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(54) **INTEGRAL MOTOR CENTRIFUGAL PUMP**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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(52) **U.S. Cl.** **417/423.7**; 417/423.11; 417/423.12; 417/423.14

(58) **Field of Search** 417/355, 356, 417/423.1, 423.7, 423.8, 423.11, 423.12, 423.13, 423.14, 422; 415/118, 201, 206; 416/61

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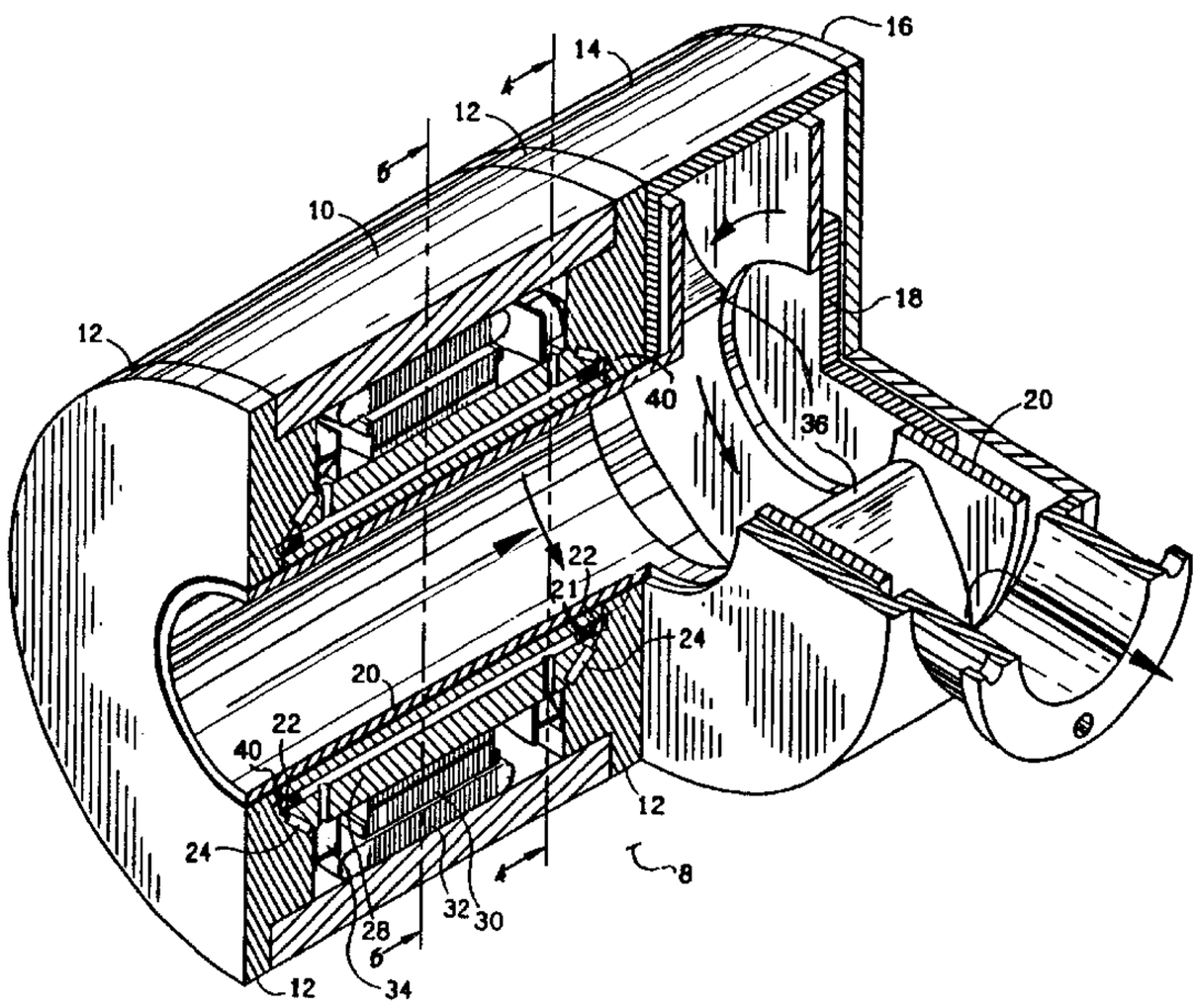
(57) **ABSTRACT**

A new integral motor/pump design utilizing a combination centrifugal enclosed impeller, shaft and feeder conduit. Whereby the impeller drive shaft serves a dual purpose of providing applied power from the hollow motor driveshaft directly to the impeller blade or blades and also is a fluid entrance conduit for the impeller media feed. The present invention hollow motor drive shaft, hollow impeller shaft and enclosed impeller also incorporates optional changeable impeller leading edge blades. These blades help facilitate the most efficient flow of various fluids and pumped media. The present invention utilizes simplicity of design whereby inspection and service accessibility is optimized. Design configuration renders radial thrust bearing curves more applicable to a broad range of applications and extended motor/pump service life.

