Aug. 28, 1956 H. H. McADAM 2,761,078

ELECTRICAL MOTOR PUMP OR COMPRESSOR

Filed March 29, 1952 3 Sheets-Sheet 1

Fig. 2.

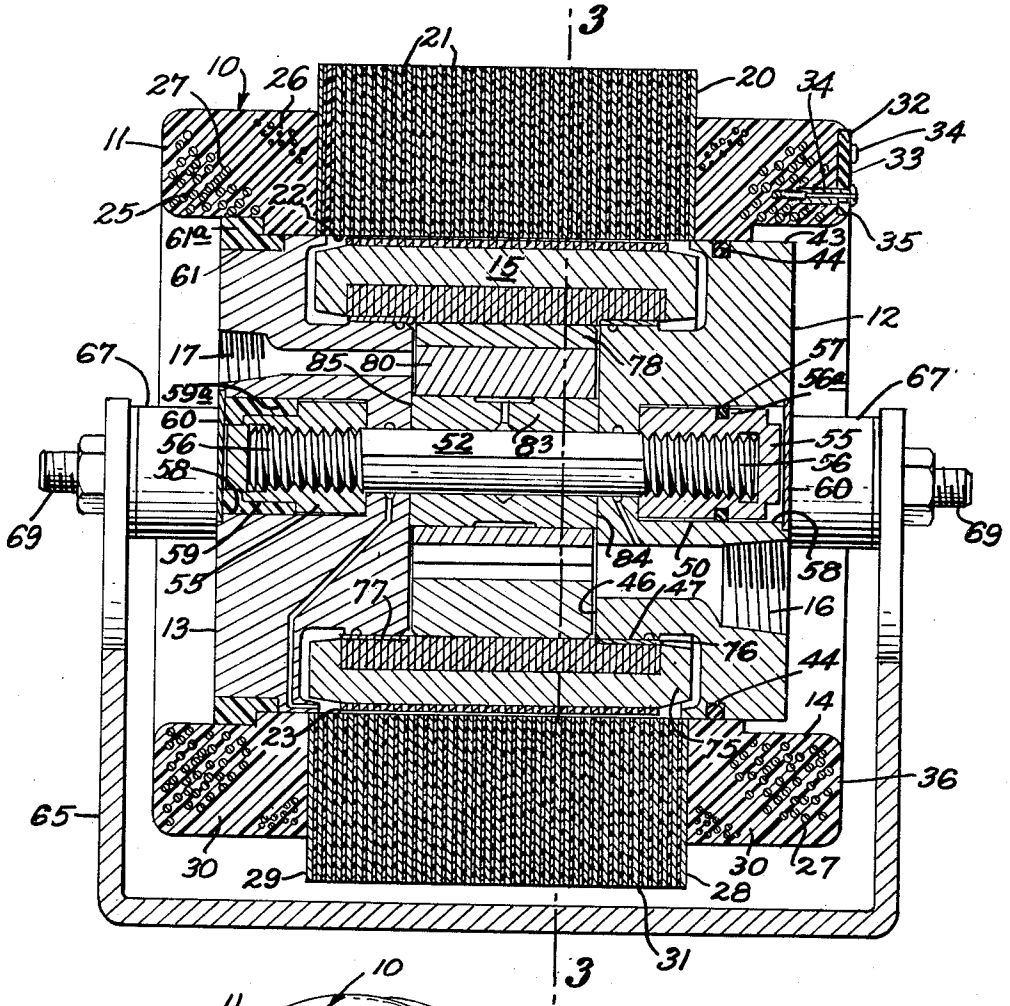
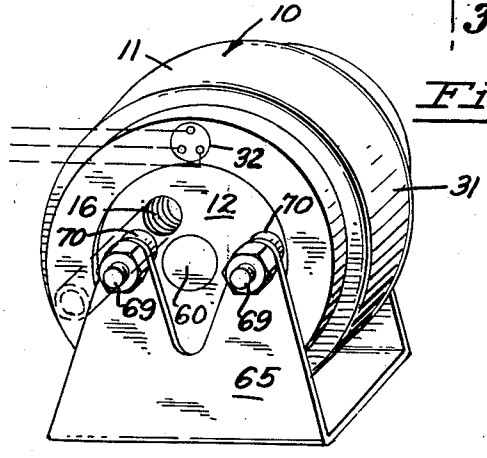


Fig. 1.



INVENTOR.
HARRY H. McADAM
BY A. Durham Ave.
ATTORNEY

Aug. 28, 1956 H. H. McADAM 2,761,078

ELECTRICAL MOTOR PUMP OR COMPRESSOR

Filed March 29, 1952 3 Sheets-Sheet 2

Fig. 3.

