July 24, 1956

M. M. COHN

2,755,932

MAGNETIC PLUG

Filed April 13, 1954

Fig. 1.

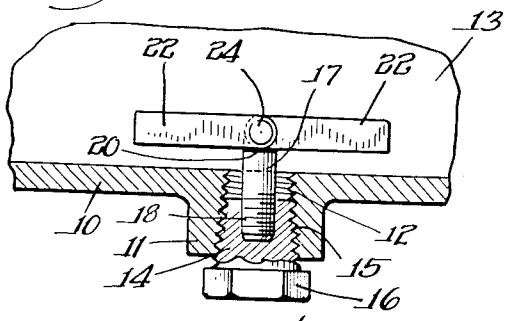


Fig. 2.

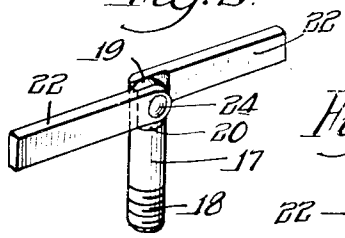


Fig. 3.

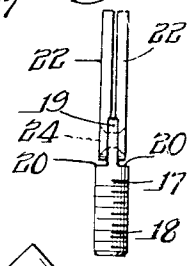


Fig. 4.

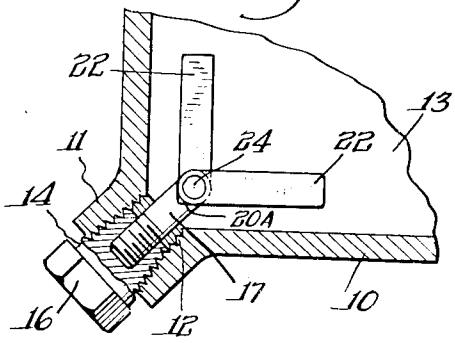


Fig. 5.

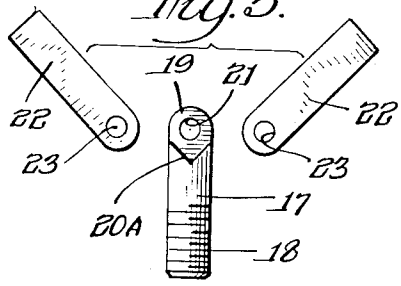


Fig. 6.

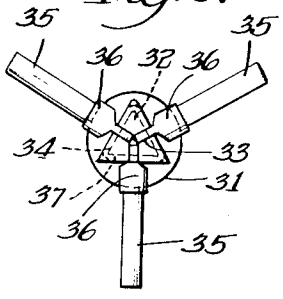


Fig. 7.

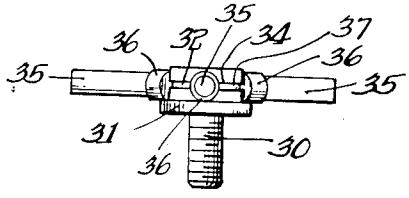


Fig. 8.

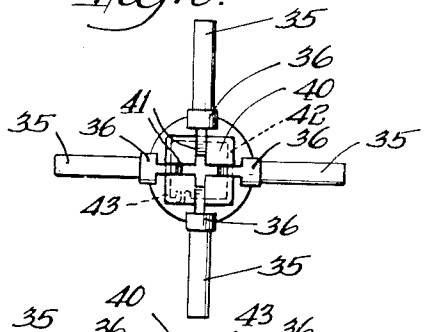
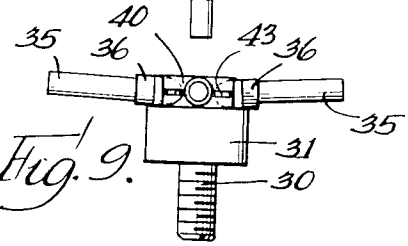


Fig. 9.



