
# Engineering Patents I: *Overview*

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# Introduction

A patent is a document issued by the government that gives the engineering applicant exclusive rights to an invention for a period of 20 years. The invention must be something that is new and useful to society. An invention that is obvious to a person with average skill in a given field is not patentable. Patents are sometimes assigned to a company with one or more of its employees listed as the inventor. This is usually done as a prior condition of employment between the company and the employee. Patent laws give individuals and companies incentive to develop their innovative ideas for their own benefit and for the benefit of others. Some large corporations spend billions of dollars a year to develop useful and beneficial products that they otherwise may not have the incentive to do without the patent laws.

Patents can be traced as far back as 500 BC to Europe where the first patents were granted in Greece for "refinements in luxury". In the 1400's, in Italy, a patent was issued for a barge that carried marble. Patents were granted in England and France in the 1600's and 1700's. The first Congress of the United States adopted a Patent Act in 1790 and the first patent was issued on July 31, 1791 titled "in the making of Pot ash and Pearl ash by a new Apparatus and Process". It was signed by George Washington. Treaties between the nations of the world including the U.S. and Canada have gone into effect whereby members of one nation may obtain patents in another nation in a manner similar to their own country.

The word "patent" comes from the Latin word "patere" which means "to lay open". This refers to the fact that, in order for a patent to be issued giving the inventor exclusive rights to his invention, he must make his idea known to the general public. That is the reason why, in certain cases, some parties do not apply for patents for innovations which they consider too important to divulge for fear they will be infringed upon or ways will be found to circumvent them.

A patent gives the inventor exclusive rights to his invention; however, it does not give him the right to interfere with another patent. For example, many inventions are improvements of existing patented products. An inventor may not produce the item with his patented improvement without the consent of the original inventor assuming that the original patent is still in effect. Patent infringement cases are held in civil courts where, if successful, monetary compensation awards are ordered. Patents may be sold, licensed, transferred, or even given away. It is common for corporations engaged in the same field of endeavor such as the automotive manufacturers to share patents for the mutual benefit of both companies.

## Patent Process

There are three types of patents; utility patents, design patents, and plant patents. Engineering patents usually fall into the category of utility patents. Utility patents involve materials, machines and components, as well as manufacturing parts and processes. Design patents involve only the appearance of an article. Plant patents, as the name suggests, are given to those that reproduce a new variety of plants.

When a new idea that is worth applying a patent for is conceived, a drawing or sketch should immediately be made and a description written that makes the idea understandable to people working in the same field. The documents should then be signed and dated by the inventor and two other people who understand the idea depicted by the sketch and the written description. If applicable, the drawing and written description should explain what is currently used, what the deficiencies are, and how they can be remedied by incorporating the new invention. The information should be presented in a detailed manner and should include one or more claims made by the inventor for his invention. Patent rights will be lost if a patent application is not filed in the U.S. Patent Office within one year.

After all the preliminary work has been done, a Patent Attorney should be consulted. The Patent Attorney, for a fee, will make a search for "prior art" with the U.S. Patent Office. Prior art includes any patent that has been written (or is pending) that is the same as or similar to the one being applied for. Assuming that the prior art shows that the proposed patent is a new and novel idea, the Patent Attorney will prepare the patent application and submit

it to the U.S. Patent Office who will examine the document and decide if a patent will be allowed. The government fee to apply for a patent is approximately $1100 for large corporations, but less than that for individuals. Patent Attorney fees can be much higher. If a patent is granted, there is a nominal yearly maintenance fee. Currently there are 150,000 patents issued every year and there have been a total of 8 million patents issued by the U.S. Patent Office since its inception.

The following pages of this course document examine a patent granted to a major U.S. car company. The patent was one of several ideas proposed in an attempt to improve the performance of automotive vehicle engine coolant pumps (waterpumps) which had become a burden on vehicle warranty costs to the company.

## Automotive Engine Coolant Pump

Vehicle engine coolant pumps (waterpumps) circulate coolant through cored passages in the engine block where it absorbs heat. The fluid is then sent to the radiator where it is cooled and the cycle repeated. Waterpumps are normally mounted on the front of the engine block where they are driven by a belt from an engine driven pulley. Figure 1 illustrates the general layout of a vehicle coolant pump. Drive pulley 1 is attached to an elongated shaft 2 which has pump rotor 3 mounted on the opposite end. The shaft is supported by double row ball bearing 4 which is mounted in waterpump housing 5 fastened to engine block 6. Fluid is pumped from the radiator through engine block opening 7 to engine block opening 8 where it flows through cooling passages, then returns to the radiator where the cycle is repeated.

The design necessitates the use of an all important cartridge seal assembly 9 that prevents coolant from entering the bearing. The seal is the highest stressed; and therefore, one of the most critically analyzed components of the waterpump. Virtually all waterpump failures occur as a result of the failure of this seal.

The cartridge seal is a rather complex assembly that incorporates, among other things, two contacting circular elements: one stationary, and a second that rotates against the first (cartridge seal assembly shown on Figure 8). The seal is so designed that the contacting surface between the two elements prevents coolant from entering the bearing. For the seal to operate satisfactorily, a small amount of coolant is allowed to enter the sealing zone for lubrication and cooling purposes. Occasionally, because of damage to the sealing surfaces from heat and the entrance of hard

particle contaminants, an excessive amount of coolant vapors and liquid pass through improperly functioning sealing elements to the next barrier which is bearing seal 10. The bearing seal is designed to be mounted as a press fit in the bearing outer ring and has multiple lips that contact the rotating shaft. Excessive amounts of coolant vapor and liquid corrode the shaft, wear away the rubber sealing lips, and enter the bearing. There they act to impregnate the grease rendering it ineffective as a lubricant which, in turn, results in a bearing failure. Replacing waterpumps can be a high warranty cost item for the automobile companies.

## Magnetic Drive Vehicle Coolant Pump Patent

Figure 2 is the first page of a U.S. Patent titled "Magnetic Drive Vehicle Coolant Pump". It was assigned to a U.S. car company with one of its employees listed as the inventor (name omitted). This first page contains the "Abstract" which, in one paragraph, defines the item being patented, its component parts, and the advantages that the design possesses. Below the abstract is a cross section drawing of the patented item with its components numbered for identification purposes.

