July 31, 1962 R. L. JAESCHKE 3,047,754

ELECTROMAGNETIC APPARATUS

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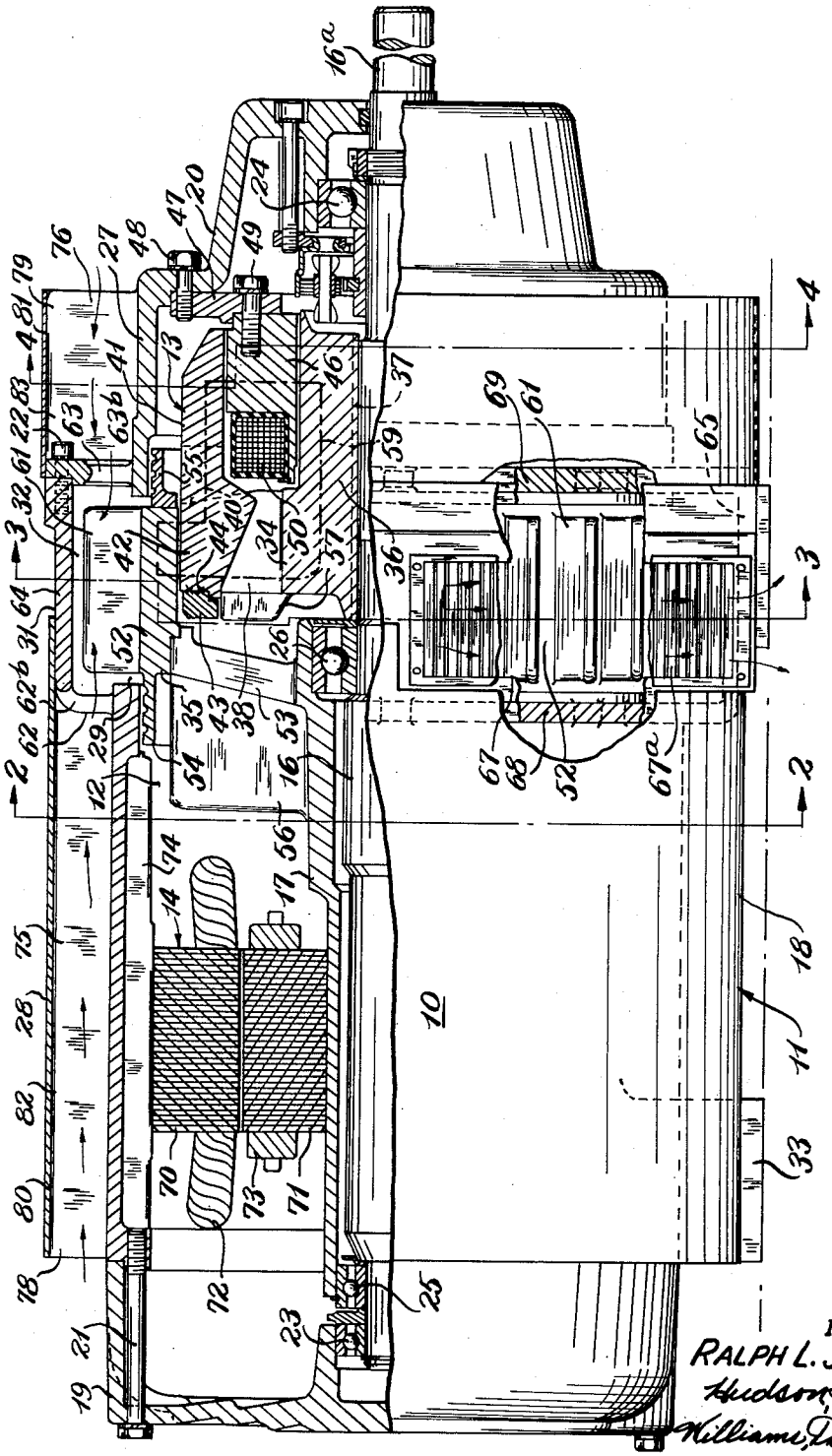


FIG. 1

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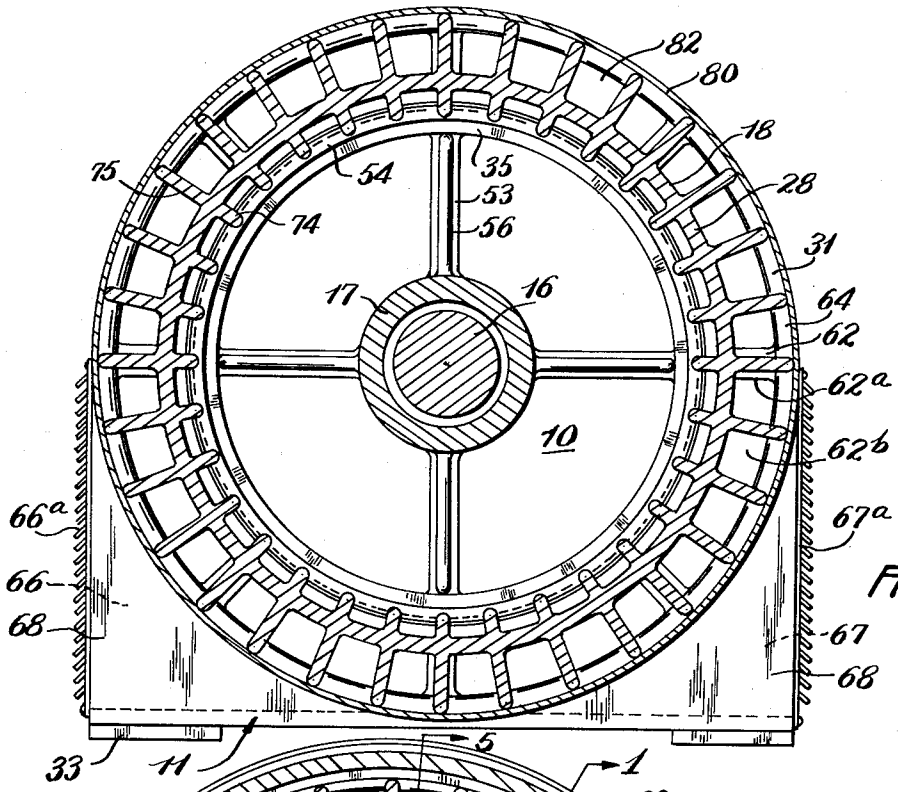