7 Claims, 4 Drawing Sheets



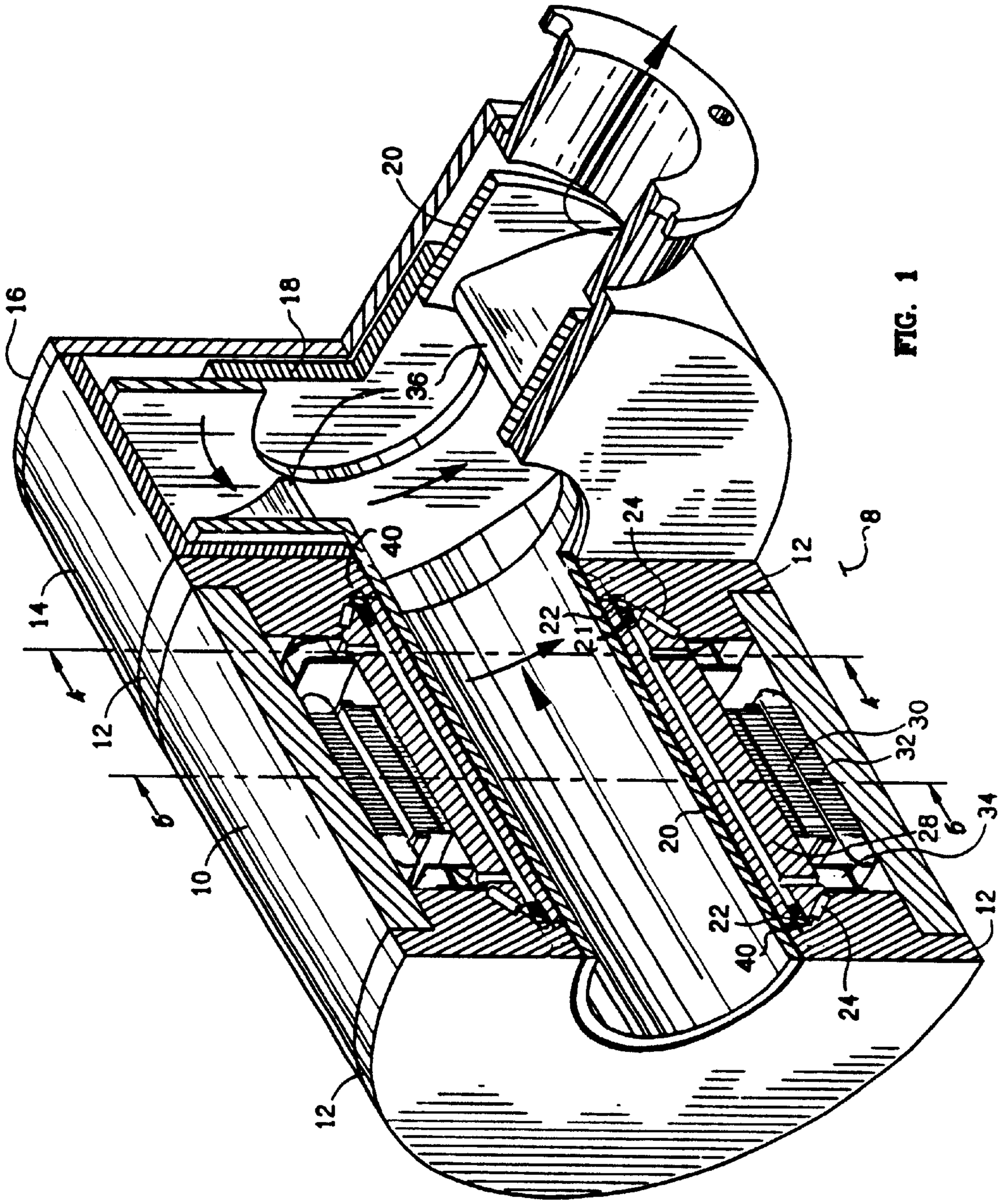


FIG. 1

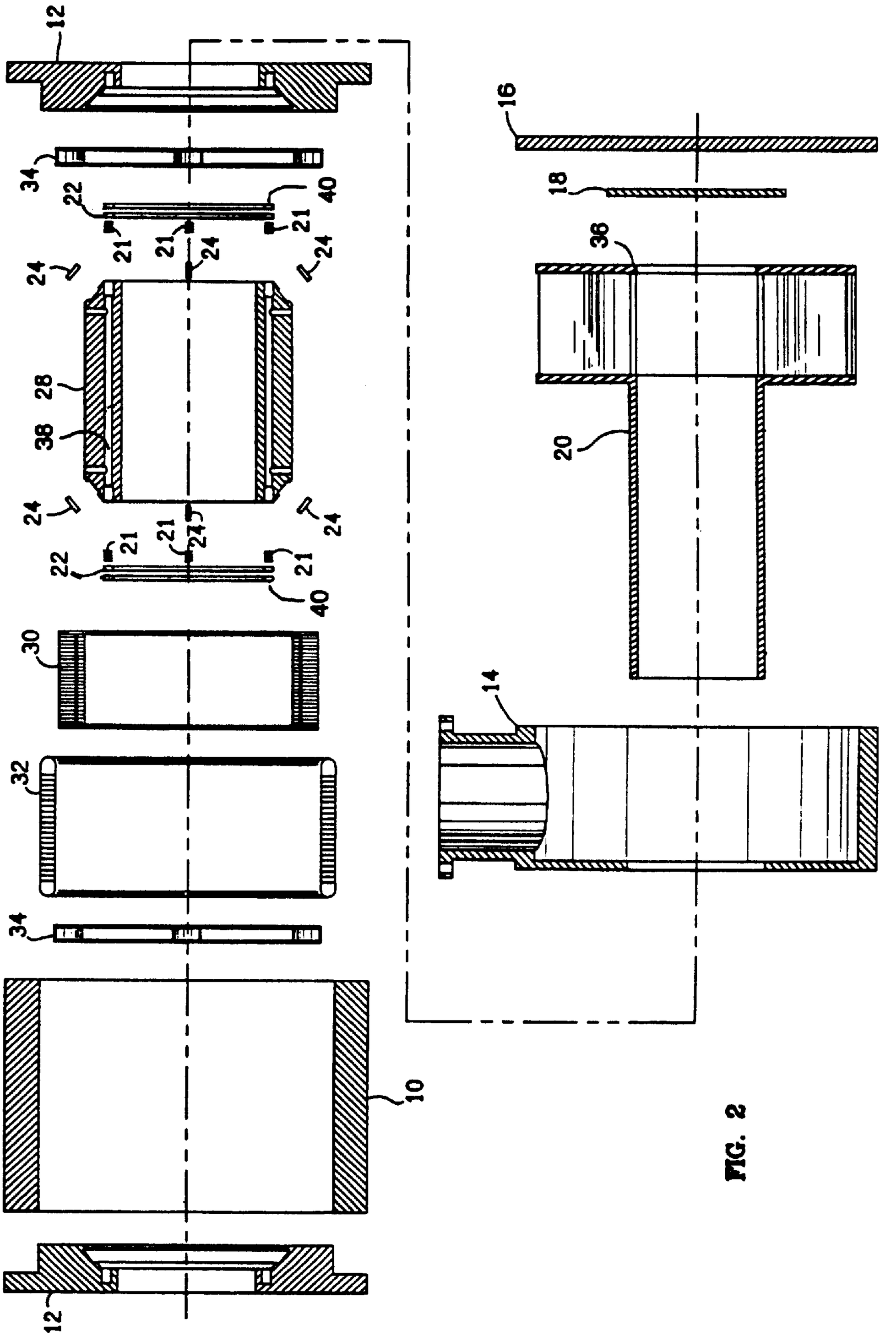

