ORIGINAL

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UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF CALIFORNIA

ILLINOIS TOOL WORKS INC., DBA WYNN'S, a Delaware corporation,

Plaintiff,

vs.

MOC PRODUCTS COMPANY, INC., a California corporation,

Defendant.

CASE NO. '09 CV 1887 MMA JMA

COMPLAINT FOR INFRINGEMENT OF U.S. PATENT NOS. 5,806,629; 6,112,855, AND 6,073,638

[Demand for Jury Trial]

CR

For its complaint against MOC PRODUCTS COMPANY, INC., a California corporation ("MOC"), Plaintiff ILLINOIS TOOL WORKS INC., DBA WYNN'S, a Delaware corporation ("Wynn's") alleges as follows:

THE PARTIES

1. Plaintiff ILLINOIS TOOL WORKS INC., DBA WYNN'S is a corporation organized and existing under the laws of the State of Delaware, and has its principal place of business at 3600 West Lake Ave., Glenview, Illinois.

2. Defendant MOC PRODUCTS COMPANY, INC. is a corporation duly organized and existing under the laws of the State of California with its principal place of business located in the City of Los Angeles, California.

JURISDICTION AND VENUE

3. This is a civil action arising in part under laws of the United States relating to patents (35 U.S.C. §§ 1 *et seq.*). This Court has subject matter jurisdiction of such federal question claims pursuant to 28 U.S.C. §§ 1331 and 1338(a). This Court has personal jurisdiction over MOC because MOC has established minimum contacts with the forum and the exercise of jurisdiction over MOC would not offend traditional notions of fair play and substantial justice. On information and belief, MOC has voluntarily conducted business and solicited customers throughout this district. On information and belief, MOC advertises, markets, sells and distributes infringing products in this district and/or contributes to infringement or induces others to infringe. In addition, on information and belief, Defendant MOC's acts of willful patent infringement arose out of transactions and occurrences that originated in this district.

4. Venue is proper under 28 U.S.C. §§ 1391(b), 1391(c) and 1400(a), because MOC is subject to personal jurisdiction in this district, and because MOC has committed acts of infringement in this district. On information and belief, MOC has voluntarily conducted business and solicited customers throughout this district. On information and belief, MOC advertises, markets, sells and distributes infringing products in this district and/or contributes to infringement or induces others to infringe. In addition, on information and belief, Defendant MOC's acts of willful patent infringement arose out of transactions and occurrences that originated in this district.

CLAIM FOR RELIEF NO. ONE

INFRINGEMENT OF U.S. PATENT NO. 5,806,629

5. Plaintiff incorporates by reference the preceding allegations of this Complaint as though fully set forth herein.

6. Plaintiff is the owner of U.S. Patent No. 5,806,629 (the "'629 Patent") which was duly granted by the United States Patent and Trademark Office on September 15, 1998. A true and correct copy of the '629 Patent is attached hereto as Exhibit 1.

7. Defendant MOC has infringed and continues to infringe the '629 Patent by making, using, selling, or offering to sell in the United States, products, devices or methods that embody or otherwise practice one or more of the claims of the '629 Patent, literally and/or pursuant to the Doctrine of Equivalents, and/or by otherwise contributing to infringement or inducing others to infringe the '629 Patent. The infringing products, devices, or methods include, but are not limited to, MOC's manufacture, use, offers for sale and sale of the MOC ATF Exchanger machines.

8. Defendant MOC's infringement of the '629 Patent is, and has been, willful and deliberate.

9. As a direct and proximate result of Defendant MOC's infringement of the '629 Patent, Plaintiff has been and continues to be damaged in an amount to be proven at trial.

10. Defendant MOC's infringement is ongoing and has caused, and, unless enjoined and restrained by this Court, will continue to cause Plaintiff great and irreparable injury to, among other things, Plaintiff's good will, business reputation, and market share. Plaintiff is therefore entitled to injunctive relief enjoining and restraining Defendant MOC, and its respective officers, agents, servants, and employees, and all persons acting in concert with them, and each of them, from further infringement of the '629 Patent.

CLAIM FOR RELIEF NO. TWO

INFRINGEMENT OF U.S. PATENT NO. 6,112,855

11. Plaintiff incorporates by reference the preceding allegations of this Complaint as though fully set forth herein.

12. Plaintiff is the owner of U.S. Patent No. 6,112,855 (the "'855 Patent") which was

duly granted by the United States Patent and Trademark Office on September 5, 2000. A true and correct copy of the '855 Patent is attached hereto as Exhibit 2.

13. Defendant MOC has infringed and continues to infringe the '855 Patent by making, using, selling, or offering to sell in the United States, products, devices or methods that embody or otherwise practice one or more of the claims of the '855 Patent, literally and/or pursuant to the Doctrine of Equivalents, and/or by otherwise contributing to infringement or inducing others to infringe the '855 Patent. The infringing products, devices, or methods include, but are not limited to, MOC's manufacture, use, offer for sale and sale of the MOC ATF Exchanger machines and adapter kits for the MOC ATF Exchanger machines.

14. Defendant MOC's infringement of the '855 Patent is, and has been, willful and deliberate.

15. As a direct and proximate result of Defendant MOC's infringement of the '855 Patent, Plaintiff has been and continues to be damaged in an amount to be proven at trial.

16. Defendant MOC's infringement is ongoing and has caused, and, unless enjoined and restrained by this Court, will continue to cause Plaintiff great and irreparable injury to, among other things, Plaintiff's good will, business reputation, and market share. Plaintiff is therefore entitled to injunctive relief enjoining and restraining Defendant MOC, and its respective officers, agents, servants, and employees, and all persons acting in concert with them, and each of them, from further infringement of the '855 Patent.

CLAIM FOR RELIEF NO. THREE

INFRINGEMENT OF U.S. PATENT NO. 6,073,638

17. Plaintiff incorporates by reference the preceding allegations of this Complaint as though fully set forth herein.

18. Plaintiff is the owner of U.S. Patent No. 6,073,638 (the "'638 Patent") which was duly granted by the United States Patent and Trademark Office on June 13, 2000. A true and correct copy of the '638 Patent is attached hereto as Exhibit 3.

19. Defendant MOC has infringed and continues to infringe the '638 Patent by making, using, selling, or offering to sell in the United States, products, devices or methods that embody or

otherwise practice one or more of the claims of the '638 Patent, literally and/or pursuant to the Doctrine of Equivalents, and/or by otherwise contributing to infringement or inducing others to infringe the '638 Patent. The infringing products, devices, or methods include, but are not limited to, MOC's manufacture, use, offer for sale and sale of MOC Universal Induction Tool.

20. Defendant MOC's infringement of the '638 Patent is, and has been, willful and deliberate.

21. As a direct and proximate result of Defendant MOC's infringement of the '638 Patent, Plaintiff has been and continues to be damaged in an amount to be proven at trial.

22. Defendant MOC's infringement is ongoing and has caused, and, unless enjoined and restrained by this Court, will continue to cause Plaintiff great and irreparable injury to, among other things, Plaintiff's good will, business reputation, and market share. Plaintiff is therefore entitled to injunctive relief enjoining and restraining Defendant MOC, and its respective officers, agents, servants, and employees, and all persons acting in concert with them, and each of them, from further infringement of the '638 Patent.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff prays for judgment against Defendant as follows:

(1) for a judicial determination and declaration that Defendant has infringed the '629 Patent;

(2) for a judicial determination and decree that Defendant's infringement of the '629 Patent has been willful;

(3) for damages resulting from Defendant's infringement of the '629 Patent, and the trebling of such damages because of the willful and deliberate nature of Defendant's infringement;

(4) for injunctive relief enjoining against further infringement of the '629 Patent by Defendant, its officers, directors, shareholders, agents, servants, employees, and all other entities and individuals acting in concert with them or on their behalf;

(5) for a judicial determination and declaration that Defendant has infringed the '855 Patent;

(6) for a judicial determination and decree that Defendant's infringement of the '855 Patent has been willful;

(7) for damages resulting from Defendant's infringement of the '855 Patent, and the trebling of such damages because of the willful and deliberate nature of Defendant's infringement;

(8) for injunctive relief enjoining against further infringement of the '855 Patent by Defendant, its officers, directors, shareholders, agents, servants, employees, and all other entities and individuals acting in concert with them or on their behalf;

(9) for a judicial determination and declaration that Defendant has infringed the '638 Patent;

(10) for a judicial determination and decree that Defendant's infringement of the '638 Patent has been willful;

(11) for damages resulting from Defendant's infringement of the '638 Patent, and the trebling of such damages because of the willful and deliberate nature of Defendant's infringement;

(12) for injunctive relief enjoining against further infringement of the '638 Patent by Defendant, its officers, directors, shareholders, agents, servants, employees, and all other entities and individuals acting in concert with them or on their behalf;

(13) for an assessment of prejudgment interest on damages;

(14) for a declaration that this is an exceptional case under 35 U.S.C. § 285 and for an award of attorneys' fees and costs in this action;

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and for such other and further relief as the Court deems just and equitable.

DATED: August 28, 2009

THOMAS WHITELAW & TYLER LLP

By: _____

JOSEPH E. THOMAS
BRIAN G. ARNOLD
WILLIAM J. KOLEGRAFF
Attorneys for ILLINOIS TOOL WORKS INC., DBA WYNN'S, a Delaware corporation

DEMAND FOR JURY TRIAL

Plaintiff hereby demands a trial by jury of any issue triable by right of a jury pursuant to Rule 38 of the Federal Rules of Civil Procedure.

DATED: August 28, 2009

THOMAS WHITELAW & TYLER LLP

By: _____
JOSEPH E. THOMAS
BRIAN G. ARNOLD
WILLIAM J. KOLEGRAFF
Attorneys for ILLINOIS TOOL WORKS INC., DBA WYNN'S, a Delaware corporation

TABLE OF CONTENTS OF EXHIBITS

1. Exhibit 1: U.S. Patent No. 5,806,629
2. Exhibit 2: U.S. Patent No. 6,112,855
3. Exhibit 3: U.S. Patent No. 6,073,638

EXHIBIT 1

EXHIBIT 1

US005806629A

United States Patent [19]

Dixon et al.

[11] Patent Number: 5,806,629

[45] Date of Patent: Sep. 15, 1998

[54] APPARATUS AND METHOD FOR SERVICE OF AN AUTOMOTIVE AUTOMATIC TRANSMISSION

[75] Inventors: **Patrick Lewis Dixon**, San Dimas, Calif.; **Todd Michael Rounds**, Orlando, Fla.; **Michael Joseph Camacho**, Rancho Cucamonga, Calif.

[73] Assignee: **Wynn Oil Company**, Azusa, Calif.

[21] Appl. No.: **816,486**

[22] Filed: **Mar. 13, 1997**

[51] **Int. Cl.**[6] **F16C 3/14**

[52] **U.S. Cl.** **184/1.5**; 141/98

[58] **Field of Search** 184/1.5, 6.12; 141/98

[56] **References Cited**

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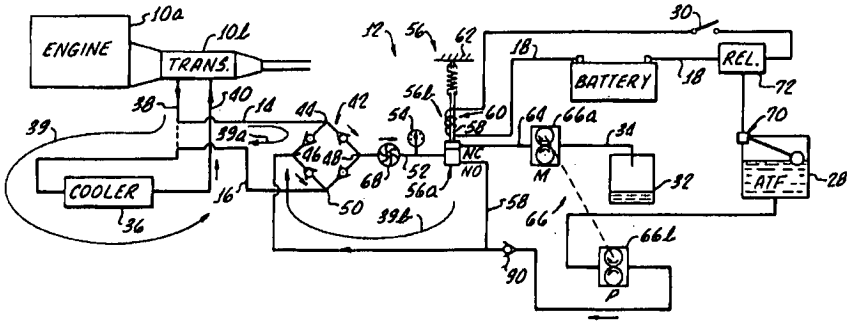
Primary Examiner—Thomas E. Denion
Attorney, Agent, or Firm—Terry L. Miller

[57] **ABSTRACT**

A fail-safe transmission service machine allows old ATF to be pumped out of a transmission while the vehicle engine runs, and responsively pumps a matching volume of new ATF into the transmission so that dry running of the transmission can not occur. If the supply of new ATF runs out or if power to the service machine is interrupted, the machine reverts to closed loop fluid circulation for the transmission. A hydraulic rectifier provides for universal connection of hoses between the transmission cooler fluid circulation loop of the vehicle and the service machine. An alternative embodiment of the machine allows for similarly fail-safe exchange of power steering fluid from a vehicle, and replacement of the old fluid with new power steering fluid.

17 Claims, 2 Drawing Sheets



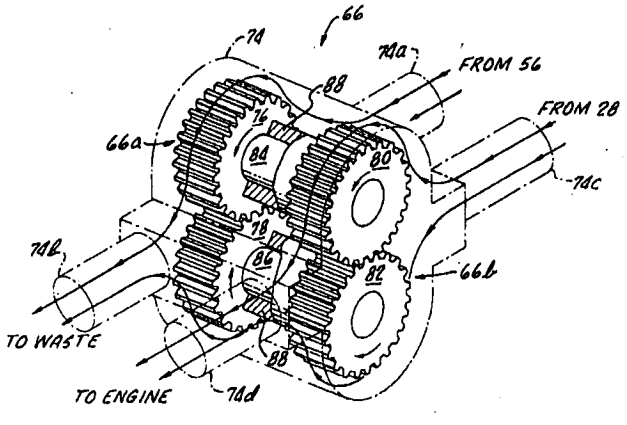
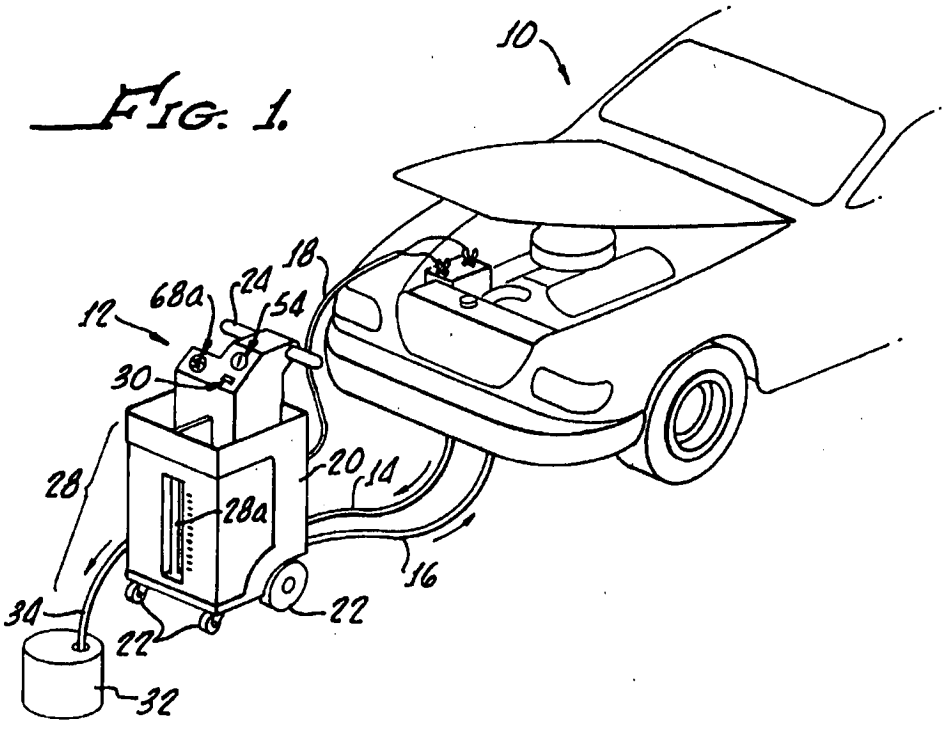


FIG. 1.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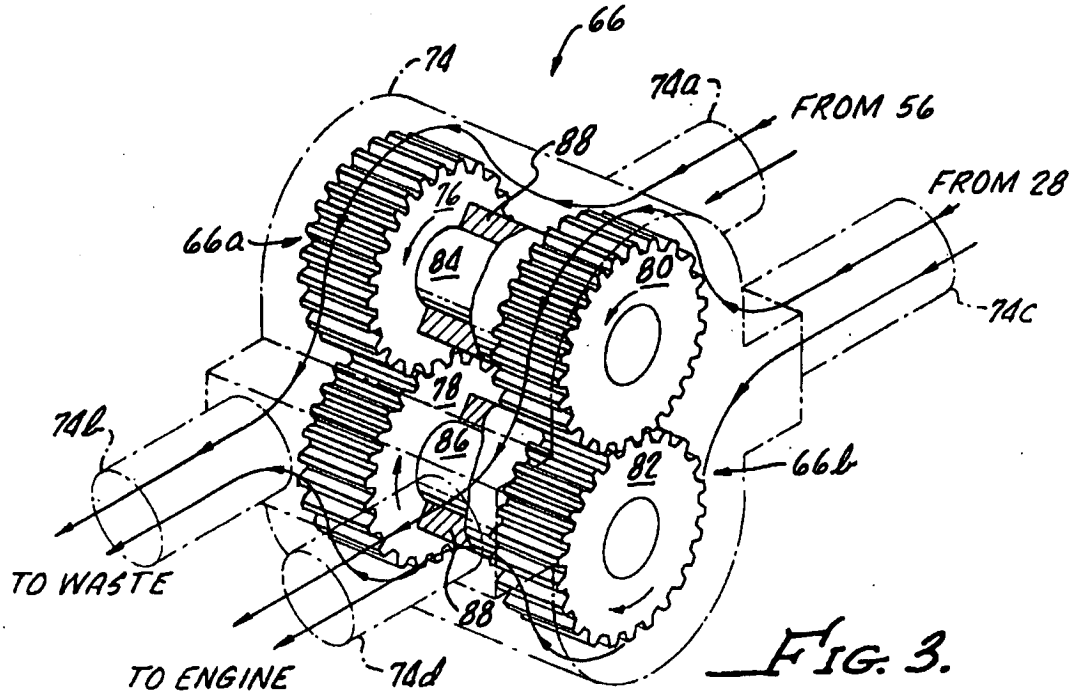
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TO ENGINE
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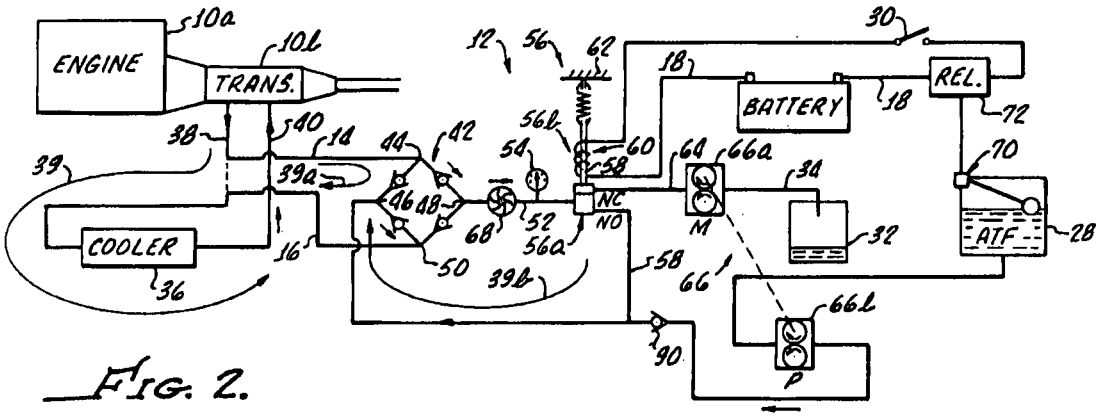
FIG. 3.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46
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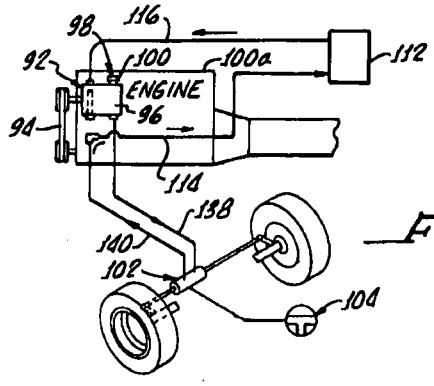
FIG. 2.


98
116
92
100
100a
112
ENGINE
96
94
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138
140
102
104

FIG. 4.

APPARATUS AND METHOD FOR SERVICE OF AN AUTOMOTIVE AUTOMATIC TRANSMISSION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is in the field of apparatus and method used to effect exchange of fluid from a system of an automobile. For example, the apparatus and method may be used to change automatic transmission fluid (ATF) from an automotive automatic transmission. The apparatus and method may also be used to change power steering fluid from an automotive power steering system. More particularly, the present invention relates to a fail-safe machine and to a method of its operation and use in exchanging the used ATF of an automatic transmission with fresh ATF, or in exchanging used power steering fluid with fresh fluid, and which is very economical in its construction, energy efficient in its operation, environmentally responsible, and uniquely easy to use for the automotive technician.

2. Related Technology

Many conventional machines and methodologies presently exist for withdrawing the used ATF from an automotive automatic transmission, while simultaneously replacing the used fluid with new. These devices and methods are a response to the widely-held recognition that simply dropping the pan from an automatic transmission while doing a filter change (or draining the pan of those transmissions fitted with a drain plug), and then refilling the transmission to the proper level with new fluid results in more than half of the old contaminated ATF remaining in the transmission. Such is the case because, for example, the clutch actuators, control valves, pump(s), ATF cooler and connecting conduits, and torque converter of the transmission still hold old ATF. In order to extract this old ATF from the transmission, the vehicle engine must be operated while a fluid exchange for the transmission is in progress.

This operation of the vehicle engine is usually accomplished on a chassis roller set allowing the drive wheels to spin and the clutches of the transmission to be cycled. Operation of the vehicle engine powers the internal fluid pump of the transmission and also facilitates flow of ATF through the torque converter and other parts of the transmission system, effectively flushing out the old ATF and replacing it with new fluid. Alternatively, the vehicle engine can be run with the transmission in "neutral" or "park", with most of the old ATF being exchanged in this way (i.e., without the drive wheels spinning or the transmission clutches being cycled). In this latter case, the old ATF will still be flushed from the torque converter, ATF cooler, and connecting conduits of the transmission system.

Unfortunately, this operation of the vehicle engine creates a risk that the transmission can be damaged or destroyed by dry running. That is, if the old transmission fluid is drained out, and the transmission is not simultaneously refilled with sufficient new fluid so that the fluid level in the transmission drops too low, then the transmission can be damaged by dry running. In some situations, the old ATF is drained out by opening an ATF cooler connection conduit while the vehicle engine is running, and infusing new ATF at the fill tube of the transmission only when bubbles of air are observed to drain also with the ATF from the transmission. These bubbles are an indication that the fluid level of the transmission is low enough that its internal pump is drawing air.

AT this time, a dose of new transmission fluid is added via the fill tube of the transmission. In this case, the new transmission fluid may be allowed to partially or completely drain out (perhaps while the attendant is distracted or absent for some reason), and the transmission can be damaged. To be done safely, this method requires the full-time attention of two attendants—one to watch the draining ATF and signal the presence of bubbles, and one to infuse new ATF at the fill tube in response to a signal from the first attendant. Obviously, this method is both labor intensive and prone to error.

In other situations, the supply of new ATF available to the service machine is inadequate or has been allowed to run completely out of the service machine to begin with (the attendant may not check to see that a reservoir for new ATF actually holds an adequate supply, for example). Again, a sufficient infusion of new ATF into the transmission may not take place during the service procedure with resulting damage to the vehicle transmission.

Still alternatively, an external power failure to the transmission service machine may occur during the service process, with the vehicle under service still running. This may result in the vehicle running without sufficient ATF in the transmission or with its external transmission cooler loop open and the fluid from the transmission being pumped to waste. Again, transmission damage can result unless the attendant catches this situation early enough.

Accordingly, a desire and a recognized need exists to safely and economically effect the replacement with new ATF of substantially all of the used ATF in an automatic transmission. Unfortunately, many of the machines and methods presently existing for this purpose suffer from one or more of the deficiencies of being ineffective in their service of the transmission (i.e., allowing some of the used fluid to remain in the transmission), possibly resulting in damage to the transmission if not closely attended, or are complex in their construction or operation.

For example, a cleaning machine for an automotive automatic transmission is known according to U.S. Pat. No. 5,337,708, issued 16 Aug. 1994 to We-Yu Chen. The '708 patent is believed to teach a transmission fluid change machine in which an external ATF circulation loop of the transmission is opened, with part of the machine completing this loop in one mode of operation. The used transmission fluid, possibly with a transmission flushing solution, is circulated in the external circulation loop as completed by the machine. When operated in an exchange/refill mode, the machine receives old transmission fluid and supplies new fluid at a selected pressure or volume delivery rate.

