UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	10/12/2021	11143120	CET1090.077	2699

26629 7590 09/22/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Champion Power Equipment, Inc., Santa Fe Springs, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

26629 7590 07/12/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Robyn L. Templin	(Typed or printed name)
/Robyn L. Templin/	(Signature)
September 14, 2021	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

TITLE OF INVENTION: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	10/12/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRAN, LONG T	3747	123-525000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Ziolkowski Patent Solutions Group, SC
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Champion Power Equipment, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Santa Fe Springs, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Timothy J. Ziolkowski/ Date September 14, 2021

Typed or printed name Timothy J. Ziolkowski Registration No. 38,368

Champion - EX2098, Page 2 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/946,439	**09/14/2021 03:28:17 PM ET**	**CET1090.077**

Title of Invention

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2699	FILED BY	Robyn Templin
PATENT CENTER #	60312333	FILING DATE	06/22/2020
CUSTOMER #	26629	FIRST NAMED INVENTOR	Kendall J. Collie
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Timothy Ziolkowski

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
2021.09.14 Issue Fee.pdf	1	Issue Fee Payment (PTO-85B)	199 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2021.09.14 Issue Fee.pdf	5C6123B4F5061086412EB0D960E89939F902BAFB097128AA78D09FE62ED2136F979684D7C76F2451B03AA5CD8167EF9C1C8B253C2426C61CDFA1CB6D012BEFBD

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as

described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/946,439	09/14/2021 03:28:17 PM ET	CET1090.077

Title of Invention

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2699	FILED BY	Robyn Templin
PATENT CENTER #	60312333	AUTHORIZED BY	Timothy Ziolkowski
CUSTOMER #	26629	FILING DATE	06/22/2020
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Kendall J. Collie

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 4529	E20219DF29481927	Robyn Templin

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2501	UTILITY ISSUE FEE	600.00	1	600.00
			TOTAL AMOUNT:	$600.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

26629 7590 07/12/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER
TRAN, LONG T

ART UNIT	PAPER NUMBER
3747	

DATE MAILED: 07/12/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

TITLE OF INVENTION: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	10/12/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

Champion - EX2098, Page 7 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

PART B - FEE(S) TRANSMITTAL

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Commissioner for Patents
P.O. Box 1450
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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

26629 7590 07/12/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

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Certificate of Mailing or Transmission

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(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

TITLE OF INVENTION: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	10/12/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRAN, LONG T	3747	123-525000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Champion - EX2098, Page 8 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

26629 7590 07/12/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER	
TRAN, LONG T	

ART UNIT	PAPER NUMBER
3747	

DATE MAILED: 07/12/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Champion - EX2098, Page 9 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/946,439	Applicant(s) Collie et al.	
	Examiner LONG T TRAN	Art Unit 3747	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 1 July 2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-19 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/LONG T TRAN/
Primary Examiner, Art Unit 3747

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

2. Claims 1 – 19 are allowed.

3. The following is an examiner's statement of reasons for allowance: The IDS filed July 1, 2021 did not yield prior art that anticipates the claimed invention. While each of the references cited teach various aspect of the invention, none of the references discloses or teach in combination a multi-fuel engine comprising an engine operable on a liquid fuel and a gaseous fuel; a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl; a liquid cutoff solenoid coupled to open and close a liquid fuel path to the engine; a gaseous cutoff solenoid coupled to open and close a gaseous fuel source to the engine; a switch selectively coupling a power source to the liquid cutoff solenoid and the gaseous cutoff solenoid to open and close the liquid fuel path and the gaseous fuel path; and one or more timing circuits electrically coupled to the liquid cutoff solenoid and the gaseous cutoff solenoid that operate to control an actuation time of the liquid cutoff solenoid and the gaseous cutoff solenoid.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG T TRAN whose telephone number is (571)270-1899. The examiner can normally be reached on Mon - Fri 9:00 - 5:00.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lindsay Low can be reached on 571-272-1196. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/LONG T TRAN/
Primary Examiner, Art Unit 3747

Notice of References Cited	Application/Control No. 16/946,439	Applicant(s)/Patent Under Reexamination Collie et al.	
	Examiner LONG T TRAN	Art Unit 3747	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20140238340-A1	08-2014	Dunn; Mark E.	F02D19/0615	123/299
*	B	US-20130221000-A1	08-2013	IWAYA; Norifumi	F02M25/0836	220/86.2
*	C	US-20110290203-A1	12-2011	Pursifull; Ross Dykstra	F02D19/0605	123/41.08
*	D	US-4878475-A	11-1989	Birsa; Ludwig	F02D19/0642	123/525
*	E	US-4811720-A	03-1989	Katumata; Shoji	F02D19/0647	123/527
*	F	US-3807377-A	04-1974	Hirschler, Jr.; Daniel A.	F02M31/18	123/575
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