FIG. 2

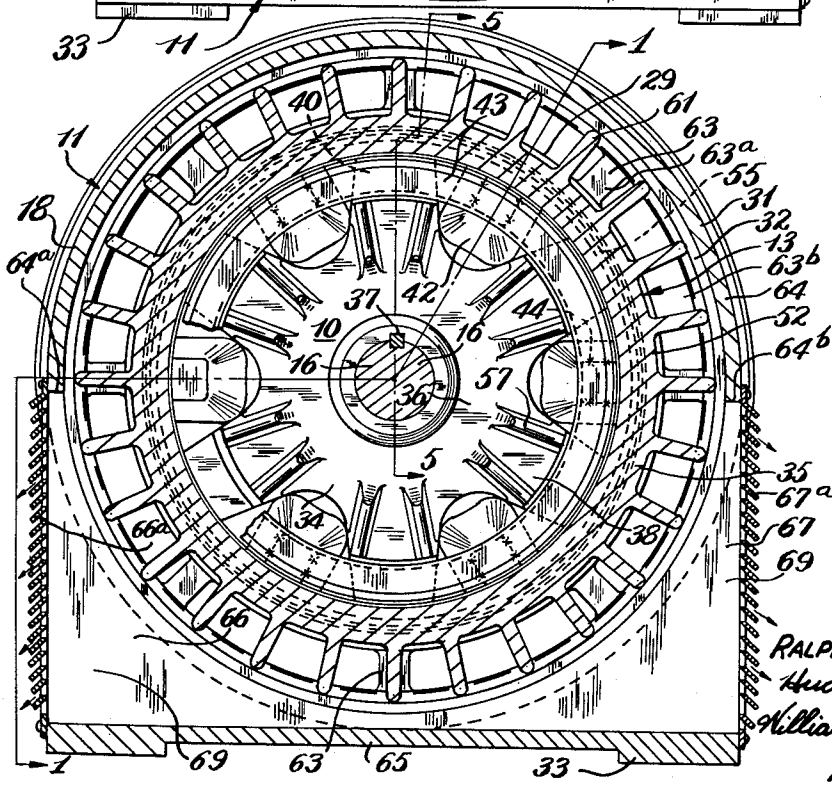


FIG. 3

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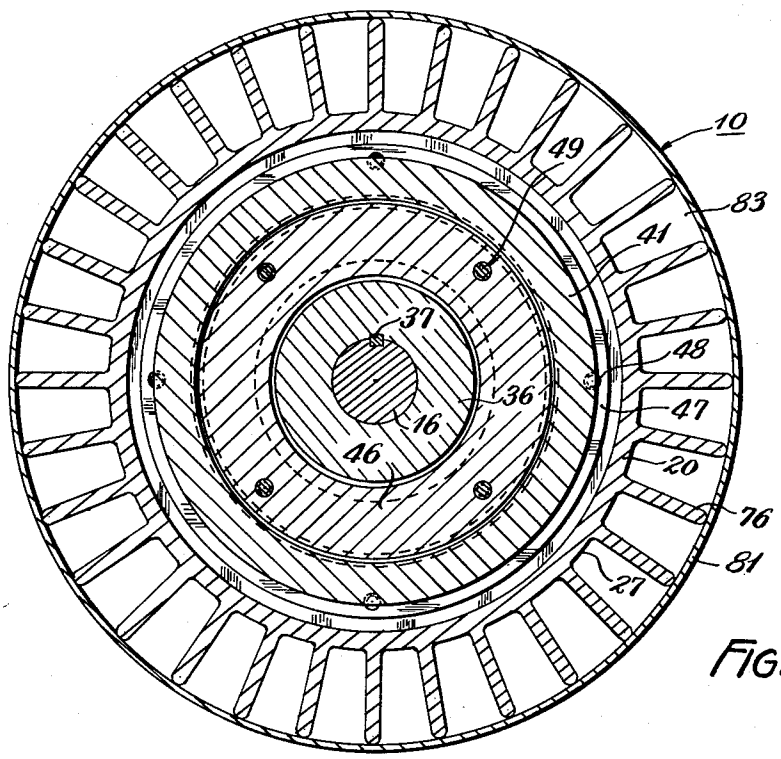