The Chen machine is intended to be operated from the 12 volt power supply of the automobile or other automotive vehicle being serviced. The new transmission fluid tank of this device appears to be provided with a level sensor, so that the system can be reverted to loop configuration (filtration/flushing) should the level of new ATF drop too low. An external power-driven pump is utilized to move new ATF from the fluid tank to the transmission being serviced. However, it is not clear from this patent that in the event the power supply to this device is interrupted or the pump ceases to operate, that the configuration of the device is reverted to loop form so that the transmission of the vehicle being serviced is not damaged by being operated with insufficient ATF. Although this patent asserts that a power failure will cause reversion of the apparatus to loop configuration in the event of a power failure, how this change in configuration is to be effected or powered does not appear to be explained.

Another transmission fluid change apparatus is disclosed by U.S. Pat. No. 5,318,080, issued 7 Jun. 1994 to James P. Viken. The '080 patent is believed to disclose an apparatus in which supply of the new ATF is provided by a pressurized storage container, which container is pressurized by the inflow of used ATF pumped from the transmission by its own internal pump. The storage container has a chamber which is separated by a flexible wall (i.e., a rolling-diaphragm piston) into two sub-chambers expanding and contracting in opposition. As used ATF from the transmission is received into one sub-chamber, new ATF is displaced from the other sub-chamber to the transmission. Another embodiment of this device uses two separate containers, one receiving the old ATF and the other holding new ATF. Air displaced from the one container is routed into the other with the idea that the air will drive the new ATF into the transmission. A pressurized air assist to this delivery of new fluid is provided. There is considerable uncertainty with these machines that the rate of new fluid delivery really matches the rate of old fluid draining from the transmission under service.

A transmission service machine is also known according to U.S. Pat. No. 5,370,160, issued 6 Dec. 1994 to Zachary T. Parker. The '160 patent is believed to disclose a service machine in which the external ATF fluid return loop for the transmission is completed by a reservoir from which the fluid is drawn by a pump. Accordingly, in the event that operation of the pump is interrupted while the serviced vehicle continues to operate, the transmission of the vehicle is at risk of damage from dry running. A separate pump is used to supply new ATF to the transmission, but this pump may suffer from the same power supply interruption, so that the transmission is still at risk of damage from dry running. The Parker '160 patent does not appear to provide a closed external ATF circulation loop for the transmission being serviced (other than the one relying on operation of an external power-driven pump), and does not use a three-way valve to complete or open such an external ATF circulation loop.

Still another apparatus for exchanging the fluid of an automatic transmission is known in accord with U.S. Pat. No. 5,447,184, issued 5 Sep. 1995 to Eduardo Betancourt. The '184 patent is believed to disclose an apparatus in which a reservoir for new ATF is provided so that the volume of new fluid supplied to the transmission can exceed the withdrawn volume. The '184 patent appears to include a sensor operating a bell to bring the attendant's attention to the fact that the supply of new ATF is at risk of running out. However, if the attendant is either not close at hand to hear the bell or is inattentive, the transmission may still be damaged if the supply of new ATF runs out while the transmission is being flushed. Still further, the device taught by the '184 patent is not believed to provide any safeguard to protect the automatic transmission in the event of a power failure to the apparatus while the transmission is being flushed during operation.

Finally, another automatic transmission flush apparatus is known according to U.S. Pat. No. 5,472,064, issued 5 Dec. 1995. The feature which the '064 patent appears to contribute to the art is the use of a conventional directional flow control valve. This flow control valve is inserted into the fluid flow conduits connecting the service machine to the external loop of the transmission, and allows connection of the apparatus to the external ATF circulation loop (i.e., the ATF cooler loop) of the transmission with no need to take note of the direction of fluid circulation in this loop. If the internal fluid flow direction of the machine happens to be correct as connected, there is no need to change the valve position. In the event the internal fluid flow direction of the machine is opposite to that of the transmission connection, then reversing the position of the flow control direction valve will match the internal flow direction to the direction of the fluid flow in the external ATF flow loop of the transmission. This machine requires attention and manual intervention of the technician to correct the fluid flow directions so that service can begin in the event that by chance these connections to the transmission are not right to begin with.

SUMMARY OF THE INVENTION

In view of the deficiencies of the conventional art, a primary object for this invention is to avoid one or more of these deficiencies.

Another object is to provide a fail-safe automatic transmission service machine.

Yet another object is to provide a machine for exchanging old fluid with fresh fluid in an automotive power steering system.

Accordingly, the present invention provides a method of exchanging used ATF with new ATF in an automotive automatic transmission having an internal pump and an external fluid circulation loop, and without limitation on the volume of ATF which can be exchanged, the method comprising steps of providing a source of new ATF; connecting a positive displacement motor/pump unit into the external fluid circulation loop, so that the loop is opened and old ATF from the transmission flows via a motor portion of the motor/pump unit to waste by reason of pressure provided by the internal transmission pump and drives the pump portion of the motor/pump unit, and flowing new ATF from the source through the pump portion of the motor/pump unit to the automatic transmission so as to effect a pseudo-closing of the external fluid circulation loop, whereby used ATF pumped out of the transmission by the internal pump is continuously replaced in equal volume with new ATF from the source by the motor/pump unit.

According to another aspect, the present invention provides a fail-safe transmission fluid exchange machine for an automotive automatic transmission, which automatic transmission includes an internal pump moving automatic transmission fluid (ATF) through an external circulation loop, the machine comprising: a conduit for conducting ATF from the external ATF circulation loop, a three-way valve in a first position communicating ATF received via the first conduit from the external circulation loop to a second conduit, which second conduit returns ATF to the external ATF circulation loop, the three-way valve in a second position thereof communicating ATF from the external ATF circulation loop to waste; a yieldably-biased back-drivable actuator which when actuated moves the three-way valve from the first to the second position thereof and which when deactivated returns the three-way valve to the first position by self-bias; a container for holding a supply of new ATF; a sensor for indicating when the container holds an adequate supply of new ATF; a pump receiving new ATF from the container therefor and supplying the new ATF pressurized via the second conduit to the external ATF circulation loop; a control system interconnecting the pump, the sensor, and the actuator to allow actuation of the actuator to place the three-way valve in the second position only while the sensor indicates an adequate supply of new ATF, the control system deactivating the actuator in the event of an inadequate supply of new ATF to allow the three-way valve to be returned to the first position by self-bias of the actuator.

A better understanding of the present invention will be obtained from reading the following description of a single exemplary preferred embodiment of the present invention taken in conjunction with the appended drawing Figures. It will be understood that the appended drawing Figures and description here following relate only to one exemplary preferred embodiment of the invention, and as such, are not to be taken as implying a limitation on the invention. No such limitation on the invention is implied, and none is to be inferred.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** provides a fragmentary pictorial and somewhat schematic depiction of an automobile having its automatic transmission serviced by a machine embodying the present invention;

FIG. **2** is a schematic representation of automobile power train (engine and transmission) as well as the transmission service machine seen in FIG. **1**, and depicts alternative modes of operation (or fluid flow paths) utilized during the servicing of the transmission;

FIG. **3**, provides a perspective view of a motor/pump unit used in the transmission service machine seen in FIGS. **1** and **2**, and is shown with the housing of this motor/pump illustrated in phantom lines for improved clarity of description; and

FIG. **4** provides a schematic representation of an automotive power steering system, during servicing to exchange old fluid with fresh fluid using a machine and method according to the present invention.

DETAILED DESCRIPTION OF AN EXEMPLARY PREFERRED EMBODIMENT OF THE INVENTION

Referring to FIG. **1**, an automotive vehicle **10** is seen having its automatic transmission serviced by use of a fail-safe machine **12** embodying the present invention. It will be understood that the vehicle **10** is illustrative only, and that other types of automotive vehicles may have their transmissions serviced by use of the machine **12**. For example, some heavy trucks and buses use automatic transmissions, which also may be serviced in the way described below.

In general view, it is seen that the machine **12** is connected to the vehicle **10** in two respects. First, the machine **12** is connected by a pair of hoses **14** and **16** to the transmission cooling fluid circuit of the vehicle **10**, as will be explained. Also, the machine **12** is electrically connected in this case by a cable **18** to receive electrical power from the vehicle **10**. The cable attaches by clamps **18***a* to the appropriate terminals of the vehicle battery. The machine **12** requires no line power (i.e., no 110 volt or 220 volt AC power, for example), and uses only a small current of electrical power from the vehicle **10** to operate a fail-safe function of the machine. As will be seen, an alternative embodiment of the machine **12** can be provided which does not even require this electrical connection to the vehicle **10**, and in which the machine **12** operates without any external electrical power input.

The machine **12** includes a cabinet **20** having wheels **22** and a handle **24** providing for the cabinet to be rolled about a service area, for example, to an appropriate position next to a vehicle to be serviced. The machine **12** will be seen to have a very low center of gravity so that it is easily tipped for moving and is stable both while stationary and during such moving on its wheels about a service area. Such low center of gravity is provided by the machine **12** because essentially the entire lower portion **28** of the cabinet defines a reservoir for new transmission fluid, providing an exceptionally low center of gravity for the machine **12**. The front of the machine **12** is provided with a vertically extending sight glass **28***a* (actually formed of break-resistant plastic tubing) providing an indication of the fluid level in the reservoir portion **28** of the machine **12**.

Still viewing FIG. **1**, it is seen that during service of the transmission of vehicle **10**, the vehicle engine is run, and the vehicle may be in neutral or park, or may be on a chassis roller stand allowing the drive wheels of the vehicle to spin with the vehicle stationary. In this situation, the internal pump(s) of the transmission will be operating, and used ATF will flow from the vehicle transmission via hose **14** to the machine **12**. During an initial transmission flushing mode of operation, the used ATF (possibly with a flushing chemical added for this phase of transmission cleaning during which varnish and debris in the transmission are loosened for removal) flows back to the transmission via hose **16**. In other words, in a flushing mode of operation, the machine **12** completes an external closed fluid flow loop for the transmission.

However, when a service technician actuates switch **30** the machine **12** enters an AFT exchange mode of operation. In this exchange mode of operation, used ATF flows from the transmission to machine **12**, and then to a container **32** via a hose **34** for recycling or appropriate disposal. The hose **34** may simply be routed to a large used-fluid storage tank maintained by some service facilities for this purpose. The service area in this case will have access to many conveniently located inlets to this storage tank, and the container **32** will not be needed. Simultaneously, new ATF is supplied by the machine **12** from the reservoir **28** into the transmission of the vehicle via hose **16**. While this AFT exchange process is going on the fluid flow rates in the hoses **14** and **16** are substantially matched to one another by the machine **12**. Accordingly, the fluid level in the transmission of the vehicle **10** can not drop too low, and transmission damage from dry running can not occur.

In the event the reservoir **28** is allowed to run out of new ATF, the machine **12** will either not enter exchange mode, or will automatically revert from this mode to flush (i.e., recirculation) mode. Again, dry running of the vehicle transmission can not occur. Also, in the event that power to the machine **12** is interrupted (i.e., if one of the clamps **18***a* becomes disconnected, for example), then the machine **12** reverts instantly to flush mode without the need for manual attention from an attendant and without power being required to effect this reversion to flush mode.

Attention now to FIG. **2** will reveal a schematic of the plumbing and functional structures of the machine **12**. The engine and transmission of the vehicle **10** are indicated with numerals **10***a* and **10***b*, respectively. Those ordinarily skilled in the pertinent arts will understand that the transmission **10***b* is associated with a transmission fluid cooler **36** of the vehicle **10**. ordinarily, this transmission cooler **36** is built into a portion of the vehicle coolant radiator and is an ATF-to-engine-coolant type. Alternatively, the transmission cooler **36** may be configured as a separate ATF-to-air heat exchanger, which is usually installed behind the grill of the vehicle. In some cases, vehicles are equipped with both types of ATF coolers. The cooler **36** is connected in fluid flow to the transmission **10***b* by conduits **38** and **40**, with ATF flow directions in these conduits being indicated by the arrows on FIG. **2**. The conduits **38**, **40**, and cooler **36**

cooperatively define an external closed ATF circulation loop for the transmission lob, which external closed fluid circulation loop is indicated by numeral **39** on FIG. **2**.

Conduit **38** is shown in FIG. **2** with a portion of its length depicted in dashed line. When the vehicle **10** is in normal operation, the dashed line portion of conduit **38** is connected together, and fluid flows from the transmission to the cooler **36** along this conduit. However, during service of the transmission using machine **12**, one of the conduits **38** or **40** is interrupted as suggested in FIG. **2**, and the machine **12** is connected into the previously-closed ATF circulation loop **39** for cooler **36**. In FIG. **2**, conduit **38** is the one shown opened for connection of machine **12**. However, either of the conduits **38** or **40** may be so opened, dependent upon which one is most easily accessible to the service technician on each particular individual vehicle to be serviced. Either of conduits **38** or **40** may be accessed for service of the transmission with absolutely no difference in the effectiveness of the service performed. In preparation for and during the transmission service, the accessed one of the conduits **38** or **40** is interrupted, and after the service is complete the connection of the conduit is restored to its original fluid flow continuity.

Machine **12** includes a fluid-flow rectifier assembly, indicated with numeral **42**. This rectifier assembly includes four nodes (or fluid flow confluences and branchings) respectively indicated with numerals **44**, **46**, **48**, and **50**; and also includes four check valves each indicated with a respective numeral **52**. The check valves **52** are each disposed between a connected pair of the nodes **44–50**, and are oriented as shown in FIG. **2**. As is seen in FIG. **2**, hose **14** connects to node **44**, and the hose **16** connects to node **50**. The check valves **52** are each oriented so that fluid can flow only to node **48** and only away from node **46**. Accordingly, no matter which way the hoses **14** and **16** are connected to the opened ends of the interrupted one of conduits **38** or **40**, ATF flow is always from one of nodes **44** or **50** to node **48**, and from the other one of nodes **44** and **50** to node **46**. Node **48** is connected by a conduit **52** including a pressure gauge **54** and a flow meter **68** to the common port of a spring-loaded three-way solenoid valve **56**. The flow meter **68** has a visible indicator **68***a* of fluid flow, which is displayed on the front of machine **12**, as is seen in FIG. **1**.

The solenoid valve **56** has a normally-open (N.O.) port from which a conduit **58** connects to node **46**. Accordingly, a closed loop fluid flow connection is provided by machine **12** which completes loop **39**. This loop within machine **12** is indicated on FIG. **2** with two loop arrows referenced with numerals **39***a* and **39***b*. During flush mode of operation as described above, the machine **12** completes the circulation loop **39** by flow of ATF in the internal loop indicated with numerals **39***a* and **39***b* of FIG. **2**. During this circulation of ATF in the machine **12**, the service technician can observe the available pressure provided by the internal pump of the transmission **10***b* at gauge **54**, seen on the front of machine **12** in FIG. **1**.

Further considering the three-way solenoid valve **56**, it is seen that this solenoid valve includes a valve portion **56***a* and a solenoid actuator portion **56***b*. The solenoid actuator portion **56***b* includes an armature member **58** movably disposed within a solenoid coil **60**, and a spring **62** biasing the armature **58** toward a first position. The armature member **58** interacts with the valve portion **56***a* so that when the armature **58** is in its first position the common port is connected only to the N.O. port of the valve portion **56***a*. When the solenoid coil **60** is actuated electrically, armature member **58** is moved to a second position (not shown) in which the common port of the valve portion **56***b* is connected only to the N.C. port of this valve portion. The N.C. port of solenoid valve **56** connects via a conduit **64** to one portion (a motor portion) of a motor/pump unit **66**. From this motor portion (indicated with numeral **66***a*), fluid flows via a hose **34** to the waste-fluid container **34**.

The machine **12** is also provided with a float switch **70** at reservoir **28**, which electrically allows connection of the common port of solenoid valve **56** to the N.C. port only if a sufficient volume of new ATF is in this reservoir, and which closes if the level of this new ATF falls too low. Float switch **70** controls a relay **72** in circuit with the switch **30**, solenoid coil **60**, and the battery of the vehicle **10** via cable **18**. When the service technician closes switch **30**, solenoid coil **60** is actuated if relay **72** allows (i.e., if the float switch **70** indicates a sufficient level of new ATF in the reservoir **28**), and the common port of solenoid valve **56** is switched from communication with the N.O. port to communication to the N.C. port. Thus, the internal closed ATF circulation loop of the machine **12** (recalling arrows **39***a* and **39***b*) is opened, and used ATF from the transmission **10***b* flows to waste container **32**.

Considering now FIG. **3**, it is seen that the motor/pump unit **66** includes a housing **74** defining an inlet port **74***a* and outlet port **74***b* from motor portion **66***a*. Similarly, the housing **74** defines an inlet port **74***c* and outlet port **74***d* to and from a pump portion **66***b*. The motor portion **66***a* and pump portion **66***b* are each defined by a meshed pair of spur gears (respectively indicated with numerals **76**, **78**, **80**, and **82**. The housing **74** defines closely fitted chambers for these meshed gears, which is conventional in the art of spur-gear pumps and motors. However, in this case, the housing **74** also journals a pair of connecting shafts, indicated with numerals **84** and **86**. The shafts **84** and **86** drivingly connect the indicated spur gears for rotation in unison, as is indicated by the arrows on FIG. **3**. Thus, as used ATF flows through the motor portion **66***a* (from port **74***a* to port **74***b*) of motor/pump unit **66** the gears **76** and **78** are forced to rotate as indicated, driving the gears **80** and **82** in rotation via shafts **84** and **86**. The motor/pump unit **66** is a positive-displacement fluid motor/pump unit, with each side having identically the same fluid displacement per rotation of the gears **76–82** (ignoring some slight and insignificant volume of fluid which may leak from the motor portion to the pump portion of the unit).

Further to the above, it is seen that according to the one illustrated embodiment of the unit **66**, the housing **74** carries a pair of elongate plain journal bearings **88** (only a portion of each being seen in FIG. **3** for clarity of illustration). These journal bearings **88** are closely and precisely fitted to the shafts **84** and **86** so that these shafts (and the gears **76–82**) are very free running. Importantly, the close fitting of these journal bearings and shafts is relied upon to effect a sufficient fluid seal between the motor side and pump side of the motor/pump **66** so that only an insignificantly small amount of ATF flows along the shafts **84**, **86** without the use of a contact type of sealing element. Consequently, no significant mixing of old ATF with new ATF takes place in the motor/pump unit **66**. Those ordinarily skilled in the pertinent arts will recognize that other sealing expedients are possible in motor/pump unit **66**, and which also provide for free running of the internal components of this unit. For example, a labyrinth seal could be used along the length of the shafts **84** and **86** to inhibit fluid flow between the motor and pump portions of this unit, still without the use of a contact sealing element. Alternatively, a low-friction type of contact sealing element can be used on the shafts **84**, **86**. This may take the

form of, for example, a carbon ring face seal, or a low-friction radial lip seal disposed between the housing **74** and each of the shafts **84, 86**. In each case, the motor/pump unit **66** can achieve motoring and pumping operation utilizing only a relatively low fluid pressure provided by the internal pump of transmission **10***b*. This makes transmission servicing possible even with the engine **10***a* idling.

Accordingly, during fluid exchange mode new ATF is drawn from reservoir **28**, flows from port **74***c* to port **74***d* of the pump portion **66***b* of motor/pump unit **66**, and is delivered to the loop **39***b* via a check valve **90**. This new ATF flows to the node **46**, and then to the one of the hoses **14** and **16** which is connecting to the connection at the conduits **38** and **40** having the lower pressure.

It will be recalled in view of the above, that fluid flow in the apparatus seen in FIG. **2** is being impelled entirely by the internal pump of the automatic transmission **10***b*. Accordingly, there is a progressive pressure drop along the length of all flow paths, and the fluid flow at the connections to one of conduits **38** and **40** will be differentiated from one another by this fluid pressure differential. Accordingly, no matter which one of the conduits **38** or **40** is interrupted for transmission service, and no matter which way the hoses **14** and **16** are connected to the open ends of the interrupted conduit **38** or **40**, flow of used ATF will be from one of these open ends of the interrupted conduit **38** or **40**, and flow of new ATF will be delivered by the machine **12** into the other open end of the interrupted conduit.

In other words, the circulation loop **39** of the transmission is complete during flush mode and appears to be complete during exchange mode also, but new ATF is being supplied by the machine **12** in response to and in matching volume to the pumping out of old ATF by the transmission **10***b* during exchange mode. During this fluid exchange mode of operation, the technician can verify that fluid is flowing by observing the indicator **68***a* of flow meter **68**. Preferably, this flow meter is a turbine type with a transparent wall though which the technician can not only seen the spinning turbine, but can also observe the color and turbidity of the ATF flowing from the transmission to waste (i.e., this is visible on the front of machine **12** as seen in FIG. **1**). Thus, when the out-flowing ATF is observed to change from the turbid burnt-umber of old fluid to the clear bright red of new fluid, the technician knows that the flushing and fluid exchanging operation is complete.

To repeat, in the event the level of new ATF in reservoir **28** drops too low during the service process, and even if the attendant is not present, the float switch **70** will open electrically, and as a result the spring-loaded solenoid will return valve **56***a* to the position connecting the common port only to the N.O. port. This takes place due to its own spring bias and the fact that the solenoid actuator **56***b* can be back-driven by this spring bias.

Thus, in the event of cessation of operation of the machine **12** (because of interruption of electrical power, for example) or a shortage of fresh transmission fluid, the loop **39** is restored, withdrawal of transmission fluid stops, and the transmission **10***b* can not run out of fluid or be damaged by dry running.

When the process described above is complete, the technician disconnects the machine **12** at the connections to one of the conduits **38** or **40**, restores the circulation loop **39**, and sends the old transmission fluid for disposal or to a recycling facility.

FIG. **4** schematically illustrates an alternative embodiment of the present invention, in which a machine is used to service the power steering system of a vehicle to exchange old fluid from the system with new fluid. In order to obtain reference numerals for use in describing this alternative embodiment of the invention, features which are either the same as those depicted and described above, or which are analogous in structure or function, are referenced in FIG. **4** using the same numeral used above, and having one-hundred (100) added.

Viewing now FIG. **4**, a vehicle includes an engine **110***a* driving a power steering pump **92** by means of a belt **94**. This pump **92** includes a reservoir portion **96** disposed generally above the pump **92**. The reservoir portion **96** has a fill opening **98** closed by a cap **100**. Also, a low-pressure hose **140** connects onto a fitting on the body of the reservoir portion **96** in order to allow return of low pressure power steering fluid into this reservoir. During operation of the engine, the pump **92** draws power steering fluid from the reservoir portion **96**, and delivers this fluid pressurized via a high-pressure hose or conduit **138** to a power steering unit **102**. The power steering unit **102** is connected to the dirigible wheels of the vehicle, and has a steering input from a steering wheel **104**.

Now, in order to allow a machine **112** to be used in exchanging fluid from the power steering system seen in FIG. **4**, the low pressure hose **140** is interrupted or disconnected at its connection to the fitting at reservoir portion **96**. This disconnection of the hose **140** allows it to be connected to one of the hoses **114** or **116** of the machine **112**. In view of the explanation above of the hydraulic rectifier **42**, it will be appreciated that either hose **114** or hose **116** may be connected to receive low-pressure power steering fluid from the system as depicted. The other hose **114** or **116** from machine **112** is either attached to the fitting on the reservoir **96** from which hose **140** was disconnected, or is simply routed so as to deliver fluid into the reservoir **96** via fill opening **98**.

Accordingly, when the engine **110***a* is operated, the pump **92** is powered and delivers high-pressure power steering fluid to the unit **102**. Power steering fluid at a lower pressure flows from the unit **102** via hose **140**, but is routed to machine **112** rather than flowing into reservoir **96**. This power steering fluid is routed to machine **112**, where it powers a motor/pump unit as described above. The machine **112** is provided with a source of new power steering fluid, which will be easily understood in view of the description above of providing machine **12** with a source of automatic transmission fluid. The motor/pump unit of the machine **112** delivers new power steering fluid at a matching volume rate to the reservoir **96** of the pump **92** via hose **116**. It will be recalled that hoses **114**, and **116** can be reversed in function, as will be appreciated in view of the operation of the hydraulic rectifier of machine **12** as described above. In this way, the old power steering fluid is removed from the system depicted in FIG. **4**, and the system is provided with new power steering fluid.

While the present invention has been depicted, described, and is defined by reference to a single particularly preferred embodiment of the invention, such reference does not imply a limitation on the invention, and no such limitation is to be inferred. The invention is capable of considerable modification, alteration, and equivalents in form and function, as will occur to those ordinarily skilled in the pertinent arts. For example, it is apparent that an alternative embodiment of the machine **12** can be provided which requires no electrical power at all for its operation. That is, the solenoid valve **56** may be replaced by a manually-actuated three-way valve. In this case, the service technician

must manually revert the machine from exchange mode to flush mode when delivery of the new ATF into the transmission is completed.

