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Leffler et al.

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[54] **MAGNETIC PRINTING CYLINDER**

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[73] Assignee: **Dayco Corporation,** Dayton, Ohio

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[52] **U.S. Cl.** .... **101/378,** 29/125, 40/142 A, 101/382 MV, 335/306

[51] **Int. Cl.** **B41f 27/02**

[58] **Field of Search** .... 101/382 MV, 415.1; 40/142 A; 29/125, 129; 248/206 A; 335/289, 295

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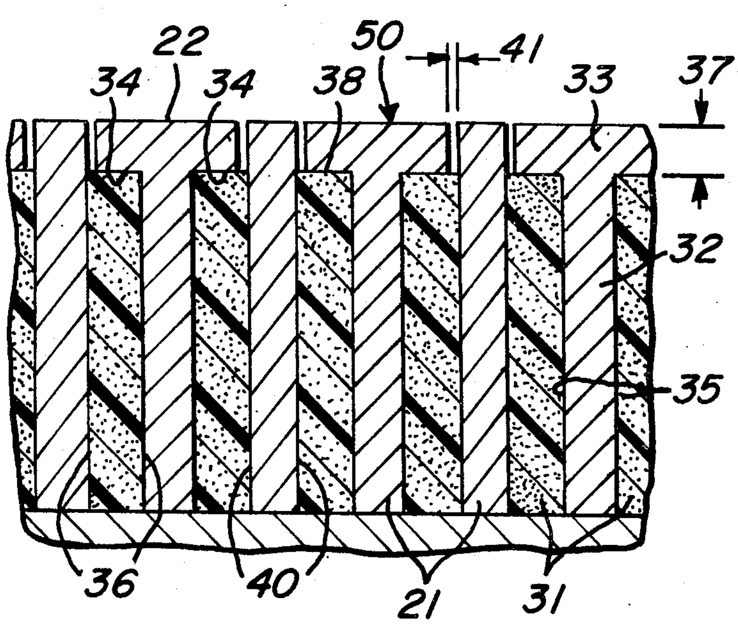
[57] **ABSTRACT**

A magnetized cylinder and method of making same is provided wherein a plurality of compressible resilient permanent magnet constructions is provided and each is defined by permanent magnets embedded in an elastomeric compressible matrix. Each permanent magnet construction is frictionally held within an associated retaining means of an annular member made of a nonmagnetic material and comprising the magnetized cylinder. The annular members are supported alternately with a plurality of rings made of a magnetic material along an elongated central support to define such cylinder. The use of such permanent magnet constructions enables each magnet construction to be held in more intimate contact against an associated ring and more firmly within associated retaining means due to the radial expansion thereof caused by compression of each magnet construction in its assembled state.

14 Claims, 10 Drawing Figures



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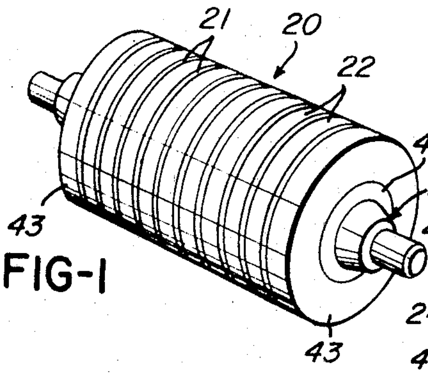
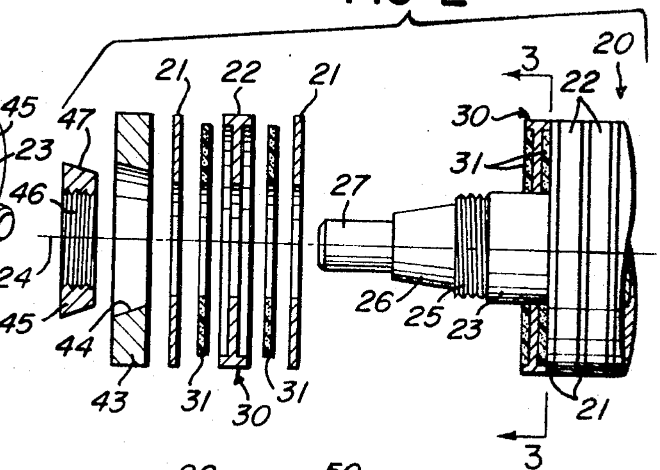


