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(54) **FUEL PUMP ASSEMBLY**

(75) Inventors: **Kevin L. Israelson**, Cass City, MI (US); **Ronald H. Roche**, Cass City, MI (US)

Correspondence Address:
REISING, ETHINGTON, BARNES, KISSELLE, P.C.
P O BOX 4390
TROY, MI 48099-4390 (US)

(73) Assignee: **Walbro Engine Management, L.L.C.**

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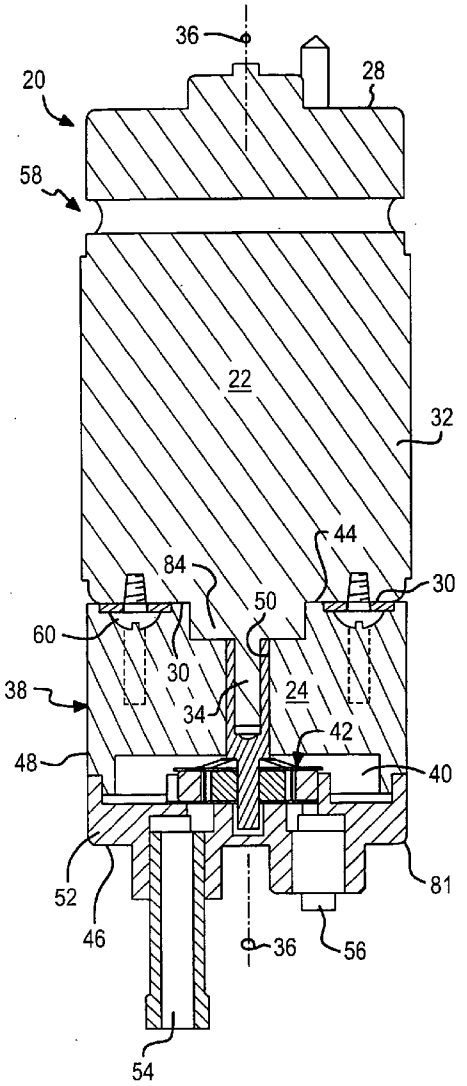
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(57) **ABSTRACT**

A fuel pump assembly has a pump mounted to an electric motor by a spring clamp device preferably having a plurality of arms spaced circumferentially around the pump and extending axially generally parallel to an axis of rotation of the motor, from a common base member. The base member is preferably received by the motor, and each arm preferably has a clip which projects radially inward to contact an outboard end face of the pump. The clips are preferably disengageable from the pump and exert a controlled force on the pump, thus producing a consistent and controlled clamping force across the housing encasement to eliminate any potential distortion of the preferably plastic housing.