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MAGNETIC PLUG

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Application April 13, 1954, Serial No. 422,772

10 Claims. (Cl. 210—1.5)

This invention is directed to a magnetic plug for an opening in a liquid reservoir for closing the opening and for separating para-magnetic particles from the liquid in the reservoir. Such magnetic plugs provided with magnets have particular utility in connection with gear cases, crank cases, transmission cases, differential cases, cooling system, liquid cooled transformers and the like where abrasive para-magnetic particles, such as steel chips and particles and the like, causing undue wear to moving parts, should be removed. The amount of para-magnetic material separated from the liquid depends in large amount upon the strength, size and surface area of the magnets used for this purpose. Quite often the spaces in the reservoirs adjacent the openings thereof for accommodating the magnets is limited by reason of the close proximity of the moving parts arranged in the reservoirs. Hence, in prior magnetic plugs the magnets have been made quite small so that their particle separating efficiency has also been quite small.

The principal object of this invention is to provide an improved magnetic plug for an opening in a liquid reservoir for closing the opening and for separating para-magnetic particles from the liquid in the reservoir wherein powerful and large bar magnets having large magnetic areas may be utilized for obtaining maximum particle separating efficiency, wherein it may be used in conjunction with reservoir spaces having limited clearance, which is simple to install and which may be inexpensively manufactured.

Briefly, the magnetic plug of this invention includes a plug member which is adapted to be removably received in the opening in the reservoir for closing the same and which is provided with a stem protruding from its inner end, and a plurality of bar magnets for separating the para-magnetic particles from the liquid in the reservoir. The ends of the bar magnets are pivoted to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir. Preferably, the like poles of the bar magnets are arranged adjacent each other so as to magnetically repel each other. As a result the bar magnets are spread apart in the reservoir by the magnetic repelling force and separate springs for this purpose are not required. By reason of this spreading apart of the bar magnets in the reservoir maximum magnetic area may be provided in a space having minimum clearance. Stops are also preferably provided for the bar magnets to limit the spreading thereof so that they will not normally contact the walls of the reservoir.

Further objects of this invention reside in the details of construction of the magnetic plug and in the cooperative relationships between the component parts thereof.

Other objects and advantages will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawing in which:

Fig. 1 is a partial sectional view through a part of a liquid reservoir and its opening showing one form of the magnetic plug of this invention mounted in the opening;

Fig. 2 is a perspective view of a portion of the magnetic plug illustrated in Fig. 1;

Fig. 3 is a side elevational view of a portion of the plug illustrated in Fig. 1 but showing the bar magnets collapsed together;

Fig. 4 is a sectional view similar to Fig. 1 but illustrating a liquid reservoir with the opening in the corner thereof and with a slightly modified form of the magnetic plug secured in the opening;

Fig. 5 is an exploded view of a portion of the magnetic plug illustrated in Fig. 4;

Fig. 6 is a top plan view of a portion of a magnetic plug having three bar magnets;

Fig. 7 is a side elevational view of the portion of the plug illustrated in Fig. 6;

Fig. 8 is a plan view of a portion of another plug having four bar magnets;

Fig. 9 is a side elevational view of the portion of the magnetic plug illustrated in Fig. 8.

In Fig. 1 there is illustrated a wall **10** of a liquid reservoir such as a gear case, a crank case, a transmission case, a differential case, a cooling system or a liquid cooled transformer or the like. The wall **10** may be provided with a boss **11** having a screw threaded or tapped hole **12** which hole may act as a drain opening for the reservoir. The reservoir contains a liquid **13** which may contain para-magnetic particles which are to be removed from the liquid. Here, the drain opening is shown to be in the bottom of the reservoir. The clearance above the drain opening **12** may be small since the reservoir may contain moving parts in close proximity to the opening.

The magnetic plug of this invention includes a plug member **14** which is preferably screw threaded as indicated at **15** so that the same may be secured in the drain opening **12** by screwing the same therein. The outer end of the plug member **14** may be provided with flat portions **16** by which the plug **14** may be screwed into and out of the opening. The inner end of the plug member **14** is provided with a stem **17** which, as here illustrated, is separable from the plug member **14**. In this connection, the stem **17** is provided with screw threads **18** to be screwed into a tapped hole in the plug member **14**. If desired the stem **17** may be made integral with the plug member **14**. The end **19** of the stem **17** is provided with a pair of parallel recessed faces and is also provided with a hole **21** extending through the recessed faces. The recessed faces terminate in shoulders **20** which are substantially straight across.