FIG-1

FIG-2



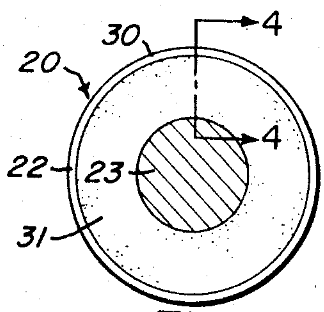


FIG-3

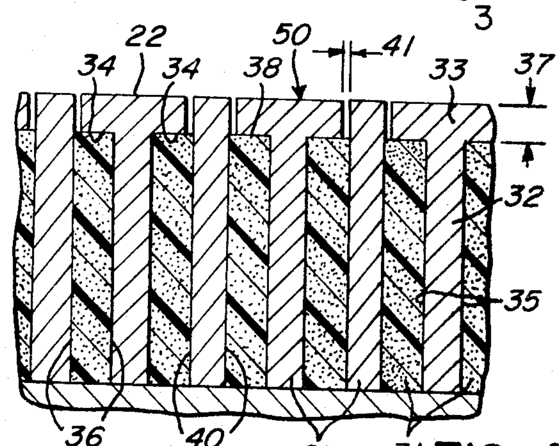


FIG-4

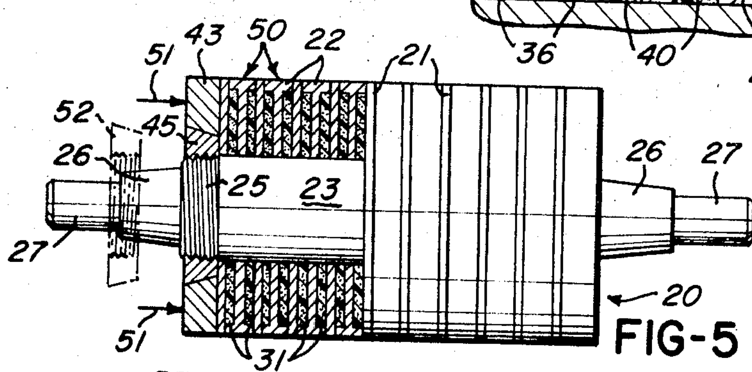


FIG-5

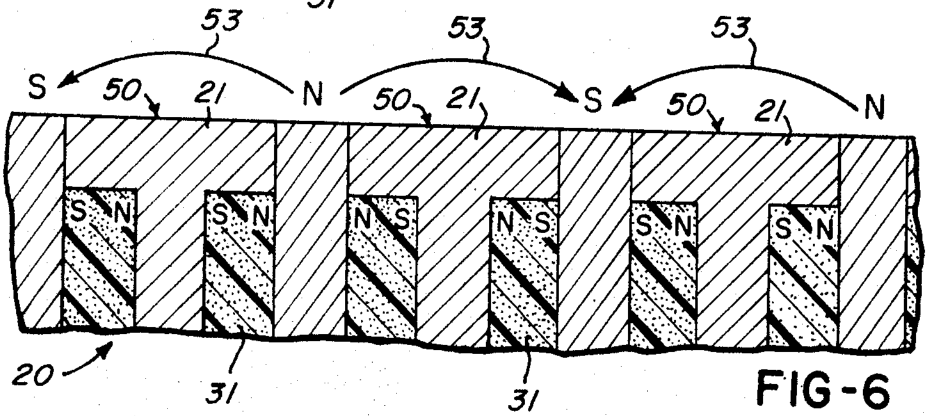


FIG-6

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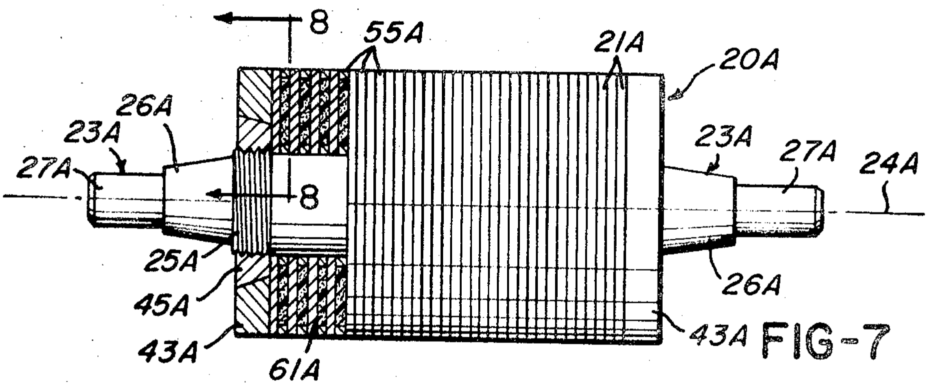

FIG-7

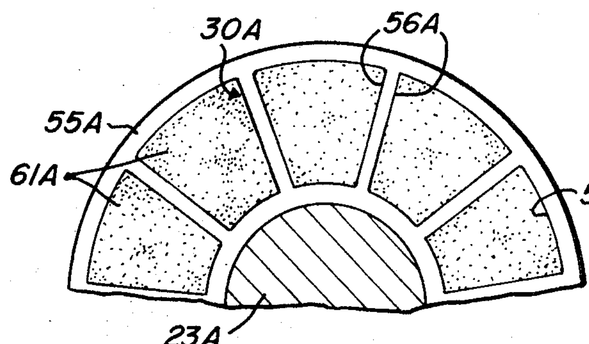

FIG-8

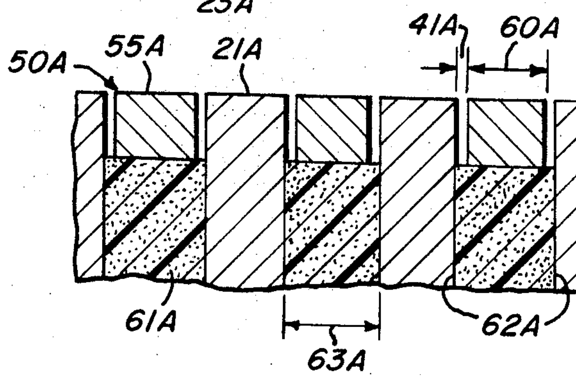

FIG-9

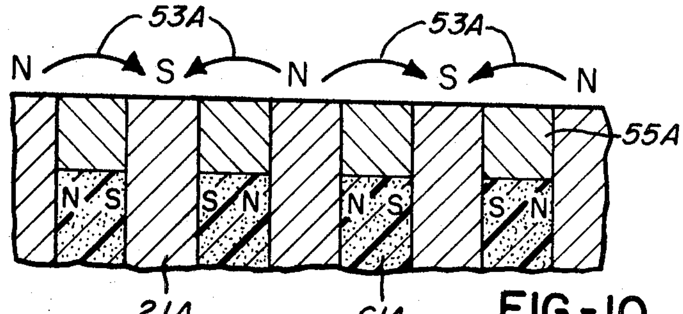

FIG-10

MAGNETIC PRINTING CYLINDER

BACKGROUND OF THE INVENTION

There are numerous permanently magnetized cylinders in use which are used to hold flexible printing blankets, plates, or the like, which contain magnetic material. The main problems with these presently used cylinders are their complex mechanical configurations and the elaborate techniques which are required to assemble such cylinders and particularly their permanent magnets whereby these cylinders are comparatively expensive. Further, these present cylinders do not provide optimum performance.

