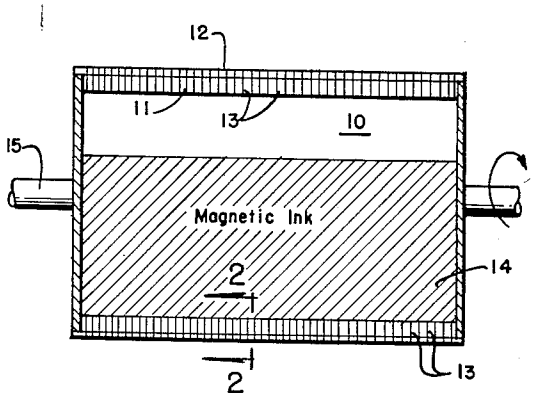
Sept. 18, 1956 J. C. SIMS, JR 2,763,204

MAGNETIC PRINTER

Filed May 11, 1955

FIG. 1.



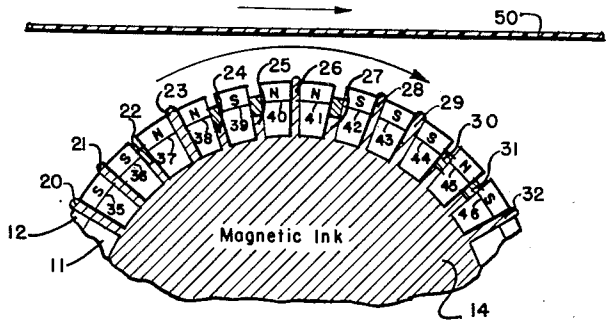


FIG. 2.

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MAGNETIC PRINTER

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Application May 11, 1955, Serial No. 507,641

16 Claims. (Cl. 101—119)

The present invention relates to printing and printing devices, and is more particularly concerned with a method and apparatus for effecting printing by utilizing magnetic principles. In this respect, the present invention is primarily concerned with printers in the nature of mimeograph machines, utilizing rotatable printing cylinders; and especially relates to such printing devices wherein a porous or grid-type printing cylinder selectively permits or inhibits the flow of an ink to an external surface of such a cylinder.

A number of mimeograph-type devices are known wherein membranes are employed which allow the selective passage of a marking fluid to a receiving surface by noninhibition of some areas of a semi-porous membrane to render corresponding areas of the receiving surface of one opacity, and by the selective inhibition of such marking fluid through other areas of such a semi-porous membrane, thereby to render other corresponding areas of the said receiving surface of a second opacity.

In conventional mimeograph-type devices, such membranes or stencils are ordinarily mechanically produced by an embosser in standard typewriters or electrical stencil cutting machines, and such stencils or embossed membranes are then transferred to printing equipment adapted to permit ink flow through porous portions of the membrane so as to produce the foregoing marking of a receiving medium. Other types of devices are known wherein porous cylinders are employed for the selective passage of marking fluid or inks therethrough, and certain of these other forms of mimeograph devices rely upon the provision of selective electrostatic or electromagnetic control of the marking fluid. Thus, prior devices, such as are exemplified in Huebner Patents 2,224,391, 2,408,-144, 2,547,706, and 2,635,534, rely upon the provision of electromagnetic control of a marking fluid through a porous membrane or stencil.

In general, such known devices are characterized by the provision of a porous printing cylinder or stencil cooperating with auxiliary "pull-out" magnets, for selectively attracting or repelling magnetic inks through a semi-porous membrane. These pull-out magnets often comprise auxiliary drums mounted adjacent an ink feeding drum, whereby the overall device is relatively bulky and expensive to manufacture; and in addition, raise serious problems of maintenance.

The present invention serves to obviate these difficulties, and provides a printing device in the nature of a mimeograph, utilizing a porous membrane or porous printing cylinder containing, internally thereof, an ink or marking fluid exhibiting magnetic properties. The membrane, stencil, or printing cylinder is further characterized by the provision of an external surface having a magnetic coating adapted to receive and store a pattern of magnetic gradients representative of information to be printed; and this stored pattern of gradients, comprising a latent image, cooperates with the aforementioned magnetic ink to selectively permit or inhibit the passage

of the said magnetic marking fluid through the porous membrane or printing cylinder. By this provision of an external magnetic coating, carrying a latent image thereon, this mimeograph operation may be achieved and excellent print transfers may be effected without the provision of auxiliary fluid controls or pull-out magnets whereby the overall device may be made smaller and more rugged in configuration than has been the case heretofore.