Figure 3 is the second page of the patent and is a larger scale replication of the drawing shown on Figure 2 that can better serve to explain the operation of the water pump. The main components of the waterpump are pulley 42 which has a cylindrical protrusion that acts as the inner ring of a double row ball bearing 54. The double row ball bearing is mounted in a cylindrical section 28 of pump housing 18. The pump housing is attached to engine block 12 using a number of fasteners 24. The pulley is belt driven by an engine driven pulley (not shown). Embedded in the pulley are a number of magnets 46 whose attractive force acts on magnets 40 embedded in pump impeller 34, which serve to rotate the impeller. The rotating impeller pumps cooled fluid from the radiator through engine block passage 14 outward to engine block passage 16 where it serves to cool the engine. It is then sent back to the radiator and the cycle repeated. Because this invention uses magnets to rotate the impeller, there is no need for a cartridge seal; the design is simple; the design is axially compact.

Figure 4 contains the third page of the patent. As can be seen from all the text that is included on this page (also on pages 17 to

19, Figures 5 to 7), Patent Attorneys (who write the actual document as a patent application) use elaborate phrasing and very descriptive language and are very careful in their selection of words in writing patents. This is done so that there is no question of what the patented item is, what it intends to accomplish, and how the accomplishments will be made. It is information that can be used as evidence in infringement cases.

Figure 4 contains the section titled "Background of the Invention" which explains, in lengthy discourse, the purpose and description of commonly used vehicle coolant pumps and problems associated with the cartridge seals. It then cites four (4) U.S. Patents that are used to argue the case of why the subject patent should be granted:

1) U.S. Patent 3,632,220, "Coolant Pump": The first page of this patent is shown as Figure 8. The abstract describes the function and operation of conventional engine coolant pumps (with drawing) and the features in the invention which serve to cool the cartridge seal and prevent particles (such as casting core sand) from causing damage to it. This patent is cited to illustrate the vulnerability of the cartridge seal in the design of conventional engine coolant pumps which adds creditability to the design of the subject patent that eliminates the cartridge seal altogether. It is also cited to show how conventional coolant pumps, with direct drive from the pulley through the bearing shaft to the pump impeller and possessing a cartridge seal, are inherently more complex and axially longer than the subject patent.

The drawing on Figure 8 shows the complexity of the cartridge seal. Part number 26 is the rotating sealing member and 27 is the

stationary sealing member. Number 28 is a spring which acts on the stationary ring to apply sealing pressure to the sealing elements. Also shown is annular boot 29 which prevents leakage around the stationary side of the seal and spring retainer 28a which serves to mount the cartridge assembly inside the pump housing bore. A simple representation of the bearing seal (not numbered) is shown just to the left of the cartridge seal.

2) U.S. Patent 3,802,804, "Magnetically Coupled Pump Structure": The first page of this patent is shown as Figure 9. It describes a magnetically driven pump mounted on the side of a large tank that contains very hot liquids and corrosive chemicals. The reason for citing this patent is to acknowledge that the magnetically driven feature of the subject patent is not itself new, but the fact that it is of simple design and axially compact (both extremely important advantages when mounting to the front of a vehicle engine block) separates it from this cited patent which has virtually no space limitations.

3) U.S. Patent 4,304,532, "Pump Having Magnetic Drive": The first page of this patent is shown on Figure 10. It is cited for the same reason that the above patent is cited. It has a magnetic drive but there are no space limitations. Also, it is powered by an electric motor, whereas a vehicle coolant pump is powered by an engine driven belt.

4) U.S. Patent 4,115,040, "Permanent Magnet Type Pump": The first page of this patent is shown on Figure 11. It is cited again for the same reason that above patents are cited. It has a magnetic drive but there are no space limitations.

The next section of the subject patent text begins on Figure 4 and is titled "Summary of the Invention". It is an extremely elaborately worded section which explains, in detail, the object of every facet of every part of the invention. Again, it is included in the patent so that there will be no mistake of what the invention is comprised of and what its patentable features are.

The next section of the patent text is contained on Figures 5 to 7 and is titled "Description of the Preferred Embodiment". It explains in great detail the function of every part of the patent using the part numbers that are given on the drawing on the first two pages of the invention (Figures 2 and 3). It ends proclaiming each of the three claims made by this invention which are as follows:

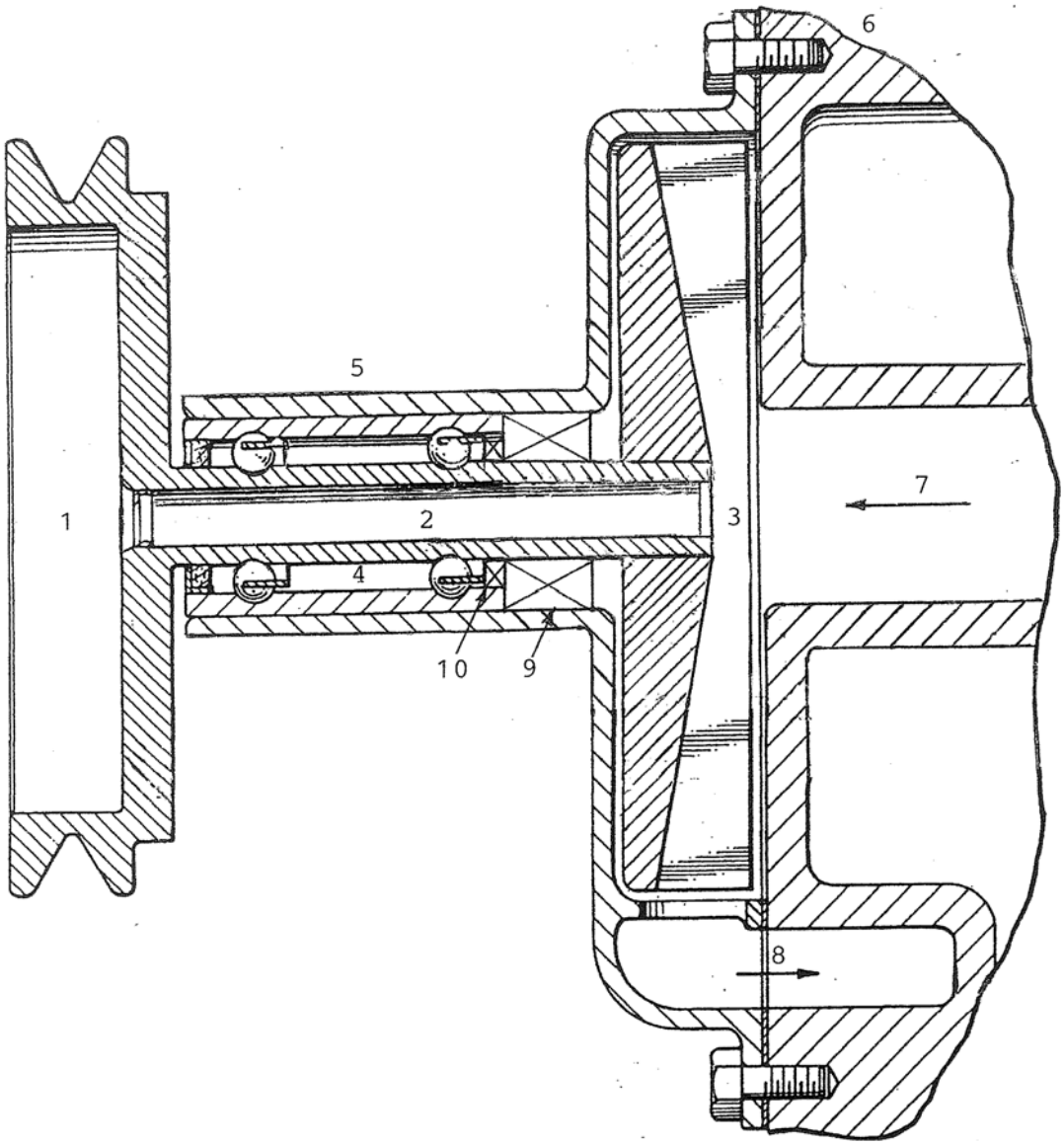
Claim 1) This claim describes the invention as comprising the pump housing and the pump impeller. However, the pulley and the hub are described as separate pieces, although this description is not the way they are shown on the drawing but is a credible option.