CPC - Searched*		
Symbol	Date	Examiner
F02M13/08; F02M21/0254; F02M21/0215; F02M63/0015; F02M17/10; F02D19/0647; F02D19/0613; F02D41/0025; F02D41/0027; F02B63/048; F02B69/02; F02B69/04	05/17/2021	LT

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor search	05/17/2021	LT
PLUS search	05/17/2021	LT
Text search	05/17/2021	LT

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	F02M13/08; F02M21/0254; F02M21/0215; F02M63/0015; F02M17/10; F02D19/0647; F02D19/0613; F02D41/0025; F02D41/0027; F02B63/048; F02B69/02; F02B69/04	05/17/2021	LT

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

Champion - EX2098, Page 17 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	05/17/2021	07/06/2021							
	1	=	=							
	2	=	=							
	3	=	=							
	4	=	=							
	5	=	=							
	6	=	=							
	7	=	=							
	8	=	=							
	9	=	=							
	10	=	=							
	11	=	=							
	12	=	=							
	13	=	=							
	14	=	=							
	15	=	=							
	16	=	=							
	17	=	=							
	18	=	=							
	19	=	=							

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	**Art Unit**
	LONG T TRAN	3747

CPC						
Symbol					**Type**	**Version**
F02D	/	19	/	0613	F	2013-01-01
F02B	/	63	/	04	I	2013-01-01
F02D	/	19	/	0647	I	2013-01-01
F02M	/	19	/	06	I	2013-01-01
F02D	/	19	/	0678	I	2013-01-01
F02D	/	19	/	0681	I	2013-01-01
F02M	/	19	/	08	I	2013-01-01
F02M	/	13	/	08	I	2013-01-01
F02B	/	43	/	00	I	2013-01-01
F02D	/	29	/	06	I	2013-01-01
F02D	/	41	/	062	A	2013-01-01
F02N	/	3	/	02	A	2013-01-01
F02D	/	41	/	0025	A	2013-01-01
Y02T	/	10	/	30	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	06 July 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20210706

Champion - EX2098, Page 19 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

INTERNATIONAL CLASSIFICATION				
CLAIMED				
F02D	/	19	/	06
F02D	/	19	/	08
F02M	/	13	/	08

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	06 July 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20210706

Champion - EX2098, Page 20 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	**Art Unit**
	LONG T TRAN	3747

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	06 July 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16946439
Filing Date	2020-06-22
First Named Inventor	Kendall J. Collie et al.
Art Unit	3747
Examiner Name	Long T. Tran
Attorney Docket Number	CET1090.077

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.T.T/	1	4287908		1981-09-08	Storgard	
/L.T.T/	2	4364370		1982-12-21	Smith et al.	
/L.T.T/	3	4416244		1983-11-22	McDonald	
/L.T.T/	4	5555873		1996-09-17	Nolen	
/L.T.T/	5	7954479	B2	2011-06-07	Kojima et al.	
/L.T.T/	6	9523497	B2	2016-12-20	Deng	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

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	First Named Inventor	Kendall J. Collie et al.
	Art Unit	3747
	Examiner Name	Long T. Tran
	Attorney Docket Number	CET1090.077

/L.T.T/	1	20070215223	A1	2007-09-20	Morris	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/L.T.T/	1	1826377	EP	A2	2007-08-29	Rotarex Star		
/L.T.T/	2	2510660	FR	A1	1983-02-04	Stetter SA		
/L.T.T/	3	H0466743	JP	A	1992-03-03	Suzuki Motor Co		
/L.T.T/	4	1999001659	WO	A1	1999-01-14	Bailey		
/L.T.T/	5	2007048633	WO	A1	2007-05-03	Dirnhofer		
/L.T.T/	6	2220679	FR	A1	1974-10-04	Servequip		

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2020-06-22
	First Named Inventor	Kendall J. Collie et al.
	Art Unit	3747
	Examiner Name	Long T. Tran
	Attorney Docket Number	CET1090.077

/L.T.T/	1	Yamaha EF2000iS Tri Fuel Conversion: Overview & Installation Tips, January 3, 2014, https://www.youtube.com/watch?v=caZawwDaRQg

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EXAMINER SIGNATURE

Examiner Signature	/LONG T TRAN/	Date Considered	07/06/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	First Named Inventor	Kendall J. Collie et al.
	Art Unit	3747
	Examiner Name	Long T. Tran
	Attorney Docket Number	CET1090.077