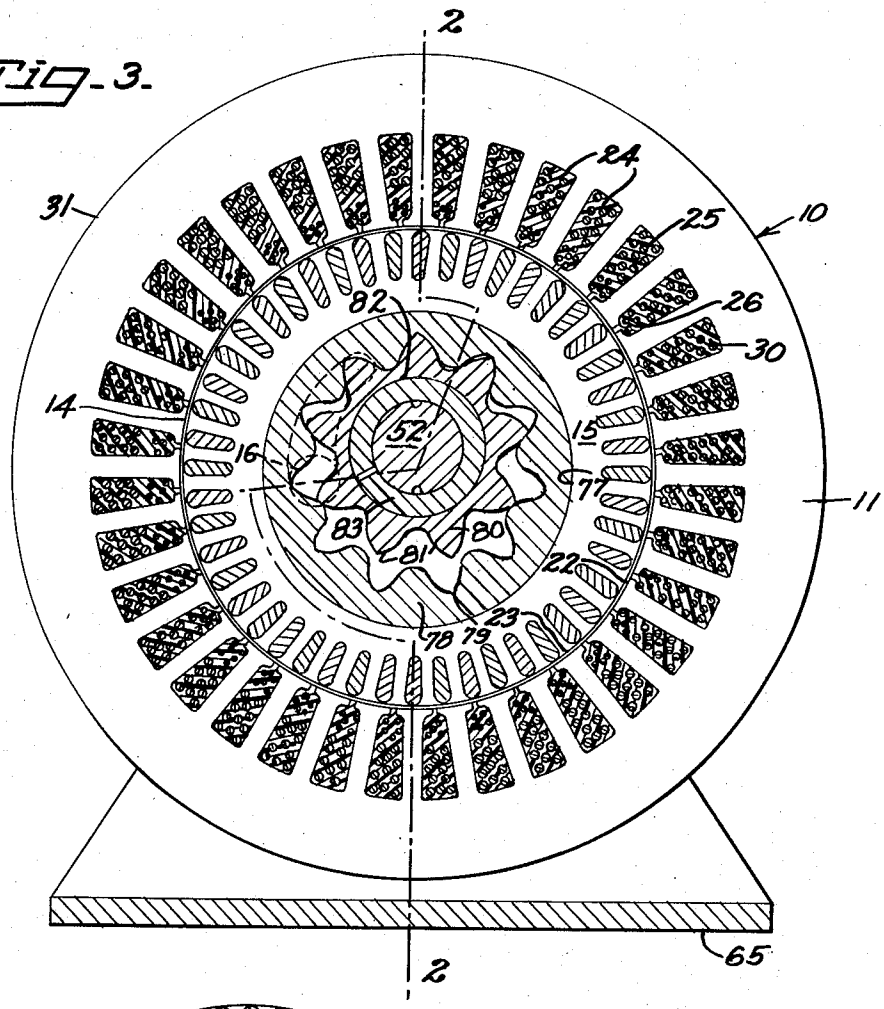
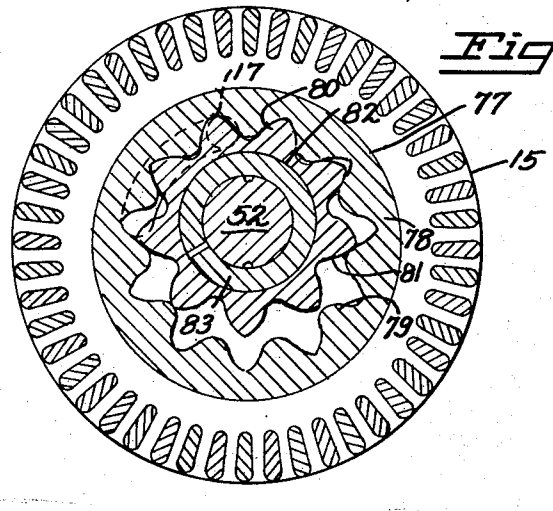


Fig. 4.



INVENTOR.
HARRY H. McADAM
BY A. Durham Owen
ATTORNEY

Aug. 28, 1956 H. H. McADAM 2,761,078

ELECTRICAL MOTOR PUMP OR COMPRESSOR

Filed March 29, 1952 3 Sheets-Sheet 3

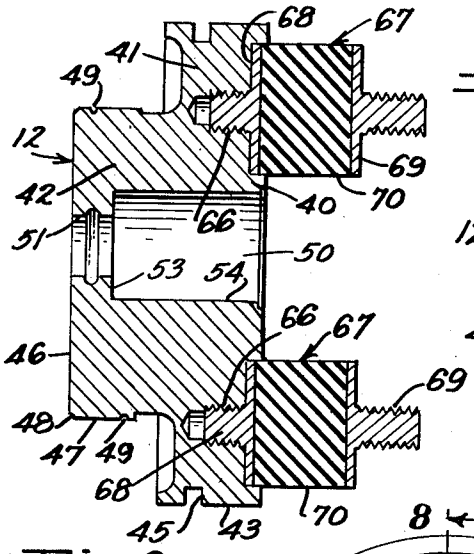


Fig. 6.

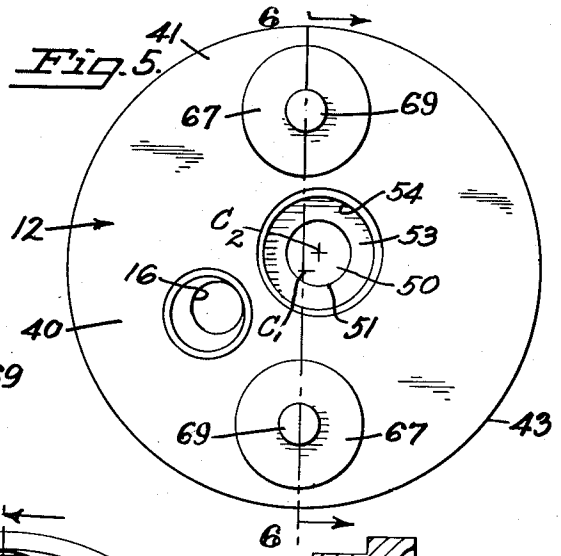


Fig. 5.