Claim 2) This claim is the same as claim 1 except the pulley and the hub are listed as one piece which is the way they are shown on the drawing.

Claim 3) This claim is the same as claim 2 except the double row "rolling" bearing is mentioned for the first time which is the way the invention is shown on the drawing. The pump could conceivably be made without a rolling bearing where arguments could be made that such a design variation is intended by claims 1 and 2 where no mention is made of the rolling bearing. Notice

that the word "rolling" was used to describe the bearing which is shown as a ball bearing on the drawing, but because it was referred to as a "rolling" bearing, this indicates that the use of a roller bearing is also part of the invention.

Figure 1



# Figure 2

**United States Patent** [19]

[11] **Patent Number: 4,645,432**

[45] **Date of Patent: Feb. 24, 1987**

[54] **MAGNETIC DRIVE VEHICLE COOLANT PUMP**

[75] Inventor:

[73] Assignee:

[21] Appl. No.: **829,305**

[22] Filed: **Feb. 14, 1986**

[51] **Int. Cl.**[4] ..... **F04B 17/00**; F04B 35/04

[52] **U.S. Cl.** ..... **417/420**; 415/10

[58] **Field of Search** ..... 417/420, 423 R, 362; 415/10, 122 R; 416/3; 310/104

[56] **References Cited**

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*Primary Examiner*—Carlton R. Croyle
*Assistant Examiner*—Timothy S. Thorpe
*Attorney, Agent, or Firm*—Patrick M. Griffin

[57] **ABSTRACT**

A magnetic drive pump for use as a vehicle coolant pump. A fluid housing fixed to the engine block as an impeller mounted on the outside of a cylindrical support integrally stamped into a front wall of the housing. A pulley has a central hub that is rotatably mounted within the cylindrical support, coaxial with the impeller bearing. A web of the pulley and the impeller both face the housing front wall in closely spaced, parallel relation, with opposed matching magnetic drive elements. The structure is particularly simple and compact, and needs no cartridge or bearing seal.

**3 Claims, 1 Drawing Figure**

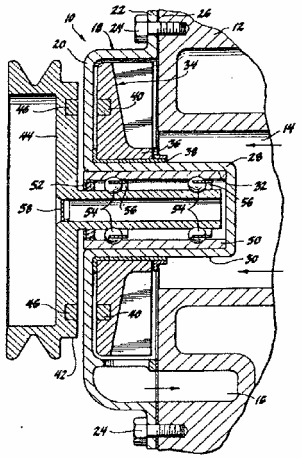
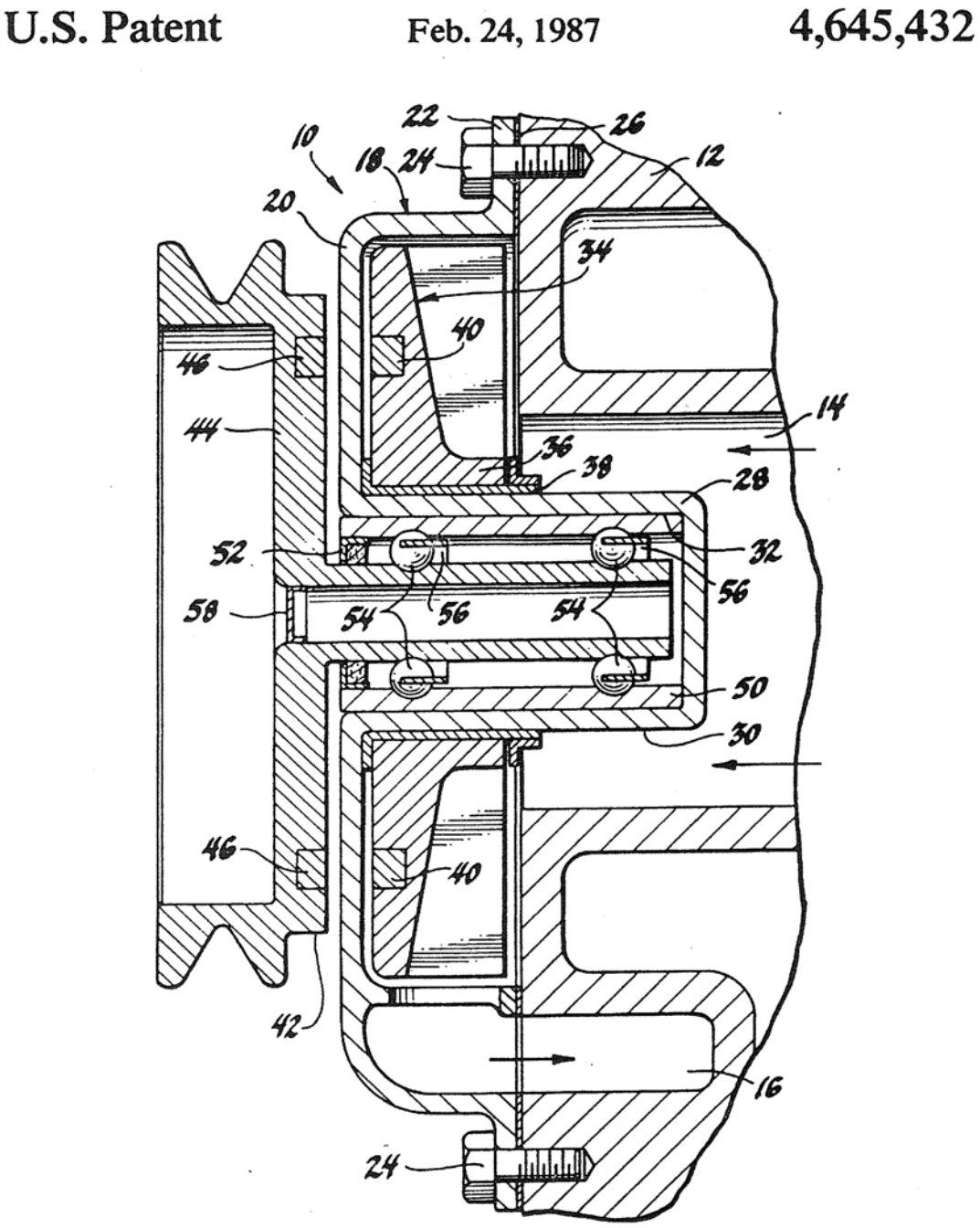