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FIG. 2

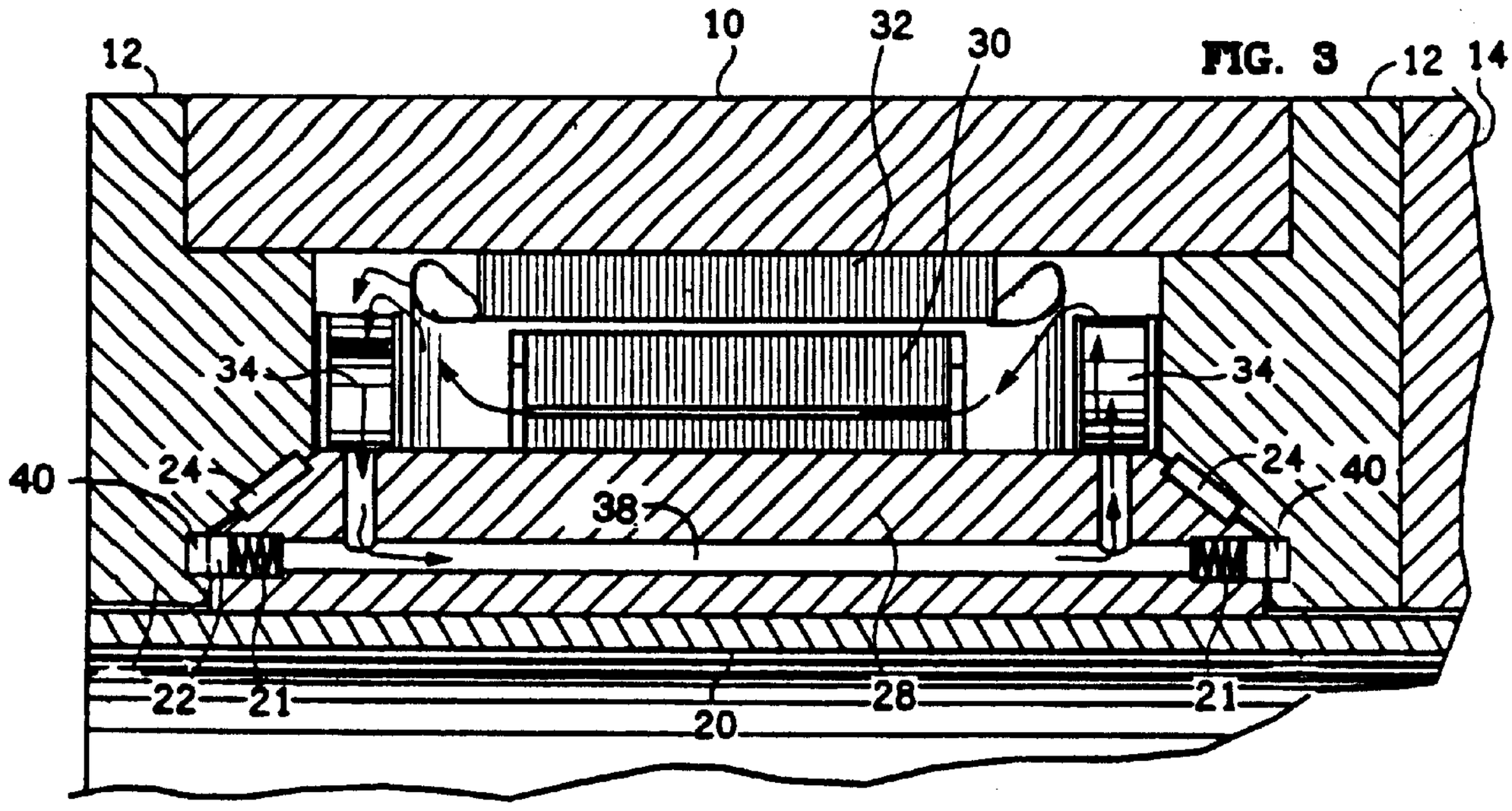
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FIG. 3