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Andrew C. Stark/	Date (YYYY-MM-DD)	2021-07-01
Name/Print	Andrew C. Stark	Registration Number	65742

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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First Named Inventor	Kendall J. Collie et al.
Art Unit	3747
Examiner Name	Long T. Tran
Attorney Docket Number	CET1090.077

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4287908		1981-09-08	Storgard	
	2	4364370		1982-12-21	Smith et al.	
	3	4416244		1983-11-22	McDonald	
	4	5555873		1996-09-17	Nolen	
	5	7954479	B2	2011-06-07	Kojima et al.	
	6	9523497	B2	2016-12-20	Deng	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	3747
	Examiner Name	Long T. Tran
	Attorney Docket Number	CET1090.077

	1	20070215223	A1	2007-09-20	Morris	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1826377	EP	A2	2007-08-29	Rotarex Star		
	2	2510660	FR	A1	1983-02-04	Stetter SA		
	3	H0466743	JP	A	1992-03-03	Suzuki Motor Co		
	4	1999001659	WO	A1	1999-01-14	Bailey		
	5	2007048633	WO	A1	2007-05-03	Dirnhofer		
	6	2220679	FR	A1	1974-10-04	Servequip		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	CET1090.077

	1	Yamaha EF2000iS Tri Fuel Conversion: Overview & Installation Tips, January 3, 2014, https://www.youtube.com/watch?v=caZawwDaRQg	

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EXAMINER SIGNATURE

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Espacenet

Bibliographic data: FR2510660 (A1) — 1983-02-04

Two-fuel reservoir system for concrete mixer trucks - uses a solenoid valve actuated by contacts on gear selector and parking brake to provide fuel source changeover

Inventor(s): DERREZ MATHIAS; LOPEZ MICHEL ± (MATHIAS DERREZ ET MICHEL LOPEZ)

Applicant(s): STETTER SA [FR] ± (STETTER SA)

Classification: **- international:** ***F02D19/06;*** (IPC1-7): B60K15/02; F02D19/06
- cooperative: **F02D19/0618 (EP)**; **F02D19/0676 (EP)**; **F02D19/0684 (EP)**; Y02T10/30 (EP)

Application number: FR19810014723 19810729

Priority number(s): FR19810014723 19810729

Abstract of FR2510660 (A1)

The fuel supply system uses two fuel tanks, each containing different fuel (1,2) and has a controller with a solenoid valve (6) which couples one of the two tanks (1,2) to the engine. The solenoid valve is operated by a relay energised through two series connected electric contacts (16,17). The two contacts are coupled to the gearbox and parking brake, so when the gear lever is placed in neutral and the parking brake engaged the fuel changeover is automatically initiated. Indicator lights (14,15) on the dashboard are supplied by auxiliary contacts (16,17) on the solenoid valve to indicate which fuel reservoir is in use.

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DEMANDE DE BREVET D'INVENTION

(21) **N° 81 14723**

(54) **Système d'alimentation en carburant à deux réservoirs, pour véhicule spécial à moteur unique.**

(51) Classification internationale (Int. Cl.³). **F 02 D 19/06; B 60 K 15/02.**

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(71) Déposant : STETTER SA, société anonyme. — FR.

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Champion - EX2098, Page 33 of 269
Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

Système d'alimentation en carburant à deux réservoirs, pour véhicule spécial à moteur unique.

L'invention concerne un système d'alimentation en carburant, à deux réservoirs, pour véhicule spécial à moteur unique, destiné à permettre une fonction transport avec un type de carburant et une fonction service à l'arrêt du véhicule avec un autre type de carburant.

L'invention est notamment destinée à équiper les bétonnières mobiles.

Il est connu d'utiliser, pour un même moteur, deux types de carburant au moyen de deux réservoirs et d'une commande d'inversion disposée dans le circuit d'alimentation.

De plus, on connaît des véhicules ou engins qui sont destinés à accomplir une fonction transport ou déplacement et une fonction service lorsqu'ils sont arrêtés, cette fonction étant assurée par le moteur du véhicule. C'est par exemple le cas d'une bétonnière portée par un véhicule et dont le tambour est entraîné par le moteur du véhicule.

Dans ce cas, le véhicule est une partie du temps en déplacement et une autre partie du temps sur un chantier. En déplacement, le moteur sert à la traction du véhicule et éventuellement en même temps à la rotation du tambour. Sur le chantier le véhicule est en stationnement, avec son frein de parcage actionné et sa boîte de vitesse au point mort tandis que le moteur ne sert plus alors qu'à la rotation du tambour.