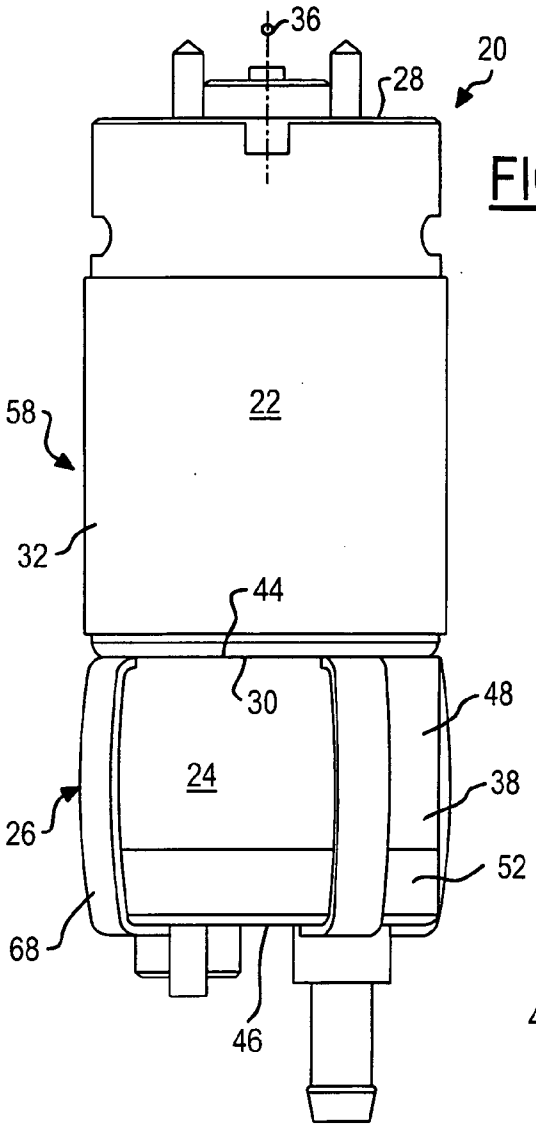


FIG. 1

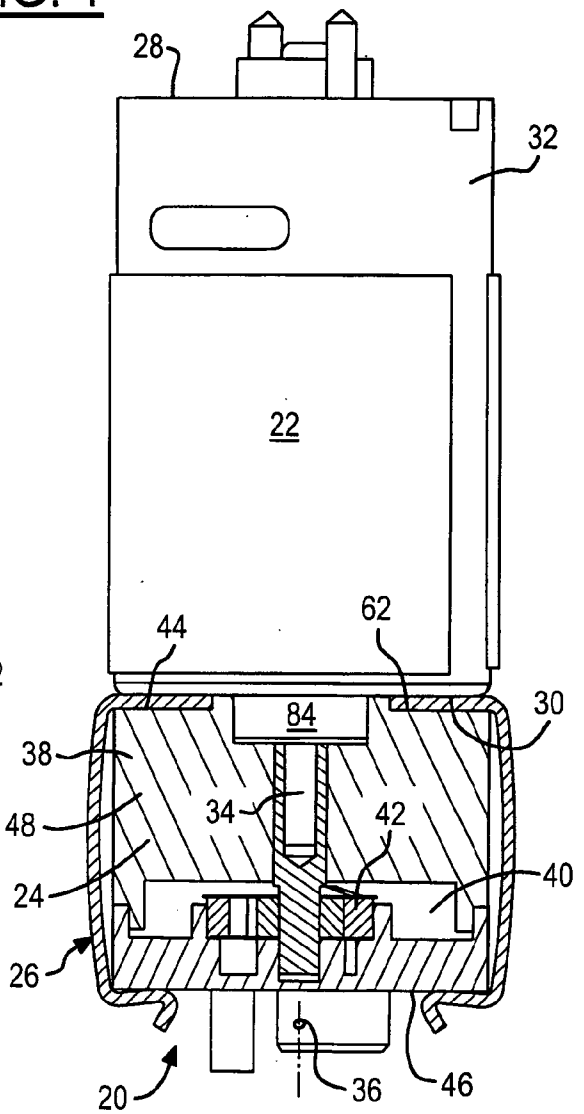


FIG. 3

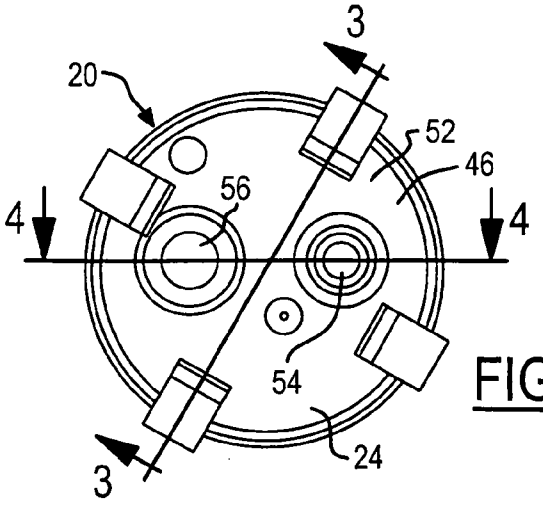


FIG. 2

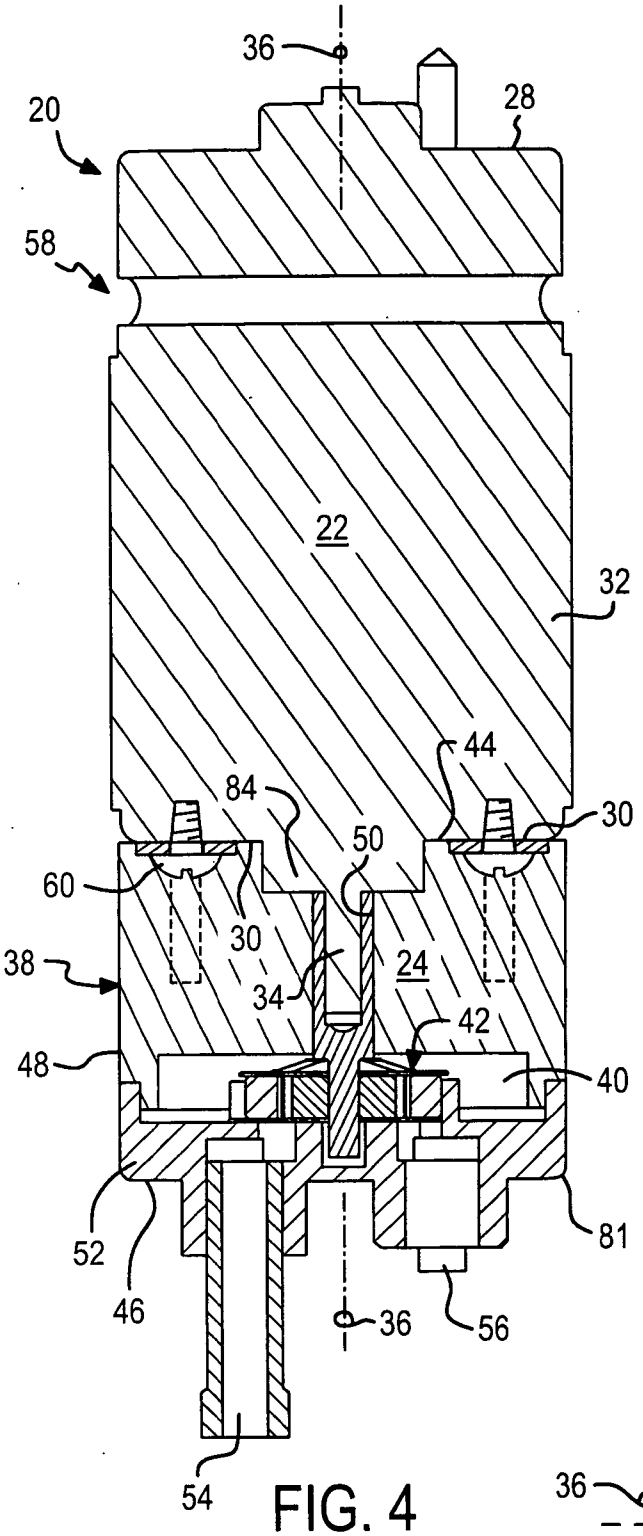


FIG. 4

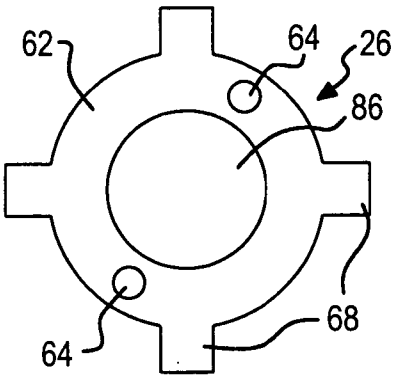


FIG. 5

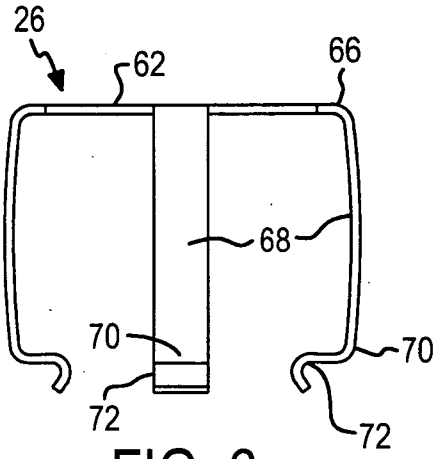


FIG. 6

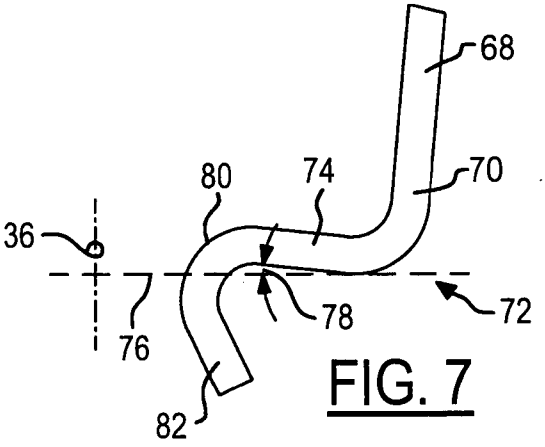


FIG. 7