It is accordingly an object of the present invention to provide an improved printing device.

A further object of the present invention resides in the provision of an improved porous membrane for use in magnetic printing applications.

Still another object of the present invention resides in the provision of a mimeograph-type printing device utilizing a porous cylinder adapted to selectively permit or inhibit the flow of a marking fluid therethrough without the necessity of providing auxiliary fluid control structures.

A still further object of the present invention resides in the provision of a printing device which is more rugged in configuration and which may be made in smaller sizes than has been the case heretofore.

Another object of the present invention resides in an improved printing device which is less expensive to manufacture and maintain than has been the care heretofore.

The foregoing objects, advantages, construction and operation of the present invention will become more readily apparent from the following description and accompanying drawings, in which:

Figure 1 represents a printing cylinder constructed in accordance with the present invention; and

Figure 2 represents an exaggerated detail view on section 2—2 of Figure 1.

In accordance with the present invention, a printing cylinder may comprise a drum of porous construction having an external coating of magnetic material. This coating may be formed on the drum itself by techniques such as electro-deposition, or spraying, or it may comprise a separate membrane adapted for attachment to a supporting drum of porous construction in accordance with conventional mimeograph techniques. These particular embodiments of the present invention will be discussed more fully subsequently.

The magnetic layer thus provided may be so treated that it stores a selected pattern of magnetic gradients, representative of a latent image, thereon. Reference is made to the copending application of John Presper Eckert, Jr., and J. C. Sims, Jr., Serial No. 221,362, filed April 17, 1951, for "Method and Apparatus for Magnetic Printing"; and to the copending application of John Presper Eckert, Jr., and John C. Sims, Jr., Serial No. 333,574, filed January 27, 1953, for: "High Speed Printer." Each of these applications has been assigned to the assignee of the instant application, and they disclose apparatuses and techniques whereby printing may be effected by the utilization of magnetic principles comprising, in general, the storage of a magnetic latent image on the surface of a printing cylinder.

In accordance with the foregoing applications, such a pattern of magnetic gradients may be effected by photoscanning a sheet of material to be reproduced, thereby to derive a series of electrical signals representative of information appearing on the said sheet. Such photoscanning may be effected by an apparatus analogous to those employed in facsimile applications; and the electrical signals derived by the said photoscanning may then be coupled to a magnetic transducer or transducers mounted closely adjacent a rotatable printing cylinder having a surface of magnetic material. The said signals thereby drive the magnetic transducers to store a desired magnetic

pattern, representative of information appearing on the photoscanned sheet of material, upon the surface of the said magnetic cylinder. The present invention contemplates the producing of a similar pattern of magnetic gradients upon a porous membrane of magnetic construction and this membrane, carrying the latent image so produced, then cooperates with an inking fluid exhibiting magnetic properties.

As will appear subsequently, the latent image on the membrane serves to selectively agglomerate magnetic particles carried by the aforesaid ink, whereby the passage of the ink or marking fluid through selected portions of the membrane is inhibited, while no such agglomeration occurs in other portions of the membrane whereby the inking fluid may readily pass therethrough.

Referring now to Figure 1, it will be seen that, in accordance with the present invention, a printing cylinder **10** may comprise a porous cylindrical structure **11** having a porous external coating **12** exhibiting a large plurality of passages **13**, through which a magnetizable marking fluid or magnetic ink **14** may pass selectively, in accordance with a pattern of magnetic gradients stored in the layer **12**; and the composite ink-containing cylinder or drum may be mounted for rotation on a shaft **15**. The image-receiving magnetizable coating **12** of the drum **10** may comprise either a separate membrane of porous construction placed upon the supporting cylinder **11**, or may in the alternative comprise a magnetic coating of porous construction physically placed upon the cylinder **11**. When the separate membrane form of the present invention is to be employed, such membranes may comprise a resilient mesh-work of magnetic material, or may in the alternative comprise a sheet of plastic coated or impregnated with magnetic oxides, and perforated, for instance, by spark techniques. Such a magnetizable membrane may then be impressed with a magnetic image by wrapping the membrane about a recording drum of the type used in facsimile equipment and scanning the said membrane, for instance with a recording head. The said image-bearing membrane may then be coated with a slurry of magnetic powder or a magnetic liquid applied to the porous image-bearing surface, whereby the high flux concentrations existing across certain of the perforations in the membrane serve to draw the said slurry or magnetic liquid into these perforations, thus effectively closing them. The said slurry or magnetic liquid may then be flushed from the remaining pores of the membrane by an air stream, by the action of centrifugal force, or by blotting the membrane with a magnetized roller, whereby a final semi-porous membrane is achieved, having certain pores thereof blocked by a magnetic material due to high flux concentrations appearing thereacross, and other pores thereof unblocked due to the lack of such high flux concentrations.

