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Miyata

[11] **3,800,914**

[45] **Apr. 2, 1974**

[54] **MAGNETIC FILTER FOR LUBRICANTS**

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[22] Filed: **Aug. 21, 1972**

[21] Appl. No.: **282,119**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 14,346, Feb. 26, 1970, abandoned.

[52] **U.S. Cl.** **184/6.25,** 210/168, 210/222

[51] **Int. Cl.** **F01m 11/00,** B01d 35/06

[58] **Field of Search** 210/222, 223, 168; 184/1.5, 6.25; 335/303-306

[56] **References Cited**

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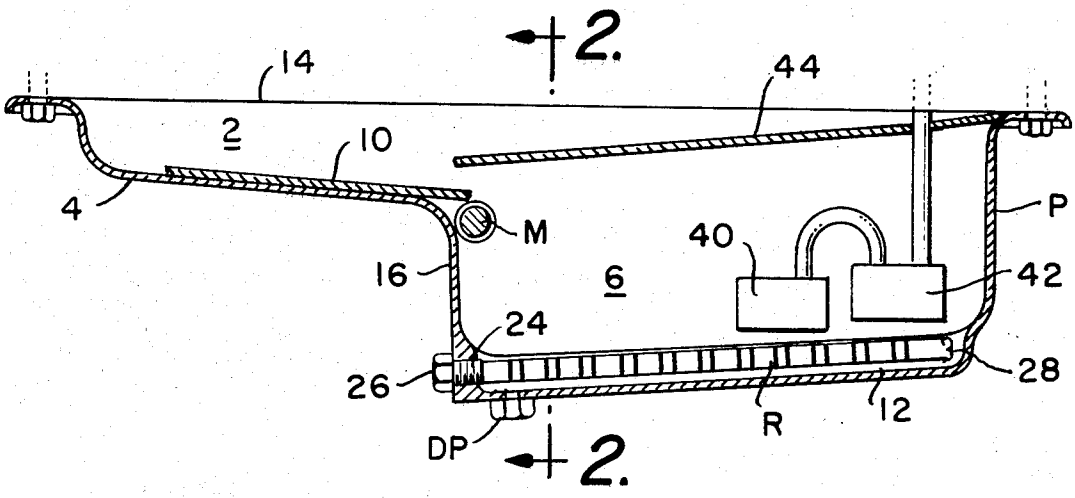
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Primary Examiner—Samih N. Zaharna
Assistant Examiner—T. A. Granger

[57] **ABSTRACT**

A magnetic filter for removing ferrous particles from a lubricating system. A magnetic rod is supported in a channel formed in the bottom of a lubricant pan to attract and retain ferrous particles. In one form of the invention an automobile crank case pan is formed with a shallow and a deep chamber. The flowing lubricating oil is collected in the shallow chamber and passed over a magnetic rod and into the deep chamber. The bottom of the deep chamber is formed with a channel in which is mounted a second magnetic rod.

14 Claims, 18 Drawing Figures



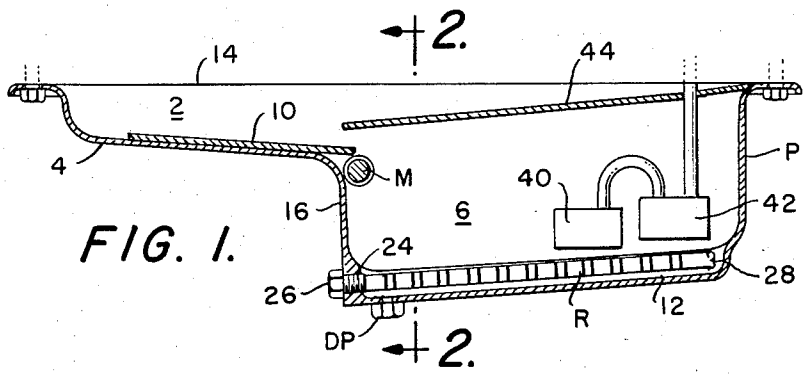


FIG. 1.