FIG. 4

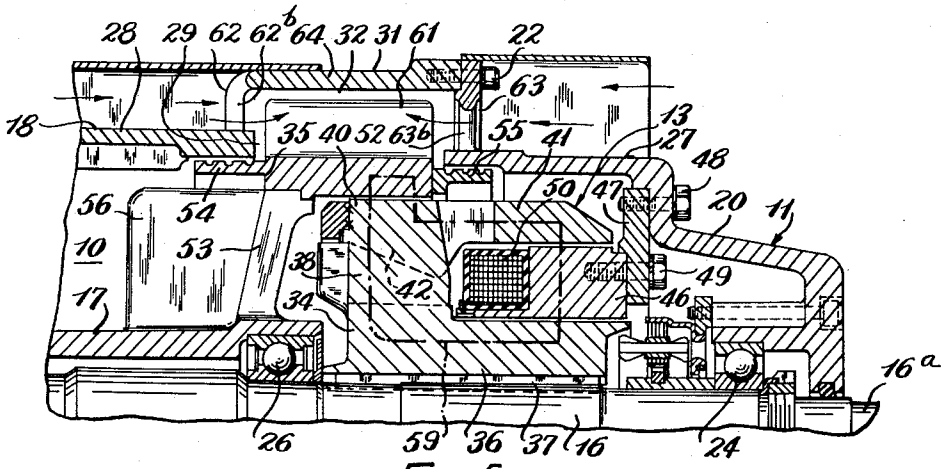


FIG. 5

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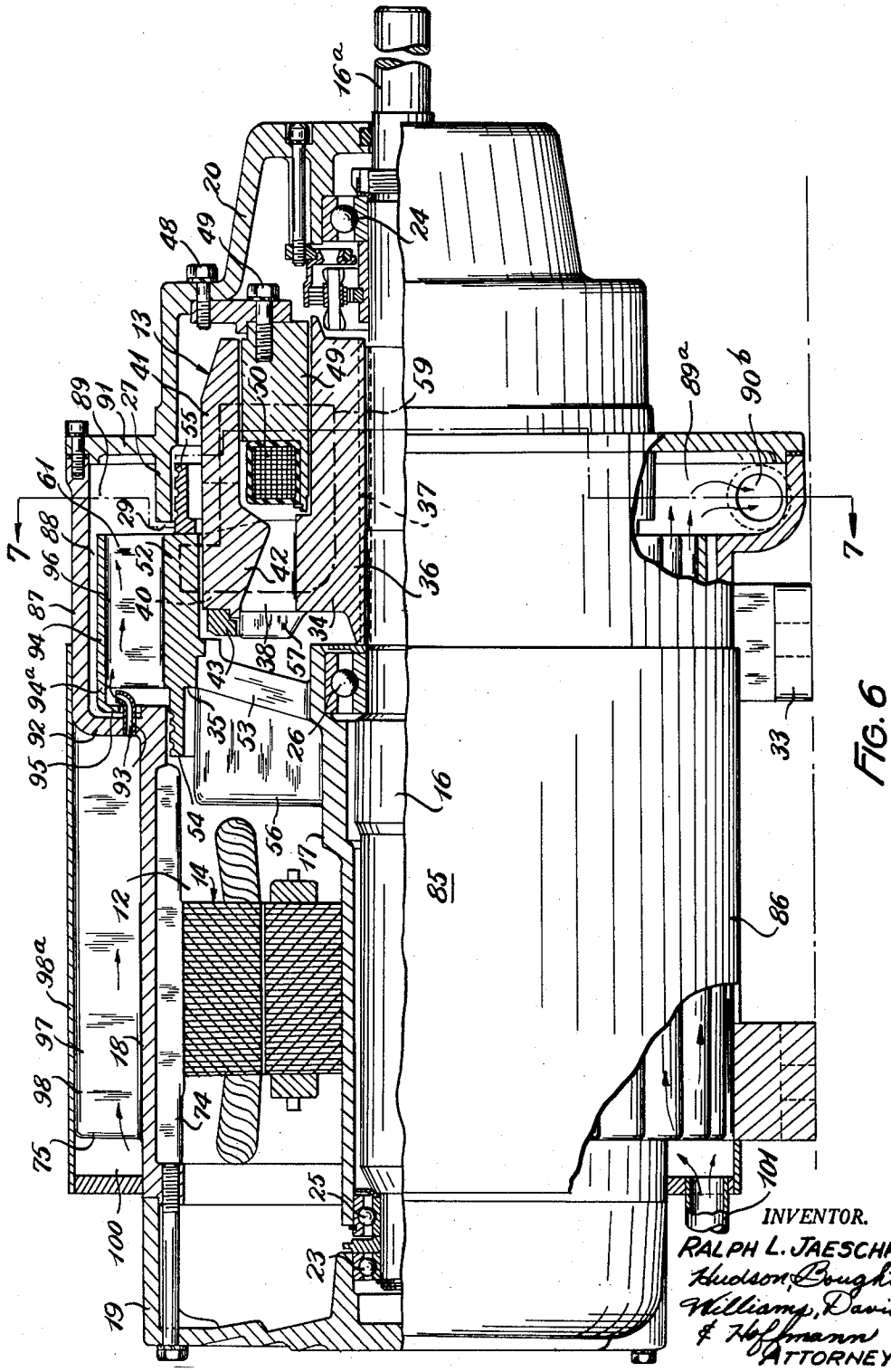


FIG. 6

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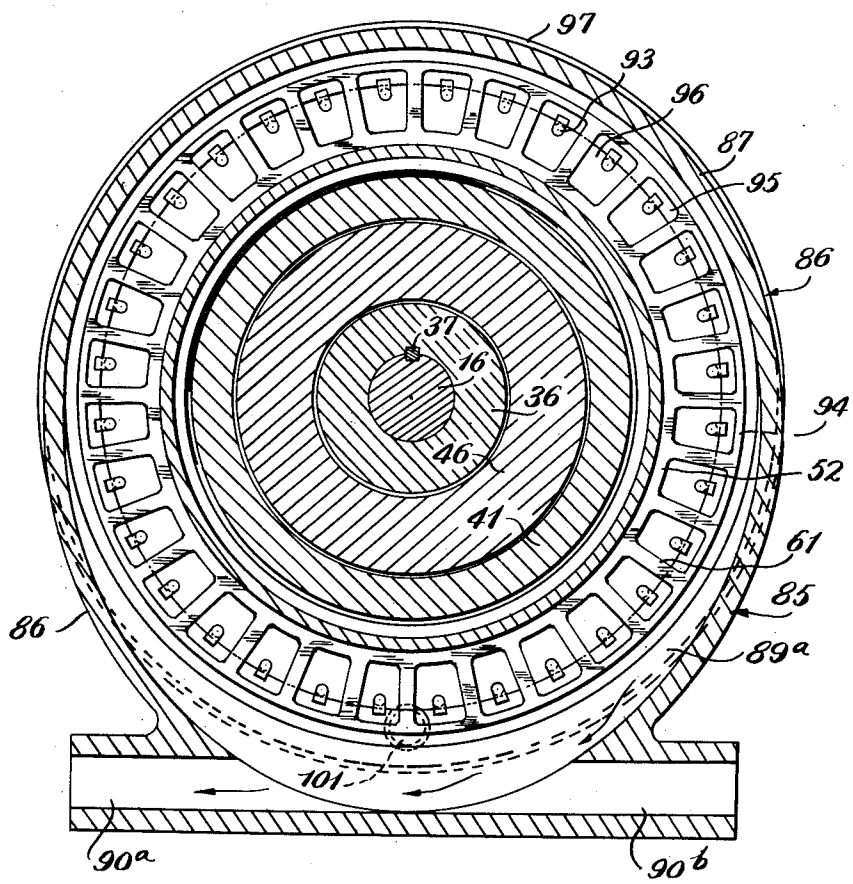


FIG. 7

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United States Patent Office 3,047,754 Patented July 31, 1962

3,047,754

ELECTROMAGNETIC APPARATUS

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Filed Aug. 5, 1960, Ser. No. 47,646
18 Claims. (Cl. 310—105)

This invention relates to electromagnetic apparatus of the eddy-current coupling type and, as one of its objects, aims to provide novel apparatus of this kind, in which cooling fluid is supplied particularly to those portions of the apparatus from which substantial amounts of heat need to be dissipated, and in which this desired result is accomplished in a practical and effective manner.

Electromagnetic apparatus of the eddy-current coupling type with which this invention is concerned can be employed as a driving means or a braking means and is frequently used in a location where the surrounding air is laden with foreign particles or dust. If such contaminated air is passed through the apparatus as a cooling medium, it would cause undesirable deposits of the foreign matter at various points within the apparatus with harmful results, such as in the bearings as well as in the air passages and air gaps.