The magnetic plug also includes a pair of bar magnets **22** which may be cast sintered magnets. One end of these bar magnets **22** are provided with holes **23**. The bar magnets **22** are so arranged that their like poles are adjacent each other so that the holes **23** are located in like poles of the magnets. Thus, the magnets **22** operate to magnetically repel each other. The magnets **22** are placed against the flat faces of the stem **17** and a flat headed rivet **24** is inserted through the holes **23** in the bar magnets and the hole **21** in the stem. As a result, one end of the bar magnets **22** are pivotally mounted on the end of the stem **17**. The bar magnets **22** which magnetically repel each other normally assume the position illustrated in Figs. 1 and 2, the spreading of the bar magnets to this position being limited by the shoulders **20**. The magnets **22** may be collapsed together against the magnetic repelling force as indicated in Fig. 3.

When the magnetic plug is installed in the opening **12** of the reservoir the bar magnets **22** are first collapsed together so that they may be inserted through the opening. After the bar magnets **22** have passed through the opening, they automatically spread apart to the po-

sition illustrated in Figs. 1 and 2 so that they do not interfere with the moving parts in the reservoir. The bar magnets **22** are relatively powerful magnets and present a large magnetic surface to provide maximum efficiency in separating the para-magnetic particles from the liquid **13** in the reservoir. At the same time, they do not protrude far into the reservoir in the way of the moving parts therein and, accordingly, maximum separating efficiency is provided for minimum clearance. Fig. 4 shows a reservoir arrangement wherein the opening **12** is located in the corner of the reservoir. For this type of installation angular shoulders **20**–A, as illustrated in Fig. 5, are utilized for limiting the extent of spreading of the bar magnets **22**. Thus, in both arrangements illustrated in Figs. 1 and 4, the shoulders **20** and **20**–A, respectively, form stops for limiting the spreading of the bar magnets **22** so that they will not touch the walls **10** of the reservoirs. This, coupled with the fact that the stem **17** and the rivet **24** are preferably made from aluminum, provides for maximum efficiency in separating the para-magnetic particles from the liquid.

Figs. 6 to 9 illustrate arrangements wherein more than two bar magnets may be utilized. In Figs. 6 and 7 the stem **30** which may be secured to the plug member **14** is provided with a flange **31** and a triangular projection **32**. This triangular projection **32** is provided with three slots **33** and is also provided around its edge with a groove **34**. The bar magnets **35** may be like those illustrated in Figs. 1 to 5 or they may be separate magnets secured into caps **36** having extensions provided with holes extending into the slots **33**. A wire clip **37** extends through the holes in the caps **36** and is located in the groove **34** for pivotally mounting the bar magnets **35** on the projection **32**. Here also like poles of the bar magnets are arranged adjacent each other so that the magnets operate to repel each other. The magnets **35** may be collapsed together for insertion through the opening in the reservoir and after they are so inserted they automatically spread apart in the reservoir by means of the magnetic repelling force. The magnetic plug arrangement of Figs. 6 and 7 operates in the same manner as discussed above in connection with Figs. 1 to 5 and a further description is not considered necessary. In the arrangement of Figs. 6 and 7 the flange **31** operates as a stop for limiting the spreading of the bar magnets **35**.

The arrangement illustrated in Figs. 8 and 9 is like that illustrated in Figs. 6 and 7 except that four bar magnets **35** are utilized instead of three. Here the flange **31** on the stem **30** is provided with a square projection **40** which is provided with slots **41** and a groove about the projection indicated at **42**. The ends of the caps **36** are received in the slots **41** and a spring clip **43** extends through the holes in the caps **36** and is located in the groove **42** for pivotally mounting the bar magnets **35** on the projection **40** of the stem **30**. Here, also, like poles of the bar magnets **35** are arranged adjacent each other so that the bar magnets **35** operate to magnetically repel each other. The manner of operation of the arrangement of Figs. 8 and 9 is like that described above in connection with Figs. 1 to 7 and a further description is not considered necessary.