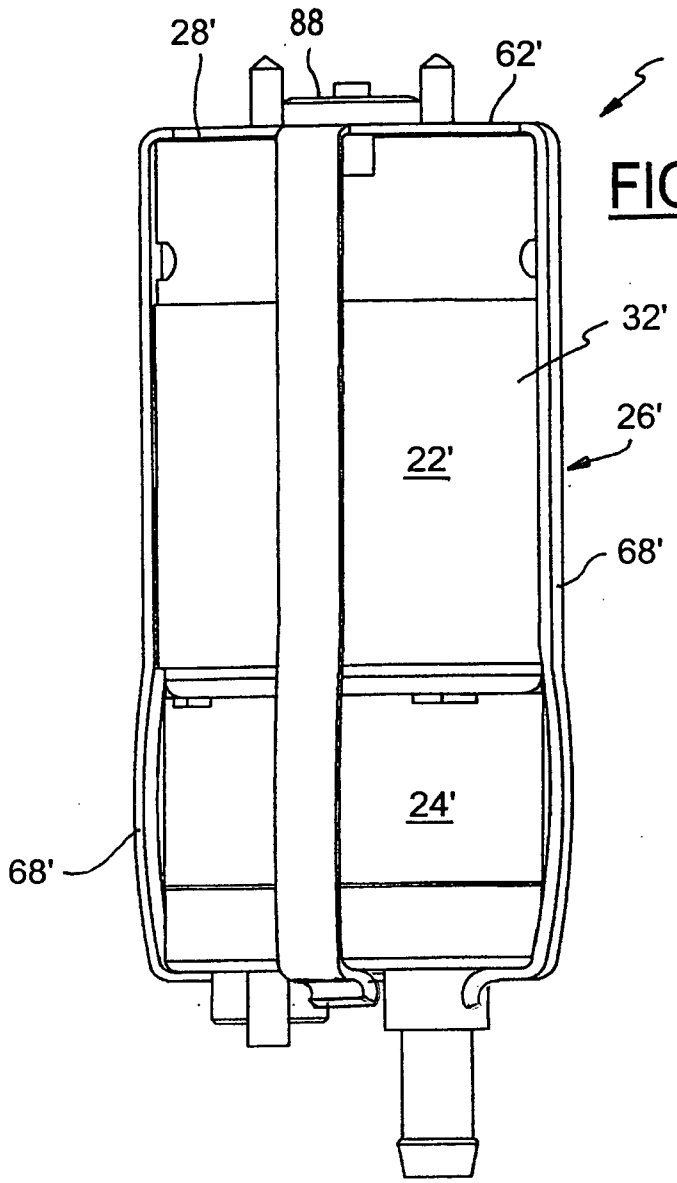


FIG. 8

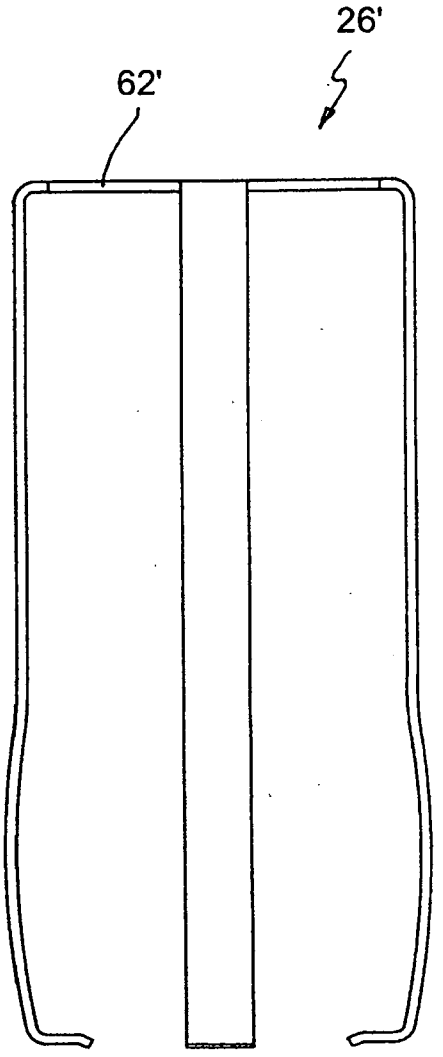


FIG. 9

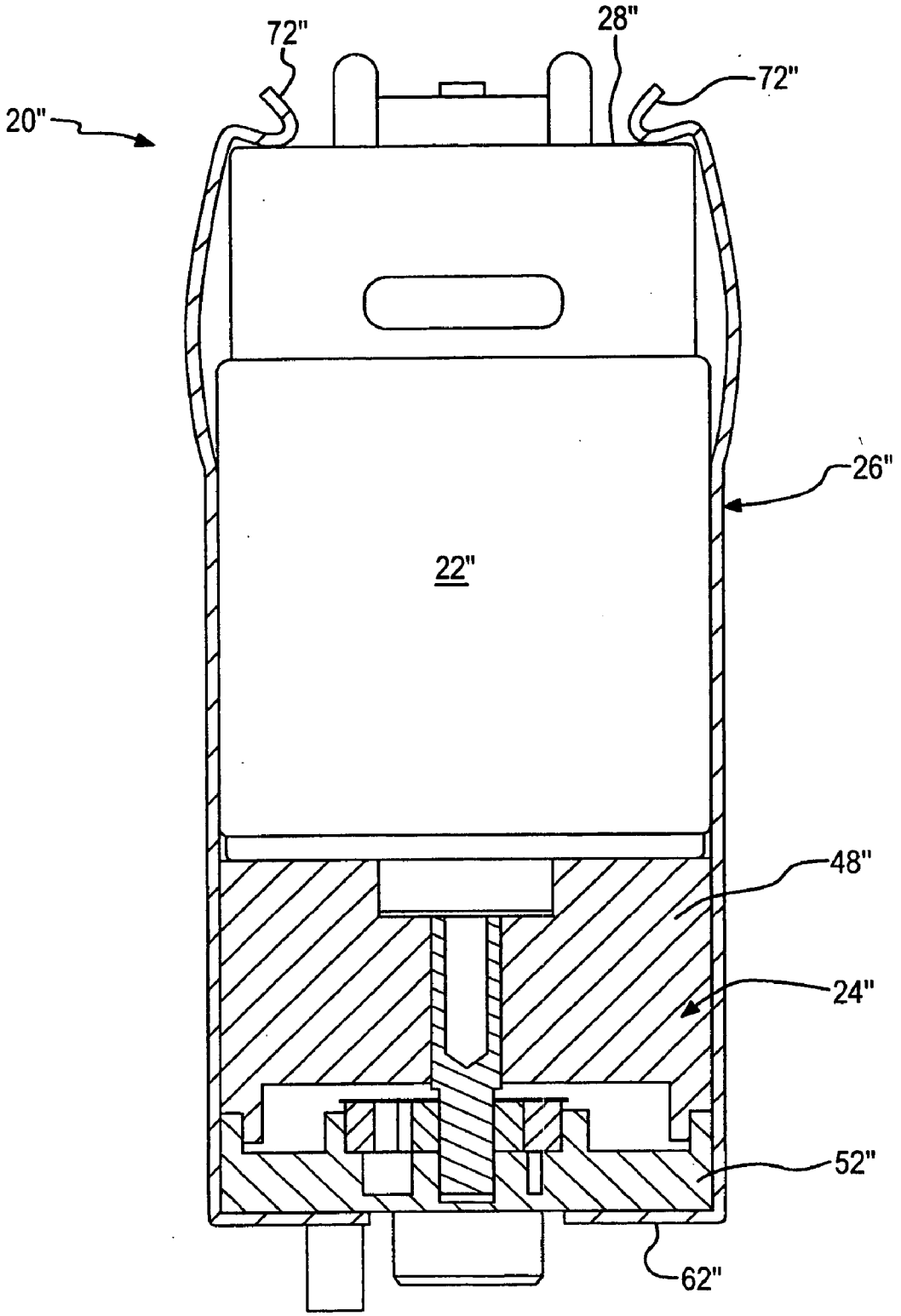


FIG. 10

FUEL PUMP ASSEMBLY

FIELD OF THE INVENTION

[0001] The present invention relates generally to a fuel pump assembly and more particularly to a spring clamp device for securing a motor to a pump of the assembly.

BACKGROUND OF THE INVENTION

[0002] Prior art automotive fuel pump assemblies typically have an electric motor with a stator and an armature with a drive shaft connected to a fuel pump between inlet and outlet end caps which are all received inside of a metallic sleeve extending axially along the entire length of the assembly. The ends of the sleeve are rolled over and project radially inward of the end caps to generally align and hold the assembly together and prevent de-coupling of the pump from the motor. During manufacturing, the various components of the pump and motor and the end caps are all assembled inside the sleeve and then both of its ends are rolled over the end caps thus securing all of the components of the pump and motor together in axial alignment.