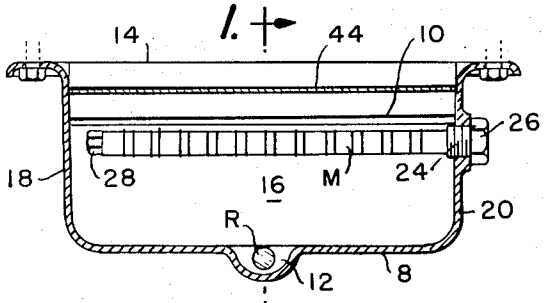


FIG. 2.

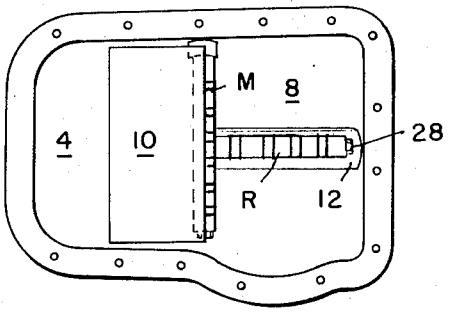


FIG. 3.

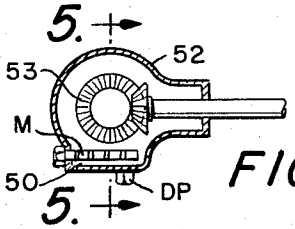


FIG. 4.

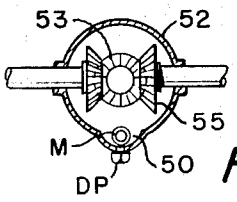


FIG. 5.

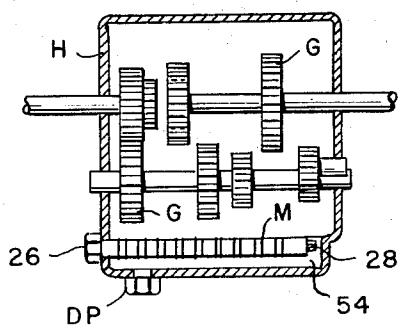


FIG. 6.

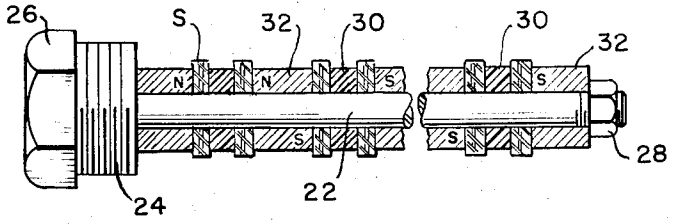


FIG. 7.

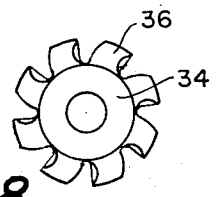


FIG. 8.

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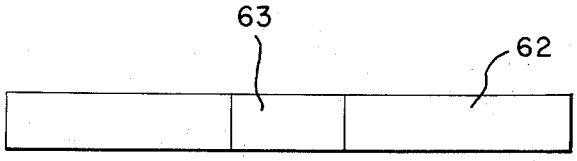