The said surface **12** may also be fabricated by other techniques. Thus, such porous membranes or cylinders may be produced by forming the cylinder **11** of photosensitive glass and exposing the sensitized glass to intense light through a Ben Day screen of suitable mesh. Subsequent etching of the glass with hydrofluoric acid produces a cylinder having a large number of radial passages therethrough per square inch, whereupon the outer surface of the said etched cylinder may then be coated with a suitable magnetizable coating **12**. The etched cylinder may be prepared for subsequent electroplating of magnetizable material thereon, for instance, by effecting a vacuum deposit of conducting material on its outer surface; or the said cylinder may be coated with a magnetizable film by the spray-painting of magnetic dispersions onto the cylinder while the inside of the said cylinder is maintained above atmospheric pressure by a suitable air compressor so as to prevent the clogging of the radial passages by the magnetizable material, while at the same time producing the desired magnetic coating on the outer surface.

It must be stressed that the precise techniques employed for the production of a porous cylinder having a magnetizable porous coating thereon, should not, per se, be considered limitative of the present invention, and many techniques are known and will suggest themselves to those skilled in the art whereby a suitable porous cylindrical surface of a suitable magnetic membrane may be effected.

Referring now to Figure 2, the action of the printing structure shown in Figure 1 will be seen. Figure 2 is considerably exaggerated for purposes of clarity, and illustrates a section of drum surface having a relatively small number of pores therein. It will be appreciated, however, that as a practical matter, the surface will comprise several hundreds of such pores per square inch. The cylinder, as may be seen in Figure 2, comprises a porous supporting structure **11** and a magnetizable coating **12** defining a plurality of passages therethrough. These passages have been designated as **20** through **32**, inclusive, in the embodiment of Figure 2, and it will be seen that each passage is separated by a portion of the supporting cylinder **11** as well as by a magnetizable portion of the coating or membrane **12**. The said coating **12** may have a latent magnetic image, corresponding to material to be reproduced, placed thereon by a photoscanning and magnetic recording technique such as has been described; and in the particular illustration of Figure 2, it will be seen that magnetic segments **35**, **36**, **39**, **42**, **43**, **44** and **46** have been so magnetized that they exhibit a south pole S on the external surface thereof, while the segments **37**, **38**, **40**, **41** and **45** have been so magnetized that they exhibit a north pole N on the external surface thereof.

As mentioned previously, the drum contains a magnetic ink **14** and such an ink or marking fluid may comprise a suspension of non-magnetic pigments and finely divided iron powder in a liquid vehicle. The iron particles should preferably have a diameter of 1 to 3 microns, and such iron powders may be readily combined with commonly used oily marking fluids to produce a satisfactory ink or marking fluid exhibiting the required magnetic properties. Upon rotation of the drum **10**, the magnetic ink tends to be forced toward the outer surface of the membrane **12** under the influence of centrifugal force. In those areas of the membrane wherein high flux concentrations exist, due to gradients arising by reason of the juxtaposition of opposite magnetic poles, the inking fluid tends to agglomerate whereby the fluid is prevented from passing to the external surface of the printing cylinder. In other areas, however, where no such high magnetic gradients exist, the inking fluid may pass readily therethrough whereby print transfers to a record receiving medium, such as paper **50**, may be effected on contact.

Examining the particular arrangement in Figure 2, it will be seen that such a high magnetic gradient exists across the pores or passages **22**, **24**, **25**, **27**, **30** and **31**, due to the fact that the magnetic portions directly adjacent these particular pores or passages are of opposing polarities. The finely divided iron powder suspended in the magnetic ink **14** thus tends to agglomerate in these particular passages, preventing the passage of ink to the external surface of the drum, while the other passages are not so inhibited. By this arrangement, therefore, a magnetic image stored on the surface of a drum itself, acts to permit or inhibit the passage of a marking fluid therethrough whereby a printing apparatus has been achieved which need not rely upon auxiliary fluid flow controls in effecting a desired print transfer.

While I have described a preferred embodiment of the present invention, it must be stressed that the foregoing description is meant to be illustrative only. Many variations, certain of which have already been suggested, will appear to those skilled in the art, and all such variations as are in accord with the principles discussed, are therefore meant to fall within the scope of the appended claims.