[0003] Unfortunately, this process requires the entire assembly be purchased from a single manufacturer who assembles and/or produces both pump and motor components. Furthermore, rolling the ends of the sleeve places a compressive force on the internal components which is not easily controlled or consistently repeated. Excessive stress placed upon the plastic components of the pump can degrade pump performance. Yet further, the sleeve-type of pump and motor assembly is expensive to manufacture and can not be repaired without destroying the sleeve.

SUMMARY OF THE INVENTION

[0004] A fuel pump assembly has a pump coupled to an electric motor by a spring clamp device preferably having a plurality of arms spaced circumferentially around the pump and motor and extending generally axially and parallel to an axis of rotation of the motor, from a common first member and to a plurality of second members. The first member spans radially and is preferably received by the motor, and the plurality of second members preferably project radially inward from the respective arms to contact an outboard face of the pump. The second members are preferably disengageable clips which exert a controlled force upon the pump, thus exhibiting a consistent and controlled stress across the pump encasement to eliminate any potential distortion of the preferably plastic encasement.

[0005] Objects, feature, and advantages of this invention include a fuel pump assembly which can be dis-assembled without destroying any of the assembly components, the motor and pump can be separately manufactured and pre-assembled, and the pump encasement can be made of relatively inexpensive plastic without concern of distortion. Operation reliability and performance is improved, and the assembly is rugged, durable, maintenance free, of relatively simple design, inexpensive to manufacture and assemble, and in service has a long useful life.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and other objects, features and advantages of this invention will be apparent from the following detailed description of the presently preferred embodiments and best mode, appended claims, and accompanying drawings in which:

[0007] **FIG. 1** is a side view of a fuel pump assembly of the present invention;

[0008] **FIG. 2** is a bottom end view of the fuel pump assembly;

[0009] **FIG. 3** is a segmented cross section of a fuel pump and spring clamp device of the fuel pump assembly taken along line **3-3** of **FIG. 2**;

[0010] **FIG. 4** is a cross section of the fuel pump assembly illustrating two fasteners and taken along line **4-4** of **FIG. 2**;

[0011] **FIG. 5** is a top view of the spring clamp assembly;

[0012] **FIG. 6** is a side view of the spring clamp assembly;

[0013] **FIG. 7** is an enlarged fragmentary side view of the spring clamp assembly of **FIG. 6**;

[0014] **FIG. 8** is a side view of a second embodiment of a fuel pump assembly;

[0015] **FIG. 9** is a side view of a second embodiment of the spring clamp device utilized in **FIG. 8**; and

[0016] **FIG. 10** is a segmented cross section of a third embodiment of a fuel pump assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Referring in more detail to the drawings, **FIGS. 1-4** illustrate an electric fuel pump assembly **20** embodying the present invention and having an electric motor **22** coupled to a fuel pump **24** secured by a spring clamp device **26** to the motor. The motor **22** is generally elongate axially and has a stator encircling an armature with a drive shaft **34** journaled for rotation by bearings carried by end caps **28** and **30** received in a housing shell **32**. The drive shaft **34** projects axially outward from the inboard end cap or surface **30** along an axis of rotation **36** for mechanical coupling to the fuel pump **24**. The motor **22** and the pump **24** are preferably pre-assembled, "off-the-shelf," items which are releasably mounted together in coaxial alignment by the snap fitting spring clamp device **26**.

[0018] Referring to **FIGS. 3 and 4**, the fuel pump **24** has an encasement or housing **38** with a base **48** and a cover or end cap **52** preferably made of non-corrosive and economical plastic which defines a cavity **40** receiving a gear-rotor assembly **42** of a positive displacement pump. The base **48** has an inboard face **44** which faces the inboard end cap or surface **30** of the motor **22** and a through bore **50** for receipt of the motor shaft **34**. The pump end cap or cover **52** is attached and sealed to the base **48** during assembly and after the gear-rotor assembly **42** is installed therein. The end cap **52** has an outboard end face **46** and an axially projecting fuel outlet **54** and a fuel inlet **56**. Inlet **56** communicates with the fuel inlet of the gear-rotor assembly **42** and outlet **54** communicates with the cavity or outlet **40** of the gear-rotor assembly through which it discharges fuel at a high pressure when operating. If desired, a turbine pump assembly or other type of fuel pump assembly may be utilized in lieu of the gear-rotor pump assembly **42**.

