the amount of ink that is

transferred during each cycle of operation between the compressed foam 52 and the applicator roller 34 is also uniform. The operation can be repeated until the entire available ink supply from the uncompressed foam 50 is used up and the remaining amount of ink in the compressed foam is also used. As can be seen from FIG. 5 the saturation of the compressed foam varies between 98 and 100% of saturation during the effective life of the uncompressed foam. Beyond that point there is still good inking characteristics until the surface saturation of the compressed foam drops below the 97% point at which time the degradation in printing and ink transfer increases rapidly.

What is claimed is:

1. An inking device for use with a printing apparatus comprising

(A) a frame

(B) ink storage and metering means comprising

(1) an ink impervious shell member rotatably mounted on said frame and having an opening formed therein,

(2) a core of a first porous material having relatively large pores and capable of holding a large quantity of ink positioned within the shell member, and

(3) a layer of a second porous material having smaller pores than said first porous material and extending around a portion of said first porous material in a position to be exposed by said opening, and

(C) applicator means rotatably mounted on said frame for intermittent contact with said second porous material for receiving ink therefrom through said opening when said applicator means contacts said second porous material whereby said second porous material meters limited quantities of ink from said first porous material to said applicator means.

2. A device as set forth in claim 1 wherein said core of first porous material is the sole source of ink for said second porous material.

3. A device as set forth in claim 2 wherein said first porous material is composed of substantially uncompressed polyurethane foam and said second porous material is composed of polyurethane foam compressed to substantially 10% of its original size whereby said second porous material maintains a substantially uniform saturation level of ink at said opening over substantially the entire time that there is ink remaining in said first porous material.

4. A device as set forth in claim 1 wherein said applicator means comprises a roller mounted on said frame adjacent said shell member in alignment with said opening and is adapted to be driven by a printing member of said printing apparatus, said roller contacting said shell member so as to rotate the latter when rotated by said printing member.

5. A device as set forth in claim 4 including means to prevent said applicator roller from remaining in contact with said shell member or said second porous material when said roller is not being rotated by said printing member.

6. A device as set forth in claim 5 wherein said means to prevent contact between said applicator roller and said shell member or said second porous material comprises a bearing supporting said applicator roller on a shaft of smaller diameter than said bearing and at a location below the axis of said shell member whereby said applicator roller moves out of contact with said shell member or said second porous material when said applicator roller is not being rotated by said printing member.

7. An inking device for use with a printing apparatus comprising

(A) a frame

(B) ink storage and metering means comprising

- (1) a substantially cylindrical ink impervious shell member rotatably mounted on said frame and having an opening formed therein,
- (2) a core of a first compressible porous material substantially filling the interior of said shell member, said material being in a substantially uncompressed state and having relatively large pores capable of holding a large quantity of ink.
- (3) a layer of a second compressible porous material extending around a portion of said first porous material and confined within said shell member adjacent said opening so as to be exposed therethrough, said second porous material being in a substantially compressed state and having smaller pores than said first porous material, whereby said second porous material draws ink from said first porous material due to greater capillary forces in the former,
- (C) an applicator roller,
- (D) means rotatably mounting said applicator roller on said frame adjacent said shell member in position to contact said second porous material through

- said opening to receive ink therethrough from said second porous material, said applicator roller being adapted to rotate said shell member and said core when said applicator roller is rotated by a printing member of said printing apparatus, and
- (E) means for maintaining said applicator roller out of contact with said second porous material where said applicator roller is not being rotated by said printing member.

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