Figure 3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# Figure 4





## MAGNETIC DRIVE VEHICLE COOLANT PUMP

This invention concerns vehicle coolant pumps in general, and specifically a coolant pump that uses a magnetic drive so as to provide a particularly simple and axially compact design.

### BACKGROUND OF THE INVENTION

Vehicle coolant pumps, often referred to as water pumps, are used to circulate coolant through the cooling passages of an engine block. They are generally operated by a driving member in the form of a pulley, which is in turn powered by a drive belt that runs off of the engine. It is necessary, of course, that the impeller of the pump be in communication with the coolant, in order to circulate it. The impeller is usually internal to a housing which is attached to the engine block and which encloses a space that communicates with the engine block cooling passages. A shaft or other member must be physically connected from the pulley to the impeller, which necessitates an opening physically through the housing. That opening must be sealed against the egress of coolant. The seal is highly stressed by the rapid rubbing rotation of the shaft that it surrounds, and by the heat of the coolant, coolant which may well contain abrasive particles, and will inevitably wear. The U.S. Pat. No. 3,632,220 to Lansinger et al illustrates well the problems with this conventional type of coolant pump. A generally cylindrical housing, 9a, which stands out from the engine block 9, has a shaft 11 supported by a bearing 12 passing through it. The shaft 11 is sealed with a complex seal assembly, generally referred to as a cartridge seal, made up of two seal members 26 and 27 spring loaded against one another. Although it is not mentioned, one skilled in the art will recognize a weep hole through the housing 9a opening to the ambient to vent the coolant that will invariably leak past the cartridge seal. In addition, a strong, and therefore highly frictional, bearing seal must be provided at the inner end of the bearing 12 to exclude leaking coolant from entering the bearing. Leaking coolant is the major cause of water pump bearing failure. It will also be noted that the pump disclosed is not particularly axially compact, as measured along the axis of the shaft 11. The housing 9a extends out from, not into, the engine block, and the bearing is spaced axially far away from the pump impeller 21. The complexity of the cartridge seal, as well as the necessity of venting the leaking coolant, all militate against making the pump more axially compact by moving the cartridge seal and bearing back inside the block, where they would not be so accessible or easily vented.

It is known, in general, to operate a pump impeller located on one side of a closure with a driver located on the other side of the closure by the use of opposed magnetic elements on the pump impeller and driver. This avoids passing a shaft physically through the closure, and thus no seal is necessary around the shaft. Numerous patents exist in the field of magnetic drive pumps, all of which incorporate the basic feature just described, with the consequent advantage of avoiding a seal. They are directed to various narrow and specific structures, none of which one skilled in the art could apply, without the application of inventive effort, to use as a vehicle coolant pump. Most involve very different environments and problems, such as pumps to be used



with a large tank of corrosive chemicals, where space is not a critical factor.

For example, the U.S. Pat. No. 4,314,332 to McCry shows such a pump with an impeller 38 operated by a driver 20 which that is in turn powered by a shaft 18 from a motor 12. There are no particular space limitations in such an environment, and the motor 12 can be axially far removed from the impeller 38 with no problem. Such is not the case in the cramped environment where a vehicle coolant pump is to be used. More importantly, a vehicle coolant pump cannot be powered directly by a separate power source like a motor, but must be run indirectly from the vehicle engine with a belt and pulley. That pulley must be rotatably supported and axially and radially located relative to the pump impeller. The motor 12 in McCry is large and stable, and has its own internal bearings, so it is a simple matter to rotatably support the shaft 18 and driver 20 relative to the impeller 38. Similarly usable structure is just not available in the environment of a vehicle coolant pump. Other patents illustrate the same point. The U.S. Pat. No. 3,802,804 to Zimmermann shows another magnetic tank pump, again with a large motor 40 to support and locate a driver 38 relative to an impeller 35, all occupying a relatively large space in an environment where space is not a limitation. Other patents in the same field, such as the U.S. Pat. No. 4,115,040 to Knorr, do not disclose anything about bearings to support the driver and impeller, taking it as a given that there would be more than sufficient space and structure in the particular environment to provide them.

### SUMMARY OF THE INVENTION

The subject invention provides a magnetic drive pump that is suitable for use as a vehicle coolant pump, thus eliminating the cartridge seal, and further provides such a pump that is particularly simple and axially compact.

The preferred embodiment of the coolant pump of the invention includes a fluid housing fixed to the engine block of a vehicle. The housing has a substantially planar front wall of non-magnetic material that encloses a space that is in communication with the cooling passages of the block. The front wall has an integral cylindrical support formed therein with its axis oriented substantially perpendicular to the front wall and extending into the interior of the fluid housing. The outer cylindrical surface of the cylindrical support, which is inside of the fluid housing and faces the coolant, is closed, and need not be sealed. The inner cylindrical surface opens out to the exterior of the fluid housing. A pump impeller inside the fluid housing has a central hub that coaxially surrounds the cylindrical support, and which is radially and axially supported on the outer surface thereof by by a flanged plain bearing. The impeller also has a magnetic portion that is thereby located closely facing and parallel to the inside of the front wall of the fluid housing.