Alternatively, the manually-actuated three-way valve could be spring loaded to its position completing internal loop **39***a/b*, and could be latched into its position effecting exchange mode for the machine. In this alternative, a triggering device could be used in response to the dropping of a float in reservoir **28** to cause release of the latched three-way valve and reversion of the machine to flush mode. For example, a float switch could be used and an internal battery of the machine **12** could trigger a solenoid which releases the latch of the three-way valve. Still alternatively, a float-trigger could be connected from the reservoir directly to a mechanical latch release (i.e., a sear device) to release the latched three-way valve and allow its own spring to revert the machine to flush mode. In these ways, the machine **12** may be modified to be fail-safe and either not require any electrical power from the vehicle (i.e., because of use of a battery internal to the machine **12**) or to using a mechanical latch and release device (i.e., the float-trigger alternative) so that minimal attention from an attendant is required but fail-safe operation is still assured.

Another alteration which will suggest itself is to provide a torque motor connected in driving relationship to the motor/pump unit **66**. This torque motor can be arranged to assist but not drive rotation of this motor/pump unit in the direction that it is driven by old ATF being pumped out of a transmission under service. Accordingly, those vehicles which have an internal pump maintaining only a relatively low fluid pressure which is perhaps not enough to drive the motor/pump unit without assistance can still be serviced with the present machine. A slight assistance to the motor/pump unit **66** by operation of such a torque motor would be enough to still effect the positive displacement fluid exchange under the impetus of the internal transmission pump according to the present invention.

Thus, the depicted and described preferred embodiment of the invention is exemplary only, and is not exhaustive of the scope of the invention. Consequently, the invention is intended to be limited only by the spirit and scope of the appended claims, giving full cognizance to equivalents in all respects.

We claim:

1. A method of exchanging used ATF with new ATF in an automotive automatic transmission having an internal pump and an external fluid circulation loop, said method comprising steps of:

providing a volume of new ATF;

connecting a positive displacement motor/pump unit into said external fluid circulation loop, so that said loop is opened and old ATF from the transmission flows via a rotary motor portion of the motor/pump unit to waste by reason of pressure provided by said internal transmission pump and drives a pump portion of said motor/pump unit, and

flowing new ATF from said volume through said pump portion of said motor/pump unit to said automatic transmission so as to effect a pseudo-closing of said external fluid circulation loop, whereby used ATF pumped out of said transmission by said internal pump is continuously replaced in substantially equal volume with new ATF from said volume by said motor/pump unit.

2. A fail-safe method of exchanging ATF in an automatic transmission, said method comprising steps of:

providing an external ATF circulation loop for the transmission;

including in said external ATF circulation loop only a single three-way valve in a first position communicating ATF in said external ATF circulation loop and in a second position opening said external ATF circulation loop and directing ATF from the transmission to waste;

yieldably biasing said only a single three-way valve to said first position;

providing an actuating device which when actuated reversibly moves said only a single three-way valve to said second position thereof;

providing a supply of new ATF;

providing a sensor indication when supply of new ATF is adequate;

operating a pump to add the new ATF to the transmission;

providing a control system allowing actuation of said actuating device only when said sensor indicates an adequate supply of new ATF; and in the event said actuating device is deactivated by said control system, using said resilient bias to return said only a single three-way control valve from said second position to said first position thereby restoring said external ATF circulation loop.

3. A fail-safe transmission fluid exchange machine for an automotive automatic transmission, which automatic transmission includes an internal pump moving automatic transmission fluid (ATF) through an external circulation loop, said machine comprising:

a conduit for conducting ATF from said external ATF circulation loop, only a single three-way valve in a first position communicating ATF received via said first conduit from said external circulation loop to a second conduit, which second conduit returns ATF to said external ATF circulation loop, said only a single three-way valve in a second position thereof communicating ATF from said external ATF circulation loop to waste;

a yieldably-biased back-drivable actuator which when actuated moves said only a single three-way valve from said first to said second position thereof and which when deactivated returns said only a single three-way valve to said first position by self-bias;

a container for holding a supply of new ATF;

a sensor for indicating when said container holds an adequate supply of new ATF;

a pump receiving new ATF from said container therefor and supplying said new ATF pressurized via said second conduit to said external ATF circulation loop; a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said only a single three-way valve in said second position only while said sensor indicates an adequate supply of new ATF, said control system deactivating said actuator in the event of an inadequate supply of new ATF to allow said only a single three-way valve to be returned to said first position by self-bias of said actuator.

4. The fail-safe transmission fluid exchange machine of claim **3** further including a hydraulic motor driven by used ATF pumped from said transmission by said internal pump and driving said pump of said fluid exchange machine.

5. The fail-safe transmission fluid exchange machine of claim **4** wherein said motor and said pump of said fluid exchange machine are drivingly coupled to one another for operation simultaneously in unison, and each of said motor and said pump displace an equal volume of fluid.

6. A fail-safe transmission fluid exchange machine for an automotive automatic transmission, which automatic transmission includes an internal pump moving automatic transmission fluid (ATF) through an external circulation loop, said machine comprising:

a conduit for conducting ATF from said external ATF circulation loop, a three-way valve in a first position communicating ATF received via said first conduit from said external circulation loop to a second conduit, which second conduit returns ATF to said external ATF circulation loop, said three-way valve in a second position thereof communicating ATF from said external ATF circulation loop to waste;

a yieldably-biased back-drivable actuator which when actuated moves said three-way valve from said first to said second position thereof and which when deactivated returns said three-way valve to said first position by self-bias;

a container for holding a supply of new ATF;

a sensor for indicating when said container holds an adequate supply of new ATF;

a pump receiving new ATF from said container therefor and supplying said new ATF pressurized via said second conduit to said external ATF circulation loop;

a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said three-way valve in said second position only while said sensor indicates an adequate supply of new ATF, said control system deactivating said actuator in the event of an inadequate supply of new ATF to allow said three-way valve to be returned to said first position by self-bias of said actuator;

a hydraulic motor driven by used ATF pumped from said transmission by said internal pump and driving said pump of said fluid exchange machine; and

wherein said motor and said pump of said fluid exchange machine are configured as a motor/pump unit having a pair of meshed gears in each of a pumping cavity and in a motor cavity, a shaft driven by said pair of meshed gears in said motor cavity drivingly connecting with said pair of gears in said pumping cavity, and said housing carrying a journal bearing defining in cooperation with said shaft a free-running fit with said shaft which resists fluid flow between said cavities without use of a contact seal element.

7. A fail-safe transmission fluid exchange machine for an automotive automatic transmission, which automatic transmission includes an internal pump moving automatic transmission fluid (ATF) through an external circulation loop, said machine comprising:

a conduit for conducting ATF from said external ATF circulation loop, a three-way valve in a first position communicating ATF received via said first conduit from said external circulation loop to a second conduit, which second conduit returns ATF to said external ATF circulation loop, said three-way valve in a second position thereof communicating ATF from said external ATF circulation loop to waste;

a yieldably-biased back-drivable actuator which when actuated moves said three-way valve from said first to said second position thereof and which when deactivated returns said three-way valve to said first position by self-bias;

a container for holding a supply of new ATF;

a sensor for indicating when said container holds an adequate supply of new ATF;

a pump receiving new ATF from said container therefor and supplying said new ATF pressurized via said second conduit to said external ATF circulation loop;

a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said three-way valve in said second position only while said sensor indicates an adequate supply of new ATF, said control system deactivating said actuator in the event of an inadequate supply of new ATF to allow said three-way valve to be returned to said first position by self-bias of said actuator;

further including a hydraulic rectifier allowing either of said first conduit or said second conduit to be connected in said external fluid circulation loop of said transmission so as to receive old ATF pumped by the internal pump of the transmission, and allowing either one of said first conduit or said conduit to be connected into the external fluid circulation loop of the transmission so as to deliver new ATF to the circulation loop;

said hydraulic rectifier including four fluid flow nodes, each of said four nodes being in direct fluid flow communication with two other of said four nodes, two of said nodes being bi-directional nodes which may receive fluid from said transmission or send fluid to said transmission, and a different two of said four nodes being respectively one an inflow node at which said machine receives old ATF from the transmission and an outflow node to which the machine delivers new ATF, said first and said second conduits each connecting to a respective one of said bi-directional nodes; and

four check valves interposed each one between two directly communicating nodes, said check valves being disposed such as to allow flow from each bi-directional node only to said inflow node and only from said outflow node to each of said bi-directional nodes.

8. In a machine for exchanging used ATF from an automotive automatic transmission with new ATF, said machine having:

a source of new ATF;

a pump unit flowing new ATF from said source to said automatic transmission; and

a hydraulic rectifier including four fluid flow nodes, each of said four nodes being in direct fluid flow communication with two other of said four nodes, two of said nodes being bi-directional nodes which may receive old ATF from said transmission or send new ATF to said transmission, and a different two of said four nodes being respectively one an inflow node at which said machine receives old ATF from the transmission and an outflow node to which the machine delivers new ATF; and

four check valves, each interposed one between two directly communicating nodes, said check valves being disposed such as to allow flow from each bi-directional node only to said inflow node and only from said outflow node to each of said bi-directional nodes.

9. A method of exchanging used power steering fluid with new power steering fluid in an automotive power steering system having a power steering pump and a fluid circulation loop including a power steering gear and a fluid reservoir, said method comprising steps of:

providing a source of new power steering fluid;

connecting a positive displacement motor/pump unit into said fluid circulation loop, so that said loop is opened and old power steering fluid flows from said power

steering gear via a rotary motor portion of the motor/pump unit to waste by reason of pressure provided by said power steering pump and drives the pump portion of said motor/pump unit, and

flowing new power steering fluid from said source through said pump portion of said motor/pump unit to said reservoir, whereby used power steering fluid pumped out of said power steering gear by said power steering pump is continuously replaced in equal volume with new power steering fluid from said source by said motor/pump unit.

10. A fail-safe machine for exchange of power steering fluid in an automotive vehicle, which vehicle includes a power steering system with a power steering pump, a reservoir providing power steering fluid to said power steering pump, and a power steering gear receiving high-pressure pressurized power steering fluid from said power steering pump via a high-pressure conduit and returning low-pressure power steering fluid to said reservoir via a low-pressure conduit, said machine comprising:

a first conduit conducting used power steering fluid from said low-pressure conduit to a single three-way valve;

said single three-way valve in a first position communicating power steering fluid received via said first conduit to a second conduit, which second conduit returns power steering fluid to said reservoir, said single three-way valve in a second position thereof communicating power steering fluid to waste;

a yieldably-biased back-drivable actuator which when actuated moves said single three-way valve from said first to said second position thereof and which when deactivated returns said single three-way valve to said first by self-bias;

a container for holding a supply of new power steering fluid;

a sensor for indicating when said container holds an adequate supply of new power steering fluid;

a pump receiving new power steering fluid from said container therefor and supplying said new power steering fluid via said second conduit to said reservoir;

a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said single three-way valve in said second position only while said sensor indicates an adequate supply of new power steering fluid in said container, said control system deactivating said actuator in the event of an inadequate supply of new power steering fluid to allow said single three-way valve to be returned to said first position by self-bias of said actuator.

11. The fail-safe power steering exchange machine of claim **10** further including a hydraulic motor driven by used power steering fluid pumped from said power steering system by said power steering pump and driving said pump of said machine.

12. A fail-safe machine for exchange of power steering fluid in an automotive vehicle, which vehicle includes a power steering system with a power steering pump, a reservoir providing power steering fluid to said power steering pump, and a power steering gear receiving high-pressure pressurized power steering fluid from said power steering pump via a high-pressure conduit and returning low-pressure power steering fluid to said reservoir via a low-pressure conduit, said machine comprising:

a first conduit conducting used power steering fluid from said low-pressure conduit to a three-way valve;

said three-way valve in a first position communicating power steering fluid received via said first conduit to a second conduit, which second conduit returns power steering fluid to said reservoir, said three-way valve in a second position thereof communicating power steering fluid to waste;

a yieldably-biased back-drivable actuator which when actuated moves said three-way valve from said first to said second position thereof and which when deactivated returns said three-way valve to said first position by self-bias;

a container for holding a supply of new power steering fluid;

a sensor for indicating when said container holds an adequate supply of new power steering fluid;

a pump receiving new power steering fluid from said container therefor and supplying said new power steering fluid via said second conduit to said reservoir;

a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said three-way valve in said second position only while said sensor indicates an adequate supply of new power steering fluid in said container, said control system deactivating said actuator in the event of an inadequate supply of new power steering fluid to allow said three-way valve to be returned to said first position by self-bias of said actuator; and

further including a hydraulic rectifier allowing either of said first conduit or said second conduit to be connected to said low-pressure conduit of said power steering system to receive power steering fluid at low-pressure therefrom, and allowing either one of said first conduit or said second conduit to deliver new power steering fluid into said reservoir;

said hydraulic rectifier including:

four fluid flow nodes, each of said four nodes being in direct fluid flow communication with two other of said four nodes, two of said nodes being bi-directional nodes which may receive fluid from said power steering system or send fluid to said power steering system, and a different two of said four nodes being respectively one an inflow node at which said machine receives old power steering fluid from the power steering system of the vehicle and an outflow node to which the machine delivers new power steering fluid, said first and said second conduits each connecting to a respective one of said bi-directional nodes; and

four check valves interposed each one between two directly communicating nodes, said check valves being disposed such as to allow flow from each bi-directional node only to said inflow node and only from said outflow node to each of said bi-directional nodes.

13. A fail-safe transmission fluid exchange machine for an automotive automatic transmission, which automatic transmission includes an internal pump moving automatic transmission fluid (ATF) through an external ATF cooler in a circulation loop, said machine comprising:

a conduit for conducting ATF from said circulation loop to a common port of a three-way valve, said three-way valve in a first position communicating ATF received via said first conduit from said circulation loop to a second conduit via a normally-open (N.O.) port, which second conduit returns ATF to said circulation loop, said three-way valve in a second position thereof communicating ATF from said circulation loop via a normally-closed (N.C.) port to waste;

a yieldably-biased back-drivable actuator which when actuated moves said three-way valve from said first to

said second position thereof and which when deactivated returns said three-way valve to said first position by self-bias;

a container for holding a supply of new ATF;

a sensor for indicating when said container holds an adequate supply of new ATF;

a motor/pump unit having a motor portion disposed in fluid flow series between said N.C. port of said three-way valve and waste to be driven by ATF pumped out of said transmission; and a pump portion receiving new ATF from said container therefor and supplying said new ATF pressurized via said second conduit to said circulation loop, said motor portion and said pump portion of said motor/pump unit being drivingly coupled to one another for operation simultaneously in unison with each displacing an equal volume of fluid;

a control system interconnecting said sensor and said actuator to allow actuation of said actuator to place said three-way valve in said second position only while said sensor indicates an adequate supply of new ATF, said control system deactivating said actuator in the event of an inadequate supply of new ATF to allow said three-way valve to be returned to said first position by self-bias of said actuator;

a hydraulic rectifier allowing either of said first conduit or said second conduit to be connected in said circulation loop of said transmission so as to receive old ATF pumped by the internal pump of the transmission, and allowing either one of said first conduit or said second conduit to be connected into the circulation loop of the transmission so as to deliver new ATF to the circulation loop; said hydraulic rectifier including four fluid flow nodes, each of said four nodes being in direct fluid flow communication with two other of said four nodes, two of said nodes being bi-directional nodes which may receive fluid from said transmission or send fluid to said transmission, and a different two of said four nodes being respectively one an inflow node at which said machine receives old ATF from the transmission and an outflow node to which the machine delivers new ATF, said first and said second conduits each connecting to a respective one of said bi-directional nodes; and four check valves interposed each one between two directly communicating nodes, said check valves being disposed such as to allow flow from each bi-directional node only to said inflow node and only from said outflow node to each of said bi-directional nodes.

14. A method of exchanging used ATF with new ATF in an automotive automatic transmission having an internal pump and an external fluid circulation loop, said method comprising steps of:

providing a volume of new ATF;

connecting a positive-displacement motor/pump unit into said external fluid circulation loop, so that said loop is opened and old ATF from the transmission flows via a motor portion of the motor/pump unit to waste by reason of pressure provided by said internal transmission pump and drives a rotary pump portion of said motor/pump unit, and

flowing new ATF from said volume through said rotary pump portion of said motor/pump unit to said automatic transmission so as to effect a pseudo-closing of said external fluid circulation loop, whereby used ATF pumped out of said transmission by said internal pump is continuously replaced in substantially equal volume with new ATF from said volume by said motor/pump unit.

15. A method of exchanging used ATF with new ATF in an automotive automatic transmission having an internal pump and an external fluid circulation loop, said method comprising steps of:

providing a volume of new ATF;

connecting a positive-displacement rotary motor/pump unit into said external fluid circulation loop, so that said loop is opened and old ATF from the transmission flows via a rotary motor portion of the motor/pump unit to waste by reason of pressure provided by said internal transmission pump and drives a rotary pump portion of said motor/pump unit, and

flowing new ATF from said source through said rotary pump portion of said rotary motor/pump unit to said automatic transmission so as to effect a pseudo-closing of said external fluid circulation loop, whereby used ATF pumped out of said transmission by said internal pump is continuously replaced in substantially equal volume with new ATF from said volume by said rotary motor/pump unit.

16. A method of exchanging used power steering fluid with new power steering fluid in an automotive power steering system having a power steering pump and a fluid circulation loop including a power steering gear and a fluid reservoir, said method comprising steps of:

providing a source of new power steering fluid;

connecting a positive displacement motor/pump unit into said fluid circulation loop, so that said loop is opened and old power steering fluid flows from said power steering gear via a motor portion of the motor/pump unit to waste by reason of pressure provided by said power steering pump and drives a rotary pump portion of said motor/pump unit, and

flowing new power steering fluid from said source through said rotary pump portion of said motor/pump unit to said reservoir, whereby used power steering fluid pumped out of said power steering gear by said power steering pump is continuously replaced in equal volume with new power steering fluid from said source by said motor/pump unit.

17. A method of exchanging used power steering fluid with new power steering fluid in an automotive power steering system having a power steering pump and a fluid circulation loop including a power steering gear and a fluid reservoir, said method comprising steps of:

providing a source of new power steering fluid;

connecting a positive displacement rotary motor/pump unit into said fluid circulation loop, so that said loop is opened and old power steering fluid flows from said power steering gear via a rotary motor portion of the rotary motor/pump unit and to waste by reason of pressure provided by said power steering pump and drives the rotary pump portion of said motor/pump unit, and

flowing new power steering fluid from said source through said rotary pump portion of said rotary motor/pump unit to said reservoir, whereby used power steering fluid pumped out of said power steering gear by said power steering pump is continuously replaced in substantially equal volume with new power steering fluid from said source by said rotary motor/pump unit.

* * * * *

EXHIBIT 2

US006112855A

United States Patent [19]

Camacho et al.

[11] Patent Number: 6,112,855

[45] Date of Patent: Sep. 5, 2000

[54] APPARATUS AND METHOD FOR CLEANING AN AUTOMOTIVE AUTOMATIC TRANSMISSION

[75] Inventors: **Michael Camacho**, Rancho Cucamonga; **Dale Johnson**, Burbank; **Mark Sasaki**, Riverside, all of Calif.

[73] Assignee: **Wynn Oil Co.**, Azusa, Calif.

[21] Appl. No.: **09/089,024**

[22] Filed: **Jun. 2, 1998**

[51] **Int. Cl.**[7] **F16C 3/14**

[52] **U.S. Cl.** **184/1.5**; 184/105.3; 285/12; 285/81; 285/308

[58] **Field of Search** 184/1.5, 105.3; 285/12, 305, 308, 81, 84

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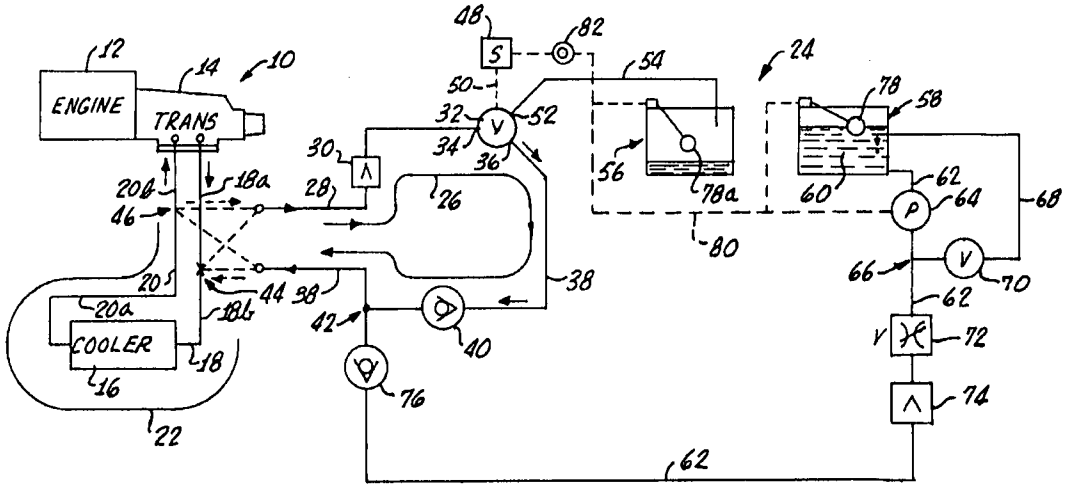
Primary Examiner—David M. Fenstermacher
Attorney, Agent, or Firm—Terry L. Miller

[57] **ABSTRACT**

A machine and method for cleaning an automotive automatic transmission by effecting the discharge of old used fluid from the transmission and the simultaneous replacement of this old fluid with new fluid on an exchange basis. The machine includes a set of primary hoses, a set of intermediate hoses, and a set of plural pairs of complementary adapter fittings which in combination adapt the machine for convenient service of a wide variety of automobiles and their transmissions. The primary hoses, intermediate hoses, and adapters are configured to fit together in a wide variety of different ways. This variability or flexibility of connection for the machine allows a very limited number of primary hoses, intermediate hoses, and adapters to interface the machine flexibly with a wide variety of different transmissions, and the different vehicles in which these transmissions are installed; all in accord with possibly differing preferences of particular service technicians who use the machine.

20 Claims, 8 Drawing Sheets



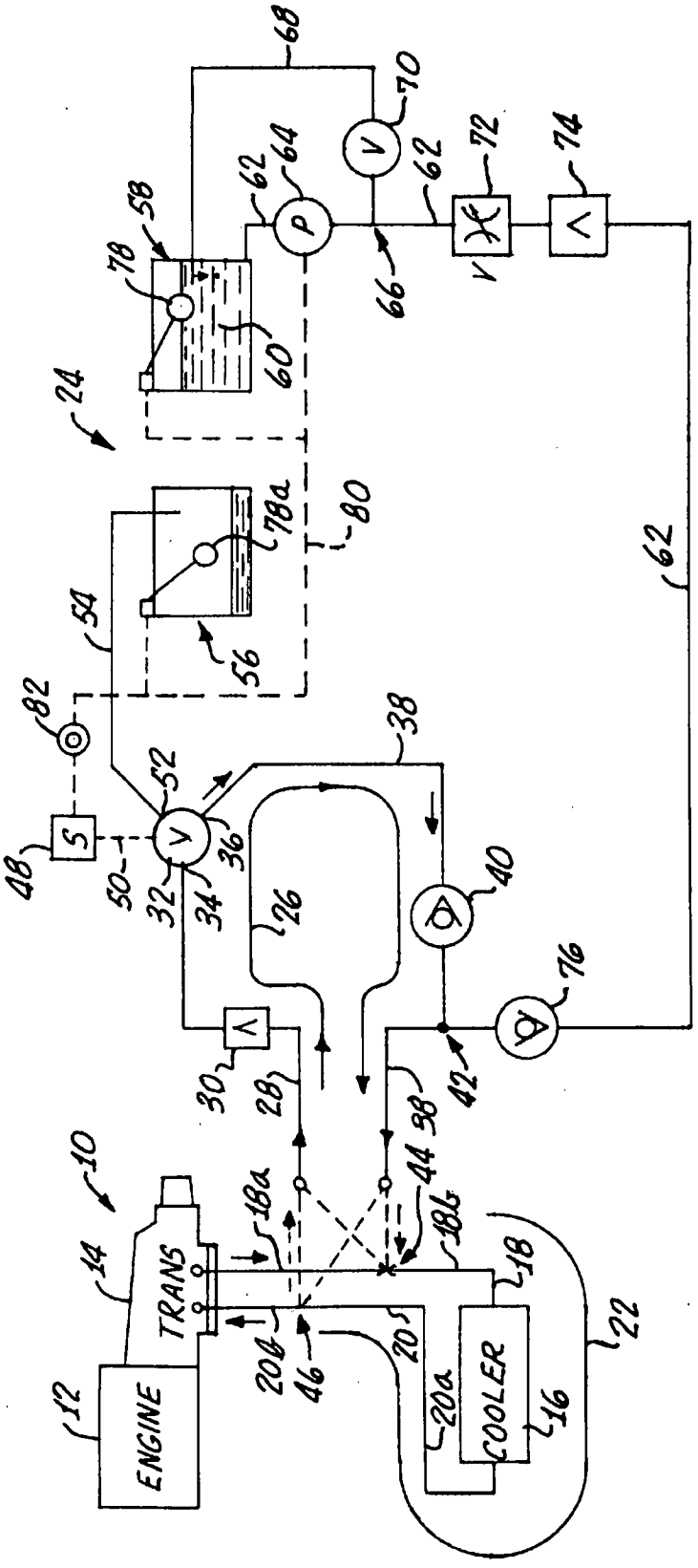


FIG. 1.