In the novel construction provided by this invention the cooling fluid is supplied particularly to the high-heat-generating portions or components of the apparatus from which large amounts of heat need to be removed, without passing the cooling fluid through various other portions of the apparatus, so as to avoid the occurrence of the above-mentioned undesirable deposits of foreign matter when the cooling fluid being used is one laden with such foreign matter. The novel construction therefore permits, and contemplates, eliminating or minimizing the supply of cooling fluid to the low-heat-generating components of the apparatus by providing the apparatus with a frame structure or housing which is closed or sealed for the exclusion of the contaminated cooling fluid therefrom.

As another of the objects thereof, this invention accomplishes the purposes and results referred to above by providing electromagnetic apparatus having auxiliary chamber means in which cooling fins or the like of one or more of the high-heat components are disposed for heat-exchange contact with cooling fluid supplied to such auxiliary chamber means, the frame structure or housing of the apparatus preferably being otherwise closed or sealed for the exclusion of foreign matter therefrom.

A further object is to provide novel electromagnetic apparatus of the character above indicated in which the auxiliary chamber means comprises an impeller chamber and the cooling fins operate therein as impeller elements for the cooling fluid.

Still another object is to provide novel electromagnetic apparatus comprising a housing having a circumferential slot in the wall thereof and an auxiliary or impeller chamber outward of the slot and communicating therewith, and wherein cooling fins or the like on a rotatable high-heat component project into the impeller chamber through such slot for operation as cooling fluid impelling elements.

Yet another object is to provide novel electromagnetic apparatus of the character referred to above wherein the high-heat components comprise an eddy-current coupling unit in one portion of the apparatus and an electric motor unit in another portion and connected with the coupling unit, the cooling fins of at least one of such components being operable as impeller elements for cooling fluid being supplied to a plurality of the components.

Additionally, this invention provides novel electromagnetic apparatus of the kind mentioned above wherein the cooling fluid is a liquid, and wherein annular rim means

connected with the cooling fins of a rotatable high-heat component adapts such component for passage of the cooling liquid through the spaces between the fins.

Other novel characteristics, objects, and advantages of this invention will be apparent in the following detailed description and in the accompanying drawings forming a part of this specification and in which,

FIG. 1 is a side elevation of electromagnetic apparatus embodying the present invention and shown partially in longitudinal vertical section as indicated by the direction line 1—1 of FIG. 3, and with other portions shown in fragmentary section;

FIG. 2 is a transverse vertical section taken through the apparatus adjacent the electric motor unit thereof and as indicated by section line 2—2 of FIG. 1;

FIGS. 3 and 4 are similar transverse vertical sections taken through the apparatus at the location of the coupling unit thereof and as indicated respectively by the section lines 3—3 and 4—4 of FIG. 1;

FIG. 5 is a partial longitudinal vertical section corresponding with a portion of FIG. 1 and further illustrating the members comprising the magnetic circuit of the coupling unit;

FIG. 6 is a side elevation shown partially in longitudinal vertical section similar to that of FIG. 1 but representing a modified form of the apparatus; and

FIG. 7 is a transverse vertical section taken on section line 7—7 of FIG. 6.

As a practical and preferred embodiment of this invention, FIGS. 1 to 5 inclusive of the drawings show electromagnetic apparatus **10** comprising, in general, a hollow frame structure or main housing **11** containing a main chamber **12**, and coupling and motor units **13** and **14** located in axially adjacent portions or compartments of the main chamber. The motor unit **14** is here shown as being an electric motor unit, preferably a reversible motor unit. The apparatus **10** also comprises inner and outer shafts **16** and **17** rotatable on a common axis and with a portion **16a** of the inner shaft projecting from the housing **11** as the power output means of the coupling **13**. The hollow outer shaft **17** is the power input shaft for the coupling **13** and, when the apparatus **10** includes the electric motor unit **14** as here shown, the shaft **17** is also the power output shaft of such motor unit.

The housing **11** is a substantially closed housing comprising a main housing section **18** and cover sections **19** and **20** secured to the ends thereof as by means of suitable connecting screws **21** and **22**. The housing **11** is provided with suitable bearings, in this case antifriction bearings **23** and **24** located in the cover sections **19** and **20**, for rotatably supporting the inner shaft **16**. A second pair of such bearings **25** and **26**, mounted on the inner shaft **16** at axially spaced points thereof, rotatably support the outer shaft **17**.

The shell of the main housing section **18** comprises an outer wall **28** extending therearound and, for a purpose to be explained hereinafter, such outer wall has a slot **29** extending circumferentially therearound and located at a point axially therealong so as to lie substantially opposite a portion of the coupling unit **13**. The cover section **20** includes an annular housing wall portion **27** which is spaced from the annular wall **28** of the main housing section **18** so that the adjacent ends of the annular walls **27** and **28** lie on axially opposite sides of the slot **29**.

The housing **11** is provided with wall portions forming an auxiliary housing means, in this case external projecting wall portions forming an annular auxiliary housing or impeller casing **31** extending around the main housing section **18** and containing an auxiliary chamber **32** which is both a cooling chamber and an impeller chamber. The chamber **32** is located adjacent to or opposite the

slot 29 and is annularly coextensive therewith. The wall portions and passages of the auxiliary housing 31 are described hereinafter. The main housing section 18 is preferably also provided with pairs of feet or pads 33 at the bottom thereof and on which the apparatus is adapted to stand.

The coupling unit 13 is of the eddy-current type and comprises first and second rotors 34 and 35, in this case inner and outer rotors, which are connected respectively with the shafts 16 and 17. The inner rotor 34 comprises a hub portion 36, which is secured on the shaft 16 as by a suitable key 37, and an annular series of spokes or support arms 38 projecting from the hub portion in a radially disposed or radiating relation thereto. The outer ends of the arms 38 form pole members 40 which constitute one group of an annular series of interdigitated pole members carried by the inner rotor.

The inner rotor 34 also comprises an annular pole ring 41 having a plurality of circumferentially spaced and axially projecting arm portions forming a second group of pole members 42 extending into such interdigitated relation to the first group of pole members 40. The pole ring 41 is supported by the radial arms 38 in a cantilever relation thereto by means of a connecting ring 43 secured to these radial arms adjacent the outer ends thereof. The pole ring 41 is attached to the connecting ring 43 by having the ends of the pole members 42 joined to the connecting ring at circumferentially spaced points, as by means of welds 44.