FIG. 9

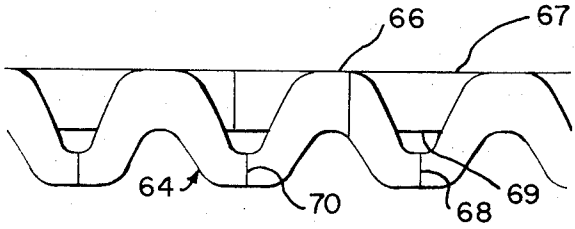


FIG. 10

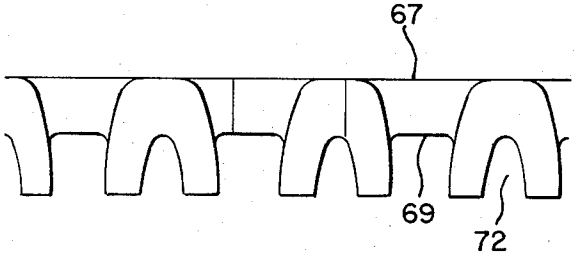


FIG. 11

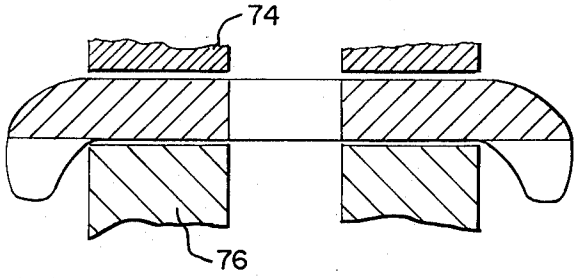


FIG. 12

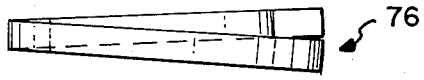


Fig. 13

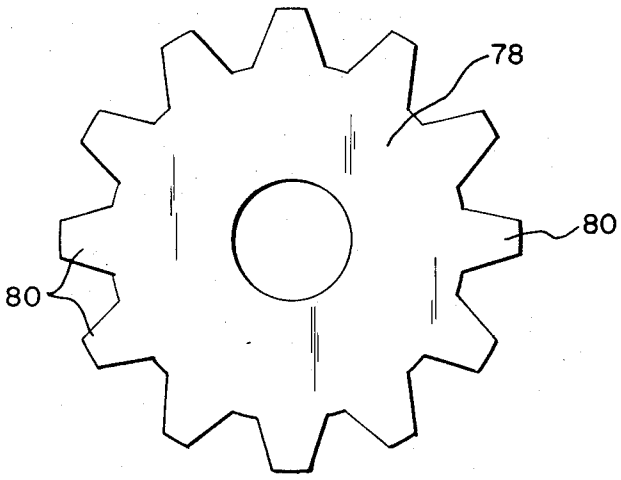


Fig. 14

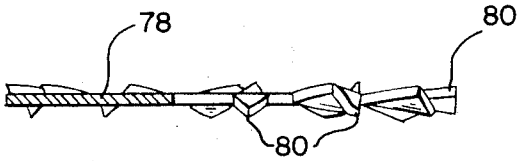
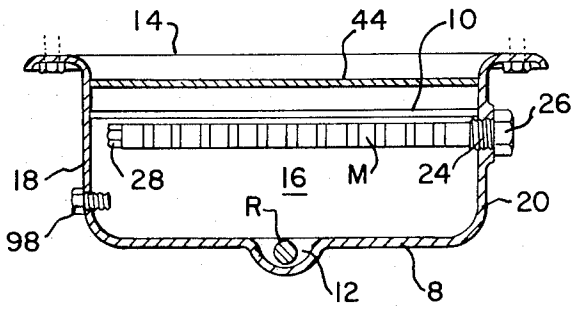