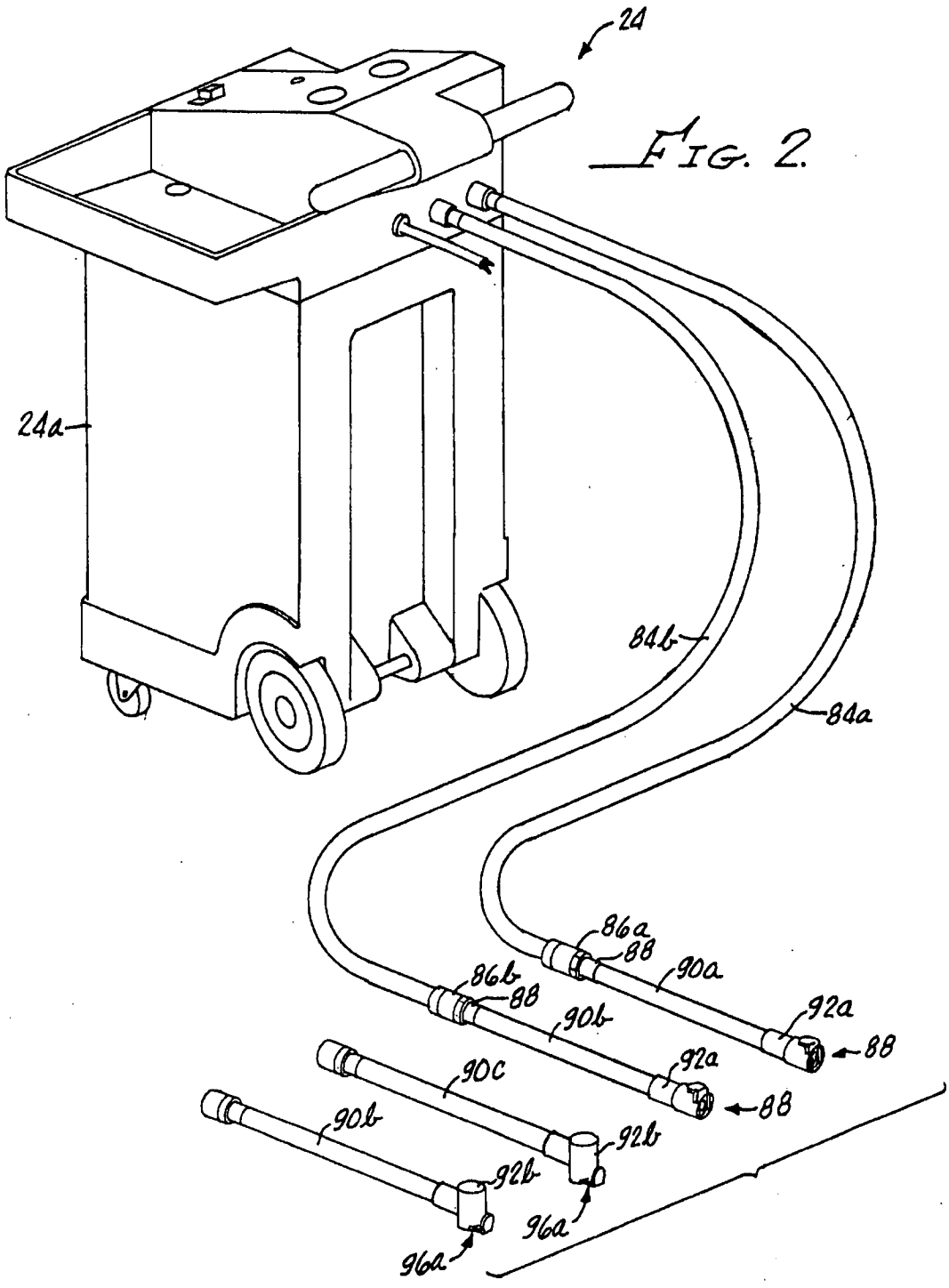

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FIG. 2.

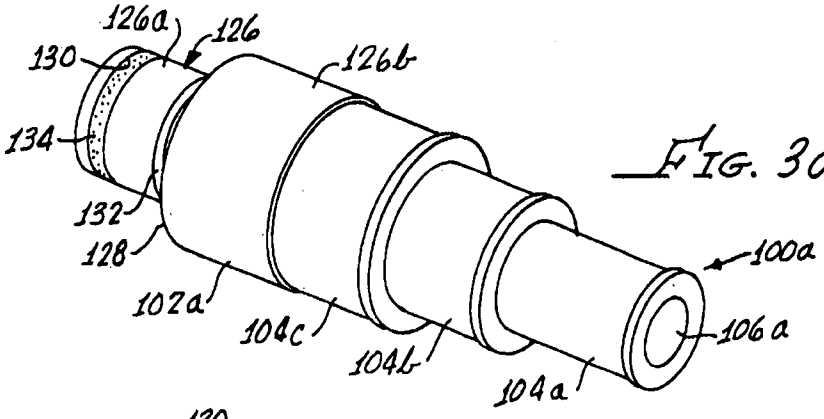


FIG. 3a.

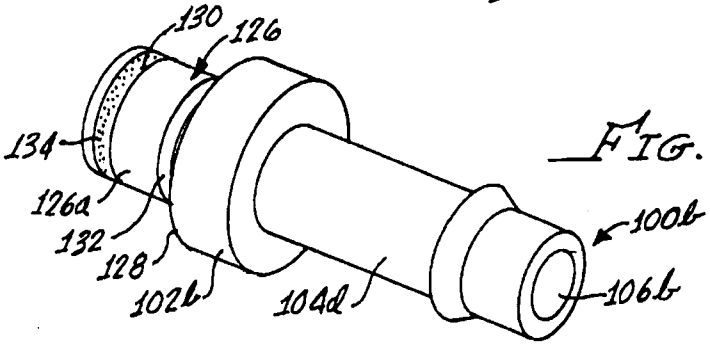


FIG. 3b.

FIG. 3c.

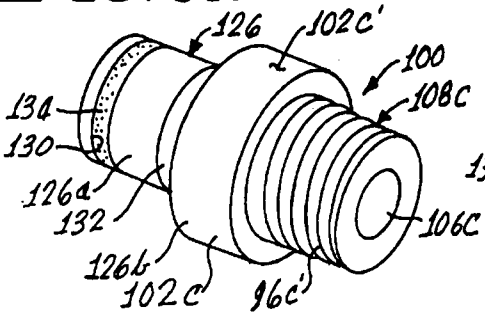


FIG. 3d.

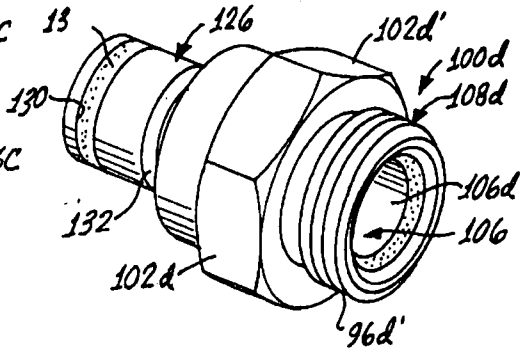
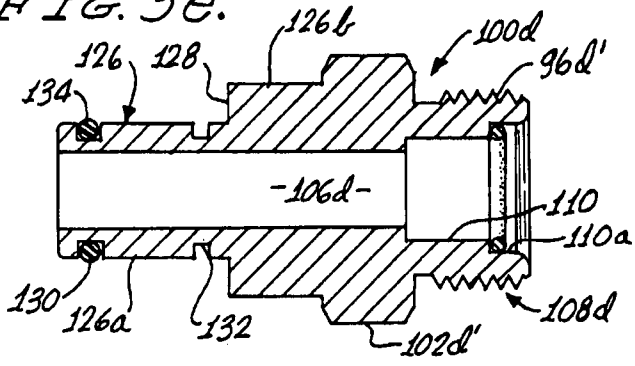


FIG. 3e.



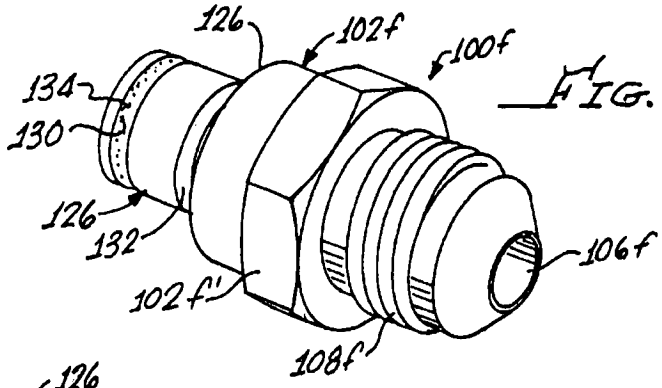


FIG. 3f.

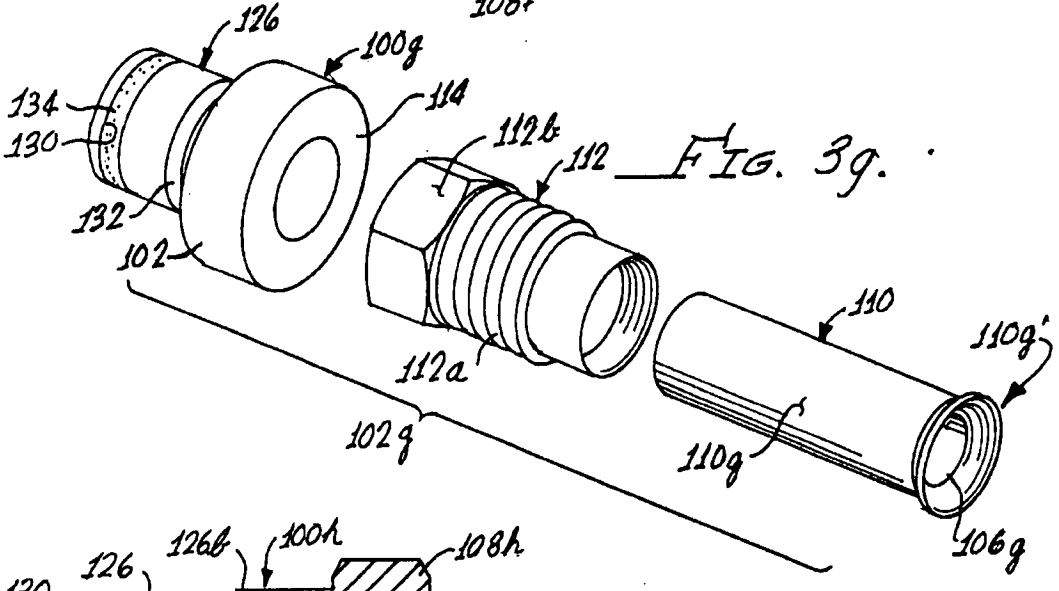


FIG. 3g.

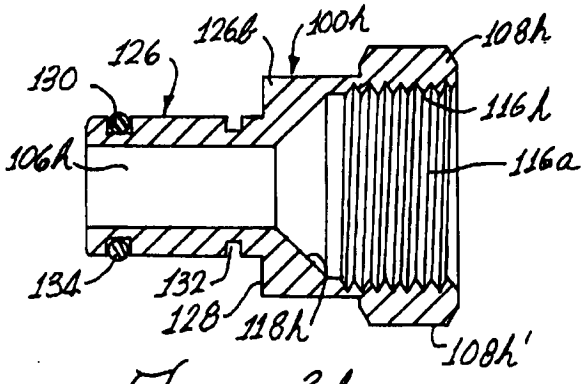


FIG. 3h.

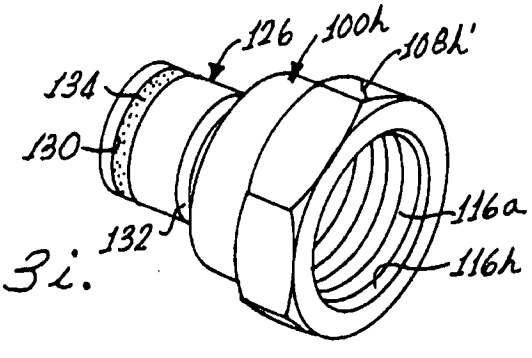


FIG. 3i.

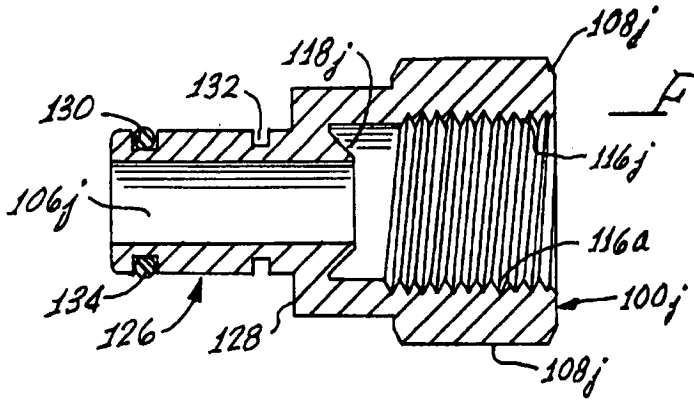


FIG. 3j.

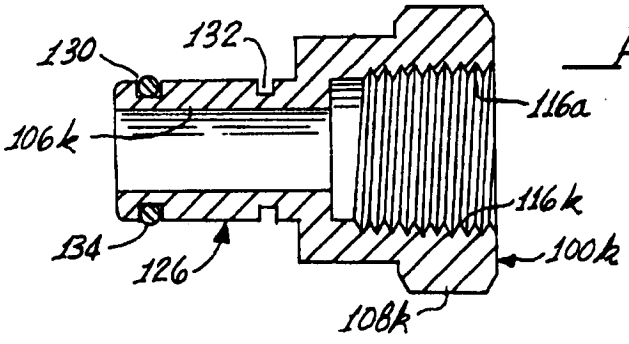


FIG. 3k.

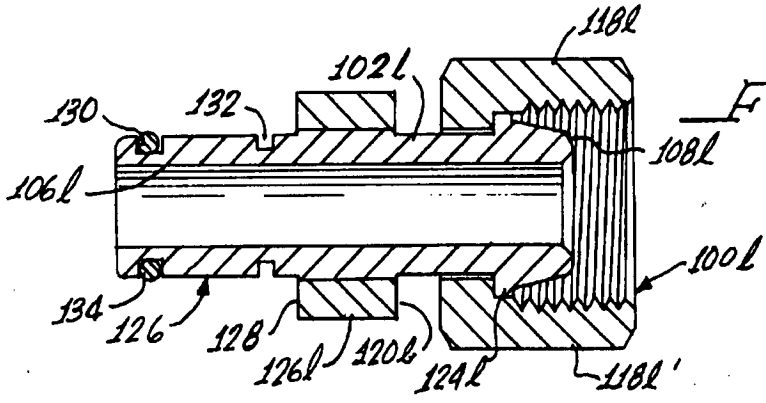


FIG. 3l.

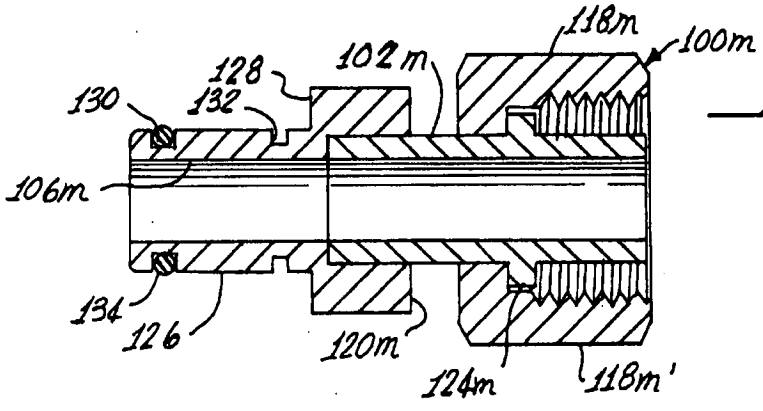


FIG. 3m.

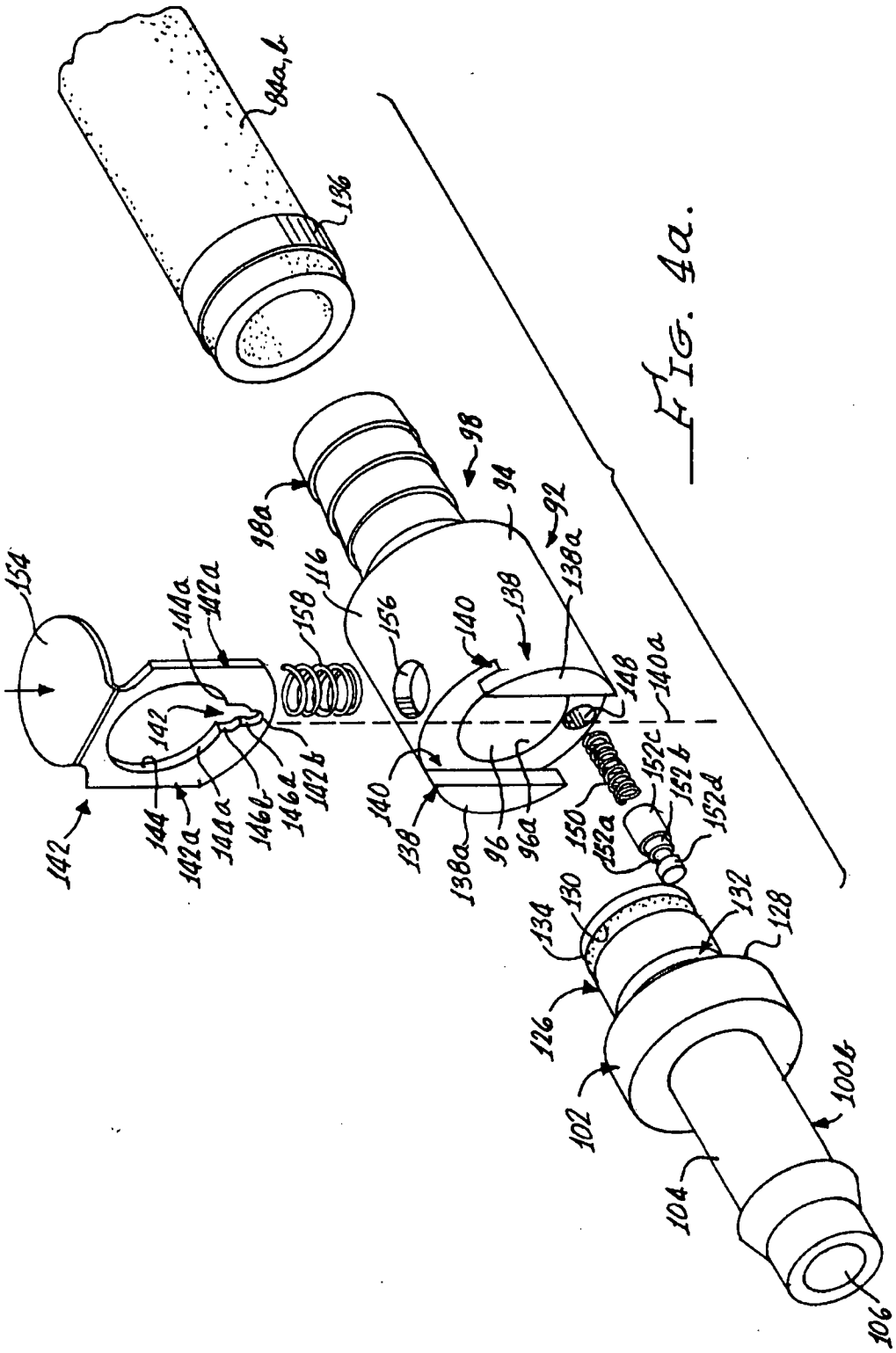

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FIG. 4a.

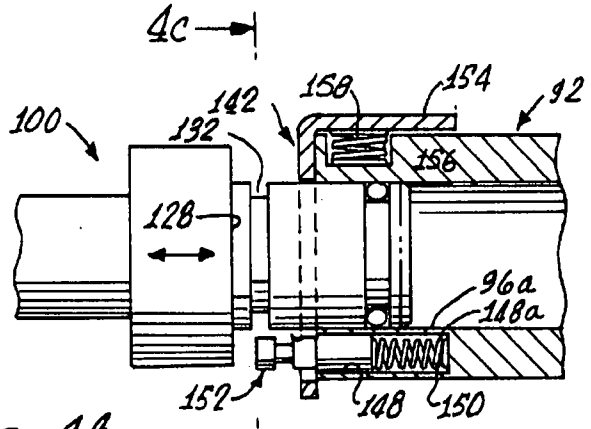

FIG. 4b.

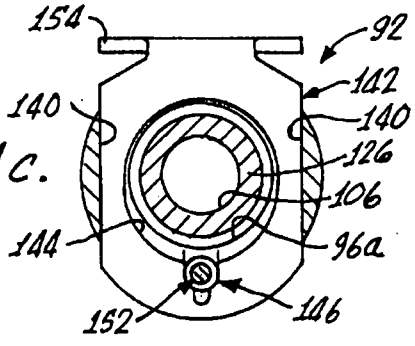

FIG. 4c.

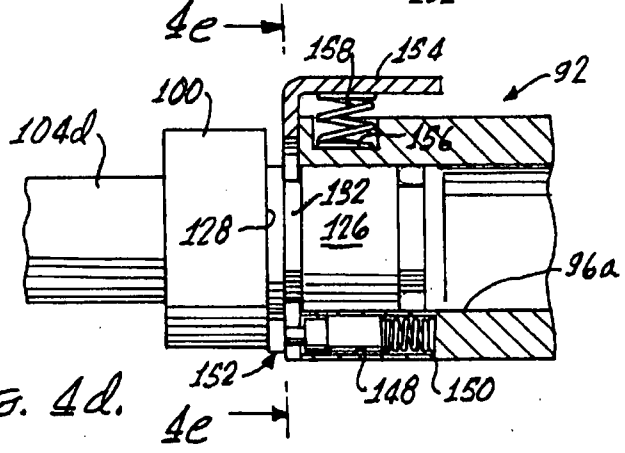

FIG. 4d.

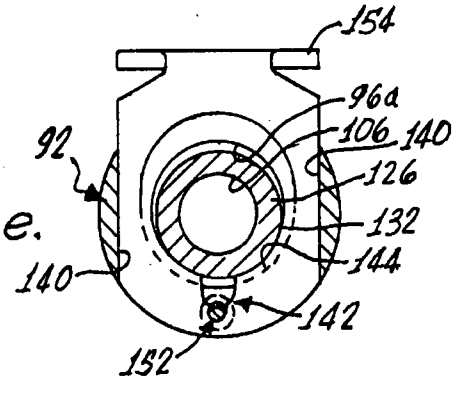

FIG. 4e.