The coupling unit 13 also includes field excitation means which, in accordance with the prior art, can be either stationary or rotatable. In the apparatus 10 the field means is shown as comprising a field ring 46 mounted on the cover section 20 of the housing 11 as by means of a suitable support ring 47 and groups of suitable connecting screws 48 and 49. A field winding comprising a ring-shaped field coil 50 is located on and supported by the field ring 46. The annular series of interdigitated pole members 40 and 42 is located radially outward of one end portion of the hub 36, and the pole ring 41 is located in a radially outwardly spaced relation to the other end portion of this hub so as to accommodate the field ring 46 and field winding 50 therebetween. The field ring 46 is thus supported and located in a stationary interposed relation, and the hub 36 and the pole ring 41 are rotatable on radially-opposite sides thereof in a relatively close air-gap relation thereto as shown in the drawings.

The outer rotor 35 comprises an inductor means which is here shown as being an eddy-current member 52 in the form of an annular drum extending around the annular series of interdigitated pole members 40 and 42 in an air-gap relation thereto and supported from the shaft 17 by an annular series of radiating spokes or support arms 53. The coupling unit 13 is located in the housing 11 so that the eddy-current member 52 will lie substantially opposite the annular slot 29 and, if desired, may project more or less into such slot. The outer rotor 35 is here shown as also comprising axial extension rings 54 and 55 which overlaps, and cooperate with, portions of the housing 11 on axially opposite sides of the slot 29 in a sealing relation thereto for substantially isolating the impeller chamber 32 from fluid-transfer or leakage communication with the main chamber 12.

If desired, the support arms 53 of the outer rotor can be reinforced by webs 56 connected between these arms and the shaft 17 and which webs also form impeller blades for causing a desired local or internal circulation of cooling air around and between the various components located within the main chamber 12. If desired, other such reinforcing webs 57 can be provided on the support arms 38 of the inner rotor 34 for reinforcing the attachment of the connecting ring 43 therewith and which latter webs also form air impeller blades for causing a local movement or circulation of cooling air around and between the components located in the main chamber 12.

From the construction and arrangement described above for the inner and outer rotors 34 and 35 it will be seen that the eddy-current member 52, together with the interdigitated pole members 40, 42, the pole ring 41, the field ring 46, and the hub 36 define a toroidal flux path 59 extending around the field coil 50 and the common rotation axis of the shafts 16 and 17. The members comprising this toroidal flux path are, of course, made of suitable magnetic material such as ferromagnetic material so that the magnetic flux traversing the same will provide a desired flux linkage and coupling effect between the eddy-current member 52 and the annular series of interdigitated pole members 40 and 42.

During the operation of the electromagnetic apparatus 10 considerable heat will be generated in the eddy-current member 52 which, for convenience of description, can accordingly be referred to as a "high-heat" member. For the dissipation of such heat from the eddy-current member 52 this member is provided with an annular series of heat-conducting elements or fins 61 projecting outwardly therefrom through the slot 29 and operable as impeller blades in the impeller chamber 32. In thus operating as impeller blades in the chamber 32, the heat conducting fins 61 produce a flow of cooling fluid through this chamber without need for such fluid to be drawn into or pass through any portion of the main chamber 12 of the housing 11, as will be further explained hereinafter.

With respect to the impeller housing 31 as formed by portions of the main housing 11, it will be seen that this impeller housing comprises radially outwardly extending wall portions 62 and 63 on axially opposite sides of the slot 29, and an axially extending outer annular wall portion 64 connecting such radially extending wall portions. The radially extending wall portions 62 and 63 are interrupted wall portions comprising annularly spaced spokes or sector portions 62^a and 63^a separated by intervening slots or sector shaped openings 62^b and 63^b. The rows of openings 62^b and 63^b comprise annular rows of cooling fluid inlet openings leading into the impeller chamber 32 at axially opposite ends thereof.

The outer wall portion 64 of the impeller housing 31 extends approximately halfway around the housing 11 on the upper side thereof as shown in FIG. 3. The lower edges 64^a and 64^b of the wall 64 terminate in a spaced relation above a transverse bottom wall portion 65 of the housing so as to leave cooling fluid outlet or discharge openings 66 and 67 on opposite sides of the lower portion of the main housing 11 as shown in FIG. 3. The side walls of the outlet openings 66 and 67 are formed by pairs of axially spaced radially projecting extension walls or portions 68 and 69 of the radial wall portions 62 and 63 as shown in FIGS. 1, 2 and 3. Suitable screens or louvered cover plate 66^a and 67^a extend across the outlet openings 66 and 67.

From the construction of the impeller housing 31 and the location of the cooling fluid inlet and outlet openings thereof it will be recognized that, during rotation of the impeller blades 61 in the impeller chamber 32, cooling fluid such as air will be drawn into the impeller housing through the air inlet openings 62^b and 63^b around substantially the full annular extent of the impeller chamber and will be discharged through one or both of the two discharge openings 66 and 67 on opposite sides of the lower portion of the main housing 11. Thus, the cooling air drawn into the impeller housing 32 through the openings of the radially disposed walls 62 and 63 will absorb heat from the impeller blades 61 for cooling the eddy-current member 52, and will be discharged through the openings 66 and 67 of the peripheral wall of the impeller housing largely by the action of centrifugal force on such air.

The coupling 13 is operable in either direction of rotation and, by reason of the discharge openings 66 and 67 of the impeller housing 31 being located in the peripheral wall 64 thereof and on opposite sides of the main hous-

ing 11, it will be seen that the cooling air will be discharged through these openings in an effective manner for both directions of rotation of the impeller blades 61 in the impeller chamber 32.

The electric motor unit 14 of the apparatus 10 comprises a stator core 70 suitably mounted in the main housing section 18 and a rotor core 71 secured on the shaft 17. The motor unit 14 also comprises suitable field coils 72 on the field core 70 and a suitable rotor winding 73 on the rotor core 71. Upon energization of the electric motor unit 14, it wiil drive the outer rotor 35 of the coupling 13 for the delivery of power through the projecting shaft portion 16[a] of the inner rotor 34. Certain components of the electric motor unit 14 comprise high-heat components and cooling thereof is accomplished by providing heat-conducting fins 74 and 75 on the inner and outer sides of the wall 28 of the main housing 11. The fins 74 and 75 are disposed in spaced relation in annular series extending around the main housing 11 with the external fins 75 located substantially opposite the internal fins 74, so that heat to be dissipated from the electric motor unit 14 will be readily transmitted from the internal fins 74 through the wall 28 to the external fins 75. The housing section 20 is preferably also provided with an annular series of spaced radial fins 76 thereon for heat-dissipating purposes.