Avec un double fonctionnement de ce type, il peut être avantageux d'alimenter le moteur avec des carburants différents respectivement pour la fonction transport et pour la fonction service seule. L'avantage est par exemple simplement économique, en utilisant un carburant plus lourd et moins cher pour le service seul et au contraîre plus performant pour le transport, comme par exemple respectivement du fioul et du gazole.

C'est pourquoi l'invention propose un système d'alimentation en carburant, à deux réservoirs, pour véhicule spécial à moteur unique, muni de moyens de commande pour alimenter le moteur à partir de l'un ou de l'autre desdits réservoirs et qui est remarquable en ce que les moyens de commande comportent une électro-vanne qui permet de positionner le circuit d'alimentation sur l'un ou l'autre des réservoirs et qui est actionné par un relai, lui-même commandé par les fermetures à la fois de deux

contacteurs électriques en série, lesdites fermetures étant obtenues respectivement par la mise au point mort de la boîte de vitesse du véhicule et par l'actionnement du frein de parcage de telle sorte que le moteur soit alimenté par l'un des réservoirs et un type de carburant en fonctionnement normal de transport et par l'autre réservoir et un autre type de carburant pour un fonctionnement de service seul lorsque le véhicule est à l'arrêt avec sa boîte de vitesse au point mort et son frein de parcage actionné.

Pour des raisons de sécurité il est avantageux selon l'invention que l'électro-vanne soit en position d'alimentation sur le réservoir destiné au fonctionnement transport lorsque ladite électro-vanne est au repos, c'est-à-dire non actionnée par le relais.

De préférence, dans ce cas deux témoins lumineux sont aménagés pour signaler le réservoir en fonction, ceux-ci étant électriquement alimentés par l'intermédiaire du relais qui ferme le circuit électrique du témoin destiné au réservoir de transport et ouvre le circuit électrique de l'autre témoin lorsque ledit relais est au repos, c'est-à-dire non commandé par les fermtures des contacteurs et au contraire ferme le circuit électrique du témoin destiné au réservoir de service et ouvre le circuit électrique de l'autre témoin lorsque ledit relais est excité par les fermetures en série des deux contacteurs.

L'invention sera mieux comprise à la lecture de la description qui va suivre et qui se réfère à la figure unique annexée représentant schématiquement un mode de réalisation selon l'invention pour moteur diesel.

Cette figure montre deux réservoirs 1 et 2 contenant par exemple respectivement du fioul et du gazole. De ces réservoirs partent des circuits d'alimentation munis chacun d'un préfiltre 3, 4 et pour le circuit gazole d'un dispositif anti-retour 5.

Les circuits des deux réservoirs passent par une électro-vanne 6 qui, au repos est en position d'alimentation gazole.

Après l'électro-vanne, le circuit unique parvient à la pompe d'alimentation 7 en passant par un bac de visualisation 8, visible de l'extérieur.

Après la pompe 7 le circuit aboutit aux pompes d'injection

9 après avoir traversé un filtre 10.

Comme le montre le dessin, le retour 11 des injecteurs se déverse dans le réservoir 1 de fioul et plus généralement dans le réservoir contenant le carburant le plus lourd et ceci quelque soit le réservoir sélectionné tandis que le retour 12 des pompes est recyclé en amont de la pompe d'alimentation 7.

L'électro-vanne 6 est actionnée par un relais 13 qui, au repos c'est-à-dire non excité, coupe le circuit électrique d'alimentation de l'électro-vanne qui reste alors en position d'alimentation/gazole. Dans cette position le relais ferme en outre le circuit électrique d'un témoin lumineux 14 (par exemple de couleur verte) tandis qu'il ouvre au contraîre le circuit électrique d'un autre témoin lumineux 15 (de couleur rouge par exemple).

Lorsque le relais 13 est excité comme il sera expliqué ci-après, celui-ci ferme le circuit électrique de l'électro-vanne 6 qui bascule dans sa position alimentation fioul (réservoir 1), ouvre le circuit électrique du témoin 14 qui s'éteint et ferme le circuit électrique du témoin 15 qui s'allume.

L'excitation du relais 13, comme le montre le dessin, est obtenue par la fermeture de son circuit d'alimentation électrique au moyen de deux contacteurs en série 16 et 17 qui sont combinés avec respectivement la boîte de vitesse 18 et le frein de parcage 19 du véhicule.

Les contacteurs 16 et 17 sont tels qu'ils sont ouverts lorsque respectivement la boîte de vitesse 18 est enclenchée sur une vitesse et le frein de parcage 19 n'est pas actionné et au contraîre fermés lorsque respectivement la boîte de vitesse est au point mort et le frein de parcage est actionné.