Fig. 15

Fig. 18



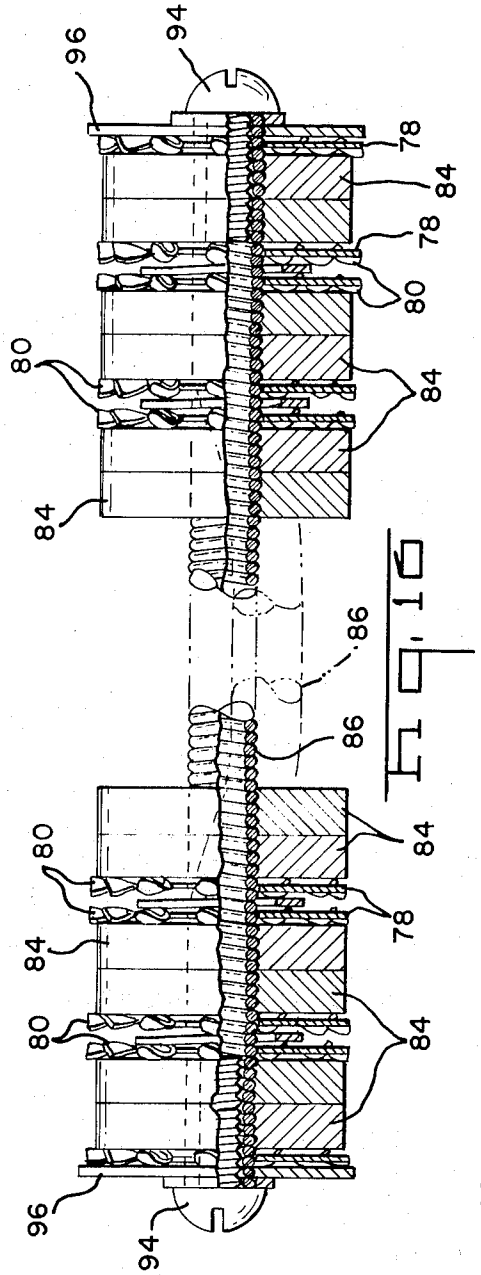

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FIG. 16

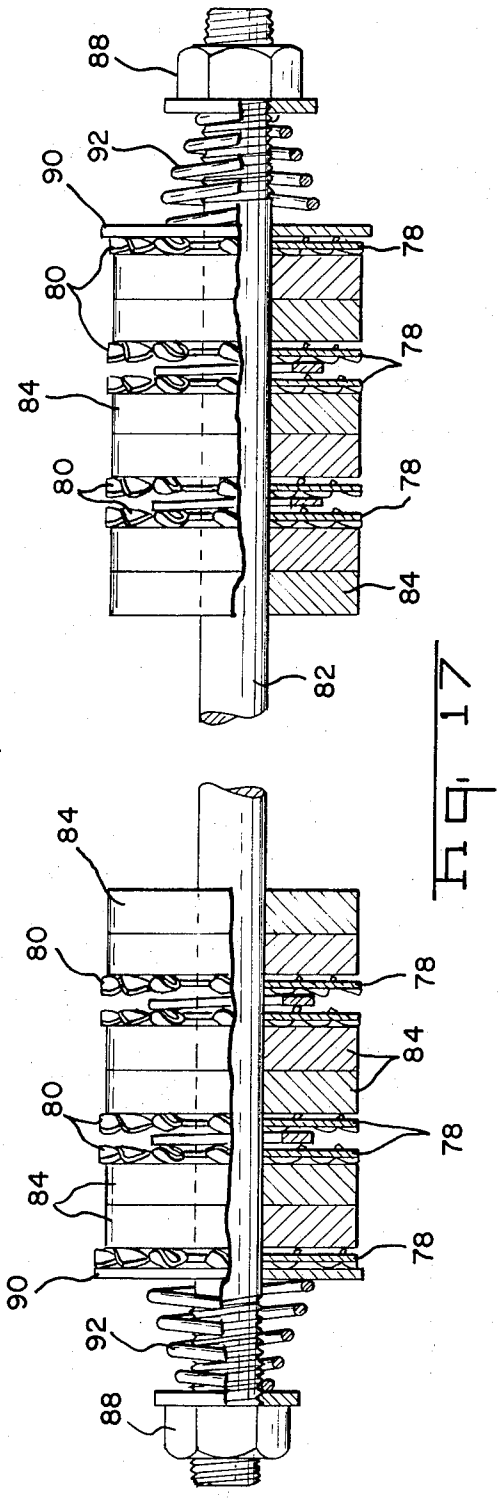

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FIG. 17

MAGNETIC FILTER FOR LUBRICANTS

This application is a continuation-in-part of my copending application, Ser. No. 14,436, Filed Feb. 26, 1970, for Magnetic Filter for Lubricants now abandoned.

This invention relates to an automobile oil pan and sump construction for preventing the circulation of contaninents in the lubricating system.