The main housing 11 is preferably constructed so as to contain cooling fluid supply passages leading to the inlet openings 62[b] and 63[b] of the impeller housing 31 with such supply passages located to cause the cooling fluid to flow in a heat-exchange relation to the annular groups of heat-dissipating fins 75 and 76. For this purpose the main housing 11 is here shown as having shroud means extending therearound and comprising shroud members 80 and 81 extending around the groups of fins 75 and 76. The shroud members 80 and 81 are supported by these annular groups of fins 75 and 76 and have their adjacent ends suitably attached to the impeller housing 31.

The spaces between the adjacent fins of the fin groups 75 and 76 form individual axial passages 82 and 83 connected with the inlet passages 62[b] and 63[b] and extending axially along the outer wall portions of the main housing 11. It will thus be seen that the cooling air which is circulated through the impeller housing 32 by the rotation of the blades 61 therein not only cools the eddy-current member 52 but also removes excess heat from the electric motor unit 14 and from the coupling unit 13 through the annular groups of fins 75 and 76, and that this effective cooling of the apparatus 10 is accomplished without need for having the cooling air pass through the main chamber 12. The main housing 11 can accordingly be a closed or sealed housing by which dust and other foreign matter will be excluded from the main chamber 12 and the harmful effects of such dust and foreign matter on the bearings and other components of the apparatus will be avoided.

FIGS. 6 and 7 of the drawings show electromagnetic apparatus 85 of a form generally similar to the apparatus 10 but which has been designed for the use of liquid as the cooling fluid instead of air. The modified apparatus 85 of FIGS. 6 and 7 is similar in construction to the apparatus 10 so far as the coupling unit 13 and the electric motor unit 14 are concerned and the same reference characters have been applied to the same corresponding parts.

The main housing 86 of the modified apparatus 85 differs from the housing 11 described above in that the auxiliary housing portion 87 thereof defines an impeller chamber 88 which includes an annular discharge chamber portion or space 89 on the right side of the slot 29 as seen in FIG. 6. The shape of the impeller housing 87 is such that the lower portion of the annular discharge space 89 will be a scroll-shaped or crescent-like space 89[a], as shown in FIG. 7, so that liquid delivery passages 90[a] and 90[b] leading from the delivery space 89 extend tangentially therefrom on opposite sides of the lower portion of the main housing 86.

The radially and annularly extending wall portion 91 of the main housing 86 forms a closed end wall of the impeller housing 87 and of the annular delivery space 89. The radial annular wall portion 92 at the opposite end of the impeller housing 87 is also a closed wall with the exception of cooling liquid inlet passages spaced therearound and here shown as comprising flow-directing members or nozzles 93.

The eddy-current member 52 is similar in construction to the eddy-current member of the apparatus 10 in that it carries an annular series of cooling fins 61 but is also provided with an annular rim member 94 extending around the fins and attached thereto. The rim member 94 is of greater axial length than the fins 61 and includes an overhanging annular end portion 94[a] having an inturned radial lip or flange 95. The rim member 94 extends in a spanning relation across the spaces between the pairs of fins 61 so that these spaces will form conducting passages 96 for the cooling liquid when such liquid is directed onto the inner side of the rim member.

The nozzles 93 are mounted in the radial wall portion 92 of the impeller housing 87 and direct streams of the cooling liquid into the area lying within the rim member 94 and, as here shown, are preferably curved nozzle members of a length and shape to extend beyond the radial lip 95 and discharge cooling liquid onto the inner side of the rim member. During rotation of the eddy-current member 52 while cooling liquid is being thus supplied thereto by the nozzles 93, such fluid will flow axially through the passages 96 to thereby remove heat from the fins 61 for cooling the eddy-current member. The liquid leaving the passages 96 is received or collected in the annular space 89 and which collected liquid will have a rotative motion in this space and will be discharged therefrom by centrifugal action through one or the other of the tangential delivery passages 90[a] and 90[b], depending upon the direction of rotation of the eddy-current member 52.

The cooling liquid being supplied to the impeller chamber 88 for cooling the eddy-current member 52 can also be used to cool the electric motor unit 14 and, for this purpose, shroud means 97 is provided in a surrounding relation to the main housing 86 so as to provide an annular cooling liquid supply space 98 leading to the passages of the nozzles 93. Cooling fins 74 nd 75 provided on the inside and outside of the main housing 86 conduct heat from the electric motor unit 14 and transfer the same to the cooling liquid in the supply space 98. The spaces between the pairs of external fins 75 form individual axial passages 98[a] leading to the individual nozzles 93 of the impeller housing 87. At the outer or left end of the space 98 as seen in FIG. 6, the passages 98[a] are connected by an annular inlet space 100 to which the cooling liquid is supplied by an inlet pipe or the like 101 located adjacent the bottom of the main housing 86.

From the construction and manner of operation described above for the modified apparatus 85 of FIGS. 6 and 7, it will be seen that the cooling liquid is circulated through the impeller chamber 88 by the operation of the impeller blades 61 of the eddy-current member 52 therein and that this flow of cooling liquid also serves to remove excess heat from the electric motor unit 14. It will likewise be seen that the construction providing for this circulation of cooling liquid isolates or excludes the cooling liquid from the main chamber 12 of the apparatus, and consequently, the main housing 86 can be a closed or sealed housing for the better exclusion of foreign matter and dust from contaminating or injurious contact with the bearings and other components located within the main housing of the apparatus.

The apparatus 10 of FIG. 1 and the apparatus 85 of FIG. 6 can both be used either as a driving means or a braking means and, when employed as a braking means,

the motor unit **14** is effective through the coupling unit **13** to retard rotation of the shaft **16** and of a rotative load connected with the shaft projection **16a**.

From the accompanying drawings and the foregoing detailed description it will now be readily understood that this invention provides novel electromagnetic apparatus of the eddy-current coupling type in which effective cooling of the coupling unit is achieved, as well as cooling of an associated electric driving motor unit, without need for the flow of any portion of the cooling fluid through the main chamber of the apparatus. It will accordingly be seen that this invention makes possible the use of a main housing which can be closed or sealed to thereby exclude dust and other foreign matter which would otherwise produce harmful effects on the bearings and main components located within the housing.