En outre l'ouverture et la fermeture du contacteur 17 entraînent respectivement l'ouverture et la fermeture du circuit électrique d'un autre témoin 20 classique de frein de parcage, de même couleur que le témoin 14.

Le fonctionnement est simple à comprendre.

En déplacement, le frein 19 n'est pas actionné et la boîte de vitesse enclenchée de telle sorte que le relais 13 n'est pas excité (les contacteurs 16 et 17 étant ouverts).

Dans ces conditions l'électro-vanne est en position

gazole, le témoin 14 est allumé et les témoins 15 et 20 éteints (conditions choisies pour le dessin). Dans ce cas, même la mise au point mort de la boîte ne change pas le type de carburant puisque le contacteur 17 reste ouvert.

Lorsque le frein 19 est actionné et que la boîte de vitesse 18 est au point mort, le relais 13 est excité de telle sorte que l'électro-vanne 6 est en position fioul tandis que le témoin 14 est éteint et les témoins 15 et 20 allumés par mise sous tension.

Cette disposition présente donc une grande sécurité et un automatisme complèt puisque les positions gazole et fioul sont automatiquement obtenues par la mise en fonction elles-mêmes, respectivement déplacement ou transport et service, le véhicule ne pouvant pas rouler sur chantier ou sur route avec du fioul (dans cet exemple). En outre en cas de défaillance électrique, les circuits restent ou passent en alimentation gazole.

Enfin, comme il a déjà été dit, l'invention est notamment destinée, mais non exclusivement, aux bétonnières portées.

REVENDICATIONS

1. Système d'alimentation en carburant, à deux réservoirs (1,2), pour véhicule spécial à moteur unique, muni de moyens de commande pour alimenter le moteur à partir de l'un ou de l'autre desdits réservoirs, système caractérisé en ce que les moyens de commande comportent une électro-vanne (6) qui permet de positionner le circuit d'alimentation sur l'un ou l'autre des réservoirs (1,2) et qui est actionnée par un relais (13) lui-même commandé par les fermetures à la fois de deux contacteurs électriques en série (16,17), lesdites fermetures étant obtenues respectivement par la mise au point mort de la boîte de vitesse (18) du véhicule et par l'actionnement du frein de parcage (19) de telle sorte que le moteur soit alimenté par l'un des réservoirs (2) et un type de carburant en fonctionnement normal de transport et par l'autre réservoir (1) et un autre type de carburant pour un fonctionnement de service seul lorsque le véhicule est à l'arrêt avec sa boîte de vitesse au point mort et son frein de parcage actionné.