SUMMARY

This invention provides an improved permanently magnetized cylinder particularly adapted for holding associated structures such as printing blankets, plates, and the like, which contain magnetic material. The cylinder utilizes compressible resilient permanent magnet means defined by permanent magnets embedded in an elastomeric material and each of the permanent magnet means is held in a compressed condition in the completed cylinder and within associated retaining means so that surfaces thereof are in intimate contact with associated magnetic rings defining pole pieces of the cylinder to thereby define a cylinder which provides improved performance. In addition, the compressed condition of such permanent magnet means assures they are more firmly held by friction within associated retaining means.

Other details, uses, and advantages of this invention will be readily apparent from the exemplary embodiments thereof presented in the following specification, claims, and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show present preferred embodiments of this invention, in which

FIG. 1 is a perspective view illustrating one exemplary embodiment of a magnetized cylinder of this invention;

FIG. 2 is a view of the cylinder of FIG. 1 with parts in cross section, parts broken away, and parts exploded from the main assembled cylinder;

FIG. 3 is a view on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged view with parts broken away taken essentially on the line 4—4 of FIG. 3 and particularly illustrating the thickness in an axial direction of uncompressed permanent magnet means or constructions comprising the cylinder prior to finally assembling such cylinder;

FIG. 5 is a view with parts in cross section, parts in elevation, and parts broken away illustrating the manner in which the compressible magnet constructions are axially compressed and held in their assembled compressed relation to define the cylinder of FIG. 1;

FIG. 6 is an enlarged, fragmentary, cross-sectional view illustrating the compressed permanent magnet constructions held in the retaining means of associated annular members and against associated rings made of a magnetic material and also illustrating the manner in which the rings define pole pieces;

FIG. 7 is a view with parts in cross section, parts in elevation, and parts broken away particularly illustrating another exemplary embodiment of a cylinder of this invention;

FIG. 8 is a fragmentary view similar to the upper portion of FIG. 3 and particularly illustrating another embodiment of annular members and permanent magnet constructions comprising the cylinder of FIG. 7;

FIG. 9 is a view similar to FIG. 4 particularly illustrating the relative positions of annular members of FIG. 8 with their compressible magnet constructions assembled in an alternating manner with magnetized rings prior to compressing the assembly together to define the completed cylinder of FIG. 7; and

FIG. 10 is a view similar to FIG. 6 showing the annular members and compressible magnet constructions illustrated in FIG. 9.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Reference is now made to FIG. 1 of the drawings wherein one exemplary embodiment of a permanently magnetized cylinder of this invention is illustrated and designated generally by the reference numeral 20. The cylinder 20 is particularly adapted to hold a flexible printing blanket, printing plates, or the like, which either contain magnetic particles or are made from magnetic materials and the cylinder has a plurality of pole pieces or spacer rings 21 made of a magnetic material which are arranged alternately with a plurality of annular members 22, made of a non-magnetic material, which carry permanent magnet means in a manner to be subsequently described. The construction of the cylinder and arrangement of the permanent magnet means are such that the rings or pole pieces 21 provided along the length of the cylinder have alternating polarities to thereby provide a high strength external magnetic field which is capable of supporting articles such as the magnetized plates, blankets, etc., mentioned previously.

As seen particularly in FIG. 2 of the drawings, the cylinder 20 comprises an elongated central support 23 which is made of a non-magnetic material and has a longitudinal axis 24 which defines the longitudinal axis of the cylinder 20. Support 23 is in the form of a shaft-like support or core and has externally threaded portions 25 at opposite ends thereof. The support 23 also has a hub portion 26 of substantially frustoconical configuration and the hub 26 has a right circular cylindrical shaft 27 extending outwardly therefrom.

The support 23 with its hub 26 and supporting shaft 27 of this example are illustrated as being made from a single piece of material; however, it will be appreciated that the hub 26 and shaft 27 may be made separately or as an assembly and fixed to the main portion of the shaft 23 using any suitable technique.