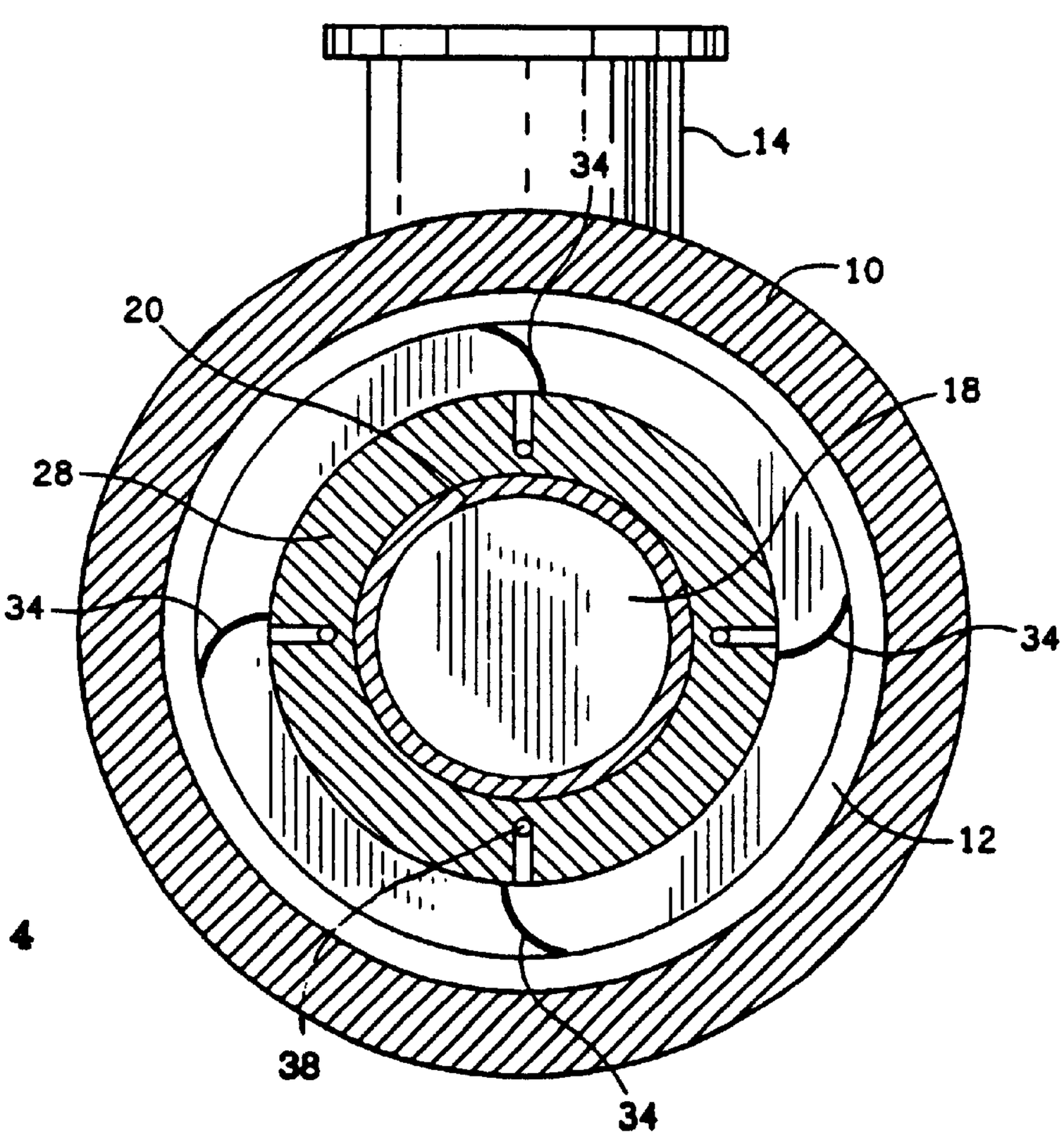
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FIG. 4