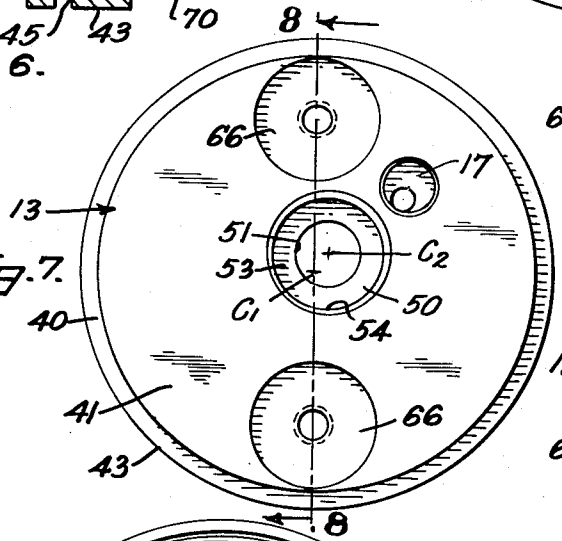


Fig. 7.

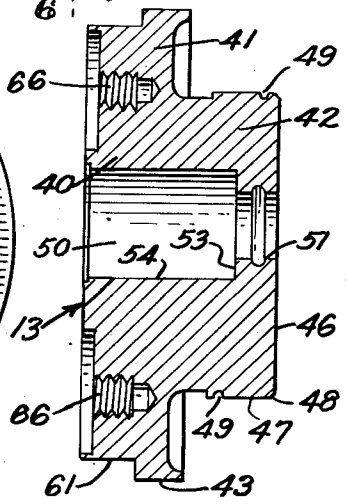


Fig. 8.

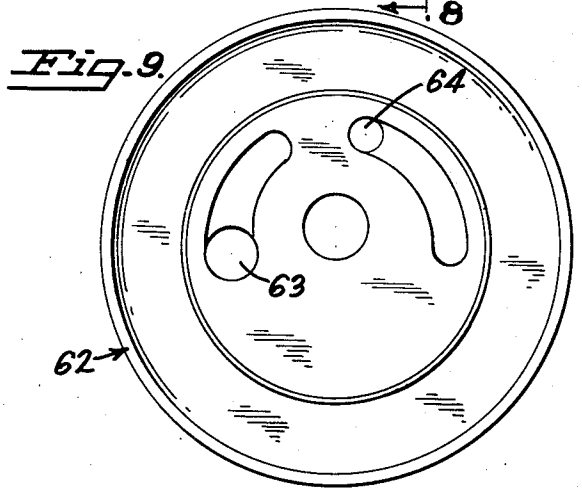


Fig. 9.

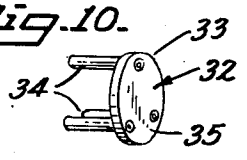


Fig. 10.

INVENTOR.
HARRY H. Mc ADAM
BY A. Durham Owen
ATTORNEY

United States Patent Office 2,761,078 Patented Aug. 28, 1956

2,761,078

ELECTRICAL MOTOR PUMP OR COMPRESSOR

Harry H. McAdam, San Carlos, Calif., assignor to Wetmore Hodges, doing business as Wetmore Hodges and Associates, Redwood City, California

Application March 29, 1952, Serial No. 279,392

17 Claims. (Cl. 310—67)

This invention relates to an improved motor-pump or compressor. More particularly it relates to a motor-pump in which the stator and a pair of end plates constitute the pressure vessel within which are all the other components of the motor-pump.

This invention solves many problems which have long confronted the pump and compressor industry, particularly in relation to such applications as compressors for domestic refrigerators, freezers, and air conditioners, water coolers, and other refrigerated devices.

Three interrelated problems have been particularly troublesome and the present invention solves them: (1) how to make small enough, light enough, and inexpensive enough motor-compressors having the requisite capacity, (2) how to improve the dissipation of the heat which the motor and compressor builds up, and (3) how to provide a pressure-tight motor-compressor, without having to encase the whole within an all-enclosing, pressure-retaining shell. A brief discussion of these three important problems will aid in understanding the present invention and its importance.

Small powerful motor-compressors have long been sought after, because space is always at a premium. Every cubic inch of space taken up by the power unit subtracts from the cabinet space that can be made available to the consumer. Moreover, large, heavy compressors have been expensive to build, ship, and store.

Their large size was one objection to the old style of compressors, which used belts and in which the motor and the compressor were separately housed. Another objection to this two-unit style of compressor was that it required shaft seals for retaining the charge of refrigerant. These shaft seals were subject to leaks, squeaks and chattering noises, which could not be tolerated. Also, these seals wore out rather rapidly and had to be replaced often.

Confronted by this problem, the industry eliminated the shaft seals by enclosing both the motor and the compressor in a single pressure-tight housing, which was usually an outer shell surrounding the whole motor-pump unit.

This brings us to the problem of heat-dissipation. An outer shell around a motor retards the passage of the heat off into the air. The more the motor is exposed to the air, where a cooling current can be passed directly over the hot parts, the cooler the motor can be kept. Enclosure of the motor-compressor in an outer shell interferes with and seriously retards the heat flow, thereby tending to keep the heat in, resulting in undesirably high operating temperatures.

The motor heat dissipation problem was made worse by the fact that the copper wire windings of the stator did not make good thermal contact with the slots through which they pass. Dissipation of the heat which built up through electrical resistance heating of the copper wire coil bundles, depended largely on transferring this heat to the motor laminations and thence through the enclosing shell to surrounding air, and this transfer had to be made by conduction through air or refrigerant vapor, which are very poor conductors.

The above factors caused the dissipation of heat to be a more serious problem than is usually realized. Since electrical conductivity is a function of the temperature of the conductor, with electrical resistance increasing with temperature rise, it becomes evident that a cool motor can and will deliver more power than a hot motor. About the only thing that could be done with a shell-enclosed motor-compressor was to increase the size of motor and the shell, to compensate for the power lost through overheating, or to add cooling fins to the casing for the same reason. These solutions, however, conflicted directly with the problem of the keeping the size, cost, and weight of the compressor small.