While for purposes of illustration, several forms of this invention have been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem

protruding from its inner end, a plurality of bar magnets for separating the para-magnetic particles from the liquid, and means for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir.

2. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, a plurality of bar magnets for separating the para-magnetic particles from the liquid, said bar magnets being arranged with their like poles adjacent each other so as to magnetically repel each other, and means for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together against the magnetic repelling force for insertion through the opening and may be spread apart in the reservoir by the magnetic repelling force.

3. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, a plurality of bar magnets for separating the para-magnetic particles from the liquid, and means for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir, and stops on the stem engageable by the bar magnets for limiting the spreading thereof.

4. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, a plurality of bar magnets for separating the para-magnetic particles from the liquid, said bar magnets being arranged with their like poles adjacent each other so as to magnetically repel each other, and means for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together against the magnetic repelling force for insertion through the opening and may be spread apart in the reservoir by the magnetic repelling force, and stops on the stem engageable by the bar magnets for limiting the spreading thereof.

5. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, said stem at its inner end being provided with a pair of parallel recessed faces and having a hole through the recessed faces, a pair of bar magnets for separating the para-magnetic particles from the liquid and arranged in parallel planes with one of their ends engaging the parallel recessed faces of the stem, said ends of the bar magnets having holes therethrough, a pin extending through the holes in the stem and the bar magnets for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir.

6. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, said stem at its inner end being provided with a pair of parallel recessed faces and having a hole through the recessed faces, a pair of bar magnets for separating the para-magnetic particles from

the liquid and arranged in parallel planes with their like poles adjacent each other so as to magnetically repel each other and with one of their ends engaging the parallel recessed faces of the stem, said ends of the bar magnets having holes therethrough, a pin extending through the holes in the stem and the bar magnets for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together against the magnetic repelling force for insertion through the opening and may be spread apart in the reservoir by the magnetic repelling force.

7. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, said stem at its inner end being provided with a pair of parallel recessed faces terminating in shoulders and having a hole through the recessed faces, a pair of bar magnets for separating the para-magnetic particles from the liquid and arranged in parallel planes with one of their ends engaging the parallel recessed faces of the stem, said ends of the bar magnets having holes therethrough, a pin extending through the holes in the stem and the bar magnets for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir, said shoulders being engaged by the bar magnets when the same are spread apart for limiting the spreading thereof.

8. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, said stem at its inner end being provided with a pair of parallel recessed faces terminating in shoulders and having a hole through the recessed faces, a pair of bar magnets for separating the para-magnetic particles from the liquid and arranged in parallel planes with their like poles adjacent each other so as to magnetically repel each other and with one of their ends engaging the parallel recessed faces of the stem, said ends of the bar magnets having holes therethrough, a pin extending through the holes in the stem and the bar magnets for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together against the magnetic repelling force for insertion through the opening and may be spread about in the reservoir by the magnetic repelling force, said shoulders being engaged by the bar magnets when the same are spread apart for limiting the spreading thereof.

9. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, the inner end of said stem having a plurality of slots therein and a groove around the stem adjacent the slots, a plurality of bar magnets for separating the para-magnetic particles from the liquid and having one of their ends received in the slots and provided with holes in said ends, and a wire extending through the holes in the bar magnets and received in the groove in the stem for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together for insertion through the opening and may be spread apart in the reservoir.

10. A magnetic plug for an opening in a liquid reservoir for closing the opening and separating para-magnetic particles from the liquid in the reservoir, comprising a plug member adapted to be removably received in the opening for closing the same and having a stem protruding from its inner end, the inner end of said stem having a plurality of slots therein and a groove around the stem adjacent the slots, a plurality of bar magnets for separating the para-magnetic particles from the liquid and having one of their ends received in the slots and provided with holes in said ends, said bar magnets being arranged with their like poles adjacent each other so as to magnetically repel each other, and a wire extending through the holes in the bar magnets and received in the groove in the stem for pivoting the bar magnets at one of their ends to the stem so that the bar magnets may be collapsed together against the magnetic repelling force for insertion through the opening and may be spread apart in the reservoir by the magnetic repelling force.

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