Although the electromagnetic apparatus of this invention has been illustrated and described herein to a somewhat detailed extent it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claims hereof.

Having described my invention, I claim:

1. In electromagnetic apparatus of the character described; a hollow frame structure provided with bearing means and containing a substantially closed main chamber; first and second rotors in said main chamber and supported by said bearing means for rotation on a common axis; said first rotor having an annular series of pole members thereon and said second rotor comprising annular inductor means in an adjacent air-gap relation to the pole members of said series; field excitation means disposed relative to said rotors to produce flux linkage between said pole members and inductor means; cooling chamber means defining an annular cooling chamber substantially isolated from fluid flow communication with said main chamber and provided with cooling fluid inlet and outlet passages communicating with said cooling chamber; said cooling chamber means having stationary wall means comprising portions of said structure, and cooperating movable wall means comprising portions of said inductor means; and heat-conducting fins on said inductor means and operable in said cooling chamber in heat-exchange contact with cooling fluid in the latter.

2. In electromagnetic apparatus of the character described; a hollow frame structure provided with bearing means and containing substantially closed main chamber means; inner and outer rotors in said main chamber means and supported by said bearing means for rotation on a common axis; an annular field member carrying field coil means adapted to be electrically energized; said inner rotor comprising connected rotor members having groups of interdigitated pole members disposed in an annular series; said outer rotor comprising annular drum means extending around said series of pole members; said rotor members, field member, pole members and drum means defining a substantially toroidal flux path around said coil means and rotation axis; auxiliary housing means comprising cooperating portions of said structure and drum means defining an annular cooling chamber substantially isolated from fluid flow communication with said main chamber means and provided with cooling fluid inlet and outlet passages communicating with said cooling chamber; and heat-conducting fins on said drum means and disposed in heat-exchange relation to cooling fluid in said cooling chamber; said fins being operable in the cooling chamber as impeller blades to cause a flow of cooling fluid into and out of said cooling chamber through said passages.

3. In electromagnetic apparatus of the character described; a hollow frame structure provided with bearing means; inner and outer rotors in said structure and supported by said bearing means for rotation on a common axis; said inner rotor having an annular series of pole members thereon and said outer rotor comprising annular inductor means extending around said series; annular field excitation means disposed relative to said rotors to produce flux linkage between said pole members and inductor means; said structure having an outer wall extending therearound and provided with a slot at the location of said inductor means and lying between parallel planes extending transverse to said axis; auxiliary housing means defining a cooling chamber substantially coextensive with said slot and communicating therewith; said housing means having cooling fluid inlet and outlet passages connected with said cooling chamber; and heat-conducting fins on said inductor means and projecting through said slot into said chamber and having heat-exchange contact with cooling fluid in the latter.

4. In electromagnetic apparatus of the character described; a substantially closed hollow frame structure provided with bearing means and containing substantially closed main chamber means; inner and outer rotors in said structure and supported by said bearing means for rotation on a common axis; said inner rotor having an annular series of pole members thereon and said outer rotor comprising annular inductor means extending around said series; annular field excitation means disposed relative to said rotors to produce flux linkage between said pole members and inductor means; auxiliary housing means comprising cooperating portions of said structure and outer rotor and containing an annular cooling chamber; certain of said cooperating portions being provided with cooling fluid inlet and outlet passages in communication with said cooling chamber; annular sealing means effective between said structure and said outer rotor at axially spaced points of the latter for substantially isolating said cooling chamber from fluid flow communication with said main chamber means; and heat conducting fins connected with said inductor means and disposed in said cooling chamber for heat-exchange contact with cooling fluid in the latter.

5. In an electromagnetic coupling or the like; a hollow frame structure provided with bearing means and containing main chamber means; inner and outer rotors in said structure and supported by said bearing means for rotation on a common axis; said inner rotor having an annular series of pole members thereon and said outer rotor comprising annular eddy-current means extending around said series; field excitation means disposed relative to said rotors to produce flux linkage between said pole members and eddy-current means; said structure having an outer wall extending therearound and provided with a slot at the location of said eddy-current means and lying between parallel planes extending transverse to said axis; external hollow projection means on said outer wall defining an impeller chamber lying outward of said slot and communicating therewith; said projection means having cooling fluid inlet and outlet passages connected with said impeller chamber; cooperating annular portions effective between said structure and outer rotor on axially opposite sides of said slot for substantially isolating said impeller chamber from communication with said main chamber means; and heat-conducting fins on said eddy-current means and projecting through said slot for operation as impeller elements in said impeller chamber.

6. In an electromagnetic coupling or the like; a frame structure provided with bearing means and containing main chamber means; rotor means comprising first and second rotors in said structure and supported by said bearing means for rotation on a common axis; said first rotor having an annular series of pole members thereon and said second rotor comprising an annular eddy-current member in an adjacent air-gap relation to the pole members of said series; field excitation means disposed relative to said rotor to produce flux linkage between said pole members and eddy-current member; said structure having an outer wall extending therearound and

provided with a slot at the location of said eddy current member and lying between parallel planes extending transverse to said axis; external hollow projection means on said outer wall defining an impeller chamber lying outward of said slot and communicating therewith; said projection means comprising peripheral wall means, and circumferential radial wall portions on opposite sides of said slot and connected by said peripheral wall means; at least one of said radial wall portions having cooling fluid inlet passage means connected with said impeller chamber, and said peripheral wall means having cooling fluid discharge passage means leading from said impeller chamber; annularly extending sealing means effective between said rotor means and structure for preventing transfer of fluid between said impeller chamber and said main chamber means; and heat-conducting fins on said eddy-current member and projecting through said slot for operation as impeller elements in said impeller chamber.

7. An electromagnetic coupling or the like as defined in claim 6 wherein said second rotor is rotatable in opposite directions and said discharge passage means comprises discharge openings in said peripheral wall at spaced locations for the discharge of the cooling fluid therethrough in accordance with the direction of rotation of said second rotor.

8. An electromagnetic coupling or the like as defined in claim 7 wherein said discharge openings are located on opposite sides of said structure and adjacent the bottom thereof.

9. An electromagnetic coupling or the like as defined in claim 6 wherein shroud means spaced from said outer wall co-operates therewith to define a cooling fluid supply space connected with said inlet passage means; and wherein cooling fins on said outer wall project into said supply space.