In this invention, a solid fill of plastic surrounds the wire bundles and totally fills all the slot voids, providing a solid, unbroken thermal path along which the wire heat is passed directly to the stator iron stack. This solid plastic fill is an appreciably better heat conductor than air or vapor. Also, since no shell encloses the stator, this heat is transferred directly to the surrounding air which is in direct contact with the outer surfaces of the laminations.

For obvious reasons, many engineers sought some way of making a pressure vessel without enclosing the motor-pump in a shell. None of these attempts were successful until the present invention. One such attempt that failed, interposed a sealing element in the air gap or clearance between the stator and the rotor of the electric motor-pump. This approach to the problem is exemplified by Canton's Patents Nos. 1,780,337, 1,780,338, 1,780,339 and 1,849,222. The trouble with this approach was that it introduced an even more serious problem. In an electric motor the "air gap" (as the clearance between the stator and the rotor is usually called) should be kept as small as possible while providing the clearance necessary for the rotor to turn. The magnetic forces between the stator and rotor are the motive forces that drive the motor, and these magnetic forces decrease greatly with any increase in the "air gap," the decrease in force being disproportionally greater than the increase in the spacing or "air gap." Normally, magnetic force decreases according to the square of the distance between the parts, and even though this law may not be strictly obeyed in the "air gap" between the stator and the rotor, due to other forces present, any increase in the air gap does cause a disproportionate falling off in the magnetic force available to run the motor. That is why Canton's interposition of a sealing member in the air gap was a failure. No way was known of making a satisfactory pressure vessel out of the motor-compressor unit without an enclosing shell.

The present invention has solved these three important related problems—how to keep the unit small in size, light in weight, and low in cost; how to dissipate the heat built up inside it; and how to do these and still have a satisfactory pressure vessel—by a novel structure in which a pressure vessel is made from the hollow motor stator and from two end plates and in which all the pumping elements are inside the motor rotor. It does this without in any way increasing the air gap between the stator and the rotor. In fact, this invention makes it possible to use an unprecedentedly small "air gap."

The motor pump or compressor of this invention also solves another important problem; namely, that of pumping or compressing fluids which are corrosive or which break down into components that tend to damage or dissolve the wire windings or their insulation. This present invention solves this problem by isolating the wires and their insulation and sealing them off from whatever fluid is being pumped or compressed, and the protecting sub-

stance is one which is not attacked by the fluids used in refrigeration nor by most other fluids.

The same isolation of the stator parts acts to eliminate or isolate any entrapped or occluded water vapor and prevent it from damaging the system.

The present invention is a motor-pump or compressor that includes a hollow stator whose laminations and wire coils are encased in and sealed together by a sealant material. The stator cavity is closed at both ends by a pair of end plates, at least one of which is ported, so that the motor-pump is provided with its intake and discharge openings. The end plates may be permanently sealed to the stator by a suitable sealant or they may be removably sealed by a gasket means. In either event, the stator and the end plates constitute the pressure vessel—without any additional shell being necessary. At the same time, the sealant is so applied that there is no foreign material in the air gap, and so that heat dissipation is improved.

Within this pressure vessel are all the components of the motor-pump, including the motor-rotor and the pumping elements. So far as the present invention is concerned, many different types of pump elements may be used. One type is illustrated in the drawings and is described by way of example, this type being the motor-pump which is further described and is claimed in my co-pending application, Serial No. 292,140, filed June 6, 1952. However, an internal gear pump, such as the Model L pumps manufactured by the Tuthill Pump Company could be used, as well as certain of the types of pumps described by Myron F. Hill in a series of United States patents issued since 1927. Still other types of pumping elements are usable in my improved pressure vessel, as will appear to those skilled in the art after they have studied the following description.

Still other objects and advantages of the invention will appear from the following description of a preferred embodiment thereof. It will be obvious that changes in detail may be made, because this description is given by way of example in order to comply with the requirements of the U. S. Revised Statutes, section 4888. The invention is not intended to be limited to the details described, its scope being indicated by the appended claims.

In the drawings:

Fig. 1 is a reduced view in perspective of a motor-pump or compressor embodying the principles of this invention. The connection of one of the conduits is indicated in dotted lines and the electrical connections are shown diagrammatically to prevent the face of the pump from being covered up.

Fig. 2 is a view in section showing the motor-pump of this invention, the section taken along the line 2—2 in Fig. 3.

Fig. 3 is a view in section taken along the line 3—3 of Fig. 2.

Fig. 4 is a view in section of the rotor of Fig. 3 and its contained parts, looking in the opposite direction and with the pump gears shown rotated through a relatively small angle.

Fig. 5 is a view in end elevation of one form of the end plates, showing an end plate having an intake port.

Fig. 6 is a view in section taken along the line 6—6 in Fig. 5.

Fig. 7 is a view in end elevation of a modified form of end plate, showing an end plate having a discharge port.

Fig. 8 is a view in section taken along the line 8—8 in Fig. 7.

Fig. 9 is a view in end elevation of a single end plate containing both an intake port and a discharge port.

Fig. 10 is a view in perspective of the electrical connection for the stator.

The electric motor-pump **10** includes a hollow stator **11** closed at each end by end plates **12** and **13**. The stator **11** and the plates **12** and **13** are impervious to fluid under pressure, and they cooperate to form a fluid-tight pressure vessel, within the cavity **14** of which are all the component parts of the motor-pump **10**, including a rotor **15** and the pump elements, which are preferably located inside the rotor **15**. Preferably, an intake port **16** is provided in one end plate **12** and a discharge opening **17** is provided in the other end plate **13**, although both ports may be provided in the same end plate (see Fig. 9).