A rotatable member, which, in the preferred embodiment is provided by a central hub that extends from the web of a driving pulley, is sized so as to fit coaxially within the cylindrical support of the fluid housing. The web of the pulley is substantially planar and generally perpendicular to its central hub, and includes a magnetic portion generally matching that of the impeller. In the preferred embodiment, the pulley hub actually fits within a cylindrical liner, which is in turn adapted to be press fitted within the inner surface of the fluid housing

# Figure 5



cylindrical support. Rolling bearing elements are disposed in the annular space between the pulley hub and the cylindrical liner to radially and axially support the pulley hub within the liner. Therefore, when the cylindrical liner with the rotatably supported pulley is press fitted within the cylindrical support, the planar web of the pulley is thereby located closely facing and parallel to the outside of the front wall of the fluid housing. The magnetic portions of the pulley web and impeller are thereby located in opposition to each other across the front wall. The pulley is thus able to magnetically drive the impeller when the pulley is rotated by the vehicle engine through a drive belt. A very simple structure is thus provided with no necessity of a cartridge seal, or for a seal to exclude leaking coolant from the bearing elements, or for weep holes to the ambient to vent leaking coolant. Furthermore, the particular spatial arrangement, with the pulley and impeller bearings located one within the other, and with the pulley web and impeller in closely facing opposition across the fluid housing front wall, gives a particularly axially compact unit. Several advantages, therefore, are cooperatively provided by the same structure.

It is, therefore, a broad object of the invention to provide a vehicle coolant pump that is magnetically driven, thus eliminating the cartridge seal, and to do so with a structure that is well suited to that specific environment, being particularly simple and axially compact.

It is another object of the invention to provide such a vehicle coolant pump structure in which a fixed fluid housing has a substantially planar wall of non-magnetic material with a cylindrical support extending from the fluid housing wall into the interior of the fluid housing and axially oriented substantially perpendicular to the housing wall, with a closed outer cylindrical surface inside of the fluid housing and an inner cylindrical surface opening to the exterior of the fluid housing, and in which a pump impeller inside the fluid housing coaxially surrounds and is radially and axially supported by the outer cylindrical surface of the cylindrical support, with the impeller having a magnetic portion that is thereby located closely facing and parallel to the inside of the fluid housing wall, and in which a rotatable member sized so as to fit coaxially within the cylindrical support and radially and axially supported by the cylindrical support inner surface has a driving member attached thereto, a driving member that has a substantially planar web located closely facing and parallel to the outside of the fluid housing wall with a magnetic portion of the web in opposition to the impeller magnetic portion so as to drive the impeller when the driving member rotates, the driving member, housing wall and pump impeller occupying a compact axial space by virtue of their relative location.

It is yet another object of the invention to provide such a vehicle coolant pump structure in which a rotatable driving member has a central cylindrical hub sized so as to fit coaxially within the fluid housing cylindrical support and radially and axially supported by the cylindrical support inner surface, so that a web of the driving member is thereby located closely facing and parallel to the outside of the fluid housing wall with its magnetic portion in opposition to the impeller magnetic portion so as to drive the impeller when the driving member rotates.

It is still another object of the invention to provide such a vehicle coolant pump structure in which the hub of the driving member fits within, and is radially and axially supported by bearing elements within, a cylindrical liner which is in turn adapted to be press fitted within the inner surface of the cylindrical support, whereby the cylindrical liner, with the rotatably supported driving member, may be press fitted within the fluid housing cylindrical support, thereby locating the planar web closely facing and parallel to the outside of the fluid housing wall with the magnetic portions of the impeller and pulley web in opposition.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

These and other objects and features of the invention will appear from the following written description and the drawing, which shows a cross section of the preferred embodiment in place on a portion of a vehicle engine block.

Referring to the drawing, the preferred embodiment of the subject invention, designated generally at **10**, provides a magnetic drive pump that is suitable for use as a vehicle coolant pump, thus eliminating the main seal, and further provides such a pump that is particularly simple and axially compact. The coolant pump of the invention **10**, is shown attached to a portion of a vehicle engine block, designated generally at **12**. Engine block **12**, as is typical, is cast with cooling passages, an inlet passage designated at **14** and an outlet passage designated at **16**. Coolant flows through the passages **14** and **16**, pumped by the coolant pump **10**, as indicated by the arrows. The coolant pump **10** includes a fluid housing, designated generally at **18**. Fluid housing **18** is stamped of aluminum or other suitable non-magnetic material, and includes a generally planar front wall **20** and a peripheral flange **22**. When it is fixed with bolts **24** and a gasket **26** to block **12**, fluid housing **18** encloses a space that is in communication with the cooling passages **14** and **16**. That fixing does not occur until after other assembly steps described below have been completed, however. A cylindrical support, designated generally at **28**, is integrally stamped into front wall **20** and extends inwardly therefrom with its axis generally perpendicular thereto. The outer cylindrical surface **30** of the cylindrical support **28**, which is inside of the fluid housing **18** and faces the coolant, is closed, and need not be sealed. The inner cylindrical surface **32** opens out to the exterior of the fluid housing **18**. A pump impeller, designated generally at **34**, is located inside the fluid housing. Impeller **34** has a central hub **36** that coaxially surrounds the cylindrical support **28**, and which is radially and axially supported on the outer cylindrical surface **30** thereof by a flanged plain bearing **38**. The impeller **34** has a magnetic portion **40** that is thereby located closely facing and parallel to the inside of the front wall **20** of the fluid housing **18**. Impeller **34** would not be added until after a prior step described below, however.

A driving member is provided by a pulley, designated generally at **42**, which would be powered by a belt driven by the vehicle engine, not shown. Pulley **42** could be formed of 1070 steel or other suitable material, and includes a generally planar web **44** into which is set a magnetic portion **46** that generally matches the magnetic portion **40** of impeller **34**. A rotatable member is provided by a central hub **48** that extends from the web **44**, generally perpendicular thereto. Hub **48** is sized so as to fit coaxially within the fluid housing cylindrical support **28**. In the preferred embodiment, the pulley hub **48** actually fits within a separate cylindrical liner **50** of bearing quality steel, which is in turn sized so that it can

# Figure 6



be press fitted within the inner cylindrical surface **32** of the cylindrical support **28**, with an annular space therebetween.

The manufacturing and assembly process of the coolant pump **10** is as follows. Ball pathways are formed in the outer and inner surfaces respectively of hub **48** and liner **50**, and induction hardened by conventional means. A dust seal **52** is pressed into one end of liner **50**. Then, two rows of bearing balls **54** are placed in through the unobstructed right end of the annular space between liner **50** and hub **48**. The balls **54** are conrad assembled between the pathways, and standard snap-in separators **56** added. This serves to radially and axially support the pulley hub **48** within the liner **50**, and creates a separately handled subunit made up of the liner **50** and the pulley **42** rotatably supported thereto. Then, by heat expanding the cylindrical support **28**, liner **50** may be press fitted easily thereinto. When the cylindrical liner **50** has been so assembled, the pulley web **44** is thereby located closely facing and parallel to the outside of the front wall **20** of the fluid housing **18**. The plain bearing **38** and impeller **34** may then be added, and the impeller magnetic portion **40** will thereby be located in opposition to the pulley magnetic portion **46**, facing it across the non-magnetic front wall **20**. Finally, the fluid housing **18** is bolted in place as described above. A dust plug **58** may be added to the center hole of hub **48**, if desired.