The annular members 22 comprising the cylinder 20 are carried concentrically around the support 23 and each of the annular members 22 has a right circular cylindrical outer surface and retaining means therein indicated generally by the reference numeral 30 and such retaining means are particularly adapted to retain a plurality of compressible resilient permanent magnet means or constructions which will hereinafter be simply referred to as magnet constructions 31. Each magnet construction 31 also has a rubberlike elastic character and may be made by permanent magnets such as permanently magnetized particles embedded in an elastomeric matrix.

As seen particularly in FIG. 4, each annular member 22 has a substantially T-shaped cross-sectional configuration defined by a vertical leg 32 which is arranged perpendicular to the axis 24 of the completed cylinder 20 and a horizontal arm 33 adjoining the top of such leg which is arranged substantially parallel to the axis 24. The horizontal arm 33 has a pair of inside right circular cylindrical surfaces 34 arranged on opposite sides of the vertical leg 32 and the leg 32 has a pair of parallel surfaces 35 defining its opposite sides. Each surface 34 defines circumferential retaining means for an associated magnet construction 31 and cooperates with an associated surface 35 of vertical leg 32 to hold a magnet construction 31 nested therein in position adjoining an associated ring 21.

Each magnet construction 31 is in the form of an annular disc-like member having a pair of opposed parallel planar surfaces 36 and an outer cylindrical surface 38. Each magnet construction 31 is supported within the retaining means of an annular member 22 defined by surfaces 34 and 35 with one of its surfaces 36 against a surface 35 and its surface 38 frictionally held against surface 34. The arm 33 of annular member 22 has a dimension 37 parallel to its vertical leg 32 which is a small fractional part of the height of the leg 32 whereby the disc-like magnet constructions 31 are arranged closely adjacent the outside cylindrical surface of the rings or pole pieces 21 and, thus, closely adjacent the outside cylindrical surface of the cylinder 20.

The rings 21 are in the form of annular rings having a right circular cylindrical outside surface which corresponds to the outside surface of the annular members 22. The rings 21 also have opposed parallel surfaces 40 which in the assembled cylinder are arranged perpendicular to the longitudinal axis 24.

As indicated earlier, the magnet constructions 31 are compressible and resilient and have rubberlike properties whereby each magnet construction may be compressed radially inwardly so that its circumferential surface 38 is retained by an associated cylindrical surface 34 and held solely by friction. Each magnet construction also has an axial thickness as measured along the longitudinal axis 24 which is greater than the corresponding dimension of its associated circumferential retaining surface 34 by an amount indicated at 41 in FIG. 4 with the cylinder 20 unassembled and, hence, with the magnet construction 31 in a relaxed or uncompressed condition in the axial direction.

Once the cylinder 20 is assembled, in a manner to be subsequently described, each magnet construction 31 is compressed axially which produces two important results. First, axial compression causes some radially outward expansion against the associated right circular cylindrical surface 34 to assure that the magnet construction is held more firmly in position. Second, axial compression assures intimate contact between an outer surface 36 of magnet construction 31 and an annular planar surface 40 of an associated ring 21 to thereby provide an optimum magnetic connection or contact and thus assure that the rings or pole pieces 21 produce magnetic lines of force of optimum strength.

As seen in FIGS. 1, 2, and 5, the cylinder 20 has a pair of end plates 43 each of which is adapted to engage an outermost ring 21. Each end plate 43 has a recessed substantially frustoconical inside surface 44, the purpose of which will be apparent from the subsequent description. A threaded nut 45 is provided and has threads 46 which are adapted to threadedly engage an associated threaded portion 25 of support 23 and the nut 45 has a cooperating outside frustoconical surface 47 which is particularly adapted to engage a frustoconical inside surface 44 of an end plate 43 and hold the plate firmly in position on the central support 23.

Thus, it is seen that the cylinder 20 is defined by annular members 22 which carry magnet constructions 31 to define what may be referred to as annular assemblies 50. The assemblies 50 are alternated with rings 21 along the support 23 and are held with the magnet constructions axially compressed and in sandwiched relation between end plates 43 which are in turn held in position by the nuts 45 threadedly engaging opposite ends of the support 23.