The usual location of the oil pump intake for an internal combustion automobile engine is at the lowest part of the oil pan and often in a sump that is formed in the bottom of the pan. The contaminents which are created during engine operation are deposited in the low part of the pan or sump and are sucked up with the oil by the pump and forced between the moving parts for lubricating the rubbing surfaces. The contaminated oil contains, *inter alia*, iron particles which are grated from the sliding elements and operate as an abrasive to produce wear. In addition, the iron particles produce more iron particles to produce excessive wear.

It is an object of this invention to provide an oil pan and pump arrangement that will remove the iron particles from the lubricating system and store the particles in a manner that will prevent escape into the system.

It is a further object of this invention to produce a device as aforesaid which provides for simple means for removing the iron particles from the pan.

It is a further object of this invention to produce a device as aforesaid in which the sludge produced by engine operation can be collected and stored and then removed.

These and other objects of the invention will become manifest upon reading the following description in conjunction with the accompanying drawing wherein:

FIG. **1** is a longitudinal section of the oil pan and pump structure taken on line **1—1** of FIG. **2**;

FIG. **2** is a section taken on line **2—2** of FIG. **1**;

FIG. **3** is a top plan view of the pan;

FIG. **4** is a schemmatic view of a differential in a housing incorporating the principles of the invention illustrated in FIG. **1**;

FIG. **5** is a view taken on the line **5—5** of FIG. **4**;

FIG. **6** is an illustration of a transmission including the principles of the invention disclosed in FIGS. **1** and **4**;

FIG. **7** is a magnetic bar used in FIGS. **1–6**;

FIG. **8** is an illustration of the pole piece;

FIG. **9** is an end view of a magnetic disc before deformation to form a modified pole piece;

FIG. **10** is an end view of the disc of FIG. **9** with its peripheral portion corrugated and the crests of the corrugations cut;

FIG. **11** is an end view of the disc having radially extending flutes;

FIG. **12** is a diametrical cross-section view of a disc shown in FIG. **11** assembled with a magnet and a non-magnetic spacer;

FIG. **13** is an end view of a spacer used between pole pieces;

FIG. **14** is a plan view of a magnetic disc before deformation, to form a second modified form of pole piece;

FIG. **15** is an end view, partly in section, showing the second modified form of pole piece;

FIG. **16** is a side view partly in section of a coil spring rod supporting the magnetic assembly;

FIG. **17** is a similar view showing a resilient plastic rod supporting the magnetic assembly; and

FIG. **18** is a view of an oil pan similar to FIG. **2** with the addition of a drain plug.

In accordance with the invention a magnetic rod is positioned in a channel formed in the bottom of the pan. The magnetic rod is formed with a plurality of spaced pole pieces to concentrate the field. The iron particles can be removed by a strong high pressure air and solvent jet stream.

With reference to the drawing there is illustrated an oil pan P for an internal combustion engine. The pan comprises a shallow chamber **2** having a bottom **4** and a deem chamber **6** having a bottom **8.** A flow control plate **10** is secured to the bottom **2** as by welding and a channel **12** is formed in the bottom **8.**

The bottom **4** is tipped in one direction with reference to the top **14** of the pan to direct oil flow toward chamber **6** and the bottom of **8** is tipped in the opposite direction to form a settling zone bounded by the walls **16, 18, 20** and the bottom **8.** A magnetic rod M is secured to side wall **20** as by being threaded thereto and is positioned under the free edge of plate **10** adjacent the border or line of contiguity between chambers **2** and **6.** A magnetic rod R is secured in channel **12** as by being threaded in wall **16.**

The magnetic rods are similar and consist of a rod body **22** of non-magnetic material, such as brass, formed with a threaded section **24** for threading into the pan and head **26** for engagement by a wrench at one end and a threaded section for receiving a nut **28** at the other end. A plurality of pole pieces S separated by discs **30** of non-magnetic material are mounted on the body between magnets **32.** The magnets are mounted with like or unlike poles facing each other.