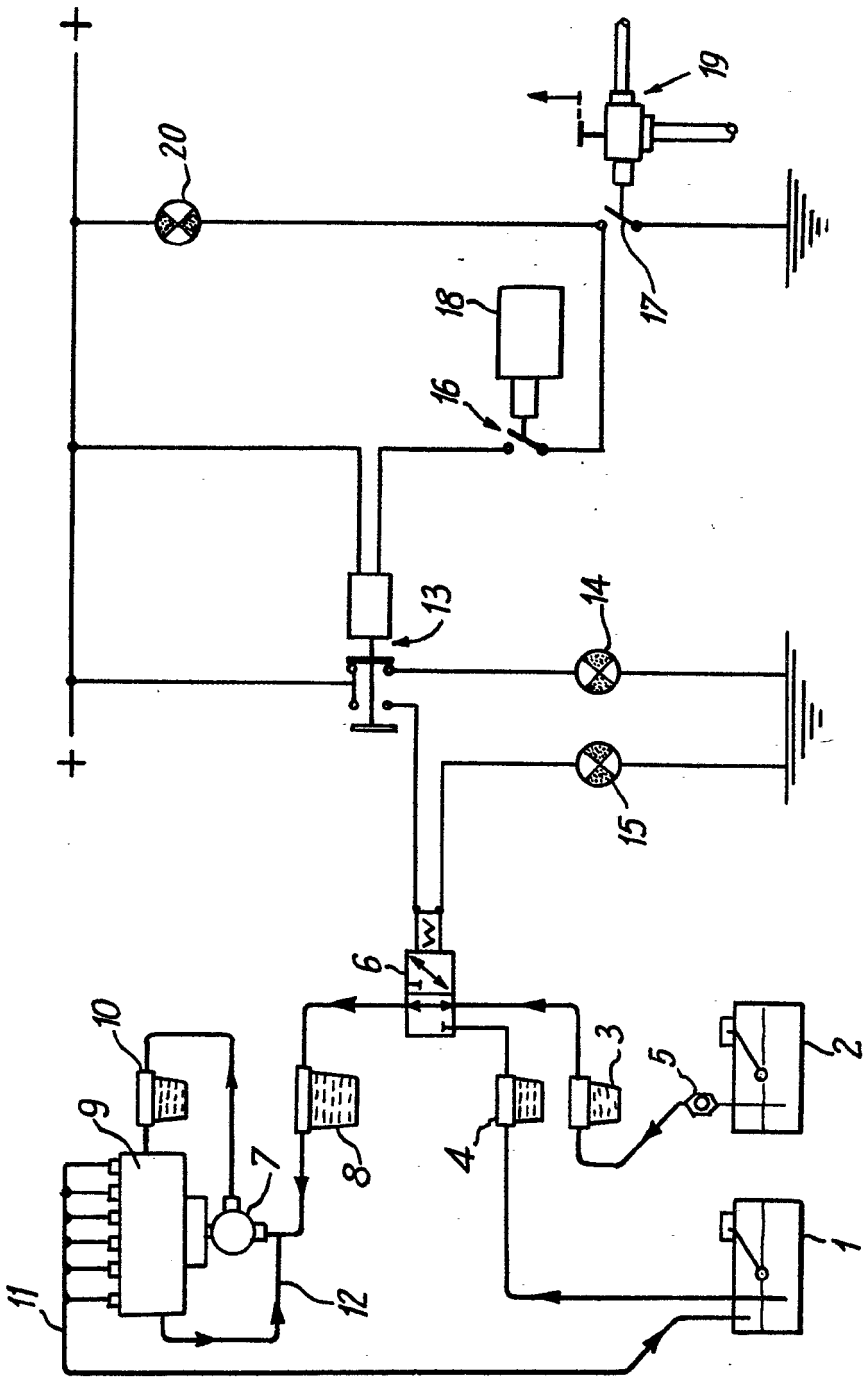
2. Système selon la revendication 1, caractérisé en ce que l'électro-vanne (6) est en position d'alimentation sur le réservoir (2) destiné au fonctionnement transport lorsque ladite électro-vanne est au repos, c'est-à-dire non actionnée par le relais (13).

3. Système selon la revendication 2, caractérisé en ce que deux témoins lumineux (14,15) sont aménagés pour signaler le réservoir en fonction, ceux-ci étant électriquement alimentés par l'intermédiaire du relais (13) qui ferme le circuit électrique du témoin (14) destiné au réservoir (2) de transport et ouvre le circuit électrique de l'autre témoin (15) lorsque ledit relais est au repos, c'est-à-dire non commandé par les fermetures des contacteurs (16,17) et au contraîre ferme le circuit électrique du témoin (15) destiné au réservoir (1) de service et ouvre le circuit électrique de l'autre témoin (14) lorsque ledit relais est excité par les fermetures en série des deux contacteurs (16,17).

4. Système selon l'une des revendications 1 à 3, pour moteur diesel, caractérisé en ce que le réservoir (2) destiné à la fonction transport contient du gazole et l'autre réservoir (1) du fioul.

5. Système selon l'une des revendications 1 à 4, caractérisé en ce que le réservoir (2) de transport est muni d'un dispositif anti-retour (5), que les circuits des deux réservoirs sont munis chacun d'un préfiltre (3,4) disposé en amont de l'électro-vanne (6) et qu'un bac de visualisation (8), visible de l'extérieur est prévu dans le circuit aval de l'électro-vanne (6).

6. Système selon l'une des revendications 1 à 5 caractérisé en ce que le véhicule est une bétonnière mobile et que le moteur unique assure d'une part le déplacement du véhicule et éventuellement en même temps, la rotation du tambour lorsque ledit moteur est alimenté par le réservoir (2) de transport et d'autre part seulement la rotation du tambour lorsqu'il est alimenté par le réservoir (1) de service, c'est-à-dire lorsque ledit véhicule est en position fixe, sur chantier par exemple.