Having thus described my invention, I claim:

1. In a printer, a porous membrane having a coating

of magnetizable material thereon, said coating having a pattern of magnetic gradients thereon representative of information to be reproduced, and a marking fluid, exhibiting magnetic properties, adjacent said membrane whereby said magnetic fluid is selectively inhibited from passing through selected pores in said membrane having high magnetic gradients adjacent thereto.

2. The printer of claim 1 wherein said porous membrane comprises the external surface of a cylindrical printing drum, said magnetic marking fluid being disposed within said drum, and a print receiving medium contiguous with the external surface of said drum.

3. In a printer, a porous membrane of magnetizable material having a latent image thereon comprising a pattern of magnetic gradients representative of information to be reproduced, said pattern of gradients comprising unlike magnetic poles adjacent certain of the pores in said membrane and like magnetic poles adjacent other in said membrane and like magnetic poles adjacent other of the pores in said membrane, and a magnetic marking fluid disposed adjacent one side of said membrane, whereby said fluid is magnetically retained in those pores of said membrane having unlike magnetic poles adjacent thereto while said magnetic fluid readily passes through the pores of said membrane having like magnetic poles adjacent thereto thereby to effect a selective passage of marking fluid through said membrane in accordance with said latent image.

4. The printer of claim 3 wherein said marking fluid comprises a suspension of unmagnetized particles of magnetic material in a liquid vehicle.

5. The printer of claim 4 wherein said membrane comprises the external surface of a fluid permeable printing cylinder, said marking fluid being disposed on the interior of said cylinder, and a print receiving medium contiguous with said external surface of said printing cylinder.

6. The printer of claim 5 wherein said external surface of magnetizable material comprises a removable magnetic membrane supported by said printing cylinder.

7. In a printer, a printing cylinder mounted for rotation, said printing cylinder being of porous construction and having an external surface of porous magnetizable material, said external surface having a pattern of magnetic gradients stored thereon representative of information to be reproduced, a magnetic marking fluid disposed within said printing cylinder for selective passage through said cylinder and surface in accordance with said stored pattern of magnetic gradients, and a print receiving medium contiguous with said external surface.

8. The printer of claim 7 wherein said marking fluid comprises a mass of finely divided magnetic particles in liquid suspension, whereby said magnetic particles agglomerate in those pores of said external magnetizable surface having relatively high potential gradients thereacross.

9. In a printer, a porous membrane of magnetizable material having a latent image thereon comprising stored magnetic gradients representative of information to be reproduced, fluid passage control means comprising magnetic particles selectively retained within selected pores of said membrane in accordance with said stored magnetic gradients, a marking fluid adjacent one side of said membrane, and a print receiving medium adjacent the other side of said membrane, whereby said marking fluid is inhibited from passing through those pores of said membrane having said magnetic particles retained therein, said marking fluid passing through pores of said membrane, not so inhibited, to said print receiving medium.

10. The printer of claim 9 wherein said porous membrane comprises an external coating on a porous printing cylinder.

11. The printer of claim 10 wherein said magnetic particles are in suspension in said marking fluid.

12. The printer of claim 9 wherein said porous membrane is disposed on the external periphery of a cylindrical printing drum.

13. The printer of claim 12 wherein said magnetic particles comprise finely divided ferromagnetic material in suspension in said marking fluid, said marking fluid being disposed on the interior of said printing drum.

14. In a printer, a porous member having a magnetizable surface adapted to contact a print receiving medium, said surface having a pattern of magnetic gradients stored thereon representative of information, a marking substance exhibiting magnetic properties in contact with the surface of said member opposite the surface adapted to contact the print receiving medium, whereby said marking substance is selectively inhibited from passing through the pores in said member having high magnetic gradients adjacent thereto.

15. In a printer, a porous member having a coating of magnetizable material thereon, said coating having a pattern of magnetic gradients thereon representative of information to be reproduced, and a marking medium exhibiting magnetic properties adjacent said member whereby said marking medium is selectively inhibited from passing through selected pores in said member having high magnetic gradients adjacent thereto.

16. Printing apparatus comprising a porous member including a magnetizable surface having impressed thereon a pattern of magnetic gradients representing information to be printed, and a magnetic printing medium adjacent said member, said member being pervious to said medium in areas of said surface having low magnetic gradients and impervious to said medium in areas of said surface having high magnetic gradients.

No references cited.