The stator 11

The stator **11** may be made up of a plurality of thin iron laminations **20** secured together by a suitable thermosetting plastic or some other sealant material **21**. In the drawings the thickness of the sealant layers **21** has had to be exaggerated, but in reality the laminations **20** are just as close together as in any other stator, the plastic film being very thin. The sealant **21** may be put on by dip, spray, or film application to the individual laminations **20** prior to their stacking, or the sealant **21** may be forced under pressure to enter between the laminations **20** and seal their interfaces after the stack has been assembled. (For methods of applying the plastic, reference may be had to my co-pending application, Serial No. 286,880, filed May 9, 1952, now Patent Number 2,693,313.

This sealed stack is pressure tight, but its inner and outer peripheries are preferably not coated. It is important that none of the sealant material **21** be allowed to protrude out into the stator bore **22**, so that the clearance area **23** between the stator and the rotor **15** remains unchanged and unobstructed by the application of the sealant **21**. For one thing, a layer of plastic, coating the stator bore **22** would perforce increase the "air gap" or clearance area **23**, thereby decreasing disproportionately the electromotive force flowing between the stator **11** and rotor **15**, as disclosed earlier. The stator bore **22** is preferably perfectly smooth, although it is in effect made up of alternate layers of the metal laminations **20** and the plastic material **21** therebetween. The plastic **21** is not allowed to project even the slightest distance beyond the metal **20** because any roughness or protrusions tend to obstruct rotor-to-stator clearance and seriously interfere with the movement of a fluid film normally present between the static stator wall and the rotating rotor wall. This film is subjected to the shearing action caused by the rotative forces created by the rotor **15** turning in the stator bore **22**. Any roughness or protrusions into the clearance area **23** tends to set up additional retarding forces. Therefore, it becomes apparent that extreme smoothness and uniformity are of the utmost importance.

The stator **11** is provided with a suitable number of wire slots **24** to receive suitable wire windings **25** and **26**, the main windings **25** preferably being augmented by starting windings **26** which, if desired, may also remain in the circuit after starting. All the windings **25** and **26** pass through the stator slots **24** and protrude at **27** beyond the iron stack ends **28**, **29**, as shown in Fig. 2. These windings **25**, **26** are completely imbedded in and encased by a suitable thermosetting plastic **30** or other suitable material both in the slots **24** and where the wires protrude. The encasing material **30** may be the same as the sealant **21** that seals the laminations **20**, or it may be a different material. The encasement of the wire coils **25**, **26** by the plastic **30** may be achieved by vacuum-pressure-heat molding as described and claimed in my copending application, Serial No. 286,880, filed May 9, 1952, in which the wound stator **11** is placed inside a suitable mold into which the plastic **30** is forced.

The sealant **21** or **30** may be the thermosetting plastic described and claimed in the application Serial No. 286,026 filed May 3, 1952, by myself, William Hodges and Tibor Wiener. This plastic is a filled epoxy-type polymer or epon resin having substantially the same coefficient of thermal expansion as the iron laminations, so that there will be no breaking away by the resin. The preferred fillers are fine fiber asbestos and whiting. When

properly applied, the plastic will not check, crack, or break away from the metal, but will act to make the stator **11** into a bonded unit not subject to leakage of gases therethrough even under high pressures. This plastic is not attacked by or dissolved by refrigerant fluids or most other fluids, so that it protects the wires.

The filling of the space between the wires **25**, **26** with the plastic **30** aids in dissipating the heat that is generated in the wires. This solid fill of plastic, surrounding the wire bundles and each individual wire in the bundle, totally fills all the slot voids and provides a solid unbroken thermal path along which the wire heat is passed directly to the stator iron stack. This solid plastic fill is an appreciably better conductor of heat than air or vapor.

Preferably, there is no plastic film coating on the outer periphery **31** of the stator laminations **20**, because any such film would tend to retard the heat dissipation from the motor-pump **10**. Since no shell encloses the stator **11**, the wire heat and stator stack heat are transferred directly to the surrounding air, which is in direct contact with the outer surface **31** of the laminations. If desired, for other reasons (e. g. for preventing corrosion in certain uses) the outer surface **31** and inner surface **22** may be electroplated or otherwise protected.

Another noteworthy feature of the stator **11** is the electrical fitting **32** shown in Figs. 1 and 10. Preferably, the fitting **32** consists of an electrically nonconductive circular flat disc **33** carrying three metallic female prong sockets **34**. This electrical fitting **32** is partially encased in and sealed by the encasing material **30**, so that there can be no leakage out from the pressure vessel along the wires. Preferably, the flat exterior surface **35** of the disc **33** is substantially flush with the outer surface **36** of the stator coil encasing plastic **30**. The terminals of stator wires **25**, **26** are soldered to the inner end of the sockets **34**, and the sockets **34** are adapted to receive suitable companion male fittings (not shown) in the usual manner commonly associated with three-socket plugs.

The ends plates 12 and 13

In addition to the stator **11**, the pressure vessel for the motor-pump **10** comprises the pair of end plates **12** and **13** which close the ends of the stator cavity **14**. The end plates **12** and **13** are in some manner ported to provide for the fluid intake and discharge openings. Figs. 1, 2, and 5 show the intake port **16** in the end plate **12**. Figs. 2 and 7 show the discharge port **17** in the other end plate **13**. However, as illustrated in Fig. 9, both the intake and discharge ports may be in one end plate or may be in both end plates.

In their general shape, the end plates **12** and **13** are substantially identical. Two forms of end plates **12** and **13** are illustrated in Figs. 5–8. Figs. 5 and 6 show an end plate **12** adapted to be removably sealed to the stator **11** by a gasket means, whereas Figs. 7 and 8 show an end plate **13** adapted to be permanently sealed to the stator **11** by some sealant such as the plastic **30**. It will be understood that normally both end plates **12** and **13** of any one motor-pump **10** will be sealed in the same manner, either by gaskets or by a permanent sealant.