Once the above assembly steps are completed, it will be understood that pulley **42** will able to magnetically drive the impeller **34** when it is rotatably driven by the vehicle engine. The driven impeller **34** will circulate the coolant in the pattern shown by the arrows. The use of this indirect, magnetic drive makes several things possible. It allows for a very simple structure, compared to conventional, directly driven vehicle coolant pumps. No cartridge seal or tight bearing seal is necessary, giving a very low friction and low torque structure with almost no parts susceptible to wear or failure. Nor are weep holes opening to the ambient out of the housing necessary. Eliminating these conventional items allows the pulley bearings **54** to be moved axially inboard, inside of and occupying essentially the same axial space as the impeller bearing **38**. This gives a highly axially compact unit, which is very advantageous in the cramped environment of increasingly smaller cars. Alternatively, the particular compact spatial arrangement may be thought of as serving to bring the pulley web **44** and impeller **34** into sufficiently closely facing relation to allow the matching magnetic portions **46** and **40** to operate. However the invention is conceptualized, it is apparent that a number of advantages cooperatively flow from a very simple and tightly interacting structure.

Variations of the preferred embodiment disclosed may be made within the sprit of the invention. For example, a separate shaft could replace the hub **48**, with a pulley attached separately to it, although that would mean more total parts. While the integral ball pathways on the hub **48** are practical, a separable raceway could be used instead, if desired. Or, it is possible that an integral ball pathway could be formed on the inner surface of support **28**, as well as on the hub **48**, especially if the pulley **42** were made separable from its hub **48**. This would allow conrad assembly of the balls directly into the cylindrical support **28** from the left end of the annular space. This would eliminate the liner **50**, but the liner **50** is desirable since support **28** is unlikely to be formed of bearing quality material. It is also advantageous to have the easily handled subunit comprised of pulley **42** and liner **50**, as described. Bearing elements other than balls **54** could be used, as well, although balls are particularly easy to assemble in the environment disclosed. Therefore, it will be understood that it is not intended to limit the scope of the invention to just the preferred embodiment disclosed.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

**1**. An axially compact magnetic drive pump for use as a vehicle coolant pump, comprising,

a fixed fluid housing having a substantially planar wall of non-magnetic material with a cylindrical support extending from said fluid housing wall into the interior of said fluid housing, said cylindrical support having its axis oriented substantially perpendicular to said housing wall and having a closed outer cylindrical surface inside of said fluid housing and an inner cylindrical surface opening to the exterior of said fluid housing,

a pump impeller inside said fluid housing coaxially surrounding and radially and axially supported by the outer cylindrical surface of said cylindrical support, said impeller having a magnetic portion that is thereby located closely facing and parallel to the inside of said fluid housing wall,

a rotatable member sized so as to fit coaxially within said fluid housing cylindrical support and radially and axially supported by said cylindrical support inner surface, and,

a driving member having a substantially planar web with a magnetic portion, said driving member being attached to said rotatable member so that said planar web is located closely facing and parallel to the outside of said fluid housing wall with its magnetic portion in opposition to said impeller magnetic portion so as to drive said impeller when said driving member rotates, said driving member, housing wall and pump impeller occupying a compact axial space by virtue of their relative location.

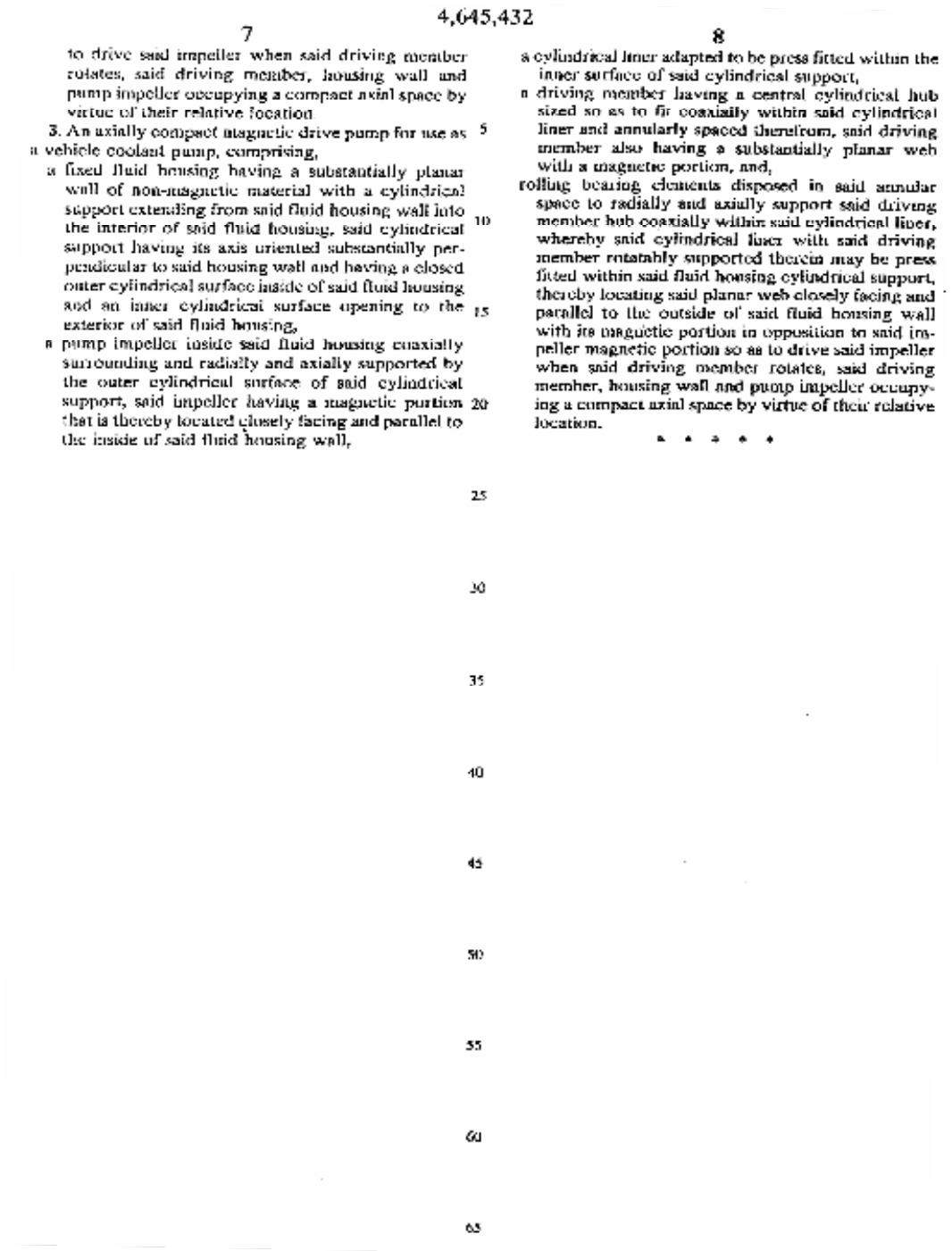
**2**. An axially compact magnetic drive pump for use as a vehicle coolant pump, comprising,