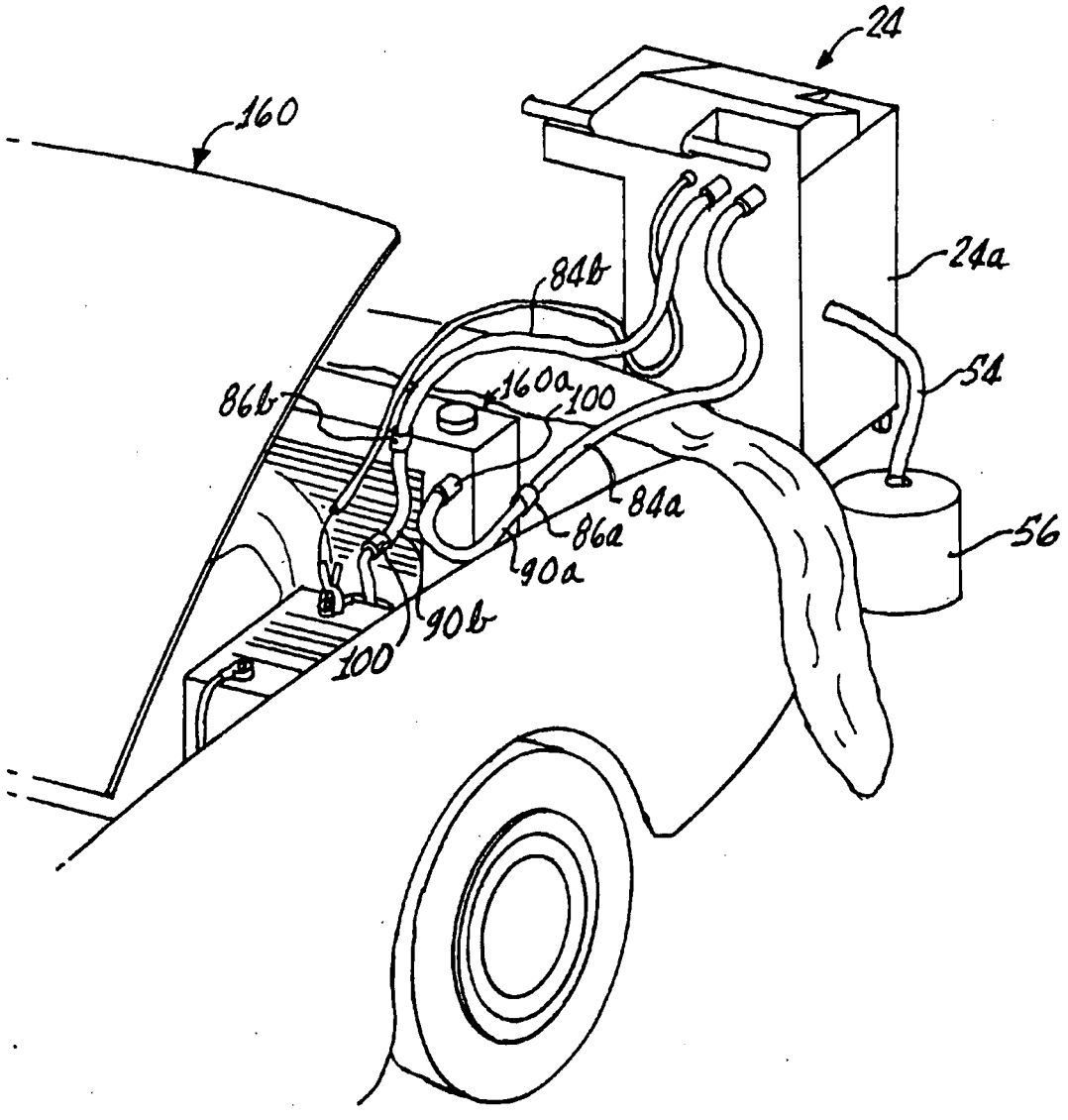

FIG. 5.

APPARATUS AND METHOD FOR CLEANING AN AUTOMOTIVE AUTOMATIC TRANSMISSION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is in the field of apparatus and methods used to clean foreign material, varnish, oxidation products, metallic wear particles, and other environmental and operating residues from an automotive automatic transmission. More particularly, the present invention relates to a machine for connection in a relation of fluid flow recirculation or exchange with an automotive automatic transmission, and which provides for circulation of a cleaning fluid through the transmission, as well as for replacement of the used transmission fluid from the transmission with new fluid which is provided from a reservoir associated with machine. The machine includes a set of especially configured hoses each of which are fitted at their opposite ends with quick-disconnect couplings. One of the quick-disconnect couplings is configured to interface with the fluid exchange machine, and the other is configured to interface with any one of a variety of adapter fittings which are provided in a set. The set of fittings includes pairs of complementary adapter fittings. The pairs of adapter fittings of the set each include differently configured and complementary end fittings which on the one hand connect with the quick-disconnect couplings on the hoses and on the other hand also connect with various ones of the wide variety of fittings and connections used in various automotive vehicles and the wide variety of automotive automatic transmissions of these vehicles.

2. Related Technology

A conventional cleaning machine for an automotive automatic transmission is known according to U.S. Pat. No. 5,337,708, issued Aug. 16, 1994 to We-Yu Chen. The '708 patent is believed to teach a transmission fluid change machine in which an external ATF circulation loop is opened, with part of the machine completing this loop in one mode of operation. The used transmission fluid, possibly with a transmission flushing solution, is circulated in the external circulation loop as completed by the machine. When operated in an exchange/refill mode, the machine receives old transmission fluid and supplies new fluid at a selected pressure or volume delivery rate. The machine is intended to be operated from the 12 volt power supply of the automobile or other automotive vehicle being serviced. The new transmission fluid tank of this device appears to be provided with a level sensor, so that the system can be reverted to loop configuration (filtration/flushing) should the level of new ATF drop too low. A pump is utilized to move new ATF from the fluid tank to the transmission being serviced. However, it is not clear from this patent that in the event the power supply to this device is interrupted or the pump ceases to operate, how the configuration of the device is reverted to loop form so that the transmission of the vehicle being serviced is not damaged by being operated with insufficient ATF. Although this patent asserts that a power failure will cause reversion of the apparatus to loop configuration in the event of a power failure, how this change in configuration is to be effected or powered is not set out.

Another conventional transmission fluid change apparatus is disclosed by U.S. Pat. No. 5,318,080, issued Jun. 7, 1994 to James P. Viken. The '080 patent is believed to disclose an apparatus in which supply of the new ATF is provided by a pressurized storage container, which is pressurized by the used ATF withdrawn from the transmission. The storage container has a chamber which is separated into two sub-chambers expanding and contracting in opposition by a flexible wall. As used ATF from the transmission is received into one sub-chamber, new ATF is displaced from the other sub-chamber to the transmission. This device has the limitation that the volume of new transmission fluid supplied to the transmission can not easily exceed the volume of old fluid removed from the transmission. This may be a disadvantage because flushing of contaminated old fluid from the transmission may require infusion of more than an equal volume of new transmission fluid.

Yet another conventional transmission service machine is known according to U.S. Pat. No. 5,370,160, issued Dec. 6, 1994 to Zachary T. Parker. The '160 patent is believed to disclose a service machine in which the external ATF fluid return loop for the transmission is completed by a reservoir from which the fluid is drawn by a pump. Accordingly, in the event that operation of the pump is interrupted while the serviced vehicle continues to operate, the transmission of the vehicle is at risk of damage from dry running. A separate pump is used to supply new ATF to the transmission, but this pump may suffer from the same power supply interruption, so that the transmission is still at risk of damage from dry running. The Parker '160 patent does not appear to provide a closed external ATF circulation loop for the transmission being serviced (other than the one relying on operation of a pump), and does not use a three-way valve to complete or open such an external ATF circulation loop.

Still another conventional apparatus for exchanging the fluid of an automatic transmission is known in accord with U.S. Pat. No. 5,447,184, issued Sep. 5, 1995 to Eduardo Betancourt. The '184 patent is believed to disclose an apparatus in which a reservoir for new ATF is provided so that the volume of new fluid supplied to the transmission can exceed the withdrawn volume. The '184 patent appears to include a sensor operating a bell to bring the attendant's attention to the fact that the supply of new ATF is at risk of running out. However, if the attendant is not close at hand or is inattentive, the transmission may still be damaged if the supply of new ATF runs out while the transmission is being flushed. Still further, the device taught by the '184 is not believed to provide any safeguard to protect the automatic transmission in the event of a power failure to the apparatus while the transmission is being flushed during operation.

Finally, another conventional automatic transmission flush apparatus is known according to U.S. Pat. No. 5,472,064, issued Dec. 5, 1995. The feature which the '064 patent appears to contribute to the art is the use of a conventional directional flow control valve. This flow control valve allows connection of the apparatus to the external ATF circulation loop (i.e., the ATF cooler loop) of the transmission with no need to take note of the direction of fluid circulation in this loop. If the internal fluid flow direction of the apparatus happens to be correct, there is no need to change the valve position. In the event the internal fluid flow direction of the apparatus is incorrect, then reversing the position of the flow control direction valve will match the internal flow direction to the direction of the fluid flow in the external ATF flow loop of the transmission.

A persistent problem and disadvantage with all of the conventional machines noted above for service of an automotive automatic transmission, as well as with other conventional machines for this purpose, is that the machines each require a great number of hoses, fittings, and adapters in order to interface in fluid recirculation and exchange

relationship with the wide variety of different automotive automatic transmissions, and the vehicles in which these transmissions are installed. That is, automotive automatic transmissions generally have a transmission fluid cooler, which in some cases is configured as a liquid-to-air heat exchanger mounted near the vehicle's radiator, and in other cases is configured as a liquid-to-liquid heat exchanger (i.e., transferring heat from the transmission fluid to engine coolant, which is then cooled in the "radiator" (which itself is a liquid-to-air heat exchanger). In many cases, the fittings and adapters are configured as end termination structures which are permanently attached to lengths of hose, sometimes including sections of rigid metal tubing permanently attached to lengths of hose, and to which an end termination fitting or coupling is permanently secured.

Accordingly, a wide variety of differing sets of hoses, adapters, couplings, and fittings have been provided for use with these machines. Depending upon the variety of such fittings, couplings, and adapters, various ones of the conventional machines may or may not be able to service the automatic transmissions of particular automotive vehicles. That is, the proper set a couplings, adapters, and fittings may not be available for some vehicles. Further, the variety of hoses, adapters, couplings and fittings, has necessitated the provision of a considerable storage space for all this equipment. And service technicians must study instructions for all these couplings, fittings, hoses, and adapters, or simply figure out an arrangement on their own, in order to service the transmission of various vehicles. Dependent upon the ingenuity of particular service technicians, a convenient or more difficult interconnection with a particular vehicle may be accomplished.

In other words, conventionally, this large number of hoses, fittings, couplings and adapters that are encountered in servicing of automotive vehicles has been considered necessary in order to interface with the great variety of differing transmission installations and connections provided by the large number of differing vehicles encountered in a contemporary automotive service environment. A disadvantage of the large number of hoses in addition to the storage space required for these in a service area, is the necessity for a service technician to deal with a long and heavy piece of hose while making the interconnections of this hose to a vehicle being serviced. After the hose is interconnected with a vehicle to be serviced, then the hose is connected to a service machine, and the service procedure can begin. However, access in many modern cars and other vehicles to the transmission fluid cooler loop is not easy. Having to deal with this commonly restricted access and to also manipulate a cumbersome length of hose while making the connections is not an easy task.

Further, in addition to representing a considerable investment in hardware, some of which is only rarely used, this large number of hoses, fittings, and adapters disadvantageously requires a considerable storage space in, adjacent to, or accessible conveniently close to a transmission service machine. Also, because of the large number of hoses, adapters, and fittings, there also is presented the possibility that the service technician who uses the machine will use an incorrect fitting or adapter, possibly resulting in leakage of transmission fluid. Further, the great number of hoses, fittings, and adapters required by conventional transmission service machines provides an abundant opportunity for the service technician to lose or misplace a hose or fitting, so that some vehicles can not be serviced until a replacement is obtained.

In view of the above, it would be desirable to provide a machine and method to service an automotive automatic transmission which machine and method requires a greatly reduced number of hoses, adapters, and fittings in comparison to conventional machines of this type in order to interface with the transmissions of the most commonly encountered automotive vehicles in the contemporary service environment.

SUMMARY OF THE INVENTION

In view of the above, it would be an advantage, and is an object of the present invention, to provide a machine and method for cleaning a variety of different automotive automatic transmissions which avoids one or more of the deficiencies of the conventional related technology.

An additional object of this invention is to provide a machine and method for cleaning a variety of different automotive automatic transmissions which requires a greatly reduced number of hoses, adapters, and fittings to interface the machine in fluid recirculation and exchange relationship with the commonly encountered variety of transmissions.

Yet another object for this invention is to provide an automotive transmission service machine which includes a pair of hoses respectively for conducting transmission fluid from a transmission to the machine, and from the machine back to the transmission; along with a set of adapters and fittings interfacing with these hoses to adapt the one pair of hoses to a wide variety of automotive vehicles and the transmissions of these vehicles, so that the fluid recirculation and exchange relationship of the machine with the automotive transmission is effected via a pair of hoses, interfaced with appropriate fittings and adapters.

Accordingly, the present invention according to one aspect provides a machine for service of an automotive automatic transmission, which transmission has an external fluid circulation loop, said machine being effective for use in interrupting said external fluid flow loop at a coupling therein and to effect exchange of used transmission fluid from the transmission with new fluid from a supply thereof, said machine comprising: a first fluid flow conduit for conducting used transmission fluid from the transmission to a waste container, and a second fluid flow conduit for conducting new transmission fluid from a source thereof into the transmission; a pair of elongate primary hoses, each one of said pair of primary hoses defining a respective portion of one of said first conduit and of said second conduit, each one of said pair of primary hoses including at a distal end thereof a respective one of a pair of substantially identical first quick-disconnect coupling portions; an intermediate pair of hoses each one including at a proximal end thereof a respective one of a pair of substantially identical second quick-disconnect coupling portions complementary to said first quick-disconnect coupling portions, and at a distal end thereof each one of said another elongate pair of hoses having a respective one of pair of substantially identical additional quick-disconnect coupling portions; and a pair of adapters each one having a substantially identical first end portion complementary to and sealingly engageable with one of said pair of additional quick-disconnect coupling portions, and a second end portion providing a termination feature complementary to said coupling of said external fluid circulation loop; whereby said pair of adapters form a fluid flow connection between said external fluid circulation loop of said transmission and said first conduit and said second conduit.

According to another aspect, the present invention provides a set of adapters for use with a machine for changing fluid in an automotive automatic transmission on an

exchange basis for new fluid, the set of adapters including plural pairs of adapters each pair of which is complementary at one end to one another and to a particular coupling on an automotive vehicle, the pairs of adapters each also including a second end all of which are substantially identical to one another.

A better understanding of the present invention will be obtained from the following description of a single exemplary preferred embodiment of the present invention taken in conjunction with the appended drawing Figures, in which the same reference numeral is used though out the several views to indicate the same feature, or features which are analogous in structure or function. It will be understood that the appended drawing Figures and description here following relate only to one exemplary preferred embodiment of the invention, and as such, are not to be taken as implying a limitation on the invention. No such limitation on the invention is implied, and none is to be inferred.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** provides a schematic depiction of an automotive automatic transmission in combination with an engine, a transmission fluid cooler, and a machine according to the present invention;

FIG. **2** provides a perspective view of a machine which physically embodies the present invention, and which includes a set of four hoses (three of which are fragmentarily depicted) each of a different configuration, and which are used two at a time to interconnect the machine with an automatic transmission in a vehicle.

FIGS. **3***a* through **3***m* provide illustrations of an exemplary set of adapters including fittings for interface on the one hand with any one of the set of hoses seen in FIG. **2**, and on the other hand adapting the hoses for interface in fluid flow connection with a variety of automotive automatic transmissions, thus to interface a physical implementation of the machine schematically depicted in FIG. **1** (and as seen in FIG. **2**) to an automotive automatic transmission;

FIG. **4***a* and FIGS. **4***b*–**4***e* respectively provide an exploded perspective view and fragmentary cross sectional views of a coupling structure making up part of each one of the conduits seen in FIG. **2**, and which can interconnect a part of any one of the adapters seen in FIG. **3**;

FIG. **5** provides a fragmentary pictorial illustration of an exemplary example of an actual connection of the machine of FIGS. **1** and **2** to an automotive automatic transmission in an exemplary vehicle using two of the set of four hoses seen in FIG. **2**, and a selected pair of adapters from the set illustrated in FIG. **3**.

DETAILED DESCRIPTION OF AN EXEMPLARY PREFERRED EMBODIMENT OF THE INVENTION

An overview

Referring to the appended drawing Figures, with attention first to FIG. **1**, the numeral **10** indicates an automotive power train including an engine **12**, an automatic transmission **14** driven by the engine **12**, and a transmission fluid cooler **16**. The power train **10** is disposed in an automotive vehicle, generally indicated with numeral **10***a*. It is to be understood that the vehicle **10***a* may be an automobile, truck, bus, or other type of automotive vehicle having an automatic transmission. The rest of the power train **10** may include, for example, a drive shaft or axle shafts and driving road wheels, all of which will be so well understood by those ordinarily skilled in the pertinent arts that it is not illustrated in FIG. **1**. The transmission fluid cooler **16** may be associated with a coolant radiator (not shown) of the engine **12** (i.e., a liquid-to-liquid type of cooler or heat exchanger) or may be a separate liquid-to-air cooler (i.e., heat exchanger). In high performance, heavy-duty, or tow-vehicle installations, the transmission **14** may be provided with both a radiator-associated transmission cooler (liquid-to-liquid) and also with a separate air-cooled (liquid-to-air) transmission cooler. All of these alternative possibilities for the automatic transmission cooler **16** (and others) are subsumed in the generic cooler indicated with the numeral **16**.

In each case, the automatic transmission **14** is connected to the transmission cooler **16** by a hot-side supply conduit **18**. During operation of the engine **12**, an internal pump (not shown) of the automatic transmission **14** provides pressurized transmission fluid via the conduit **18** to the cooler **16**. This transmission fluid will have been heated by operation of the transmission **14**. A cool-side return conduit **20** returns transmission fluid from the cooler **16** to the transmission **14**. Accordingly, it is seen that a first external transmission fluid circulation loop (indicated with the numeral **22**) is cooperatively defined by the supply conduit **18**, cooler **16**, and return conduit **20**.

In order to connect a transmission cleaner machine (which is generally indicated with the numeral **24**) to the transmission **14**, the first loop **22** is interrupted (as will be described), and is expanded to include an additional second fluid flow loop (indicated with numeral **26**) defined within the machine **24**. The loop **26** of machine **24** includes an intake conduit **28** in which a fluid flow meter **30** is interposed. Conduit **28** connects to a three-way valve **32** at a first (input) port **34**. From a second port **36** of valve **32** a conduit **38** extends back to the power train **10**, and has a check valve **40** and T-connection **42** interposed therein. As will be explained, the three-way valve **32** is biased to a fail-safe position in which port **34** is connected only to port **36**, so that conduit **28** is connected only to conduit **38** and the loop **26** is completed for fail-safe operation of the transmission **14**. By "fail safe" is meant that damage to the transmission of a vehicle cannot occur because of running of the vehicle engine while the transmission has insufficient fluid, even if the vehicle being serviced is allowed to run after electrical power supply to the machine **24** has been interrupted, or the machine has been allowed to run out of new transmission fluid, as will be seen.

As mentioned, the connection of the loop **26** into the loop **22** (expanding the latter) will require that either or both of the conduits **18** and **20** is opened somewhere along its length, or is disconnected either at its connection to the transmission **14** or at the cooler **16**. In the event that only conduit **18** is opened, as is indicated at the "X" marked with the numeral **44**, then the upstream part (**18***a*) of conduit **18** is connected to conduit **28**, as is indicated by one dashed line. The return conduit **38** is then connected to the downstream part (**18***b*) of conduit **18**, as is indicated by one of the dashed lines. In the event that only conduit **20** is opened, as is indicated at the "X" marked with the numeral **46**, then the upstream part (**20***a*) of conduit **20** is connected to conduit **28**, as is indicated by one dashed line. The return conduit **38** is then connected to the downstream part (**20***b*) of conduit **20**, as is indicated by one of the dashed lines. If the decision by a service technician is made to interrupt both conduits **18** and **20**, then the cooler **16** will be temporarily removed from loop **22**. The upstream conduit part **18***a* is be connected to conduit **28** at "X" **44**, and the return conduit **38** is connected to return conduit part **20***b* at "X" **46**.

In any of these cases described immediately above, and dependent upon the particulars of the vehicle being serviced

and how a service technician decides to connect the machine **24** in order to service the transmission **14** when the engine **12** is operated, the internal pump of the transmission **14** circulates transmission fluid through the loop **26**. During this operation, the technician may observe the rate of fluid circulation at the meter **30**.

As will be seen, a cleaning material according to the present invention may be added to the transmission **14** in order to facilitate suspension of dirt, contaminants, and wear particles therein. In order to allow removal of used transmission fluid from the transmission **14**, which will also carry the suspended dirt, contaminants, and wear particles out of the transmission **14**, the machine **24** includes a spring-loaded solenoid **48** which is operatively connected to three-way valve **32** (as is indicated by dashed line **50**). When energized, the solenoid **48** shifts the three-way valve **32** so that port **34** is connected only to a port **52**. The solenoid **48** is back-driveable by its own spring load when deactivated to return the three-way valve **32** to its first position from the second position of this valve. A conduit **54** extends from port **52** to a waste container **56**. During removal of transmission fluid, the technician may observe the rate of fluid flow to the waste container at flow meter **30**. It will be noted that when the solenoid **48** is energized, the loop **26** (and therefor, the loop **22** as well) is opened and dumps into waste container **56**.

In order to allow removal of used transmission fluid from the transmission **14** to waste container **56** while ensuring that the transmission does not suffer from an insufficient fluid level, the machine **24** includes a supply tank **58** for fresh transmission fluid **60**. A conduit **62** extends from near the bottom of tank **58** to the T-connection **42**. Interposed in this conduit is a pump **64**. Immediately downstream of the pump **64** is located a T-connection **66** to conduit **62**, and from which a return conduit **68** extends back to the tank **58**. A pressure relief valve **70** is interposed in conduit **68**. Downstream of the T-connection **66**, a variable flow control valve **72**, a flow meter **74**, and a check valve **76** are interposed in the conduit **62**. The check valve **76** is located adjacent to the T-connection **42**.

Operation of pump **64** removes fresh transmission fluid from the tank **58** and delivers this fluid to the transmission **14** via conduit **62**, conduit **38**, and the part of loop **22** downstream of the "X" connection **44** or **46** in effect. During removal of old transmission fluid and replacement of this fluid with fresh fluid from tank **58**, the technician matches the flow rates on flow meters **30** and **74** by manipulation of flow control valve **72**.

In order to insure fail-safe operation of the machine **24**, a sensor **78** is provided on tank **58** to insure an adequate supply of fresh transmission fluid **60**. Sensor **78** is depicted as being of a float-type, but a variety of liquid-level sensors may be used. Sensor **78** is interfaced with solenoid valve **48** and with pump **64** by a safety interlock circuit, indicated by dashed line **80**. The safety interlock circuit **80** will not allow solenoid **48** to be energized unless the sensor **78** indicates that an adequate supply of fresh transmission fluid is present in tank **58**, and pump **64** is in operation. When these conditions exist, the service technician may initiate transmission fluid withdrawal and replacement by actuating an input control **82** to the safety interlock circuit **80**. The input control **82** may take the form of a push button switch which the technician actuates to begin withdrawal of old transmission fluid into waste container **56** and the replacement of this old fluid with new fluid from supply tank **58**.

During such withdrawal and replacement of transmission fluid, should the pump **64** be stopped (i.e., possibly because of an interruption of electrical power supply to pump **64** or to the machine **24**), or should the sensor **78** indicate that the level of fresh transmission fluid **60** has dropped too low, then the safety circuit **80** will disable solenoid **48**, and the spring-loaded valve **32** will return to the position connecting port **34** only to port **36**. Thus, in the event of either a cessation of operation of the machine **24**, or of a shortage of fresh transmission fluid **60**, the loop **26** is restored, and the transmission can not run out of fluid and be damaged by dry running. A similar sensor **78***a* may be provided on waste container **56** to prevent the overflowing of this tank in the event the service technician forgets to empty this container for recycling frequently enough. The sensor **78***a* may optionally be provided as a safety factor to prevent overflow of old transmission fluid, and if it is not employed the fail-safe aspect of the present service machine would remain fully in effect.

An Exemplary Implementation of Machine **24**

Viewing now FIG. **2**, a machine embodying the present invention (also indicated with the numeral **24** and having a housing **24***a* within which the machine elements of FIG. **1** are received) is seen. This machine **24** additionally provides two elongate hoses **84***a*, and **84***b*, which each include at a distal end thereof a respective female portion **86***a*, **86***b* of a quick-disconnect coupling structure. Female coupling portions **86***a* and **86***b* are substantially the same. Respective male coupling structure portions **88** of the quick-disconnect coupling structures (i.e., each complementary to and capable of interconnection with either of the female portions **84***a* and **84***b*) are disposed at proximal ends of each one of four intermediate hoses **90***a*, **90***b*, **90***c*, and **90***d*. As can be seen in FIG. **2**, these intermediate hoses **90***a–d* are provided in two pairs, with each pair including two substantially identical intermediate hoses. One pair of the intermediate hoses **90***a*, and **90***b* provide at their distal ends a respective straight female quick-disconnect coupling structure, each referenced with the numeral **92***a*, while the other pair of intermediate hoses **90***c* and **90***d* provide a similar female quick-disconnect coupling structure (referenced with the numeral **92***b*) differing from the structures **92***a* only in that they have an L-shaped configuration.

Male coupling portions (all generally identified with the numeral **122**, as will be seen below), which are complementary to the female quick-disconnect coupling portions **92***a* and **92***b* will be seen below to be integrally formed each as part of an individual one of a set of adapters to be further described below. It will be understood that any one of the intermediate hoses **90***a–**90***d* can be connected to machine **24** as will be described.