The pole pieces are of magnetic material such as mild steel and consist of a disc **34** formed with radially extending vanes **36** which are fluted having an outer radius at least as great as that of the magnets and are preferably twisted to form corrugations.

The series of magnets, pole pieces, and separators, are mounted as illustrated in FIG. **7** and secured by tightening nut **28.**

In use, the customary strainer, **40** and pump **42** are positioned near the upper end of the sloped bottom **8** by conventional mounting means (not illustrated). A flow plate **44** is secured by means, not shown, in a tipped position to cause the lubricant dropping from the motor to flow toward the left as illustrated in FIG. **1** to a position beyond the magnet rod M.

In operation, the lubricant drops off the end of plate **44** onto plate **10** to combine with the lubricant which has dropped into the shallow chamber to flow as a combined stream over magnet rod M where ferrous particles are attracted and restrained. The flow of the lubricant in chamber **6** will cause ferrous particles that have escaped attraction by magnet rod M to be attracted to magnet rod R.

Sludge and particles will collect in the settling zone during periods of non operation leaving the cleaner lubricant adjacent the inlet to the pump.

In the form of the invention illustrated in FIGS. **4** and **5** a channel **50** is formed in the lower portion of the differential housing **52** and a magnetic rod M similar to rod M heretofore described is threaded into the channel. The ferrous particles produced by the rubbing of

the gears 53, 55 will be attracted to the magnetic rod in a manner described above.

In the form of the invention illustrated in FIG. 6 a transmission housing H is formed with a channel 54 into which is inserted a magnetic rod M as described with reference to FIGS. 1–5. The metal particles created by the rubbing of the gears G of the various gear trains will be attracted to the magnetic rod.

In each of the forms of the invention the lubricant can be withdrawn by removal of a drain plug DP. The magnetic rod can be withdrawn and cleaned before being reinserted for use with a new batch of lubricant.

A further form of pole piece and one which provides a greater area which is exposed to the circulating fluid for the same amount of pole piece material is shown in FIG. 11. This pole piece is formed from a flat disc 62 having a central opening 63 as shown in FIG. 9. The peripheral portion of the disc is stamped in such a way as to form corrugations 64 with the crests 66 in the plane of one surface 67 of the disc while the opposite crests 68 protrude from the opposite disc surface 69 as in FIG. 10. The crests 68 of the corrugations are then cut as at 70 and the edges of the material on both sides of the cuts bent forwardly of the disc surface 69 to appear as as shown in FIG. 11 in the form of radially extending flutes 72. In FIG. 12 is shown a pole piece formed in the manner described above positioned between a magnet 74 and a non-magnetic spacer 76. The spacer 76 may be made in the form of split spring washers with their upper and lower surfaces not parallel. When placed between the flat surfaces of the pole pieces they maintain the latter in spaced apart relation so that their surfaces do not touch. The magnets used are preferably of the alloy type, such as Alnico.

A still further modified form of pole piece is shown in FIG. 14. This modification comprises centrally apertured flat disc 78 of magnetic material provided with radially extending vanes 80 about its periphery. The vanes are all twisted in on direction through an angle of less than 90° about a radial line extending from the center of the pole piece through each vane, as shown in FIG. 15.

The pole pieces 62 or 78 are mounted on a rod as shown in FIGS. 16 and 17, with a non-magnetic spacer 76 between adjacent surfaces thereof. A pair of Alnico magnets 84 in the form of flat circular discs are positioned between opposing surfaces of the pole pieces which are opposite to the surfaces engaging the spacers. The magnets of each pair which are in direct contact are in series aiding relation while the adjacent pairs of magnets are in series opposing relation to each other.