a fixed fluid housing having a substantially planar wall of non-magnetic material with a cylindrical support extending from said fluid housing wall into the interior of said fluid housing, said cylindrical support having its axis oriented substantially perpendicular to said housing wall and having a closed outer cylindrical surface inside of said fluid housing and an inner cylindrical surface opening to the exterior of said fluid housing,

a pump impeller inside said fluid housing coaxially surrounding and radially and axially supported by the outer cylindrical surface of said cylindrical support, said impeller having a magnetic portion that is thereby located closely facing and parallel to the inside of said fluid housing wall, and,

a rotatable driving member having a central cylindrical hub sized so as to fit coaxially within said fluid housing cylindrical support and radially and axially supported by said cylindrical support inner surface, said driving member also having a substantially planar web with a magnetic portion that is thereby located closely facing and parallel to the outside of said fluid housing wall with its magnetic portion in opposition to said impeller magnetic portion so as

# Figure 7



4,645,432

7

to drive said impeller when said driving member rotates, said driving member, housing wall and pump impeller occupying a compact axial space by virtue of their relative location

3. An axially compact magnetic drive pump for use as a vehicle coolant pump, comprising,

a fixed fluid housing having a substantially planar wall of non-magnetic material with a cylindrical support extending from said fluid housing wall into the interior of said fluid housing, said cylindrical support having its axis oriented substantially perpendicular to said housing wall and having a closed outer cylindrical surface inside of said fluid housing and an inner cylindrical surface opening to the exterior of said fluid housing,

a pump impeller inside said fluid housing coaxially surrounding and radially and axially supported by the outer cylindrical surface of said cylindrical support, said impeller having a magnetic portion that is thereby located closely facing and parallel to the inside of said fluid housing wall,

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a cylindrical liner adapted to be press fitted within the inner surface of said cylindrical support,

a driving member having a central cylindrical hub sized so as to fit coaxially within said cylindrical liner and annularly spaced therefrom, said driving member also having a substantially planar web with a magnetic portion, and,

rolling bearing elements disposed in said annular space to radially and axially support said driving member hub coaxially within said cylindrical liner, whereby said cylindrical liner with said driving member rotatably supported therein may be press fitted within said fluid housing cylindrical support, thereby locating said planar web closely facing and parallel to the outside of said fluid housing wall with its magnetic portion in opposition to said impeller magnetic portion so as to drive said impeller when said driving member rotates, said driving member, housing wall and pump impeller occupying a compact axial space by virtue of their relative location.

* * * * *

Figure 8

# United States Patent

[11] **3,632,220**


[72] Inventors **Jere R. Lunsinger**
Westland;
**James E. MacAfee, Troy, both of Mich.**



[21] Appl. No. **67,436**
[22] Filed **Aug. 27, 1970**
[45] Patented **Jan. 4, 1972**
[73] Assignee **Chrysler Corporation**
**Highland Park, Mich.**


[54] **COOLANT PUMP**
**9 Claims, 4 Drawing Figs.**


[52] U.S. Cl. ..... 415/112, 415/170
[51] Int. Cl. ..... F01d 11/00
[50] Field of Search ..... 415/110, 111, 112, 170



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| 2,769,390 | 11/1956 | Heimbuch | 415/111 |



*Primary Examiner*—C. J. Husar
*Attorney*—Talburtt and Baldwin



**ABSTRACT:** A rotary coolant pump for an internal-combustion engine has a coaxial annular centrifuge cavity and a scoop operable upon rotation of the pump to collect fluid coolant into the cavity under pressure through an inlet port located between radially outer and inner discharge ports of the cavity. The inner discharge port communicates with an annular seal for the pump journal and is isolated from high-velocity coolant flow within the cavity by a region therein of enlarged cross-sectional area which reduces the coolant velocity at a location spacing the inner discharge port from the inlet and outer discharge ports. Coolant and high-density particles such as core sand are thus discharged radially outwardly from the cavity by centrifugal force through the outer discharge port, whereas clean pressurized coolant flows through the inner discharge port to cool the seal.


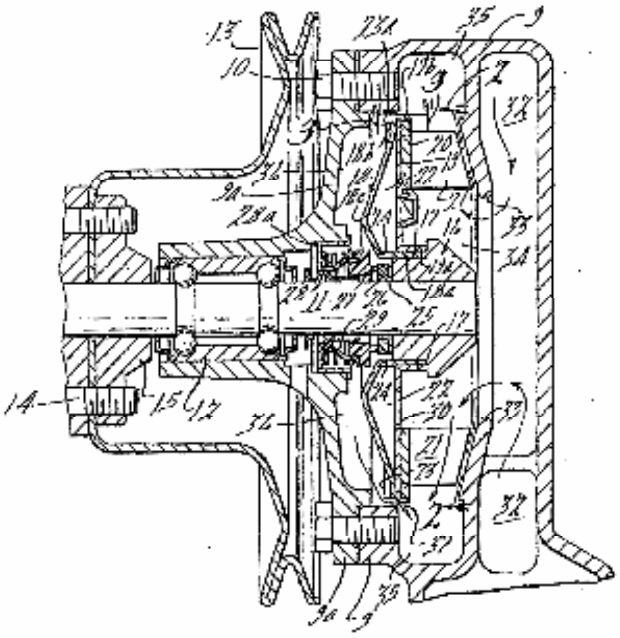

Figure 9

**United States Patent** [19]
**Zimmermann**

[11] **3,802,804**
[45] **Apr. 9, 1974**

[54] **MAGNETICALLY COUPLED PUMP STRUCTURE**

[75] Inventor: **Frederick N. Zimmermann,** Deerfield, Ill.

[73] Assignee: **March Manufacturing Company,** Skokie, Ill.