Dependent upon the particulars of access to the conduits **18** and **20** (i.e., to the transmission connections of these conduits, and to the transmission cooler connections of these conduits in a particular vehicle to be serviced) a service technician will select two of the intermediate hoses **90***a–d* for use in servicing the particular vehicle. Thus, any one of the four intermediate hoses **90***a–**90***d* can be connected alternatively and completely interchangeably to either of the connectors **86***a* and **86***b* of the machine **24**, and can thus be used to define a respective part of either conduit **28** or of conduit **38** (i.e., recalling the alternative connections indicated by dashed lines in FIG. **1**). It is seen that in the present machine, a wide variety of interconnection possibilities for connecting the machine to a wide variety of vehicles is provided by the use of only the four intermediate hoses **90***a–d*, as is illustrated in FIG. **2**, along with a variety of adapters presented in FIG. **3** (to be further described below). This flexibility of selection for service of a variety of

automobiles with a relative few components for the machine **24** expands the utility of the machine **24** very economically. Further, as will be further seen, the utility of the machine **24** and of intermediate hoses **90***a–b* is expanded yet again at the point of fluid flow interface with the vehicles to be serviced by the completely interchangeable and complementary pairs of adapters (seen in FIG. **3**) which are provided to connect with the wide variety of service and connection fittings on vehicles to be serviced using the machine **24**.

Interconnection of Intermediate Hoses **90***a–d* with Machine **24**

Further to the above, it is seen that each of the distal end terminations of intermediate hoses **84***a*, **84***b* includes and is defined by a respective female coupling structure, generally indicated with numeral **92***a* or **92***b*, as is more particularly seen in FIG. **4***a*, and recalling FIG. **2**. Each coupling structure **92** includes an elongate body **94** of generally tubular configuration providing in the case of couplings **92***a* a stepped through bore **96** extending through the coupling structure **92** to communicate with a respective end portion of one of the intermediate hoses **84***a*. In the case of the coupling structures **92***b*, the body **94** includes a L-shaped passage **96***a* (indicated by an arrow on FIG. **2**) and similarly communicating with a respective one of the intermediate hoses **84***b*. It will be noted that in FIG. **4***a* only one end of the through bore **96** is seen. All of the female coupling structures **92** are substantially the same, except as is noted. Thus, in the following description, only the straight coupling structures **92***a* are described in detail, with the coupling structures **92***b* being understood to be substantially similar.

Turning to FIG. **4**, it is seen that the coupling structure **92** includes a body **94** having an elongate tubular section **98**, carrying a hose barb section **98***a*. In the case of the straight couplings **92***a* on hoses **84***a* (i.e., straight or aligned with the hose), tubular section **98** is straight. On the other hand, as is illustrated in FIG. **2**, the coupling body **94** of the coupling structures **92***b* on hoses **84***b* (i.e., L-shaped or providing a 90° connection relative to the length of the intermediate hoses **84***b*) are each of elbow shape. In this way, a service technician having the hoses **84***a*, **84***b* available will chose the two of these four hoses giving best access to the location chosen on a particular vehicle to be serviced in order to connect with the conduits **18** or **20** of the vehicle (recalling the description above of how the machine **24** interfaces with the fluid flow of a transmission in a vehicle).

Continuing now the consideration of the female coupling structures **92**, viewing still FIG. **4***a*, it is seen that the bore **96** includes a cylindrical section **96***a* opening on the end of the coupling structure **92**, and into which a male coupling portion **126** of a representative one of the adapter members (to be further described below) may be sealingly received in order to facilitate fluid flow connection with the respective hose **84***a*, **84***b*. On FIG. **4***a*, this male coupling portion **126** is illustrated along with an adapter (i.e., adapter **100***b*) seen in FIG. **3***b*, which is merely representative at this point as an assistance to the reader, and which will be further described below. A further description of the structure and operation of the coupling structure **92** will be given below after a consideration of the wide variety of complementary adapter fittings **100** (the reader will be referred to FIG. **3** for a description of these) which can interchangeably couple with the coupling structures **92**.

Providing for Convenient Connection of Machine **24** to a Variety of Vehicles

Viewing now FIG. **3**, the details of various ones of a plurality of adapter fittings is illustrated (each generally referenced with the numeral **100** having an alphabetical suffix added) each of which also form a respective male coupling portion **126** for fluid flow interface with the coupling structures **92**. As will be seen, the adapters **100** of FIG. **3** are generally provided in complementary counterparts, or complementary pairs, so that when the transmission cooler fittings of a particular vehicle are opened in preparation for servicing the transmission, one adapter **100** fits on and connects to the fitting of the automobile on one side of the opened conduit **18** or **20**, and another adapter **100** (usually the other adapter of a complementary pair) fits on and connects to the other fitting of the automobile on the other side of this opened conduit. Further, the adapters **100** are each complementary at one end to a quick-disconnect fitting provided as part of the intermediate hoses **90**. In other words, the adapters **100** at one end are complementary of one another and of fittings on a vehicle, and at the opposite end are complementary of the quick-disconnect fittings of the hoses **90** by means of an integral portion of each adapter. Further, the adapters **100** or very compact.

Two adapters which at first blush might be thought to be exceptions to this rule of complementary pairs for the adapters **100** are seen in FIGS. **3***a* and **3***b*. These two adapter fittings are intended to be used on automobiles in which the transmission cooler conduits are at least in part defined by flexible hose, and are connected to hose barbs. In servicing this type of installation, the technician will disconnect the hose of the automobile from its hose barb, and use one of the fittings **100***a* or **100***b* to connect with this disconnected hose. In order to connect with the exposed hose barb of the automobile, the technician will use another fitting **100***a* or **100***b* and a short section of matching hose. Thus, the fittings **100***a* and **100***b* are provided in pairs of two identical fittings and are not alone complementary to one another. However, while they are in use to service a vehicle, these fittings **100***a* and **100***b* are made complementary by the use of a piece of matching hose.

Continuing this description, in FIG. **3***a* is seen an adapter **100***a* having an elongate straight tubular body **102***a*. This tubular body **102***a* outwardly defines a stepped series of hose barb sections **104***a*, **104***b*, and **104***c*. The body **102***a* defines a through bore **106***a* for communicating transmission fluid through the adapter **100***a*. In the servicing of a vehicle using a hose to connect transmission fluid to or from the cooler **16** (thus forming a portion of conduit **18** or **20**), the technician may choose to disconnect this hose and to use of the adapter **100***a* to interface with the end of the disconnected hose. As described above, another adapter **100***a* may be connected with the fitting from which the hose of the automobile has been removed.

FIG. **3***b* shows an adapter **100***b* which is similar to the adapter **100***a*, and which also includes a body **102***b* of elongate tubular configuration. This body **102***b* defines a through bore **106***b*, and outwardly defines a single hose barb section **104***d* of a selected size. The adapter **100***b* may be provided in a variety of sizes each having a different size of hose barb **104***d*.

FIGS. **3***c*, **3***d*, **3***e*, and **3***f* introduce a family of adapters **100***c*, **100***d*, and **100***f*, which each has a respective elongate tubular body **102***c*, **102***d*, and **102***f*. Outwardly, the bodies provide a surface portion (indicated with the numerals **102***c*', **102***d*', and **102***f*') which provides for wrenching of the adapter. In the case of adapter **102***c* of FIG. **3***c*, the wrenching surface **102***c*' is a smooth cylindrical surface, and a pipe wrench is intended to be used on this surface. The bodies **102***c–102e* each define a through bore (indicated with numeral **106** with the appropriate suffix). Each of these adapters **100***c–100f* includes a respective integral end ter-

mination portion **108***c*, **108***d*, and **108***f*. In the case of adapter **100***c*, the end termination portion outwardly defines a male pipe thread. Various adapters **100***c* may be provided with pipe thread portions **108***c* of various sizes of male pipe thread. Adapter **100***d* (seen in FIGS. **3***d* and **3***e*) includes a termination portion **108***d* outwardly defining a straight male thread, and inwardly providing a stepped cylindrical bore **110** with a bore portion **110***a* for sealingly receiving an O-ring sealing member. Those ordinarily skilled in the pertinent arts will recognize that adapter **100***d* provides for sealing interface with O-ring type male tubular fittings which have a captive nut for threaded engagement with the thread on portion **108***d* (see, FIG. **3***m* for an example of this type of fitting as part of one of the complementary adapters of the present invention). Again, various adapters of the type seen in FIGS. **3***d* and **3***e* may be provided in a variety of sizes.

FIG. **3***f* illustrates an adapter **100***f* which at end portion **108***f* is configured as a male flare tube fitting. That is, the adapter **100***f* at portion **108***f* will sealingly interface with transmission cooler fittings or with conduits which employ a female flare tube fitting (see, FIG. **3***h* for an example of this type of fitting as a part of one of the complementary adapter fittings of the present invention). As will be understood, when this type of fitting on a vehicle is opened, one male side and one female side of the opened fittings is presented. As will be seen, the complementary pairs of adapters **100** provide for this eventuality. Again, adapters **100***f* of various sizes may be provided.

FIG. **3***g* illustrates one of a family of adapters **100***g* which may be provided in various sizes as needed. The adapter **100***g* includes an elongate tubular body **102***g* having an elongate tubular termination portion **110** which outwardly defines a cylindrical surface **110**g. The portion **110** ends in a flare part **110**g', and a sleeve member **112** is rotatably carried on portion **110** captured between the flare part **110**g' and a shoulder **114** on the body **102**. The sleeve member **112** outwardly defines a straight male thread **112***a* and includes a hexagonal surface portion **112***b* providing for wrenching of the adapter. This type of fitting will interface with vehicles using flared tube fittings with male seats in the female portions of the fittings (see, FIG. **3***j* for an example of this type of fitting as a part of one of the complementary adapter fittings of the present invention).

The fitting **100***g* shown in FIG. **3***g* is of a 45° flare configuration, but those ordinarily skilled will recognize that other types of flare tube fittings of this design may be provided with flare angles other than 45°. AN type fittings, for example, may use a flare angle that is other than 45°. Thus, an adapter **100***g* as is shown in FIG. **3***g*, but with a flare angle other than 45° may be employed as necessitated by the vehicles to be serviced using machine **24**.

FIGS. **3***h* through **3***k* illustrate another family of adapters **100***h*, **100***j*, and **100***k*, which also may be provided in various sizes dependent upon the requirements of vehicles to be serviced with machine **24**. FIGS. **3***h* and **3***i* depict an adapter **100***h* which has an integral end termination portion **108***h* outwardly providing a surface portion **108***h*' which is configured in a hexagonal shape to allow wrench engagement with the adapter. Inwardly, this adapter **100***h* provides a bore **116***h* with straight female thread **116***a* leading to a female tapered seat **118***h* (seen in FIG. **3***h* only). Those ordinarily skilled will recognize that the adapter **100***h* will interface with a fitting of the type also requiring use of the adapter **100***f* shown in FIG. **3***f*. That is, when a vehicle having this type of fittings is serviced, the fittings are opened, and one side connects to an adapter **100***f*, while the other side connects to an adapter **100***h*.

FIG. **3***j* depicts another adapter of this family, which adapter **100***j* has an integral end termination portion **108***j* outwardly providing a hexagonal surface portion **108***j*', and which inwardly provides a bore **116***j* with a respective straight female thread **116***a*. In this case, the thread **116***a* leads to a male tapered seat **118***j*. Those ordinarily skilled will recognize that the adapter **100***j* will interface with a fitting of the type also requiring use of the adapter **100***g* shown in FIG. **3***g*.

Finally, FIG. **3***k* shows an adapter of this same family which has a termination portion **108***k* inwardly providing a respective female pipe thread **116***a*. This adapter is used as the counterpart or complement to the adapter of FIG. **3***c*.

FIGS. **3***l* and **3***m* illustrate two additional adapters, which are respectively counterparts of the adapters seen in FIGS. **3***g* and **3***d*/*e*. The adapter of FIG. **3***l* has an elongate tubular body **1021** upon which a nut member **1181** is captively retained between a shoulder **1201** and a ring part **1241**. The nut member **1181** has a surface portion **1181**' configured hexagonally to allow wrench engagement. Also, the ring part **1241** of the body **1021** is welded to the reminder of this body so that the nut member **1181** is permanently rotationally retained on the adapter **1001**. The termination portion **1081** of this adapter **1001** is configured to interface with a fitting counterpart to the flare tube fitting that is shown in FIG. **3***g*, although this form of flare tube fitting will use a shorter sleeve member than the one shown in that drawing Figure.

In the case of the adapter **100***m* shown in FIG. **3***m*, this adapter is a counterpart of the adapter seen in FIGS. **4***d*/*e*. The adapter of FIG. **3***m* has an elongate tubular body **102***m* upon which a nut member **118***m* is Captively retained between a shoulder **120***m* and a ring part **124***m*. The nut member **118***m* has a surface portion **118***m*' configured hexagonally to allow wrench engagement. Also, the ring part **124***m* of the body **1021** is welded to the reminder of this body so that the nut member **118***m* is permanently rotationally retained on the adapter **100***m*. The termination portion **108***m* of this adapter **100***m* is configured to provide a shoulder against which an O-ring sealing member seats, and can interface with a fitting counterpart to the O-ring adapter shown in FIGS. **3***d*/*e*.

Interconnecting Adapters **100** and Hoses **84***a*/*b*

Reviewing FIG. **3**, it is seen that each adapter **100** includes a male coupling portion **126** which is stepped with a smaller diameter portion **126***a* and a larger diameter portion **126***b* cooperating to provide a shoulder **128**, both portions **126***a* and **126***b* are tubular and of cylindrical shape. The bore **106** opens centrally on the male coupling portion **126**. Along its length, the male coupling portion **126** defines a pair of spaced apart circumferential grooves **130** and **132**. Groove **130** closest to the end of portion **126***a* receives an O-ring **134** while groove **132** adjacent to shoulder **128** remains open.

Returning to a consideration of the couplings **92**, one example of how the hoses **84***a* and **84***b* may be joined sealingly to their respective coupling structures **92** is seen in FIG. **4***a*. In this example, each hose is sealingly secured to a respective coupling structure **92** by means of a malleable ring **136** which is swaged to a smaller diameter after the end portion of the respective hose is slipped onto the hose barb section **98***a*. Those ordinarily skilled in the pertinent arts will understand that other alternatives are available by which the hoses **84***a* and **84***b* may be sealingly joined to their respective female coupling structures **92**.

At the end of body **94**, as is best seen in FIG. **3***a*, this body includes a pair of axially extending D-shaped bosses, each indicated with the numeral **138**. These D-shaped bosses **138**

each have a respective flat face **138***a*, which faces are spaced apart on opposite sides of the opening of bore **96**. Each boss **138** also defines a laterally extending groove **140**, which is disposed toward the groove of the other of the pair of bosses **138**, so that the pair of grooves **140** cooperate to define a laterally extending guide way, the center of which is indicated with a dashed line and numeral **140***a*. Slidably received in the guide way **140***a* is an apertured plate-like retainer member **142** having a pair of spaced apart straight and parallel side edge portion **142***a*, each of which is slidably received in one of the grooves **140**. This retainer member **142** defines an aperture **144**, which is sized to be slightly larger than the opening of bore **96**, and is large enough to pass the male coupling portion **126** of any one of the adapters **100** (recalling the descriptions of FIG. **3**).

The aperture **144** is somewhat keyhole shaped, and has a stepped recess **146** about midway between the side edge portion **142***a*, viewing now FIGS. **4***a*–**4***e* in conjunction with one another. This recess **146** includes a smaller sized portion **146***a* leading to a larger sized portion **146***b*, which communicates with the remainder of the aperture **144**. Aligning with the recess **146**, the body **94** defines a blind bore **148** spaced from and parallel with bore **96**. Received into the bore **148** is a coil compression spring **150**, which seats against the blind end wall **148***a* of the bore **148**, and a stepped and headed plunger member **152**. Plunger member **152** has a smaller-sized stepped section **152***a* (best seen in FIG. **4***a*), which is sized to fit in portion **146***a* of recess **146**. A larger-sized stepped section **152***b* of the plunger **152** is sized to fit in portion **146***b* of recess **146**. This plunger member **152** also has a body portion **152***c* and a head portion **152***d*, both of which are sized to slidably fit into bore **148**. Retainer member **142** includes a connecting section **142***b* aligning with the recess **146**, and also includes a thumb-tab **154** aligning with a blind radially extending bore **156**. A coil compression spring **158** is received into the bore **156**, and seats against the blind end wall **156***a* of this bore. An end of spring **158** engages against the thumb-tab **154** to resiliently urge this thumb-tab (and retainer member **142**) upwardly as viewed in FIG. **4**.

In view of the above and with reference to FIG. **4**, it can be seen that during assembly of the coupling **92**, the spring **150** and plunger **152** are received into and are held entirely into the bore **148**. Next, retainer member **142** is then slid laterally into grooves **140** so that the portion **142***b* of the retainer member passes over bore **148** and the head portion **1152***d* of this plunger member is received into and extends partially outwardly through the aperture **144** at recess **146**. In order for the head portion **152***d* of the plunger member **152** to extend outwardly via aperture **144**, the retainer member **142** must be moved along grooves **140** in the direction of the arrow on thumb-tab **154** so that the aperture **144** is beyond alignment with bore **96**. The retainer member **142** is then allowed to return under the bias of spring **158** into a position of alignment at aperture **144** with bore **96**, viewing FIG. **4***c*. This position of the retainer member **142** is its first position. This first position for retainer member **142** is seen in FIGS. **4***b* and **4***c*. Stated again, in this first position of the retainer member **142** relative to the body **94**, the portion **152***b* of plunger member **152** is received into recess portion **146***b*, and holds the retainer member **142** with aperture **144** in alignment with bore **96**.

In this first position of the retainer member **142**, the portion **126***a* of an adapter **100** may be inserted into bore **96**. As the groove **132** comes into alignment with retainer member **142**, viewing FIGS. **4***d* and **4***e*, the head portion **152***d* of the plunger member **152** is engaged by shoulder **128**, and is pushed inwardly, releasing the latching of retainer member **142** from its first position. Thus, this retainer member **142** is released by plunger **152** to be moved by spring **158** to a second position in which the portions **144***a* are received in the groove **132**, and the adapter member **100** is thus latched into engagement with a coupling assembly **92**, viewing FIG. **4***d*.

Understandably, release of the adapter **100** from the coupling assembly **92** requires only that the thumb-tab **154** be pressed slightly downwardly as is indicated by the arrow on this thumb tab in FIG. **4***a*. This downward movement of the retainer member **142** will release the portion **144***a* from the coupling assembly **92**, and will also allow the plunger member **152** to latch the retainer member **142** again in its first position, as is seen in FIG. **4***b*. Because of the presence of the portion **126***a* of an adapter **100** in the bore **96**, the retainer member **142** is not able to move far enough in the direction of the arrow on tab **154** to result in the plunger **152** being released from bore **148**. It will be understood that other designs of quick-disconnect couplings may be used to interface the adapters **100** with the intermediate hoses **90**.

An Example of the Use of Machine **24**

Viewing now FIG. **5**, an example is pictorially presented showing the under-hood area of the an exemplary vehicle **160** having an automatic transmission cooler connection into an end tank of the vehicle's radiator, which is indicated with arrowed numeral **160***a*. Also shown is the use of a pair of the adapter fittings **100** to interconnect the machine **24** with this vehicle. In this case, the service technician has selected adapter fittings **100***g* and **100***j* (FIGS. **3***g* and **3***j*, respectively) which are complementary to one another, and also to the existing fittings for the transmission cooler connection **160***a* of this particular vehicle. The service technician has disconnected the two parts of the connection **160***a* from one another (as is seen in FIG. **5**), and has then connected the adapters **100***g* and **100***j* to the fittings of the vehicle **160**. It will be noted that while connecting the adapters **100** within the confines of the under-hood area of the vehicle **160**, the service technician has only to deal with the relatively small and easily handled pair of complementary adapters. Thus, a greater convenience and additional room for hands is provided by the small size of these adapters in the frequently-cramped working area available for the connection of machine **24** to the vehicle **160**.

In order to interconnect the two selected ones of the intermediate hoses **90***a*–*d*, the technician selects the pair of these intermediate hoses giving best access to the particular vehicle, and connects these intermediate hoses to the hoses **84***a* and **84***b* at couplings **86***a* and **86***b*. Thus, a configuration of hoses is created which will substantially form the conduits **28** and **38** (recalling the description above). Those ordinarily skilled in the pertinent arts will recognize that the selection of the most appropriate two of the four intermediate hoses is within the judgment of the service technician, and that many vehicles present the possibility that other combinations of the intermediate hoses and adapter fittings will be used to agree with the particular needs and preferences of the vehicles and of the personal choices of the technicians servicing these vehicles. For example, a technician who is left-handed may choose a different place of access to a vehicle than a technician who is right-handed, and may accordingly use a different combination of intermediate hoses and adapters. In this case, the service technician has chosen to connect the pair of hoses **90***a* and **90***b*, each with a straight or in-line shape of end portion, as was seen in FIG. **4**. Again, another different technician may have chosen the intermediate hoses **90***c* and **90***d* for use on this same vehicle. The intermediate hoses are coupled to the adapters **100**.

As is described, the engine of the vehicle **160** will be operated, and as a result transmission fluid will flow from the transmission via conduit **18**, to the machine **24** via hose **84***a*, through the machine **24**, back to the transmission cooler **16** via hose **84***b*, and then back to the transmission via a conduit **20** (which is not visible in FIG. **2**). Other possible connections to the conduits **18** and **20** are possible. Some technicians may choose to connect into the external fluid circulation loop **22** at places adjacent to the transmission itself (e.g., this may be the case when the technician chooses to service the automobile **160** while it is on a lift—making access to the underside of the vehicle most convenient). Thus, after the machine **24** is interconnected with the transmission, the service of this transmission is carried out as outlined above and as further explained below.

Preferably, the transmission will already be at operating temperature, or is brought to operating temperature. The transmission is next operated for about 20 minutes while circulating a cleaning material in the transmission fluid. This may be accomplished on a chassis roller stand allowing the vehicle drive wheels to rotate as the technician shifts through various gears to insure that the cleaning material in the transmission ATF is circulated through all parts and mechanisms of the transmission. During this process, transmission fluid will circulate both in internal loop **22** (which is opened by attachment of machine **24** at connection **160***a*) and in external fluid circulation loop **26**. As soon as this cleaning process is completed, the technician initiates withdrawal of the old transmission fluid and addition of new fluid by starting pump **64**, providing the necessary operator input at control **82**, observing the outflow rate at flow meter **30**, and matching the inflow rate at meter **74** by manipulation of control valve **72**.

Again, the transmission is operated in different gears to insure that the old fluid is removed from the various mechanisms of the transmission, including the torque converter. As was pointed out above, over **94** percent of the old transmission fluid will be replaced by new fluid in this way. The technician may observe the color and turbidity of fluid entering the waste container **56** in order to assess when a sufficient quantity of the old fluid has been displaced by new fluid. As the old fluid is discharged from the transmission, dirt, contaminants, wear particles, varnishes, and sludge removed from the mechanism of the transmission by the present cleaner will also be carried to waste container **56**.

A particular advantage of the present invention results from the small number of hoses **84***a* and **84***b*, the small number of intermediate hoses **90***a*–**90***d*, and the small, easily handled complementary pairs of adapters **100** which can be used, and which allow the machine **24** to be used to service the transmission of a wide variety of vehicles. In comparison with the conventional transmission machines using a plurality of hoses, many having permanently secured adapters and fittings (some conventional machines require as many as 20 to 30 hoses, or more), the present service machine **24** in comparison reduces initial investment, saves storage space, reduces maintenance requirements for the machine, and allows a simplified and much more convenient and flexible connection of the machine **24** to a wide variety of vehicles. In other words, rather than having to determine or figure out how to use the correct ones of 20 or more hoses and adapters conventionally utilized, a technician using the present transmission service machine need only select and use two of four intermediate hoses, and the appropriate two of the complementary pairs of adapters **100**.

While the present invention has been depicted, described, and is defined by reference to a single particularly preferred embodiment of the invention, such reference does not imply a limitation on the invention, and no such limitation is to be inferred. The invention is capable of considerable modification, alteration, and equivalents in form and function, as will occur to those ordinarily skilled in the pertinent arts. The depicted and described preferred embodiment of the invention is exemplary only, and is not exhaustive of the scope of the invention. Consequently, the invention is intended to be limited only by the spirit and scope of the appended claims, giving full cognizance to equivalents in all respects.