[0019] Referring to **FIGS. 5-7**, the spring clamp device **26** releasably mounts and attaches together the motor **22** and pump **24** of the fuel pump assembly **20**. The clamp device **26** preferably attaches to the inboard end cap or surface **30** of the motor **22** by two fasteners or screws **60** and extends radially outward and axially along the pump housing **38** to partially envelope or "cage," and resiliently engage the pump **24**. An annular member or base plate **62** of the spring clamp device **26** has two diametrically opposed holes **64** to receive the screws **60** which thread into the end cap **30** of the motor **22** and hold the base plate **62** directly against the end cap **30** in a substantially perpendicular orientation to the axis of rotation **36**. Four resilient flex arms **68** project substantially axially downward from a peripheral edge **66** of the base plate **62** and are preferably integral and unitary with the base plate. The arms **68** are preferably substantially equally spaced circumferentially from one another and are preferably slightly bowed outward when not flexed for engagement to the pump **24**. Located at the distal end **70** of each arm **68** is a finger or clip **72**, which projects generally radially inward, and resiliently snaps over the outboard face **46** of the pump encasement **38** as the arms **68** resiliently flex from a radially outward unstressed state and in a generally radially inward direction toward a radial unstressed state and axial stressed state.

[0020] Each clip **72** has a contact portion **74** which projects radially inward from its associated flex arm **68** and preferably angles axially inward at an angle **78** preferably about five degrees when in a disengaged state (as best shown in **FIGS. 6 and 7**) and with respect to an imaginary plane **76** disposed perpendicular to the axis of rotation **36**. From the contact portion **74**, the clip **72** has a rounded cam-like return bend **80** which extends to a generally axially outward projecting distal tab **82** of the clip **72**. The spring clamp device **26** is preferably made from a single stamping of sheet metal or spring steel.

[0021] During assembly of the fuel pump assembly **20**, a downward projecting cylindrical shoulder **84** of the motor housing **32**, disposed concentrically about the shaft **34**, is received in the base plate **62** of the spring clamp device **26** through a central hole **86** (as best shown in **FIG. 5**). The screws **60** are then threaded into the motor end cap **30** which rigidly holds the base plate **62** to the motor **22** with the flex arms **68** projecting generally axially away from the motor **22** (as best shown in **FIGS. 3 and 4**). The clips **72** of the flex arms **68** are then resiliently moved radially outward so that the clips **72** radially clear the pump housing **38** when the pump **24** is moved between them, and axially toward and coupled with the motor **22**.

[0022] With the pump **24** coupled to the motor drive shaft **34** and the flex arms **68** released, the cam-like bends **80** of the clips **72** are preferably in biased contact with a slightly rounded peripheral edge **81** of the pump encasement **38** but not yet in direct contact with the outboard face **46**. An external force applied in a radially inward direction against the mid-section of each bowed flex arm **68** causes the flex arms to generally straighten and the contact portions **74** of the clips **72** to align parallel with the imaginary plane **76** (as best shown in **FIG. 7**). The cam-like bend **80** then assists each clip **72** to snap over the edge **81** and slide over the outboard face **46** in a radially inward direction. When the external force placed upon the flex arms is released, the resilience or spring force of the bowed flex arms **68** and clips **72** exert an evenly distributed and consistent force upon the plastic pump encasement **38** in an axially inward direction. If removing the pump **24** from the motor **22** is desired, a radially outward force is placed upon the clip tabs **82** which flexes the arms **68** radially outward to radially clear the clips **72** from the cylindrical pump housing **38**. Once cleared, the pump **24** can then be moved axially away and de-coupled and removed from the motor **22**.

[0023] **FIGS. 8 and 9** illustrate a modified spring clamp device **26'** wherein the flex arms **68'** extend the entire axial length of the pump **24'** and motor **22'** and the base plate **62'** is in biased contact with the outboard end cap **28'** of the motor housing **32'**. Preferably the end cap **28'** has a cylindrical shoulder **88** over which the base plate **62'** is received. With this modification, separate fasteners or screws are not required.

[0024] Skilled persons will understand that the orientation of the spring clamp device **26"** relative to the motor **22"** and pump **24"** could be reversed so that the clips **72"** engage the motor end cap or surface **28"** and the base plate **62"** is attached to the pump base **48"** or overlies and engages to the pump end cap **52"** (as best shown in **FIG. 10**).