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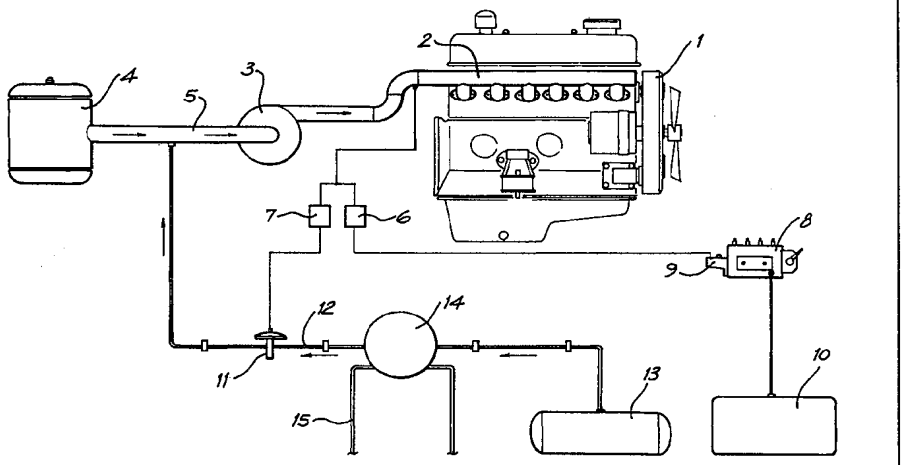
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(54) Title: A DUAL–FUEL METHOD FOR BOOST FUEL SUBSTITUTION IN TURBO–CHARGED DIESEL ENGINES

(57) Abstract



An assembly for boost fuel substitution in turbo charged diesel engines; the assembly including: a diesel engine including an inlet manifold (2) and an exhaust manifold; a turbocharger (3) in communication with said inlet manifold (2); first and second reservoirs of diesel (10) and gas (13) respectively selectively in communication with said engine; a fuel injection pump (8) including an aneroid (9) intermediate the first reservoir of diesel (10) and said inlet manifold (2); a control valve (11) intermediate the second reservoir of gas (13) and said inlet manifold (2); characterised in that the assembly includes at least two solenoids (6, 7) each capable of moving between first and second operational states; wherein a first of said solenoids (6) is located between the inlet manifold (2) and said fuel injection pump (8) and the second solenoid (7) is located between said inlet manifold (2) and said control valve (11) wherein, said first solenoid (6) responsive to a predetermined engine operating parameter moves between a first state in which pressurised air from said inlet manifold (2) communicates with said aneroid (9) and atmospheric air is isolated from the aneroid (9) and a second state in which manifold air to the fuel injection pump (8) is interrupted and atmospheric air is in communication with the aneroid (9) and pressurised air from said inlet manifold (2) terminates at said first solenoid (6); and wherein the second solenoid (7) responsive to said predetermined engine operating parameter and/or signal is located between said inlet manifold (2) and said control valve (11) and moves between a first state in which atmospheric air is in communication with said control valve (11) and second state in which pressurised air from said inlet manifold (2) is in communication with said control valve (11); wherein when the first solenoid (6) isolates said first fuel type, the second solenoid (7) operates responsive to a signal to allow boost fuel provided by said second fuel type to communicate between the second fuel source (13) and the engine.

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A DUAL-FUEL METHOD FOR BOOST FUEL SUBSTITUTION IN TURBO-CHARGED DIESEL ENGINES

BACKGROUND

The present invention relates to fuel systems and more particularly relates to a system in which a second fuel is admitted as a substitution for boost fuel in a turbo-charged diesel engine. The invention also relates to a dual fuelling system which may be retro-fitted in a simple manner to an existing single-fuel turbo-charged diesel engine.

PRIOR ART

Diesel engine operation is typically controlled by the fuel injection pump. Turbo-charged diesel engines introduce a degree of complexity to the control of the engine, over normally aspirated diesel engines due to the fact that the amount of air admitted to each cylinder for each cycle (air charge), changes as a result of the change in manifold air pressure. This change in air charge coupled to the requirement to run diesel engines lean, requires the inlet manifold pressure to be an input to any system controlling the engine. Therefore, on turbo-charged diesel engines, typically a pressure line connects the inlet manifold to an aneroid on the injection pump to facilitate the variation in fuel flow rate due to variations of inlet manifold pressure.

Other means of facilitating this variation of fuel flow rate are known. For example, one system electronically senses the manifold pressure, then the output of the electronic sensor is processed, with the output of this processor electrically driving an electromagnetic device associated with the injection pump.

US patent 4,517,928 (corresponds to Australian application 17878/83) discloses an existing system for using a gas such as LPG as a secondary boost fuel in diesel engines. According to the arrangement shown in the US patent a signal proportional to the momentary effect of fuel consumption controls the gas supply to the engine. A valve in a gas supply line is connected to a control lever of the engine governor to allow gas supply only in a load range above approximately 25% and up to a maximum of approximately 40% of the full load total fuel consumption. In the lower range, incomplete combustion

of the gas is avoided and in the high low range destination and overload are avoided and the opacity of the exhaust is improved. The consumption of liquid fuel is reduced and the exhaust gas composition is improved. An adjustable stop in the arrangement described limits the maximum injectable liquid fuel quantity when the engine is operated in a duel fuel mode. Whilst it is known to retrofit a dual fuel system incorporating diesel fuel and boost LP gas fuel as a substitution for diesel fuel, the known arrangements require considerable interference with the existing engine equipment and more particularly requires significant interference with the diesel fuel pump and aneroid. Whilst US patent 4,517,928 teaches no intervention into the inside of the fuel pump or the governor there is still required at the outside of the fuel pump a stop for a control lever. Thus, a limiter for the control rod has to be added increasing the labour in retrofitting.