Having described the detailed component parts comprising the cylinder 20, a brief detailed description will now be made of the method in which the cylinder 20 may be made or assembled with optimum simplicity and without requiring complex holding fixtures, assembly techniques, or additional assembly materials, such as adhesives, or the like. In particular, a nut 45 is threaded in position over a threaded end portion 25 of the elongated central support 23 and an end plate is placed concentrically therearound so that the frustoconical surface 44 of such end plate engages and is suitably centered in position by the outside frustoconical surface 47 of nut 45. The support 23 with its threaded nut 45 and end plate 43 is preferably placed on a simple conventional fixture, not shown, which is, in turn, supported on a horizontal platen or worktable of a conventional press, not shown, so that the support 23 extends vertically.

The annular assemblies 50 (each comprised of member 22 and magnet constructions 31) are then stacked alternately with rings 21 along the full length of the support 23. Once the outermost or top ring 21 is stacked in position, the opposite end plate 43 is placed on such ring and force is applied by the press acting against suitable bearing blocks, designated by arrows 51 in FIG. 5, to thereby axially compress the members 22 and rings 21 against each other. However, as indicated earlier, each magnet construction 31 initially has a thickness which extends outwardly of a member 22 by a distance as indicated at 41 in FIG. 4. Upon axially compressing the assemblies 50 and rings 21 the magnet constructions 31 are also compressed causing radial outward expansion thereof against their associated surfaces 34 as well as against the outside surface of the central support 23. This axial compressing also eliminates the outward extensions of the magnet constructions indicated at 41 to define the compacted cylinder, as shown in FIG. 5, whereby each magnet construction 31 in its axially compressed condition constantly urges against its associated ring 21 and is in intimate contact therewith to assure optimum magnetic contact. With the members 21 and 50 urged together by blocks 51, the opposite threaded nut 45 is threaded from the dotted line position illustrated at 52 in FIG. 5 to the illustrated solid line position to thereby define the completed cylinder.

In the assembled magnetic cylinder 20 it will be seen that the magnet constructions 31 are supported and retained within their associated annular members 22 with their north and south poles essentially as shown in FIG. 6 of the drawings. This arrangement of the poles of the magnet constructions 31 assures that the rings or pole pieces 21 have alternating polarity along the length of the cylinder as indicated by the alternating north and south poles. Further, the external lines of magnetic force are provided as illustrated at 53 whereby the magnetic field surrounding the cylinder 20 is particularly adapted to hold associated articles such as magnetic blankets firmly thereagainst without requiring additional support.

Another exemplary embodiment of this invention is illustrated in FIGS. 7–10 of the drawings. The cylinder illustrated in FIGS. 7–10 is very similar to the cylinder 20; therefore, such cylinder will be designated generally by the reference numeral 20A and parts of the cylinder 20A which are similar to corresponding parts of the cylinder 20 will be designated by the same reference numeral as in the cylinder 20 also followed by the letter designation A and not described again. Only those component parts which are substantially different from the corresponding parts of the cylinder 20 will be designated by a new reference numeral also followed by the letter designation A and described in detail.

The cylinder 20A also has an elongated central support 23A which has an integral hub portion 26A and a supporting shaft 27A. The cylinder 20A also has oppositely arranged end plates 43A and threaded nuts 45A and includes a plurality of rings 21A arranged alternately with annular members 55A. As seen in FIG. 8, each annular member 55A has retaining means also indicated generally by the reference numeral 30A and in this example such retaining means is in the form of a plurality of cutouts 56A. Each cutout 56A defines a peripheral wall or surface 57A and each annular member 55A has a substantially uniform thickness as indicated at 60A in FIG. 9.