[22] Filed: **July 21, 1967**

[21] Appl. No.: **655,109**

[52] **U.S. Cl.** ..... **417/360,** 417/420
[51] **Int. Cl.** ..... **F04b 35/04**
[58] **Field of Search**..... 103/87, 87 M; 230/15 MC; 310/104; 64/28 M; 192/84 PM; 417/420, 360

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| 3,299,819 | 1/1967 | McCoy | 103/87 M |

*Primary Examiner*—William L. Freeh
*Attorney, Agent, or Firm*—Callard Livingston

[57] **ABSTRACT**

Centrifugal pump apparatus of the magnetically-coupled type suitable for tank mounting and also including improvements in impeller and spindle structures of general application and for use with very hot liquids and corrosive chemicals. A cup-shaped motor mounting bell is provided for insertion, open side out, into a hole in the side of a tank and has a flange attaching to the tank wall. The motor is supported on mounting formations inside of the large well afforded by the bell. A smaller cup-shaped magnet well is formed by recessing inwardly on the bottom of the cup-shaped bell, which is also provided with sealing land closing and sealing with the open side of the pump housing. The driven coupling magnet of the pump fits into the small magnet well which is surrounded by the larger motor-driven magnet in the larger well. The pump impeller and magnet rotate on spindle means supported at both ends and which may be integrally conformed at one end with a part of the pump structure.

**3 Claims, 9 Drawing Figures**

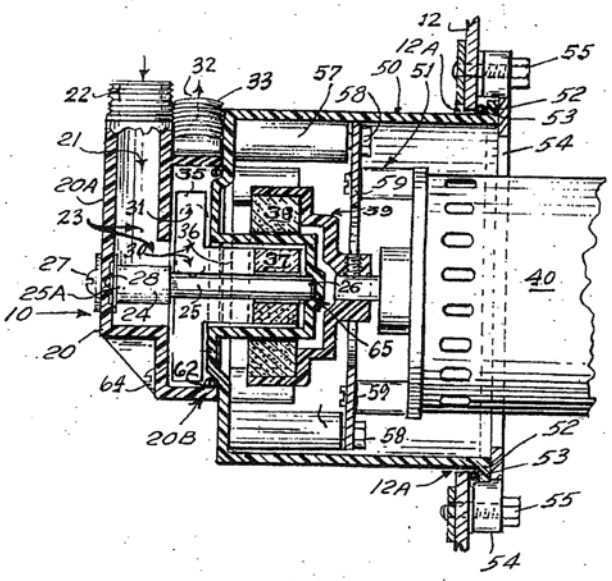

Figure 10

**United States Patent** [19]
**McCoy**

[11] **4,304,532**
[45] **Dec. 8, 1981**

[54] **PUMP HAVING MAGNETIC DRIVE**

[76] Inventor: **Lee A. McCoy**, 2605 Garfield St., San Mateo, Calif. 94403

[21] Appl. No.: **104,545**

[22] Filed: **Dec. 17, 1979**

[51] **Int. Cl.**³ ..... **F04D 13/02**
[52] **U.S. Cl.** ..... **417/420;** 310/104
[58] **Field of Search** ..... 417/420; 64/28 M; 192/84 PM; 310/104

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| 3,299,819 | 1/1967 | McCoy | 417/420 |
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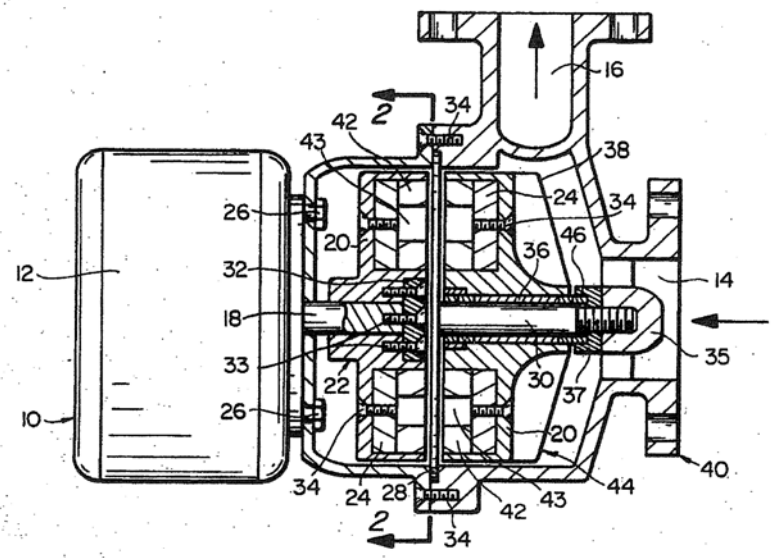
*Primary Examiner*—Richard E. Gluck
*Attorney, Agent, or Firm*—T. R. Zegree

[57] **ABSTRACT**

A fluid-handling apparatus having a magnetic drive comprises a rotatable driver member and a driven member provided with blades for imparting motion to a fluid and mounted on a stationary shaft forming a one-piece unit with a thin diaphragm positioned between said two members which comprise a plurality of permanent magnets. Each magnet has a central aperture dimensioned so that the attracting force is substantially equal throughout the body of the magnet.

**9 Claims, 5 Drawing Figures**



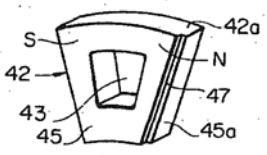



Figure 11

**United States Patent** [19]

**Knorr**

[11] **4,115,040**

[45] **Sep. 19, 1978**

[54] **PERMANENT MAGNET TYPE PUMP**

[75] Inventor: **Manfred Knorr,** Bochum-Wattenscheid, Germany

[73] Assignee: **Franz Klaus-Union,** Germany

[21] Appl. No.: **800,219**

[22] Filed: **May 25, 1977**

[30] **Foreign Application Priority Data**

May 28, 1976 [DE] Fed. Rep. of Germany ..... 2624058

[51] **Int. Cl.**[2] ..... **F04B 17/00**

[52] **U.S. Cl.** ..... **417/420;** 64/28 M; 192/84 PM; 310/104

[58] **Field of Search** ..... 417/420; 64/28 M; 192/84 PM; 310/103, 104, 105

[56] **References Cited**

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*Primary Examiner*—C. J. Husar
*Attorney, Agent, or Firm*—Woodard, Weikart, Emhardt & Naughton

[57] **ABSTRACT**

Disclosed is a permanent magnet pump in which the pump impeller and the interior rotor of a permanent magnet driving means receives drive torque transmitted in synchronism by an exterior rotor. The exterior rotor is positioned, axially in one form and radially in another form, opposite the interior rotor with an air gap defined between them. Thin, plate-like permanent magnets carried by the rotors face each other across the air gap. The pump impeller shaft and the interior rotor are housed and supported in a common space which is sealed from the exterior by a partition of non-magnetizable material extending through the air gap.

**8 Claims, 4 Drawing Figures**