What is claimed is:

1. A machine for service of an automatic transmission while the transmission is in an automotive vehicle, and which vehicle has an external circulation loop for circulation of transmission fluid external to the transmission, the external circulation loop having a vehicle coupling therein with two complementary parts coupled in fluid flow connection with one another to complete the external circulation loop, said machine being effective for use in interrupting the external circulation loop at the vehicle coupling where these complementary coupling parts are disconnected from one another, and to effect exchange of used transmission fluid from the transmission which used transmission fluid is received by said machine via one of the two complementary parts of the vehicle coupling and is replaced with new fluid supplied by said machine from a supply of new transmission fluid via the other of the two complementary parts of the vehicle coupling, said machine comprising:

a first fluid flow conduit adapted for connection to one of the complementary parts of the vehicle coupling and conducting used transmission fluid from the transmission to a waste container while the complementary parts of the vehicle coupling are uncoupled from one another, and a second fluid flow conduit adapted for connection to the other of the complementary parts of the vehicle coupling and conducting new transmission fluid from a source thereof into the transmission while the complementary parts of the vehicle coupling are uncoupled from one another;

said first fluid flow conduit and said second fluid flow conduit each including a respective one of a pair of elongate primary hoses, each one of said pair of primary hoses including at a distal end thereof a respective one of a pair of substantially identical first-disconnect coupling portions;

said first fluid flow conduit and said second fluid flow conduit each also including a respective one of an intermediate pair of hoses each one including at a proximal end thereof one of a respective pair of substantially identical second quick-disconnect coupling portions complementary to and interconnected with one of said pair of first quick-connect coupling portions, and at a distal end thereof each one of said intermediate pair of hoses having a respective one of a pair of substantially identical additional quick-disconnect coupling portions; and

a pair of adapters each one having a substantially identical first end portion complementary to and sealingly engaged with one of said pair of additional quick-disconnect coupling portions, and a second end portion providing one of a pair of complementary termination features; which complementary termination features are adapted to be complementary to one another and are also adapted to be complementary each to a respective one of the one part and the other part of the vehicle coupling;

whereby said pair of adapters from a fluid flow connection both between said first conduit and said second conduit and also between opposite sides of the external fluid circulation loop of the transmission at disconnected parts of the vehicle coupling.

2. The machine of claim **1** wherein said machine includes four intermediate hoses each having a length, and any two of which may be selected to make said intermediate pair of hoses, said four intermediate hoses including a first pair of intermediate hoses each of which has said additional quick-disconnect coupling portion arranged in alignment with the length of said respective intermediate hose, and another pair of intermediate hoses each of which has a selected one of said second quick disconnect coupling portion and said additional quick-disconnect coupling portion arranged substantially perpendicularly to the length dimension of said respective intermediate hose.

3. The machine of claim **1** wherein said second end portions of said pair of adapters are complementary to one another.

4. The machine of claim **1** further including a set of plural adapters from which said pair of adapters is selected, said set of plural adapters including plural pairs of complementary adapters, each pair of which provides a differing complementary pair of second end portions.

5. A transmission cleaning machine for servicing an automotive automatic transmission while the transmission is in an automotive vehicle, and which automatic transmission and automotive vehicle includes an external transmission fluid circulation loop including a vehicle coupling with two complementary parts in fluid flow communication with one another, said transmission cleaning machine comprising:

a container for holding a supply of new automatic transmission fluid;

a first conduit and a second conduit for respectively receiving old automatic transmission fluid from the transmission and for delivering new automatic transmission fluid to the transmission via disconnected complementary parts of the vehicle coupling;

a pump receiving new automatic fluid from said container and supplying the new automatic transmission fluid pressurized via said second conduit to the external automatic transmission fluid circulation loop;

said machine further including a set of adapters adapted to be connected respectively with said first and said second conduits in fluid flow connection with the external fluid circulation loop at respective disconnected parts of the vehicle coupling, said set of adapters including plural pairs of adapters in which the individual adapters of each pair are complementary to one another, and one pair of said plural pairs of adapters is also complementary to and is adapted to be connected in fluid flow connection with the two complementary vehicle coupling parts;

whereby, the two complementary parts of the vehicle coupling are disengaged from one another to open the external fluid circulation loop, and said one pair of adapters is selected from among said plural pairs of adapters and is utilized to interconnect with the two parts of the vehicle coupling so that each individual adapter of the one pair of adapters connects one of said first conduit and said second conduit with a respective one of the two vehicle coupling parts.

6. The machine of claim **5** wherein said machine includes four intermediate hoses each having a length dimension, and any two of which may be selected to make said intermediate pair of hoses, said four intermediate hoses including a first pair of intermediate hoses each of which has said additional quick-disconnect coupling portion arranged in alignment with the length dimension of said respective intermediate hose, and another pair of intermediate hoses each of which has said additional quick-disconnect coupling portion arranged substantially perpendicularly to the length dimension of said respective intermediate hose.

7. A method of changing old transmission fluid out of an automotive automatic transmission on an exchange basis for new fluid simultaneously introduced to the transmission as old fluid is discharged therefrom while the transmission is installed in an automotive vehicle, the automatic transmission having an external fluid circulation loop including a vehicle coupling with two complementary parts in fluid flow connection with one another, said method comprising steps of:

providing a machine having a conduit for conducting automatic transmission fluid from the external circulation loop to a waste receptacle;

providing a supply of new transmission fluid;

providing a pair of elongate primary hoses, opening the fluid circulation loop at the vehicle coupling by disconnecting the two complementary parts of the vehicle coupling, and connecting a respective one of said primary hoses each to a respective one side of the opened fluid circulation loop each at a respective disconnected one of the two complementary parts of the vehicle coupling;

defining a respective portion of said first conduit and of said conduit each at respective distal ends thereof by use of a respective pair of substantially identical first quick-disconnected coupling portions;

providing an intermediate pair of hoses each one including at a proximal end thereof one of a pair of substantially identical second quick-disconnect coupling portions complementary to said first quick-disconnect coupling portions and connecting in fluid flow connection with said first quick-disconnect coupling portions, and at a distal end thereof each having a respective one of pair substantially identical additional quick-disconnect coupling portions; and

supplying a pair of adapters each having a substantially identical first end portion complementary to and sealingly engaged with one of said pair of additional quick-disconnect coupling portions, and also having a second end portion adapted to provide a termination feature complementary to and connecting in fluid flow connection to a respective one of the disconnected parts of the vehicle coupling of the external fluid circulation loop of the vehicle.

8. The method of claim **7** further including the step of:

providing a set of adapters each for use with differing vehicles for connecting the machine at said first and said second conduits in fluid flow communication with external fluid circulation loops of the respective vehicles at respective parts of a coupling thereof, said set of adapters including plural pairs of adapters in which the individual adapters of each pair are complementary to one another.

9. The method of claim **8** including the step of providing one pair of adapters which at said end termination portion is complementary to a hose.

10. The method of claim **8** including the step of providing one pair of adapters at said end termination portion is complementary to a pipe thread.

11. The method of claim 8 including the step of providing one pair of adapters at said end termination portion is complementary to a flare tube fitting.

12. The method of claim 8 including the step of providing one pair of adapters at said end termination portion is complementary to an O-ring fitting.

13. The method of claim 8 including the step of providing one pair of adapters at said end termination portion is complementary to a reversed flare tube fitting.

14. In combination, a machine for service of an automatic transmission in an automotive vehicle, which vehicle has an external circulation loop for transmission fluid, the loop having a vehicle coupling therein with two complementary parts connecting in fluid flow connection, and a set of plural pairs of adapters for interfacing said machine with each of the two complementary parts of the vehicle coupling when the parts of the vehicle coupling are disconnected from one another; said machine and a selected one pair of said plural pairs of adapters being affective for use in interrupting the external fluid flow loop by disconnection of the complementary adapters of the selected one pair of adapters, and to effect exchange of used transmission fluid from the transmission with new fluid from a supply thereof, said machine comprising:

a first fluid flow conduit for conducting used transmission fluid from the transmission via one of the complementary parts of the vehicle coupling and one of the selected one pair of adapters to a waste container, and a second fluid flow conduit for conduit for conducting new transmission fluid from a source thereof via the other of the complementary parts of the vehicle coupling and the other of the selected one pair of adapters into the transmission;

a pair of elongate primary hoses, each one of said pair of primary hoses defining a portion of a respective one of said first conduit and of said second conduit, each one of said pair of primary hoses including at a distal end thereof a respective one of a pair of substantially identical fir quick-disconnect coupling portions;

an intermediate pair of hoses, each one of said intermediate pair of hoses including at a proximal end thereof one of a respective pair of substantially identical second quick-disconnect coupling portions complementary to said first quick-disconnect coupling portions, and at a distal end thereof each one of said intermediate pair of hoses having a respective one of a pair of substantially identical additional quick-disconnect coupling portions; and

said plural pairs of adapters each having a substantially identical first end portion complementary to and sealingly engageable with one of said pair of additional quick-disconnect coupling portions, and a second end portion adapted to be complementary both to each other and also each being adapted to be complementary to and connecting in fluid flow connection to one part of the vehicle coupling.

15. The combination of claim 14 wherein one pair of said plural pairs of adapters includes end termination portions which are complementary to a hose.

16. The combination of claim 14 wherein one pair of said plural pairs of adapters includes end termination portions which are complementary to a pipe thread.

17. The combination of claim 14 wherein one pair of said plural pairs of adapters includes end termination portions which are complementary to a flare tube fitting.

18. The combination of claim 14 wherein one pair of said plural pairs of adapters includes end termination portions which are complementary to an O-ring fitting.

19. The combination of claim 14 wherein one pair of said plural pairs of adapters includes end termination portions which are complementary to a reversed flare tube fitting.

20. A set of adapters for use to connect a transmission service machine and any one of a multitude of differing vehicles each having an automatic transmission to be serviced by use of the machine, the one vehicle having a fluid circulation loop in which transmission fluid flows during operation of the vehicle, and the fluid circulation loop including at least one vehicle coupling, each at least one vehicle coupling including two complementary vehicle coupling parts; and set of adapters comprising:

plural pairs of adapters, each adapter part of a pair being adapted for connecting the transmission service machine in fluid flow connection with respective complementary parts of a vehicle coupling when the two complementary parts of the vehicle coupling are disconnected from one anther; each pair of said plural pairs of adapters including two adapter parts, each adapter part at a respective first end termination portion being complementary to the other adapter part of the pair and to one part of the disconnected vehicle coupling, and each adapter part of also including a second and termination portion, which second end termination portion is substantially similar to respective individual second end termination portions of each adapter part of said plural pairs of adapters, and said second end termination portion being configured to connect in fluid flow connection with a quick-disconnect coupling.

* * * * *

EXHIBIT 3

EXHIBIT 3

US006073638A

United States Patent [19]

Sasaki et al.

[11] Patent Number: 6,073,638

[45] Date of Patent: Jun. 13, 2000

[54] **METHOD AND APPARATUS FOR CLEANING AN AUTOMOTIVE ENGINE**

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[73] Assignee: **Wynn Oil Company**, Azusa, Calif.

[21] Appl. No.: **09/360,713**

[22] Filed: **Jul. 26, 1999**

Related U.S. Application Data

[63] Continuation of application No. 08/976,889, Nov. 24, 1997, Pat. No. 5,970,994.

[51] **Int. Cl.**[7] **B08B 3/04**; B08B 9/00

[52] **U.S. Cl.** ..... **134/22.18**; 134/36; 134/39; 134/102.2; 134/169 A

[58] **Field of Search** ..... 134/102.1, 102.2, 134/169 A, 22.18, 36, 39; 123/198 A

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Primary Examiner—Philip R. Coe
Attorney, Agent, or Firm—Terry L. Miller

[57] **ABSTRACT**

An apparatus and method for cleaning the intake system of an internal combustion engine, such as an automobile engine, employs intake manifold vacuum of the running engine to ingest and atomize a liquid cleaner using a bleed of ambient air. Atomizing of the liquid cleaner provides better dispersion of the cleaner to surfaces of the intake system of the engine, and prevents puddling of the liquid in low spots of the intake system.

9 Claims, 2 Drawing Sheets

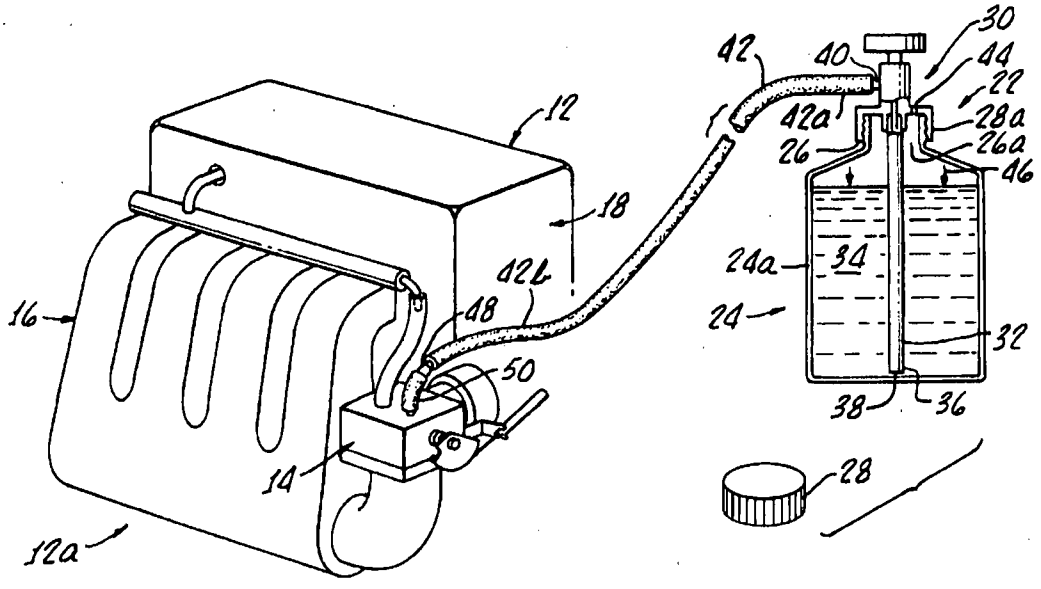
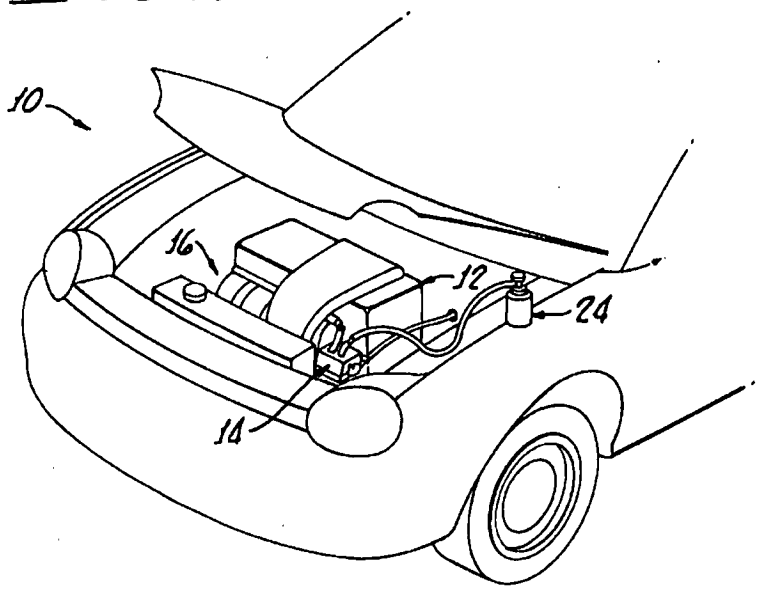


FIG. 1.


10
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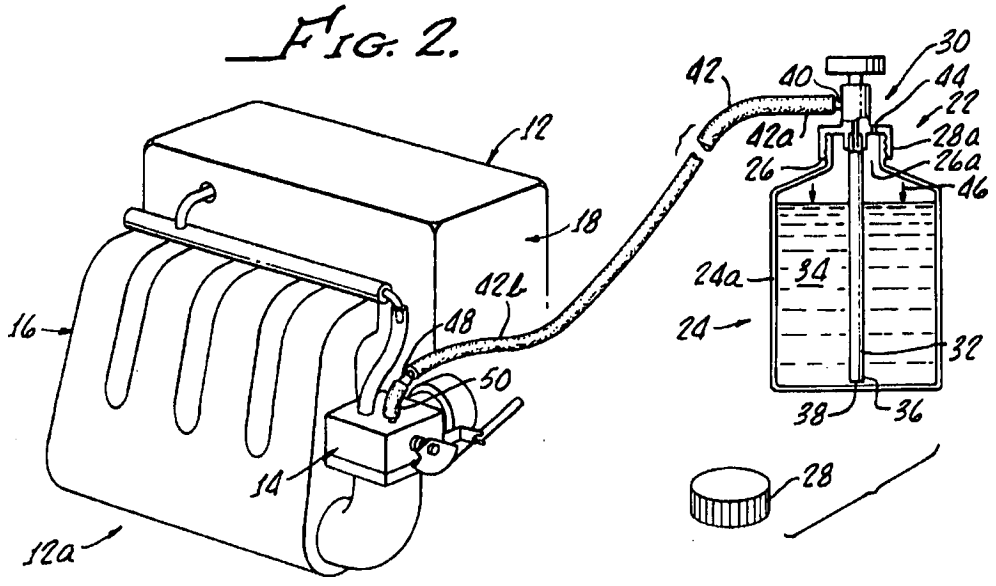
24
14

FIG. 2.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12a

FIG. 3.

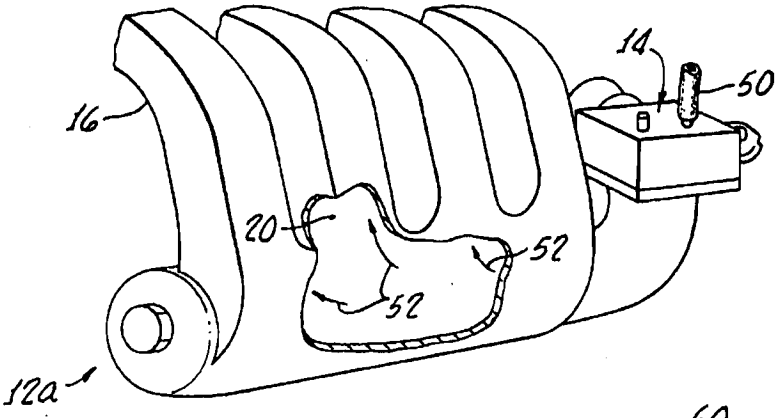
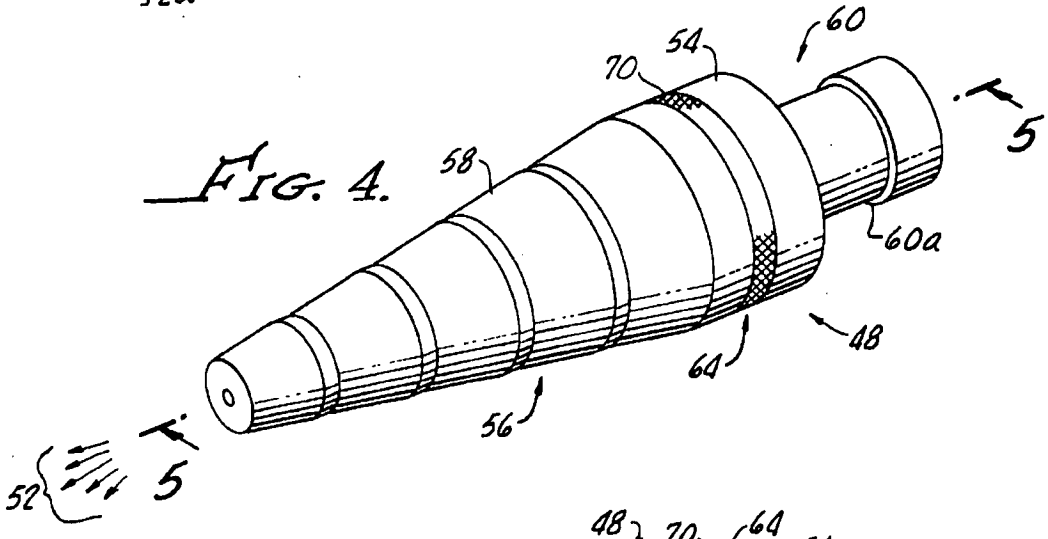


FIG. 4.



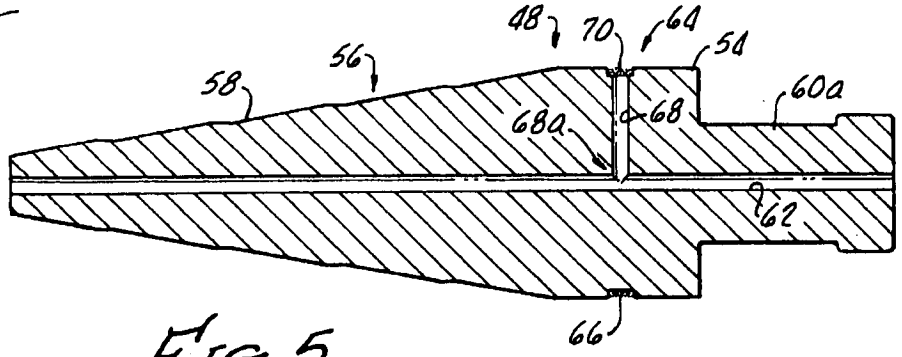


FIG. 5.

METHOD AND APPARATUS FOR CLEANING AN AUTOMOTIVE ENGINE

RELATED APPLICATIONS

This application is a divisional of U.S. patent application Ser. No. 08/976,889 filed Nov. 24, 1997, and now U.S. Pat. No. 5,970,994.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is in the field of method and apparatus for cleaning internal structures and components of an automotive engine. More particularly, the present apparatus relates to a method and apparatus for cleaning the intake system, including the intake plenum, runners, and ports; and intake valves and combustion chambers of an automotive engine while the engine is assembled and running.

2. Related Technology

The cleaning of carburetors, intake systems, intake valves and combustion chambers of assembled automotive engines (i.e., without requiring disassembly of the engine) has been an objective for mechanics and the operators of automobiles almost from the beginning of the automobile itself. Carburetor cleaning spray aerosol products are very common, and are generally dispensed into the air intake of a carburetor on an engine while the engine is running. These products provide a spray of the cleaning liquid, which the user generally directs to the most soiled areas of the carburetor while applying the spray into the running engine. With products of this nature, the combination of a relatively slow rate of introduction of the liquid cleaner, and the structures of the carburetor itself against which the spray is directed (tending to break up the spray into droplets), generally prevent the accumulation of liquid in the intake system of the engine.

Other engine cleaning products of this nature have been developed in recent years which are introduced into the intake system of an automotive engine while it is running, and which are introduced via a vacuum fitting of the engine, for example. These products are generally supplied in liquid non-aerosol form, and are introduced into the running engine in liquid form using engine vacuum to draw the product into the engine. These newer products are generally more effective at cleaning an engine than the older conventional and aerosol products, but also have a problem in that distribution of the cleaning product among the several intake runners, intake ports, intake valves and combustion chambers of a multi-cylinder engine is not uniform. In other words, some of the cylinders of an engine cleaned in this way may receive an excess of the cleaning product, while other cylinders of the engine receive less of the cleaner, or virtually none at all. Understandably, an engine will not be cleaned satisfactorily if a liquid cleaner product is not distributed with a substantial degree of uniformity within the intake system and among the cylinders of the engine.

Further, a problem with some automotive engines is that the cleaner is introduced at a rate sufficient in some cases to cause liquid puddling in the intake systems of the engines. Generally, these engine cleaning products are introduced in liquid form by engine intake manifold vacuum, which draws the liquid from a dispensing container via a connecting hose or conduit. A metering orifice may be disposed in the liquid flow path to limit the rate at which the cleaning liquid is drawn into the engine by engine vacuum. Moreover, in most

engine designs these newer cleaning products cause no problem because the cleaner is broken up into droplets, and is drawn into the combustion chambers of the engine without accumulating to any large extent. However, some engine designs, for example, those with an intake manifold floor or plenum floor which at least in part is lower than the intake valves of the engine can experience difficulty with such engine cleaner products. That is, a persistent problem with some designs of automobile engines when such products are used has been the puddling of cleaning liquid in the intake manifold of the engine. In other words, some engine designs are such that the intake manifold offers low areas or recesses where significant quantities of cleaning liquid can accumulate even though the liquid is introduced while the engine is running.

Further, the air flow in the intake system of an engine while idling or at a speed slightly above idle (which is ordinarily the case while the cleaner is being introduced) is generally not sufficient to either move the puddled liquid to a combustion chamber, or to vaporize the liquid. This problem may be worsened if the engine is not properly warmed up prior to use of the cleaner. In such cases, the intake manifold is cool, and the liquid cleaner is not as readily vaporized.

In cases resulting in puddling of the cleaning liquid in the intake manifold of an engine, subsequent racing of the engine or moving of the automobile, for example can result in liquid from the puddle being sloshed or drawn by engine air flow into one or more of the combustion chambers of the engine while it is running. In such an event, if a quantity of liquid cleaner is drawn into a combustion chamber and is sufficient to completely fill the clearance volume of the chamber, hydraulic locking of the engine results. That is, serious damage to the engine can result when a piston of the running engine approaches the engine head and is blocked by a quantity of essentially incompressible liquid. Operation of the running engine is then brought suddenly to a stop, with possible internal damage to the engine.