The cylinder 20A also has a plurality of compressible permanent magnet means or constructions also defined by permanent magnets embedded in an elastomeric material and such compressible magnet constructions are identical in composition to the magnet constructions 31 except for the shape thereof; however, to avoid confusion, such magnet constructions will be designated by the reference numeral 61A. The magnet constructions 61A have a peripheral outline which corresponds to the peripheral outline of the peripheral wall 57A and each magnet construction 61A is sized so that it requires slight inward compression in order to install such magnet construction within an associated cutout 56A with the peripheral surface thereof against peripheral wall 57A whereby each magnet construction 61A is held solely by friction. Each annular member 55A has a plurality of magnet constructions 61A installed therein and corresponding in number to its cutouts 56A to define an assembly 50A.

The magnet constructions 61A are in the form of solid disc-like members having opposed planar parallel surfaces 62A and the axial dimension or thickness of each member as measured in a direction parallel to the longitudinal axis 24A of cylinder 20A is such that each magnet construction 61A extends outwardly of one side of its associated annular member 55A by a distance 41A which may be compared to the distance 41 that each magnet construction 31 extends outwardly from a side of an associated annular member 22. Thus, each magnet construction 61A has a corresponding uncompressed thickness indicated at 63A which is greater than the thickness 60A of its associated annular member 55A and each magnet construction 61A extends completely axially through an associated cutout opening 56A.

The cylinder 20A with its rings 21A, assemblies 50A and other components is assembled in a similar manner as described in connection with the cylinder 20 and particularly the illustration and description associated with the FIG. 5 presentation whereupon axial forces are applied in a conventional press using bearing blocks similar to the bearing blocks 51. The application of axial forces causes each permanent magnet construction 61A to be compressed axially essentially from its uncompressed thickness illustrated in FIG. 9 to the compressed condition illustrated in FIG. 10.

Thus, each magnet construction 61A is placed in intimate contact against associated ring spacers 21A to provide optimum magnetic contact. In addition, each compressed magnet construction is also urged more firmly against its associated peripheral retaining wall 57A.

The completed magnetic cylinder 20A will also have its magnet constructions 61A arranged with the north and south poles thereof as shown in FIG. 10. Thus the rings 21A along the length of the cylinder 20A will have alternating polarity and are indicated as alternating north and south poles.

The central supports 23 and 23A of exemplary cylinders 20 and 20A respectively are made of nonmagnetic materials. However, it will be appreciated that such supports may be made of any suitable material known in the art. Further, should such supports be made of a magnetic material each would be surrounded by a suitable isolator sleeve in accordance with standard practice.

The end plates for each cylinder 20 or 20A may be attached to the central support using any suitable means known in the art. For example, an annular end plate similar to the end plates illustrated may be threadedly fastened directly to an associated threaded end portion of the central support whereupon another member or assembly comprised of a hub portion and supporting shaft may be suitably fixed to the threadedly fastened end plate.

The various annular members 22 and 55A may be made utilizing any suitable manufacturing technique and/or material. Further, in the case of member 55A, the cutouts may be provided by punching, drilling, stamping, or other suitable process depending upon the application.

The compressible magnet constructions 31 and 61A need not necessarily have peripheral outlines as shown but may have any suitable peripheral outline. For example, each construction 61A may have either a noncircular outline as shown or a circular outline; however, regardless of their physical configurations, magnet constructions 31 and 61A are made of permanent magnets embedded in an elastic-like or resilient elastomeric matrix and the magnet constructions may be compressed without impairing their magnetic properties. In particular, any suitable elastomer may be used for this purpose including natural rubber, synthetic rubber, or an elastomeric material in the form of a high molecular weight organic plastic material.

Each magnet construction 31 is shown extending outwardly from a side of an associated annular member by a distance 41 and each magnet construction 61A is shown extending outwardly from opposite sides of its associated annular member 55A by distances 41A. The distances 41 and 41A are shown in an exaggerated manner to highlight the fact that the magnet constructions are compressed axially to assure intimate contact with their associated magnetized rings.

The actual distance that a magnet construction extends outwardly of a side of an associated annular member would be generally of the order of a few thousandths of an inch ranging between one and ten thousandths. In one application of this invention, the dimension **41**A associated with a magnet construction **61**A was two thousandths of an inch.