Both end plates **12** and **13** consist basically of a stepped disc **40** having a wider diameter outer portion **41** and a narrower-diameter axially-offset portion **42**. The outer portion **41** has a generally smooth outer rim **43** which nests into the stator bore **22**. A suitable "O"-ring **44** may fit in an outer annular groove **45** in the rim **43** to make the gasket connection with the stator bore **22**.

The inner disc portion **42** preferably terminates in a flat wall **46**, which is preferably ground to insure that it has a perfectly plane surface. The periphery **47** of the portion **42** is concentric with the outer rim **43** and forms a bearing surface for rotatably supporting the motor-rotor **15**. The proportioning, spacing, and concentricity of the two peripheries **43** and **47** insure perfectly accurate alignment and spacing of the stator **11** and rotor **15** so that the clearance area **23** between them can be very small and so that uniform rotor-to-stator clearance and uniform rotor-to-stator parallelism are thereby assured. The inner edge of the bearing **47** may be chamfered at **48** to facilitate assembly of the parts, and a helical oil groove **49** may be provided around the bearing **47**.

The end plates **12** and **13** may also be provided with an eccentricaly located, stepped circular opening **50** whose center C_2 is radially offset with respect to the center C_1 of the rim **43** and the bearing surface **47**. The inner smaller-diameter portion **51** of the opening **50** engages the cylindrical body of a through-bolt **52** which extends beyond the shoulder **53** into the wider-diameter portion **54** of the opening **50**. Blind nuts **55** may be threaded on the outer ends **56** of the bolt **52** so that they abut the shoulders **53** and thereby urge the end plates **12** and **13** inwardly against a cylindrical bearing member **83** which will be described later. Each blind nut **55** may be provided with an annular groove **56***a* in its outer surface to receive an O-ring **57** which makes a tight seal with the wall **58** of the opening **54**. Or a portion **59** of the outer periphery of the blind nut **55** may be relieved and a sealant **59***a* forced therein to bond the nut **55** to the wall **58**. For the sake of appearance covers **60** may be fitted flush into the counterbored opening **54**.

The end plate **13** shown in Figs. 7 and 8 is identical with the end plate **12** except for the discharge opening **17**, some oil grooves and bores (not described herein but referred to in my application Serial No. 292,140), and the means by which it is sealed to the stator **11**. Instead of having a gasket type of seal, a portion **61** of the outer rim **43** is relieved to provide a space where plastic or other sealant **61***a* can be poured to bond the plate **13** to the stator bore **22**. Normally, either both end plates **12**, **13** will be sealed in this manner or both of them will have gaskets, but if desirable, one may be of one type and one of the other, as shown in Fig. 2.

The end plate **62** shown in Fig. 9 is like the end plates **12** and **13**, except that it has both an intake port **63** and a discharge port **64**. The opposite end plate may have no ports in it or may also have an intake and/or a discharge port.

All of the intake and discharge ports **16**, **17**, **63**, **64** may be threaded or otherwise adapted to receive the ends of suitable conduits therein.

Attachment of the end plates 12, 13 to a base 65

The motor-pump **10** may be used without a base, simply being supported by suitable brackets (not shown) affixed to the stator **11**. However, for some purposes, a base **65** is wanted, and then the supporting structure shown in Fig. 1 is preferred. In this event, a pair of counterbored threaded blind openings **66** are provided in each end plate **12**, **13** (see Figs. 6 and 8). The vibration mount **67** may comprise a pair of flat head bolts **68**, **69** having a resilient (e. g. rubber) portion **70** between them. The bolts **68** may be threaded into the end plate openings **66**, and the bolts **69** may be bolted to the base **65** as shown in Fig. 1. The isolation of the two bolts **68**, **69** by the resilient separating body **70** serves to damp the vibrations of the motor-pump **10**.

The motor-rotor 15 and the pump elements

The motor-rotor **15** (see Figs. 2, 3, and 4) may be of the usual squirrel-cage induction design having generally annular projecting portions **75** at each end.

Annular bearings **76** may be provided on the inner surface of the central rotor bore **77**. The bearings **76** ride on the bearings **47** of the end plates.

An outer cylindrical pump element **78** may be press fitted or otherwise secured into the rotor bore **77** so that it becomes essentially integral with the rotor **15**. In the drawings a hollow gear type of pump element **78** is shown with a toothed inner surface **79**.

The inner gear element **80** may comprise a hollow cylindrical member having a toothed outer surface **81** driven by the toothed inner surface **79** of the outer element **78**.

Preferably, the inner and outer gear elements **78** and **80** are of the so-called "Rotoid" type; that is, they have an odd number of teeth, and the outer element has two more teeth than the inner element. The teeth are preferably so constructed that there is a sliding contact between the inner and outer elements which is not broken over a considerable arc as the gears rotate. Elements of this type are described and claimed in Patent No. 2,547,392, issued April 3, 1951, to Myron F. Hill and Francis A. Hill 2nd.

Preferably, the inner gear **80** is not concentric with the outer gear **78**. The outer gear **78**, being secured to the rotor **15**, rotates about center C_1, while the inner gear **80** rotates around the center C_2. The inner gear bore **82** fits around a hollow cylindrical bearing **83** which, in turn, fits around the bolt **52**.

The hollow cylindrical bearing **83** also acts as a stop and accurately spaces apart the end plates **12** and **13**, the nuts **55** being tightened on the bolt **52** until the flat surfaces **46** of both end plates **12, 13** are in tight contact with the radial faces **84** and **85** of the bearing **83**, thereby placing the bearing **83** in compression.