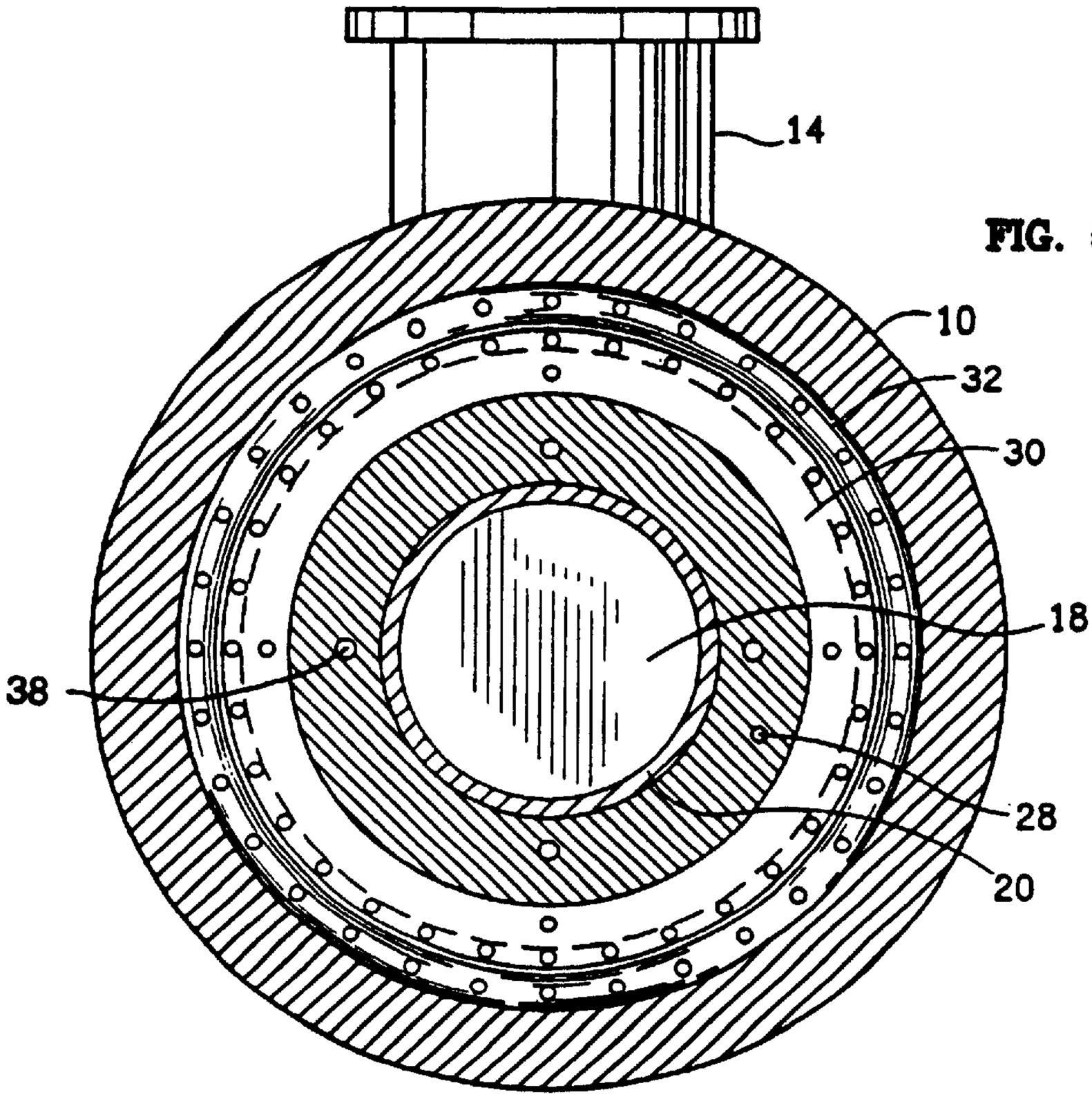

FIG. 5

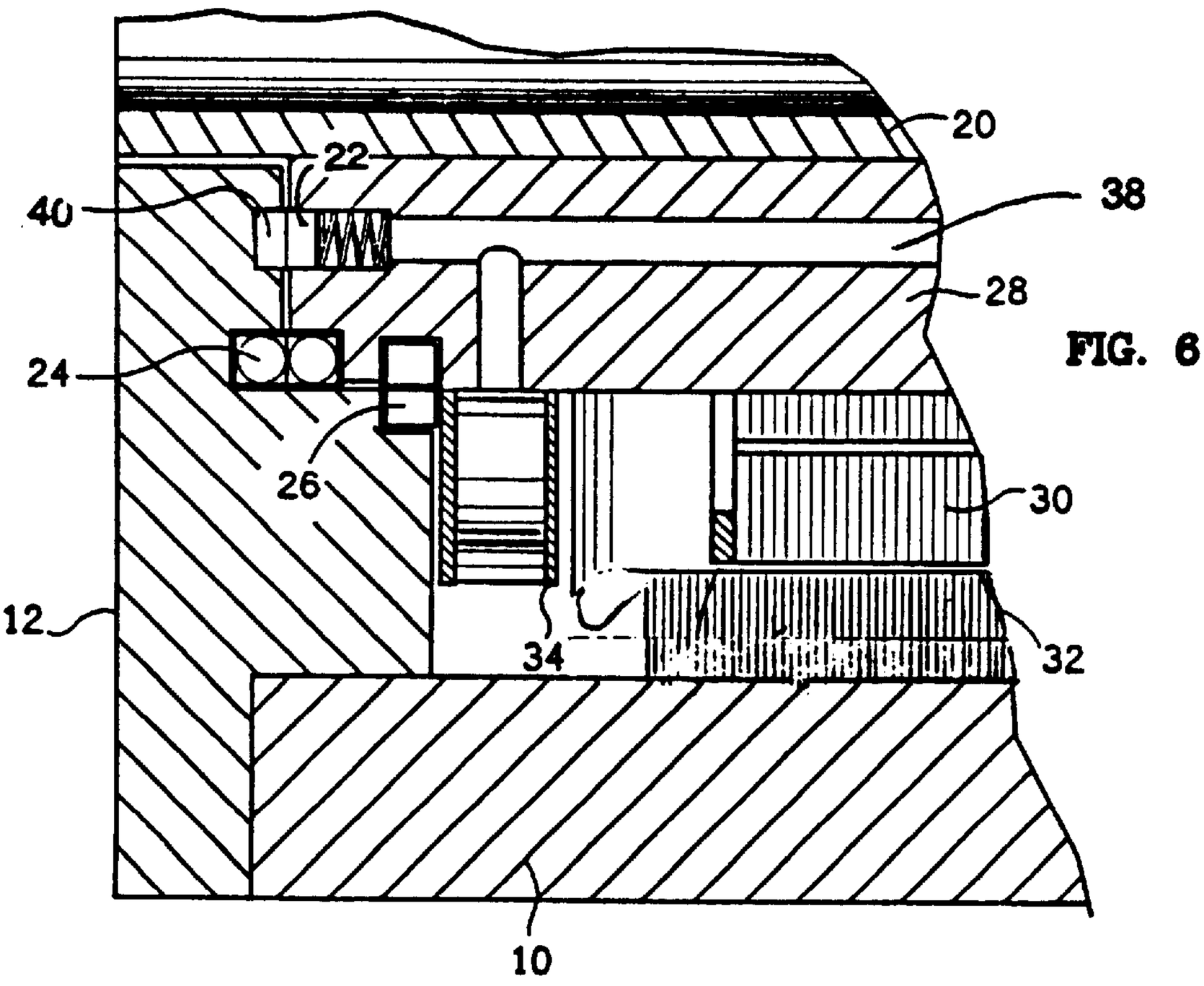

FIG. 6

INTEGRAL MOTOR CENTRIFUGAL PUMP

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to a centrifugal pump which in its conventional form comprises an impeller fitted with vanes and rotating in a closed casing. Fluid enters the casing at the center of the impeller where, due to the rotation of the impeller, the pressure of the fluid is increased and the fluid is delivered to the periphery at a high velocity. Rotation of the impeller is activated by an external electric motor shaft penetrating into the closed casing (volute) onto which the impeller is attached.

2. Description of the Related Art

U.S. Pat. No. 3,134,332, Nielson 1964, describes a conventional centrifugal pump with an electric motor driving the impeller. U.S. Pat. No. 4,773,822 Jensen et al 1988, describes the separation between the rotating impeller inlet and the volute supply inlet allowing a certain percentage of the pumped fluid to reenter the impeller suction inlet. U.S. Pat. No. 4,773,823, Pease 1988, describes the complexity of included parts in a conventional motor driven pump.

SUMMARY OF THE INVENTION

The present art of electromotive centrifugal pumping has historically required a separation between the rotating centrifugal impeller inlet and the stationary volute supply inlet. The resultant pressurized fluid effectively transits through the separation between the volute and the impeller suction inlet. The separation allows a certain percentage of the pumped media to reenter the impeller suction supply inlet. The resultant recirculation requires the application of additional electrical energy to repressurize the aforementioned recirculating media. The resultant recirculation may also wear the surfaces of either