One example of a resilient compressible permanent magnet construction which may be used to define magnet constructions **31**, **61**A, and similar constructions is sold by the 3M Company of St. Paul, Minn., and is sold under the trade name of Plastiform and employs a material such as barium ferrite in an elastomeric matrix comprised of rubber to define a permanent magnet construction of the character described above.

While present exemplary embodiments of this invention, and methods of practicing the same, have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

We claim:

1. A magnetized cylinder comprising, an elongated central support, a plurality of annular members made of non-magnetic material and carried concentrically around said support, each of said annular members having an outer cylindrical surface and retaining means therein, a plurality of rubberlike compressible permanent magnet means defined by permanent magnets embedded in an elastomeric matrix, each of said permanent magnet means being in an axially compressed condition so that its axial dimension is less than its corresponding axial dimension in an uncompressed condition, and a plurality of rings made of a magnetic material, said rings being supported alternately with said annular members along said support, said permanent magnet means being held within associated retaining means and with the poles of the magnet means arranged against an associated ring having like polarity so that said rings define pole pieces of alternating polarity along the length of said cylinder.

2. A cylinder as set forth in claim **1** in which each of said annular members has a plurality of cutouts therein defining a peripheral wall which retains an associated permanent magnet means therewithin.

3. A cylinder as set forth in claim **2** in which each of said cutouts extends completely through its associated annular member and is arranged in close proximity to the peripheral outside surface thereof.

4. A cylinder as set forth in claim **1** in which said central support has a longitudinal axis which defines the longitudinal axis of said cylinder, each of said annular members has a substantially T-shaped cross-sectional configuration with the vertical leg of the T being arranged perpendicular to said axis and the horizontal arm thereof being arranged parallel to said axis with the inside cylindrical surface of said arm arranged to one side of said leg defining circumferential retaining means for an associated permanent magnet means.

5. A cylinder as set forth in claim **4** in which each of said permanent magnet means comprises an annular disc-like member having its peripheral surface retained by an associated circumferential retaining means and having a pair of opposed parallel planar surfaces with the entire area of one of said planar surfaces yieldingly compressed against an associated ring.

6. A cylinder as set forth in claim **4** in which the arm of each T-shaped annular member has a dimension parallel to its leg which is a small fractional part of the height of said leg.

7. A cylinder as set forth in claim **3** in which said cutouts are angularly spaced apart substantially equal angular increments.

8. A cylinder as set forth in claim **1** in which each permanent magnet means is frictionally held within an associated retaining means, each permanent magnet means being held axially compressed by at least one associated ring and thus in intimate contact thereagainst to assure the provision of magnetic lines of force around said cylinder having optimum strength.

9. A cylinder as set forth in claim **8** in which each of said permanent magnet means has a pair of opposed parallel annular planar surfaces one of which has its entire surface area yieldingly compressed against said one associated ring.

10. A cylinder as set forth in claim **1** in which each permanent magnet means is frictionally held within an associated retaining means, each permanent magnet means being held axially compressed in sandwiched relation between a pair of associated rings and thus in intimate contact thereagainst to assure the provision of magnetic lines of force around said cylinder having optimum strength.

11. A cylinder as set forth in claim **10** in which each of said annular members has a uniform thickness throughout and each permanent magnet means comprises a polygonal disc-like member having a pair of opposed parallel planar surfaces with the entire areas of said planar surfaces yieldingly compressed between said pair of rings.

12. A cylinder as set forth in claim **1** in which said elastomeric matrix comprising each permanent magnet means comprises a high molecular weight organic plastic material.

13. A cylinder as set forth in claim **1** in which each of said compressible permanent magnet means is compressed within an associated retaining means and frictionally held in position by the tendency of the premamagnet means to return to its uncompressed condition.

14. A cylinder as set forth in claim **1** in which each permanent magnet means in its axially compressed condition has an axial dimension which is several thousandths of an inch less than its corresponding axial dimension in an uncompressed condition.

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