The radial end faces of the gears **78, 80** are spaced apart from the end plate surfaces **46** enough to provide a running clearance. For this purpose, they are made almost, but not quite, as long as the bearing **83**. A clearance of 0.0003 inch at each end has been used successfully.

Other types of pump elements may be used, as has been stated earlier, but a positive-displacement type of pump like the one illustrated in the drawings and further described and claimed in co-pending application, Serial No. 292,140, is preferable.

Assembly of the motor-pump 10

One blind nut **55** may be threadably attached to one end **56** of the through-bolt **52** and the bolt **52** may then be passed through the opening **50** in one end plate **12**. The hollow cylindrical bearing **83** may be placed around the through-bolt **52** and the inner gear **80** placed around the bearing **83**. The rotor **15**, with the outer gear **78** secured to it, may then be placed over the inner gear **80**, the motor-rotor bearings **76** being set to fully engage the bearing surface **47** on the end plate **12**. The other end plate **13** may then be placed over the projecting bolt **52** and guided by the bolt until its bearing **47** is in full engagement with the motor-rotor bearings **76**. The other blind nut **55** may then be threaded on its bolt end **56** and drawn up with sufficient tension to achieve slight compression of the hollow cylindrical spacer bearing **83** between the end plate inner faces **46**, thereby completing assembly of a "pump package." This "pump package" may then be placed within the stator bore **22**. Depending on the type of end plates employed, the "O"-rings **44** and **57** will complete the seal of the pressure vessel, or a sealant **59***a*, **61***a* will be poured in the reliefs **59** and **61** to bond the end plates **12** and **13** to the stator **11** and the blind nuts **55** to the end plates.

Operation

When an electric current is applied to the windings **25, 26** of the stator **11**, the rotor **15** will rotate on its bearings **47, 76**. The outer pump element **78**, being rigidly mounted to the rotor **15** will then drive the inner pump element **80**, and fluid will be drawn in through the intake opening **16** and expelled through the discharge opening **17**.

The sealants **21** and **30** protect the wires **25, 26** from the fluid and also make the stator **11** pressure-tight. The blind nuts **55** are either gasketed or bonded to the end plates **12, 13** so that the end plates are pressure-tight, and the gasketing or bonding of the end plates **12, 13** to the stator **11** completes the fluid-tight pressure vessel for the motor-pump or compressor **10**.

The heat generated inside the motor-pump **10** is dissipated out the outer periphery **31** of the laminations **20**, some of the heat being transmitted through the metal parts and some through the sealant **21, 30**.

A motor-pump made substantially as shown and described herein—without any outer shell—has already run more than 800 hours under pressure without leakage, loss of charge, or pressure drop, and without any excessive heating. The stator and end plates constituted the pressure vessel, yet there was no foreign coating in the air gap or on the outer periphery, all the sealing being done as described herein.

I claim:

1. A motor-pump, including a hollow, laminated, wire-bound stator, the laminations being bonded and sealed to each other by an impermeable plastic, the wires also being bonded and sealed to each other and to said laminations by said plastic, the bore and outer periphery of said stator laminations being uncoated by said plastic to expose bare metal there so that the rotor-to-stator clearance will be unaffected by said plastic and so that exterior air can freely carry away heat from the exterior of said stator laminations; a pair of stationary end plates sealed to said stator and forming therewith a gas-and-liquid-tight pressure vessel, each end plate being stepped and having its larger outer surface circular and fitting snugly in said stator bore and having its smaller inner surface circular and concentric with its outer surface, so as to form a bearing surface, one of said plates being provided with an intake port and said other plate being provided with a discharge port; a hollow motor rotor rotatably supported by said inner bearing surface and thereby properly spaced from said stator; and pump means inside said rotor for moving a fluid between said intake and discharge ports; said pump means including an inner element and an outer element, the outer pump-element being rigidly secured to said rotor inside said rotor.

2. The motor-pump of claim 1 in which there is an electric female plug containing a plurality of sockets electrically connected to terminals of said stator wires encased in and bonded to said plastic substantially flush therewith, whereby escape of fluid along said stator wires is prevented.

3. The motor pump of claim 1 in which said end plates have off-center openings therethrough, bolt means extending between said end plates and extending through said openings, and means securing said bolt means to said end plates.

4. The motor-pump of claim 3 in which the means for securing said bolts to said end plates comprises a pair of blind nuts, a shoulder in each of said bolt openings, and means for providing a fluid-tight seal between said blind nuts and said end plates.

5. The motor-pump of claim 4 in which said sealing means comprises an O-ring set in a groove in the outer surface of said blind nuts.

6. The motor-pump of claim 4 in which said sealing means comprises a sealant material bonded to said blind nuts and to said end plates.

7. The motor-pump of claim 3 in which there is a cylindrical stationary bearing member around said bolt between said end plates and abutting the inner surfaces of said end plates, said bearing member being under compression between said end plates, the inner gear element being rotatably mounted on said bearing member.