[0025] While the forms of the invention herein disclosed constitute presently preferred embodiments, many others are possible. It is not intended herein to mention all the possibly equivalent forms or ramifications of the invention and it is understood that the terms used herein are merely descriptive rather than limiting and that various changes may be made without departing from the spirit or scope of the invention.

1. An electric motor pump assembly comprising:

a pump;

a separate electric motor coupled to the pump along an axis of rotation; and

a spring clamp device having;

a base member carried by one of the pump and the motor;

at least two flex arms each carried by the base member and circumferentially spaced apart and extending axially along at least one portion of the pump and motor; and

a clip projecting radially inward from each flex arm adjacent a distal end of the flex arm and received by the other of the pump and motor.

2. The pump assembly set forth in claim 1 comprising:

an inboard end cap of the motor axially facing the pump; and

at least one fastener engaging the base member to the inboard end cap.

3. The pump assembly set forth in claim 2 wherein the base member is substantially disposed axially between the pump and motor.

4. The pump assembly set forth in claim 3 wherein the at least one fastener threads into the inboard end cap.

5. The pump assembly set forth in claim 1 wherein the flex arm is bowed radially outward when the spring clamp device is in a disengaged state.

6. The pump assembly set forth in claim 1 comprising a contact portion of the clip projecting radially inward from

the flex arm and projecting slightly axially inward with respect to the axis of rotation when the spring clamp device is in a disengaged state, and the contact portion being biased directly against the other of the pump and motor when the spring clamp device is in an engaged state by the flex arm.

7. The pump assembly set forth in claim 6 comprising a distal tab projecting substantially axially outward from the contact portion for moving the clip radially outward against the radially inward biasing force of the flex arm to release the spring clamp device from the other of the pump and motor.

8. The pump assembly set forth in claim 1 wherein the at least two flex arms are equally spaced circumferentially about the motor and pump and are each bowed radially outward.

9. The pump assembly set forth in claim 8 comprising a contact portion of the clip projecting radially inward from each one of the plurality of flex arms and projecting slightly axially inward with respect to the axis of rotation when the spring clamp device is in the disengaged state, and the contact portion being biased directly against the other of the pump and motor when the spring clamp device is in an engaged state by the respective plurality of flex arms.

10. The pump assembly set forth in claim 9 comprising a distal tab projecting substantially axially outward from the contact portion of the clip for moving the clip radially outward against the radially inward biasing force of each one of the at least two flex arms to release the spring clamp device from the other of the pump and motor.

11. The pump assembly set forth in claim 1 comprising:

an inboard end cap of the motor axially facing the pump;

an opposite outboard end cap of the motor;

an outboard face of the pump facing axially from the motor; and

the base member being in biased contact with the outboard end cap when the clips are in biased contact with the outboard face.

12. The pump assembly set forth in claim 11 wherein the base member is planar and annular in shape.

13. A spring clamp device for preventing de-coupling of a pump from a motor of a pump sub-assembly and along an axis of rotation, the spring clamp device having:

a base member spanning radially with respect to the axis of rotation;

a plurality of arms projecting axially from the first member and spaced circumferentially from one-another about the pump sub-assembly; and

a clip projecting radially with respect to the axis of rotation and from a distal end of each one of the plurality of arms.

14. The spring clamp device set forth in claim 13 comprising an engaged state wherein the base member and the clips are biased axially away from one-another by at least a portion of the pump sub-assembly.

15. The spring clamp device set forth in claim 14 comprising:

a disengaged state wherein each one of the plurality of arms are bowed radially outward with respect to the axis of rotation; and

the engaged state causing each one of the plurality of arms to be less bowed than when in the disengaged state.

16. The spring clamp device set forth in claim 14 comprising:

the base member being in contact with an outboard surface carried by the pump sub-assembly;

the clips being in biased contact with an opposite outboard face carried by the pump sub-assembly; and

wherein the pump sub-assembly extends axially between the outboard surface and the outboard face.

17. The spring clamp device set forth in claim 13 comprising:

the base member being in contact with an outboard surface carried by the motor;

the clips being in biased contact with an outboard face carried by the pump; and

wherein the outboard surface faces axially away from to the outboard face.

18. The spring clamp device set forth in claim 13 comprising:

the base member being engaged to the motor via at least one fastener; and

the clips being in biased contact with an outboard face carried by the pump.

19. The spring clamp device set forth in claim 13 wherein the base member, the plurality of arms and the clips are unitarily formed together from a single stamping of metal.

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