the impeller inlet and/or the volute supply inlet. This wearing process decreases the efficiency of the pump proportionally with the increased separation of the impeller inlet and the volute supply inlet. In certain pumping situations, i.e., sewage, pulp, trash pumping, etc., the recirculating media may carry suspended solids. These solids complicate the pumping process when they become wedged between the rotating impeller inlet and the stationary volute. The efficiency of the pump decreases when the wedged suspended solids causes impeller cavitation and/or friction. The wedged suspended solids could effectively disable the pump or even stop the rotation of the impeller. Damage may result to either the electromotor, the impeller or the volute intake. Depending upon the impeller, volute or pump assembly the removal of these solids from the pump could be dangerous, labor intensive or expensive.

Furthermore, electromotive centrifugal pumping has encumbered design configurations of the drive motor to be an external appendage in relation to the impeller and volute. Centrifugal pump impellers are usually driven by the electromotor shaft or pump bearing and alignment shaft intruding into the volute cavity. The impeller is usually tapped and screwed to the shaft or bolted on the shaft in some fashion. This and similar design configurations also encumber the assembly design to unnecessary parts and complexity.

It is an objective of this invention to provide an improved electromotive pump and impeller assembly. It is a more particular objective to provide in a centrifugal pump a unique means of preventing the inherent recirculation an associated problems of conventional pump assemblies. The present invention in the proposed configuration eliminates a number of parts, tooling processes and