10. An electromagnetic coupling or the like as defined in claim 6 wherein said inlet passage means comprises inlet openings in said radial wall portions, and shroud means spaced from said outer wall co-operates therewith to define cooling fluid supply spaces on axially opposite sides of said projection means and connected with said inlet openings; and wherein groups of cooling fins on said outer wall and located on axially opposite sides of said projection means extend into said supply spaces.

11. In electromagnetic apparatus of the character described; a housing having bearing means providing a rotation axis and an outer wall structure containing an annular slot extending around said axis; rotor means comprising first and second rotors in said housing and rotatable on said axis; said first rotor having an annular series of pole members thereon and said second rotor comprising an annular inductor means in an adjacent air-gap relation to the pole members of said series and located substantially opposite said slot; annular field flux producing means disposed in co-operating relation to said rotors to produce flux linkage between said pole members and inductor means; portions of said wall structure defining casing means providing an annular cooling chamber at the location of said slot and outward thereof; said wall structure having supply passage means extending to said cooling chamber for supplying cooling fluid thereto and also having discharge passage means leading from said cooling chamber; and cooling fins on said inductor means and projecting through said slot into said cooling chamber and having heat-exchange contact with cooling fluid in the latter.

12. In electromagnetic apparatus of the character described; a housing having bearing means defining a rotation axis and an outer wall structure containing an annular slot extending around said axis; rotor means comprising first and second rotors in said housing and rotatable on said axis; said first rotor having an annular series of pole members thereon and said second rotor comprising an annular eddy-current member in an adjacent air-gap relation to the pole members of said series and located substantially opposite said slot; annular field flux producing means disposed in co-operating relation to said rotors to produce flux linkage between said pole members and eddy-current member; power output shaft means connected with one of said rotors; electric motor means in said housing and connected with the other of said rotors to drive the same; portions of said wall structure defining an impeller casing means providing an annular impeller chamber at the location of said slot and outward thereof; said wall structure having supply passage means extending to said impeller chamber for supplying cooling fluid thereto and also having discharge passage means leading from said impeller chamber; first cooling fins on said eddy-current member and projecting through said slot into said impeller chamber for operation therein as impeller elements for causing a flow of cooling fluid through said passage means; and other cooling fins projecting into said passage means adjacent said motor means for cooling the latter.

13. In electromagnetic apparatus of the character described; a housing having bearing means providing a rotation axis and an outer wall structure containing an annular slot extending around said axis; rotor means comprising first and second rotors in said housing and rotatable on said axis; said first rotor having an annular series of pole members thereon and said second rotor comprising an annular eddy-current member in an adjacent air-gap relation to the pole members of said series and located substantially opposite said slot; annular field flux producing means disposed in co-operating relation to said rotors to produce flux linkage between said pole members and eddy-current member; portions of said wall structure defining an auxiliary hollow casing means at the location of said slot and outward thereof; cooling fins on said eddy-current member in an annularly spaced row and projecting into said casing means through said slot; annular rim means connected with and extending around said annular row of cooling fins in spanning relation to the spaces between the fins; and cooling liquid supply means located to supply cooling liquid to said spaces.

14. Electromagnetic apparatus as defined in claim 13 wherein a portion of said rim means projects axially beyond said cooling fins; and wherein said supply means discharges cooling liquid on the inner side of the projecting portion of said rim means for passage through said spaces.

15. In electromagnetic apparatus of the character described; a housing having bearing means providing a rotation axis and an outer wall structure containing an annular slot extending around said axis; rotor means comprising first and second rotors in said housing and rotatable on said axis; said first rotor having an annular series of pole members thereon and said second rotor comprising an annular eddy-current member in an adjacent air-gap relation to the pole members of said series and located substantially opposite said slot; annular field flux producing means disposed in co-operating relation to said rotors to produce flux linkage between said pole members and eddy-current member; portions of said wall structure defining an auxiliary hollow casing means at the location of said slot and outward thereof; cooling fins on said eddy-current member in an annularly spaced row and projecting into said casing means through said slot; annular rim means connected with and extending around said annular row of cooling fins in spanning relation to the spaces between the fins; cooling liquid supply means located on one axial side of said annular row of fins for supplying cooling liquid to said spaces; said casing means also containing an annular liquid delivery space located on the axially opposite side of said row of fins for receiving the cooling liquid from said spaces; and discharge passage means leading from said delivery space substantially tangentially thereof.

16. Electromagnetic apparatus as defined in claim 15 wherein said second rotor is rotatable in opposite direc-

tions, and said discharge passage means comprises discharge passages leading from said delivery space in substantially tangentially oppositely extending relation for the selective discharge of the cooling liquid in accordance with the direction of rotation of said second rotor.

17. In electromagnetic apparatus of the character described; a housing having an outer wall structure extending therearound and provided with an annular slot; rotor means in said housing comprising inner and outer rotors rotatable on a common axis; said inner rotor having an annular series of pole members thereon and said outer rotor comprising an annular eddy-current member extending around said series and located substantially opposite said slot; annular field flux producing means disposed in co-operating relation to said rotors to produce flux linkage between said pole members and eddy-current member; portions of said wall structure defining an impeller casing means providing an annular impeller chamber extending around said housing at the location of said slot and outward thereof; other portions of said wall structure comprising spaced wall portions defining cooling liquid supply passage means; power output shaft means connected with one of said rotors; electric motor means in said housing and connected with the other of said rotors to drive the same; first cooling fin means on said wall structure adjacent said electric motor means and disposed in heat-exchange relation to said supply

passage means; other cooling fin means on said eddy-current member comprising an annular row of spaced fins projecting into said impeller chamber through said slot; annular rim means connected with, and extending around, said annular row of other cooling fins in spanning relation to the spaces therebetween; flow directing means connected with said supply passage means and disposed so as to direct cooling liquid onto the inner side of said rim means for passage through said spaces; said impeller chamber containing an annular liquid delivery space located so as to receive the cooling liquid from said spaces; and discharge passage means leading from said delivery space.

18. Electromagnetic apparatus as defined in claim 17 wherein said housing contains main chamber means in which said rotor means and electric motor means are located; and wherein annularly extending sealing means on axially opposite sides of said slot and effective between said eddy-current member and housing substantially isolate said impeller chamber and delivery space from fluid flow communication with said main chamber means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,409,557 Gilfillan ---------- Oct. 15, 1946

FOREIGN PATENTS

1,188,748 France ---------- Mar. 16, 1959