In view of the above, it would be desirable to provide a method and apparatus for introducing a liquid cleaner into the intake system of an automotive engine while it is running, and while reducing or eliminating the possibility for the liquid leaner to puddle in the intake system of the engine.

SUMMARY OF THE INVENTION

In view of the above, it is an object of this invention to provide a method and apparatus for introducing a liquid cleaner into the intake system of a running engine, and which reduces or eliminates the possibility for the liquid cleaner to puddle in the engine.

Further, an object of this invention is to provide such a method and apparatus which introduces a liquid cleaner into the intake system of an engine at a controlled rate.

Still another object for this invention is to provide a method and apparatus of introducing a liquid cleaner into a running engine, and which uses the intake manifold vacuum of the running engine to draw in the liquid cleaner.

Yet another object for this invention is to provide such a method and apparatus, in which ambient air is ingested along with a liquid cleaning material, and the ambient air is utilized to atomize the liquid and provide an atomized "fog" of the cleaning liquid to a running automotive engine.

Accordingly, one aspect of the present invention provides an apparatus for cleaning the intake system of an automotive internal combustion engine providing intake manifold

vacuum when operating. This apparatus comprises: a source of liquid cleaner to be introduced into the intake system of the engine; a conduit extending between said source and said engine to convey said liquid cleaner; an aspirator communicating between said conduit and intake manifold vacuum of said engine for atomizing said liquid cleaner and introducing said atomized liquid cleaner into said intake system, said aspirator including an ambient air intake port aspirating ambient air and mixing said ambient air with said liquid cleaner to atomize the latter.

Another aspect of the present invention provides a method for cleaning the intake system of an automotive internal combustion engine utilizing ambient air bleed and intake manifold vacuum of the operating engine to ingest a liquid cleaner in atomized form. This method comprises steps of: providing a source of liquid cleaner to be introduced into the intake system of the engine; and utilizing an aspirator communicating said liquid cleaner into said intake system to atomize said liquid cleaner while introducing said liquid cleaner into said intake system.

Additional objects and advantages of the present invention will appear from a reading of the following description of a single exemplary embodiment of the invention taken in conjunction with the appended drawing Figures, in which like reference numerals indicate the same feature throughout the drawing Figures, or indicate features which are analogous in structure or function.

BRIEF DESCRIPTION OF THE DRAWINGS FIGURES

FIG. **1** is a pictorial representation of an automotive vehicle, and the engine of this vehicle;

FIG. **2** is a fragmentary illustration of a part of the engine of the vehicle seen in FIG. **1**, and shows this engine being cleaned using a method and apparatus embodying the present invention;

FIG. **3** provides a fragmentary view, partially in cross section, of an intake manifold of the engine seen in FIGS. **1** and **2**, which intake manifold defines a portion of the intake system for this engine, and which is being cleaned using the method and apparatus of the present invention; and

FIGS. **4** and **5** respectively are an enlarged fragmentary and cross sectional views of a portion of the engine cleaning apparatus seen in FIGS. **2–4**.

DETAILED DESCRIPTION OF AN EXEMPLARY PREFERRED EMBODIMENT OF THE INVENTION

Viewing first FIG. **1**, an automotive vehicle **10** is seen having an engine **12**. In this case, the automotive vehicle **10** is an automobile, although it is to be understood that the invention is not limited to use on automobiles. For example, the invention may be used to clean the engine of a truck, a vans, or even of a boat. Further, it is to be understood that the invention is not limited to cleaning engines of automotive vehicles. For example, a stationary engine (such as the engine of a motor-generator set) may be cleaned using the present invention. Further, an engine which is not stationary, but which is also not a propulsion engine for an automotive vehicle may be cleaned using the present invention. For example, many industrial air compressors which are portable (such as may be used at a construction site) have internal combustion engines, and these engines may be cleaned using the present invention. Accordingly, it is to be understood that a wide variety of internal combustion engines may be cleaned by use of the present invention. The only requirement is that the engine develop an intake manifold vacuum while it is running at or slightly above idle speed. Thus, the invention is not used to clean a diesel engine. However, even engines which are turbo-charged, for example, and which may operate with a supra-ambient intake manifold pressure under load at speeds above idle, may be cleaned using the present invention. Such is the case because turbo-charged engines operate with a manifold vacuum at idle and at speeds somewhat above idle when the engine is not under load.

Considering now the illustration of FIG. **2**, the engine **12** is seen to have a throttle body **14** admitting air to an intake manifold **16**, conducting the air to intake ports (not shown) formed within a head **18** of the engine **12**. The throttle body **14**, and passages **20** defined internally of the intake manifold, along with the intake ports of the engine head **18** are cooperatively referred to generally as the intake system **12***a* of the engine **12**. Within the head **18** it will be understood that the engine **12** includes intake poppet valves (not shown) which controllably open and close the intake ports. This aspect of the structure and operation of the engine **12** will be well understood to those ordinarily skilled in the pertinent arts. Viewing now FIGS. **2–4** in conjunction with one another, it is seen that the intake system of the engine **12** is being cleaned (while the engine is running at or preferably slightly above idle speed) by use of a cleaning apparatus **22**. The cleaning apparatus **22** includes a container **24**, which in this case takes the form of a can **24***a* with a threaded neck **26** defining an opening **26***a*. As depicted in the drawing Figures, the cap **28** which closed the opening **26***a* during shipping of the can **24***a* has been removed. Threaded into place on the neck **26** in place of cap **28** is a dispenser assembly **30**. This dispenser assembly **30** includes a suction tube **32** extending downwardly into a liquid cleaning material **34** (i.e., the "cleaner") to terminate at a lower end **36** adjacent bottom of the can **24***a*, and there having an opening **38**. The dispenser assembly **30** also includes an outwardly disposed hose barb **40** communicating with the suction tube **32**, and to which a proximal end portion **42***a* of an elongate flexible conduit (or hose) **42** is attached. The dispenser assembly **30** also defines an air bleed opening **44** admitting ambient air to the container **24**. Thus, as is depicted by arrows **46**, ambient air exerts a pressure force on the liquid cleaner **34** in container **24**.

At its distal end portion **42***b*, the hose **42** is connected to an aspirator fitting, generally indicated with the numeral **48**. In the illustrated case, the aspirator fitting **48** is connected to a PCV valve (i.e., positive crankcase ventilation) hose **50**, which has been temporarily disconnected to allow the engine **12** to be cleaned. Those ordinarily skilled in the pertinent arts will understand that the fitting **48** need not be installed into access with the intake system **12***a* via a PCV hose. Any convenient and accessible fitting or connection of sufficient size which opens into the intake system **12***a* so as to have intake manifold vacuum during operation of the engine **12** will be acceptable for this purpose.

As is seen in FIGS. **2–5**, during operation of the engine **12**, the aspirator fitting **48** provides a mist or "fog" (indicated with arrowed numeral **52**) of the liquid cleaner **34**. As is easily understood, this mist or fog **52** is easily and effectively moved along the intake system **12***a* into the combustion chambers (not shown) of the engine **12**, so that very little or none of the liquid cleaner **34** puddles in the intake system **12***a* regardless of its shape, configuration, or the presence of low areas in this intake system **12***a*. Moreover, the liquid cleaner **34** is not introduced as a liquid

stream, or even as coarse droplets, into the intake system **12***a*, but is instead efficiently "fogged" into the engine to substantially eliminate the puddling problem explained above. Consequently, the risk of hydraulic lock of engine **12** because of a mass of liquid cleaner **34** being drawn at once into a combustion chamber of the engine **12** is substantially eliminated. Further, it is believed that the "fogging" of the cleaner **34** into the intake system **12***a* of the engine **12** will result in a more effective distribution of the cleaner **34** to the surfaces of this system, as well as to the surfaces of the intake valves and combustion chambers of the engine **12**.

In order to provide the fogging function for cleaner **34** as discussed above, the aspirator fitting **48** includes a body **54** which along a forward exterior portion **56** thereof defines a stepped or alternatingly conical and cylindrical surface, generally indicated with the numeral **58**. The surface **58** thus provides a wide variety of diameters which may be connected conveniently to a fitting or hose leading into the intake system **12***a* of the engine **12**. A rear portion **60** of the body **54** defines a hose barb feature **60***a*, to which the hose **42** connects. Extending lengthwise through the body **54** is a central bore **62**. Preferably, this bore **62** is of a size to control the rate of introduction of liquid cleaner **34** under the intake manifold vacuum existing in engine **12** during operation at idle speed or at a speed slightly above idle speed. Most preferably, the through bore **62** is 0.037 inches in diameter. Intermediate of the portions **56** and **60**, the body **54** also defines an air intake section, indicated with numeral **64**.

Preferably, the air intake section **64** is cylindrical, with a circumferential groove **66**. From the groove **66** a lateral air intake bore **68** extends to the through bore **62**. The bores **62** and **68** have an intersection indicated by arrowed numeral **68***a*. Preferably, this intersection **68***a* is one with coincident centerlines and at a perpendicular angle. However, the invention is not so limited. For example, an angulation of the bore **62** toward or against the direction of flow of liquid cleaner **34** to engine **12** may assist in atomizing this cleaner. Similarly, the bore **68** may be arranged to intersect with bore **62** somewhat in a tangential direction so that a swirl is introduced into the liquid cleaner and air which together flow from the intersection **68***a* toward the engine **12** within the fitting **48**. The size of the bore **68** is most preferably 0.041 inches in diameter.

The size of this bore **68** is important for a number of reasons. First, the size of bore **68** is important because it influences the amount of engine vacuum communicated to the container **24**, thus affecting the rate at which cleaner **34** is drawn from this container into the engine **12**. Further, the size of bore **68** affects the amount of ambient air drawn into the engine **12** via the fitting **48**, and thus affects the degree to which the speed of the engine **10** is elevated above idle speed by virtue of this air bleed (and without an adjustment of the idle speed control screw of the engine or control of throttle position by a person at the driver's controls of the car **10**). Further, the combination of the rate of feed of liquid **34** from container **24** and the rate of intake of ambient air via bore **68** is affected by the sizes of these two bores, thus affecting the atomizing of the liquid **34** effected by the aspirator fitting **48**.

In order to protect the fitting **48** against ingestion of grit and dirt which may be present in the environment around the engine **10**, the body **54** is fitted with a collar **70** of mesh or filter material.

In use of the cleaning apparatus **22**, a user opens a container **24***a* of the cleaner **34** by removing the cap **28**, and replace the cap with the dispenser assembly **30**. The hose **42** from the dispenser assembly **30** connects with the fitting **48**, and this fitting is associated with the engine **10** so that it communicates with intake manifold vacuum when the engine **10** is running. As explained above, one way in which this connection may be effected is to temporarily disconnect the PCV valve hose of the engine **12**, and connect the fitting **48** into this hose. The fitting **48** is thus inserted into a PCV hose or other connection to intake manifold vacuum and receives manifold vacuum at the through bore **62** when the engine **10** is started. After this preparation, the user starts the engine **10**, and the intake manifold vacuum is communicated both to container **24***a* and to the ambient air bleed bore **68**. As explained above, liquid from container **24***a* is drawn from container **24***a* via dispenser assembly **30** and hose **42**, and along bore **62** to the intersection **68***a*. Downstream of the intersection **68***a* (that is leftwardly, viewing FIG. **4**), the liquid cleaner **34** and ambient air drawn in via bore **68** form an aerosol liquid and air together. As this aerosol is admitted into the intake manifold of engine **12**, a fog or mist of liquid **34** is formed, as noted above. The additional ambient air admitted to the intake manifold **16** via fitting **48** assists in insuring that the operational speed of the engine **12** during the cleaning operation is about 1500 RPM (i.e., slightly above normal idle speed for most automotive engines). The user who is conducting the cleaning operation may find it necessary to make a temporary adjustment to an idle speed control screw of the throttle body **14**, or to simply apply a slight movement to the throttle pedal of the vehicle **10** during the cleaning operation. Consequently, the cleaning liquid **34** is fogged or misted into the manifold **26** of the engine **12**, and the interior surfaces of this manifold, the intake valves, and combustion chambers of the engine are cleaned and de-carbonized.

An advantage of the present invention is dramatically illustrated by a comparison of the amount of liquid cleaner which may be recovered from the intake manifold of a vehicle which is particularly susceptible to puddling. In tests of such a vehicle a conventional metering orifice apparatus was used to feed in 473 ml. of a liquid cleaner **34**. Immediately after the feeding in of this liquid cleaner, the engine was stopped, and the intake manifold was inspected for puddled liquid. Test results varied from about 300 ml. to as much as 350 ml. of liquid was recovered from the intake manifold. Most automotive sized engines will be hydraulically locked by about 100 ml. of liquid if this liquid is drawn into a combustion chamber of the engine.

In contrast, with the same vehicle and same amount of liquid cleaner (i.e., 473 ml.), the inventive apparatus and method here described resulted in only 20–40 ml. of recovered liquid when the engine speed was kept in the 1500–2000 RPM range during the cleaning process. As can readily be seen, the inventive apparatus and method eliminated the possibility for the vehicle engine to be damaged by hydraulic locking. Further, as mentioned above, it is believed that the dispersal of the cleaner liquid **34**, and the effectiveness of the cleaning process performed, is improved by the "fogging" of the cleaner by the present method and apparatus. Thus, it is seen to be an advantage to use the present method and apparatus for all cars, even those which have no tendency to accumulate a puddle of liquid cleaner in their intake system.

While the present method and apparatus has been depicted, described, is defined by reference to one particularly preferred exemplary embodiment of the invention, the invention is not so limited. The invention is capable of considerable modification and variation, which may occur to those ordinarily skilled in the pertinent arts. For example, it

will appear that other and differing apparatus may be used to disperse, fog, or atomize the liquid cleaner **34** so as to provide for its introduction into the intake system of an automotive engine using ambient air and engine vacuum to achieve this result. A small carburetor apparatus which is temporarily communicated with the intake manifold of the vehicle being serviced might suffice for this purpose.

What is claimed is:

1. A service method for cleaning the intake system of an automotive internal combustion engine temporarily utilizing ambient air bleed and intake manifold vacuum of the operating engine to temporarily ingest a liquid cleaner in atomized form during said service, said method comprising steps of:

providing a source of liquid cleaner to be introduced into the intake system of the engine temporarily during said service;

temporarily utilizing an aspirator communicating said liquid cleaner into said intake system to atomize said liquid cleaner while introducing said liquid cleaner into said intake system during said service; and

completing said service by removing said source of liquid cleaner and also removing said aspirator from communication into said intake system.

2. The method of claim **1** further including the steps of providing said aspirator with a bore of determined diameter, and flowing liquid cleaner along said bore of determined diameter to said intake system while utilizing said bore of determined diameter to define a metering orifice for said liquid cleaner.

3. The method of claim **2** further including the steps of providing said aspirator with an ambient air intake bore of certain diameter, utilizing said ambient air intake bore to define an opening to ambient at which said ambient air intake port is defined, and utilizing said ambient air intake bore of certain diameter to define a metering orifice for ambient air flow into said intake system via said aspirator while said engine is in operation.

4. A service method of atomizing a liquid engine cleaner into an intake system of a running internal combustion engine which is not producing usable power but does produce an intake manifold vacuum in said intake system, said service method comprising steps of:

using said intake manifold vacuum to ingest ambient air along a first flow path into said intake system;

using said intake manifold vacuum to ingest said liquid engine cleaner along a second flow path into said intake system while said engine operates substantially at a fast-idle speed;

intersecting said first and said second flow paths to mix said ambient air and said liquid engine cleaner before introduction into said intake system;

flowing said mixed ambient air and liquid cleaner together toward said intake system; and

using the mixing of said ambient air and said liquid engine cleaner to atomize the latter into a fine, substantially non-precipitating fog upon introduction together into said intake system; and

discontinuing ingestion of ambient air and said liquid engine cleaner before returning said internal combustion engine to power-producing use.

5. A method of substantially preventing puddling of liquid engine cleaner in the intake manifold of an internal combustion engine during a temporary service procedure to clean said intake manifold, said method comprising steps of:

providing a source of liquid engine cleaner to be introduced into the intake manifold of the engine while said engine is substantially at a fast-idle speed and is not producing usable power; and

utilizing an aspirator communicating both said liquid engine cleaner and ambient air into said intake manifold to atomize said liquid cleaner while introducing said liquid engine cleaner into said intake manifold as an atomized substantially non-precipitating mist.

6. The method of claim **5** further including the steps of forming said aspirator with a body having a through bore of determined diameter, flowing said liquid engine cleaner from said source to said intake manifold along said through bore, and utilizing said through bore of determined diameter to define a metering orifice for said liquid engine cleaner.

7. The method of claim **6** further including the steps of providing said aspirator body with an ambient air intake bore of certain diameter, utilizing said ambient air intake bore to define an opening to ambient, defining at said opening to ambient an ambient air intake port, and utilizing said ambient air intake port to define a metering orifice for ambient air flow into said intake manifold via said aspirator.

8. The method of claim **7** further including the steps of providing said aspirator body with an end portion of tapering outer diameter, and defining at said end portion of tapering outer diameter a plurality of gradated substantially cylindrical diameter sections spaced along a length of said aspirator body.

9. A service method for cleaning the intake system of an automotive internal combustion engine while the engine is operating at a fast-idle speed, is providing intake manifold vacuum, and is not producing usable power, said method comprising steps of:

providing a source of liquid cleaner to be temporarily introduced into the intake system of the engine during said service;

providing an aspirator and communicating said liquid cleaner and ambient air via this aspirator into said intake system while simultaneously atomizing said liquid cleaner into a substantially non-precipitating fog;

continuing said service for the duration of time sufficient that a selected quantity of liquid cleaner is ingested by said engine, and

completing said service by removing said source of liquid cleaner and also removing said aspirator from communication into said intake system.

* * * * *

ORIGINAL

JS 44 (Rev. 12/07)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

I. (a) PLAINTIFFS

ILLINOIS TOOL WORKS INC., DBA WYNN'S, a Delaware corporation

(b) County of Residence of First Listed Plaintiff Cook, Ills
(EXCEPT IN U.S. PLAINTIFF CASES)

(c) Attorney's (Firm Name, Address, and Telephone Number)

Thomas Whitelaw & Tyler LLP, 18101 Von Karman Avenue, Suite 230, Irvine, CA 92612. Telephone number (949) 679-6400.

DEFENDANTS

MOC PRODUCTS COMPANY, INC., a California corporation

County of Residence of First Listed Defendant Los Angeles
(IN U.S. PLAINTIFF CASES ONLY)

NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED.

Attorneys (If Known)

'09 CV 1887 MMA JMA

FILED
09 AUG 28 PM 3:28
CLERK, U.S. DISTRICT COURT
SOUTHERN DISTRICT OF CALIFORNIA
BY: DEPUTY

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant)
(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated *or* Principal Place of Business In This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated *and* Principal Place of Business In Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT	TORTS		FORFEITURE/PENALTY	BANKRUPTCY	OTHER STATUTES
☐ 110 Insurance	PERSONAL INJURY	PERSONAL INJURY	☐ 610 Agriculture	☐ 422 Appeal 28 USC 158	☐ 400 State Reapportionment
☐ 120 Marine	☐ 310 Airplane	☐ 362 Personal Injury - Med. Malpractice	☐ 620 Other Food & Drug	☐ 423 Withdrawal 28 USC 157	☐ 410 Antitrust
☐ 130 Miller Act	☐ 315 Airplane Product Liability	☐ 365 Personal Injury - Product Liability	☐ 625 Drug Related Seizure of Property 21 USC 881	PROPERTY RIGHTS	☐ 430 Banks and Banking
☐ 140 Negotiable Instrument	☐ 320 Assault, Libel & Slander	☐ 368 Asbestos Personal Injury Product Liability	☐ 630 Liquor Laws	☐ 820 Copyrights	☐ 450 Commerce
☐ 150 Recovery of Overpayment & Enforcement of Judgment	☐ 330 Federal Employers' Liability	PERSONAL PROPERTY	☐ 640 R.R. & Truck	☒ 830 Patent	☐ 460 Deportation
☐ 151 Medicare Act	☐ 340 Marine	☐ 370 Other Fraud	☐ 650 Airline Regs.	☐ 840 Trademark	☐ 470 Racketeer Influenced and Corrupt Organizations
☐ 152 Recovery of Defaulted Student Loans (Excl. Veterans)	☐ 345 Marine Product Liability	☐ 371 Truth in Lending	☐ 660 Occupational Safety/Health	SOCIAL SECURITY	☐ 480 Consumer Credit
☐ 153 Recovery of Overpayment of Veteran's Benefits	☐ 350 Motor Vehicle	☐ 380 Other Personal Property Damage	☐ 690 Other	☐ 861 HIA (1395ff)	☐ 490 Cable/Sat TV
☐ 160 Stockholders' Suits	☐ 355 Motor Vehicle Product Liability	☐ 385 Property Damage Product Liability	LABOR	☐ 862 Black Lung (923)	☐ 810 Selective Service
☐ 190 Other Contract	☐ 360 Other Personal Injury		☐ 710 Fair Labor Standards Act	☐ 863 DIWC/DIWW (405(g))	☐ 850 Securities/Commodities/ Exchange
☐ 195 Contract Product Liability			☐ 720 Labor/Mgmt. Relations	☐ 864 SSID Title XVI	☐ 875 Customer Challenge 12 USC 3410
☐ 196 Franchise			☐ 730 Labor/Mgmt.Reporting & Disclosure Act	☐ 865 RSI (405(g))	☐ 890 Other Statutory Actions
REAL PROPERTY	CIVIL RIGHTS	PRISONER PETITIONS	☐ 740 Railway Labor Act	FEDERAL TAX SUITS	☐ 891 Agricultural Acts
☐ 210 Land Condemnation	☐ 441 Voting	☐ 510 Motions to Vacate Sentence	☐ 790 Other Labor Litigation	☐ 870 Taxes (U.S. Plaintiff or Defendant)	☐ 892 Economic Stabilization Act
☐ 220 Foreclosure	☐ 442 Employment	Habeas Corpus:	☐ 791 Empl. Ret. Inc. Security Act	☐ 871 IRS—Third Party 26 USC 7609	☐ 893 Environmental Matters
☐ 230 Rent Lease & Ejectment	☐ 443 Housing/ Accommodations	☐ 530 General	IMMIGRATION		☐ 894 Energy Allocation Act
☐ 240 Torts to Land	☐ 444 Welfare	☐ 535 Death Penalty	☐ 462 Naturalization Application		☐ 895 Freedom of Information Act
☐ 245 Tort Product Liability	☐ 445 Amer. w/Disabilities - Employment	☐ 540 Mandamus & Other	☐ 463 Habeas Corpus - Alien Detainee		☐ 900Appeal of Fee Determination Under Equal Access to Justice
☐ 290 All Other Real Property	☐ 446 Amer. w/Disabilities - Other	☐ 550 Civil Rights	☐ 465 Other Immigration Actions		☐ 950 Constitutionality of State Statutes
	☐ 440 Other Civil Rights	☐ 555 Prison Condition			

V. ORIGIN (Place an "X" in One Box Only)

☒ 1 Original Proceeding ☐ 2 Removed from State Court ☐ 3 Remanded from Appellate Court ☐ 4 Reinstated or Reopened ☐ 5 Transferred from another district (specify) ☐ 6 Multidistrict Litigation ☐ 7 Appeal to District Judge from Magistrate Judgment

VI. CAUSE OF ACTION

Cite the U.S. Civil Statute under which you are filing (Do not cite jurisdictional statutes unless diversity):
35 U.S.C. §§ 1 et seq. 28 : 1331 VMH

Brief description of cause:
Infringement of U.S. Patent Nos. 5,806,629, 6,112,855, and 6,073,638

VII. REQUESTED IN COMPLAINT:

☐ CHECK IF THIS IS A CLASS ACTION UNDER F.R.C.P. 23

DEMAND $ money damages and injunction

CHECK YES only if demanded in complaint:
JURY DEMAND: ☒ Yes ☐ No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE Anthony J. Battaglia DOCKET NUMBER 09-cv-996 JLS (AJB)

DATE 08/28/2009

SIGNATURE OF ATTORNEY OF RECORD Joseph E. Thomas

FOR OFFICE USE ONLY

RECEIPT # 4460 AMOUNT 350. APPLYING IFP _____ JUDGE _____ MAG. JUDGE _____

CP 8/28/09

Court Name: USDC California Southern
Division: 3
Receipt Number: CAS004668
Cashier ID: sramirez
Transaction Date: 08/28/2009
Payer Name: THOMAS WITELAW LLP

CIVIL FILING FEE
For: ILLINOIS TOOL WORKS V. MOC PRO
Case/Party: D-CAS-3-09-CV-001887-001
Amount: $350.00

CHECK
Check/Money Order Num: 9313
Amt Tendered: $350.00

Total Due: $350.00
Total Tendered: $350.00
Change Amt: $0.00

There will be a fee of $45.00
charged for any returned check.