associated manufacturing cost. A reduction in the number of unnecessary component parts effectively reduces the complexity, weight and size of the invention. Therefore, the necessary manufacturing, assembly and service procedures are effectively reduced. For clarification, the improvements encompass a combined rotating impeller intake -and power transmitting shaft integral with a new totally sealed water design. The hollow impeller shaft serves the dual purpose of transmitting motor rotational power to the enclosed impeller blades and serves as the impeller fluid intake conduit. This arrangement effectively eliminates the necessity of a volute intake, adjustable impeller/volute clearance tolerances and the industry standard wearing rings for enclosed impeller pumps. This present invention efficiently transmits the motor power directly to the impeller blades. This configuration completely eliminates the inherent recirculation problems associated with conventional present art centrifugal pumps. It also enhances the radial thrust bearing curve thereby dramatically increasing service life and range of the pump and impeller applications. This arrangement implements a new ease of impeller access for inspection purposes and new ease of changing the impeller unit. This present invention incorporates optional changeable impeller leading edge blades.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the integral motor/pump of the present invention.

FIG. **2** is an exploded view of the integral motor/pump of the present invention.

FIG. **3** is an expanded detail of the basic integral motor/pump components of the present invention.

FIG. **4** is a cross section including the internal motor body oil coolant impeller.

FIG. **5** is a cross section through the electromagnet and rotor section.