8. A motor-pump, including in combination a hollow, laminated, wire-wound stator, the laminations being bonded and sealed to each other by an impermeable plastic comprising an epoxy-type resin filled with asbestos fiber and whiting, the wires also being bonded and sealed to each other and to said laminations by said plastic, the bore and outer periphery of said stator laminations being uncoated by said plastic to expose bare metal there so that the rotor-to-stator clearance will be unaffected by said plastic and so that air can freely carry away heat from the exterior of said stator laminations; and electric female plug containing a plurality of sockets electrically con-

nected to terminals of said stator wires encased in and bonded to said plastic substantially flush therewith, whereby escape of fluid along said stator wires is prevented; a pair of stationary end plates each comprising a stepped disc sealed to said stator inside the bore of said stator and forming with said stator a pressure vessel, the outer circular surface of larger diameter fitting snugly in said stator bore and sealed thereto, said end plates each having an axially offset portion projecting into said bore with an outer bearing surface of smaller diameter than and coaxial with said larger diameter surface, one of said plates being provided with an intake port and said other plate being provided with a discharge port, said end plates having off-center openings therethrough; bolt means extending between said end plates and extending through said openings, blind nuts securing said bolt means to said end plates, said nuts being sealed to said end plates; a hollow motor rotor rotatably supported by said projecting bearing and thereby properly spaced from and angularly aligned with said stator; pump means inside said rotor for moving a fluid between said intake and discharge ports; said pump means including an inner element and an outer element; the outer pump element being rigidly secured to said rotor inside said rotor; and a cylindrical stationary, bearing member around said bolt between said end plates and abutting the inner surfaces of said end plates, said bearing member being under compression between said end plates, said inner gear element being rotatably mounted on said bearing member.

9. An electric motor pump, including in combination a hollow, laminated, wire-wound stator, with its laminations and wires bonded and sealed together by thermosetting impermeable plastic in a fluid-tight seal, the bore being uncoated by said plastic to expose bare metal; a pair of stationary end plates sealed to said stator and forming therewith a gas-and-liquid tight pressure vessel, each end plate being stepped and having its larger outer surface circular and fitting snugly in said stator bore and having its smaller inner surface circular and concentric with its outer surface so as to form a bearing surface, at least one of said plates being ported so that said motor pump has intake and discharge means; a hollow motor rotor rotatably supported by said bearing surface and thereby spaced from said stator; and pump means inside said rotor for moving a fluid between said intake and discharge means, said pump having an inner element and an outer element, the outer pump element being rigidly secured to said rotor inside said rotor.

10. The motor-pump of claim 9 in which there is an electric female plug containing a plurality of sockets electrically connected to terminals of the stator wires and encased in and bonded to said plastic substantially flush therewith, whereby escape of fluid along said stator wires is prevented.

11. An electric motor pump, including in combination a fluid-impervious stator having a bore therethrough; a pair of stationary end plates sealed to said stator and forming therewith a gas-and-liquid tight pressure vessel, each end plate being stepped and having its larger outer surface circular and fitting snugly in said stator bore and having its smaller inner surface circular and concentric with its outer surface so as to form a bearing surface, at least one of said plates being ported so that said motor pump has intake and discharge means; a hollow motor rotor rotatably supported by said bearing surface and thereby spaced from said stator; and pump means inside said rotor for moving a fluid between said intake and discharge means, said pump having an inner element and an outer element, the outer pump element being rigidly secured to said rotor inside said rotor.

12. An electric motor-pump, including in combination a fluid-impervious stator having a bore therethrough; a pair of stationary end plates sealed to said stator and forming therewith a gas-and-liquid tight pressure vessel, each end plate having two concentric circular surfaces, a larger outer surface fitting snugly in said stator bore and and a smaller inner bearing surface, at least one of said plates being ported so that said motor pump has intake and discharge means; a hollow motor rotor rotatably supported by said bearing surface and thereby spaced from said stator; and pump means inside said rotor for moving a fluid between said intake and discharge means, said pump having an inner element and an outer element, the outer pump element being rigidly secured to said rotor inside said rotor.

13. The motor-pump of claim 12 in which said end plates have aligned off-center openings therethrough, bolt means extending between said end plates and extending through said openings, and means securing said bolt means to said end plates.

14. The motor-pump of claim 13 in which the means securing said bolt means to said end plates comprises a pair of blind nuts, a shoulder in each of said off-center openings, and means for providing a fluid-tight seal between said blind nuts and said end plates.

15. The motor-pump of claim 14 in which said means for providing a fluid-tight seal comprises an O-ring set in a groove in the outer surface of said blind nuts.

16. The motor-pump of claim 14 in which said means for providing a fluid-tight seal comprises a sealant material bonded to said blind nuts and to said end plates.

17. The motor-pump of claim 13 in which there is a cylindrical stationary bearing member around said bolt means between said end plates and abutting the inner surfaces of said end plates, said bearing member being under compression between said end plates, the inner pump element being rotatably mounted on said bearing member.

References Cited in the file of this patent

UNITED STATES PATENTS

1,440,952	Apple	Jan. 2, 1923
1,449,371	Apple	Mar. 27, 1923
1,759,766	Szmukler	May 20, 1930
1,780,337	Canton	Nov. 4, 1930
1,780,338	Canton	Nov. 4, 1930
1,780,339	Canton	Nov. 4, 1930
1,849,222	Canton	Mar. 15, 1932
1,881,344	Apple	Oct. 4, 1932
1,911,128	Apple	May 23, 1933
2,057,503	Sawyer	Oct. 13, 1936
2,140,966	Nichols	Dec. 20, 1938
2,161,374	Moineau	June 6, 1939
2,246,275	Davidson	June 17, 1941
2,263,515	Pezzillo	Nov. 18, 1941
2,274,274	Pezzillo	Feb. 24, 1942
2,285,050	Pezzillo	June 2, 1942
2,312,848	Pezzillo	Mar. 2, 1943
2,319,730	Garraway	May 18, 1943
2,419,159	Pezzillo	Apr. 15, 1947
2,420,124	Coulson	May 6, 1947
2,423,345	Roters	July 1, 1947
2,494,295	Greenless	Jan. 10, 1950
2,500,600	Bradley	Mar. 14, 1950
2,579,865	Roters	Dec. 25, 1951

OTHER REFERENCES

"Ethoxylines" by Preiswerk and Meyerhans, Electrical Manufacturing, July 1949, pp. 78–81, 164, 166.