Preferably, the rod supporting the magnets, spacers and pole pieces is of resilient or yieldable material such as plastic as shown at 82 or in the form of tightly wound spring of copper berrylium wire as shown at 86 in FIG. 16. With such an arrangement, cleansing of the pole pieces can be more easily accomplished by merely bending the rod as shown by the dotted lines in FIG. 16 to allow the adjacent magnets and pole pieces to separate from each other, so that a cleaning tool or a strong blast of air against the surfaces will clean them of any iron particles clinging thereto. Another advantage of the yieldable rod is that when inserting it in a drain hole it can bend around obstacles or conform to the bottom of the pan when reaching it, if inserted vertically. As previously described in connection with FIG. 7, the magnets, pole pieces and spacers are stacked on their support 52 or 86 and held together by a nut 88 threaded on each end of the plastic rod 82 bearing against a washer 90 through a compression spring 92 or by a screw 94 threaded into the ends of the coiled spring 86 and bearing against a washer 96.

The oil pan shown in FIG. 1 may have its lower or deep chamber 6 provided with a drain plug 98 at a level between the rods M and R as shown in FIG. 18. In this way, before the lower rod R supporting the magnets is removed from the oil pan for cleaning purposes, the drain plug 98 is removed to permit the oil which is freer from sludge at the upper levels, to drain out. This oil can then be reused. When the lower magnetic rod is removed for cleaning, the oil in the bottom of the pan having the sludge and heavy contaminants is drained out.

I claim:

1. A magnetic assembly for attracting particles floating in a fluid, comprising

a non-magnetic elongated support member,

a plurality of centrally apertured magnets through which the support member extends with the poles in alignment,

each magnet being provided with an individual pole piece at each pole thereof with adjacent pole pieces in non-contacting relation,

said pole pieces each comprising a centrally apertured planar disc having a plurality of radially extending vanes about its periphery,

the vanes being formed with their side edges out of the plane of the disc hub but extending radially thereof.

2. A magnetic assembly according to claim 1 wherein the elongated support member is resilient.

3. A magnetic assembly according to claim 2 wherein the elongated support member is a rod of plastic material.

4. A magnetic assembly according to claim 2 wherein the elongated support member is a coiled wire spring.

5. A magnetic assembly according to claim 1 wherein the vanes are twisted about the radius of the disc along which they extend.

6. A magnetic assembly according to claim 5 wherein the pole pieces of adjacent magnets are separated by non-magnetic spacers.

7. A magnetic assembly according to claim 1 wherein the vanes are fluted.

8. A magnetic assembly according to claim 5 wherein the pole pieces of adjacent magnets are separated by non-magnetic spacers.

9. A magnetic assembly according to claim 1 wherein the elongated support member is resilient and the magnets, pole pieces and spacers are stacked on the support member, and means for securing them in stacked relation.

10. A magnetic assembly according to claim 9 wherein like poles of adjacent magnets are adjacent each other.

11. An oil pan for an internal combustion engine comprising a shallow chamber and a deep chamber contiguous thereto, magnetic means supported adjacent the line of contiguity between said chambers, means for guiding flow of fluid from the shallow chamber onto the magnetic means, and additional magnetic

means secured in the bottom of the deep chamber, the bottom of the shallow chamber being sloped toward the deep chamber, the bottom of the deep chamber being sloped toward the shallow chamber, the means for guiding the flow of fluid comprising a plate secured to the bottom of the shallow chamber with a free edge of said plate extending over said first mentioned magnetic means, the bottom of the deep chamber being formed with a channel and the second mentioned magnetic means being mounted in the channel and a plate mounted over the deep chamber with a free edge thereof extending over said first mentioned plate.

12. A device as defined in claim **11** wherein each magnetic means comprises a rod, a plurality of permanent magnets mounted on the rod with like poles facing each other, and a pair of pole pieces separated by a non-magnetic spacer mounted on the rod between each of the magnets.

13. An oil pan according to claim **12** wherein the pole pieces each comprise a planar disc having a plurality of vanes angularly spaced about its periphery extending substantially radially,

at least a portion of the edges of each of the vanes of the pole pieces of a magnet are twisted to face toward the opposite pole piece.

14. An oil pan according to claim **13** wherein the vanes are bent to position their surfaces in a plane at an angle to the plane of the disc from which they extend.

* * * * *