FIG. **6** is an expanded detail of an alternate bearing arrangement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An integral motor/pump according to the present invention is shown generally by reference numeral **8** in FIG. **1**. The pump comprises a main motor housing **10** and two motor endplates **12**. The pump volute **14** is attached in an appropriate manner to one of the motor endplates **12**. A removable volute inspection endplate **16** is attached to the volute **14**. The impeller **20** that rotates inside of volute **14** has a removable impeller inspection end plate **18** attached to its outmost blade enclosure plate. Roller bearings **24** are held in place by recessed seats in the endplates **12** and the motor shaft **28**.

Motor housing **10** secures electromagnet **32**. The electromagnet **32** being powered by an outside voltage and current source creates a rotating electromagnetic field. The rotating electromagnetic field induces a current and electromagnetic force in rotor **30**. The rotor is secured and stabilized by the hollow motor shaft **28**. The motor shaft is supported and stabilized by bearings **24** mounted on each end. The motor is sealed by floating mechanical seals **22** recessed into each

end of the motor shaft **28**. A stationary seal **40** is recessed into each motor endplate and the floating seal **22** is pressed against the stationary seal **40** by springs **21** mounted inside shaft **28**. Spring **21** exerts sealing pressure for the floating mechanical seal **22**. The hollow impeller shaft **20** is inserted into and rotated by the hollow motor shaft **28**. Internal coolant oil impeller blades **34** are mounted on opposite ends of motor shaft **28** in reverse direction of each other. The coolant oil impeller blades are used to move motor cooling oil through the heat exchange traverse conduits **38** of the motor shaft **28**.

Optional replaceable impeller leading edge blades **36** are noted in FIG. **2**. FIG. **6** shows an alternate bearing arrangement whereby bearing **24** is a double stacked thrust ball bearing. Bearing **26** is double stacked roller bearing used for shaft **28** alignment.

To summarize, the present invention is an electric integral motor/pump which is simple, clean and efficient to operate. The motor pump is especially well suited for many centrifugal pump applications. Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

What I claim is:

1. A motor driven centrifugal pump comprising:

(a) **[**an oil cooled motor comprising**]** a hollow motor shaft, a motor enclosure, **[**a top motor end plate and a bottom motor end plate**]** *and two motor endplates*;

(b) a hollow impeller shaft concentric within and coupled to said hollow motor shaft;

(c) said hollow impeller shaft **[**having a top end which extends**]** *extending* beyond said motor enclosure, past **[**said top motor end plate**]** *one of the motor end plates*;

(d) **[**top**]** *lubricated* axial bearings located in **[**said top motor end plate**]** *each of the motor end plates and* supporting said hollow motor shaft;

[(e) bottom axial bearings located in said bottom motor end plate supporting said hollow motor shaft;**]**

(**[**f**]** *e*) a **[**cylindrical volute casing enclosing the impeller said casing mounted on top of said motor end plate**]** *volute casing enclosing an impeller connected to the impeller shaft, said impeller having a top*;

(**[**g**]** *f*) a removable impeller inspection end plate attached to the top of said impeller;

[(h) said axial bearings being oil lubricated;**]**

(**[**i**]** *g*) oil lubricated mechanical sealing means located on the interface of the hollow motor shaft and the motor end plates for sealing said motor; *and*

(**[**j**]** *h*) a removable volute inspection plate attached to the top of the volute casing.

2. A motor driven centrifugal pump as described in claim **1** and further comprising:

(a) two oil circulating impellers mounted on the hollow motor shaft.

3. A centrifugal pump comprising:

a stator;

a hollow rotating shaft through which a pumpate flows, the shaft operating an impeller which pumps the pumpate, said impeller having a top;

a removable impeller inspection plate attached to the top of the impeller;

at least two bearings which support the rotating shaft relative to the stator; and

at least two mechanical seals sealing the rotating shaft such that the pumpate is substantially kept from contacting the at least two bearings.

4. The centrifugal pump of claim 3 further comprising a volute disposed about the impeller, and a volute inspection plate attached to the volute.

5. The centrifugal pump of claim 3 further comprising a rotor concentric with the rotating shaft.

6. A centrifugal pump comprising:

a shaft defining an internal channel through which a fluid can flow, the shaft operating an impeller which pumps the pumpate, said impeller having a top;

a removable impeller inspection plate attached to the top of the impeller;

a motor having a stator and a rotor, the rotor concentric with and coupled to the shaft;

first and second bearings positioned about the shaft on opposite sides of the rotor; and

first and second seals positioned about the shaft to form a substantially fluid tight barrier between the fluid and the bearings.

7. The centrifugal pump of claim 6 further comprising a volute disposed about the impeller, and a volute inspection plate attached to the volute.

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