Dual fuel systems used with diesel engines involve a mixture of diesel and gas wherein gas is used as boost fuel responsive to changes in a predetermined engine parameter. The principle of this system is to save diesel fuel by injecting a lesser quantity and replacing this with lower cost LPG and also to avoid diesel exhaust smoke at full load running.

This inevitably results in power loss so in order to regain the original power LPG is added to the inlet air. According to the modification is effected so that the engine will have the same power with dual fuel as if it was using a 100% diesel. At fuel engine power load about 30% diesel can be replaced. When more diesel is replaced the engine will demonstrate a phenomenon known as knocking will stop at part load where peak pressures in the cylinders are lower more diesel fuel can be replaced by LPG up to about 40%. At less than a quarter of full load of the engine no LPG may be added to the inlet system because of insufficient combustion.

INVENTION

The present invention provides an alternative boost fuel substitution system for a diesel engine which may be used in conjunction with and retro fitted to existing fuel systems.

The dual fuel system according to the present invention is characterised by the inclusion of a second fuel in place of diesel fuel which would in single fuel operation have been introduced to the engine due to an increase in the inlet manifold air pressure as a result of the turbo-charger, and an increase in throttle position, typically known as boost fuel. The system according to the present invention is particularly suitable for retro-fitting to conventional diesel engines without disassembly of the injection pump.

In one form, the invention is further characterised by the interruption of the manifold air pressure input to the injection pump, and the substitution for the variation of diesel fuel flow in dependence on manifold pressure and the metering of a second fuel in response to a chosen engine operating parameter or a combination of parameters. Suitable parameters include engine revolutions per minutes (R.P.M.), inlet manifold pressure, throttle position and diesel fuel flow rate. Preferably, the total fuel admitted to the engine is controlled so as to maintain the overall air-fuel-ratio in the lean range.

According to the present system, the signal sent to the injection pump to indicate that the manifold air pressure has increased, is interrupted. The interruption makes the injection pump behave as if the inlet manifold air pressure is close to atmospheric. This disables the ability of the injection pump to add the boost diesel fuel to the engine. The boost diesel fuel is substituted with a second fuel. The second fuel is admitted to the engine by a means other than the injection pump used for the diesel fuel. Typically, this is by a separate injection system (for direct injection) or by admission to the inlet manifold.

In one broad form the present invention comprises:

an assembly for boost fuel substitution in a turbo charged diesel engine; the assembly including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of two alternate fuel types in communication with said engine;

a fuel injection pump including an aneroid intermediate a first reservoir of one of said two fuel types and said inlet manifold;

a control valve intermediate a second reservoir of said fuel types and said inlet manifold;

characterised in that the assembly includes at least two solenoids each capable of moving between two states of operation; wherein a first of said solenoids is located between the inlet manifold and said fuel injection pump and the second solenoid is located between said inlet manifold and said control valve;

wherein, said first solenoid responsive to a predetermined engine operating parameter moves between a first state in which pressurised air from said inlet manifold communicates with said aneroid and isolates atmospheric air and a second state in which manifold air to the fuel injection pump is interrupted and atmospheric air is in communication with the aneroid and pressurised air from said inlet manifold terminates at said first solenoid;

and wherein the second solenoid responsive to said predetermined engine operating parameter or a second parameter is located between said inlet manifold and said control valve and moves between a first state in which atmospheric air is in communication with said gas metering valve and a second state in which pressurised air from said inlet manifold is in communication with said control valve and atmospheric air is isolated from control valve;

wherein when the first solenoid isolates said first fuel type, the second solenoid operates to allow boost fuel provided by said second fuel type to communicate between the second fuel source and the engine.

Preferably the aneroid is in direct contact with pressurised air from the manifold and responds to that pressure. Alternatively, the aneroid is in electrical contact with a sensor attached at or near said inlet manifold such that the sensor after sensing the air pressure in the manifold causes a signal to be transmitted to the aneroid.

In another form the present invention comprises;

an assembly for boost fuel substitution in turbo charged diesel engines; the assembly including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of two alternate fuel types in communication with said engine;

a fuel injection pump including an aneroid intermediate the first reservoir of one of said two fuel types and said inlet manifold;

a control valve intermediate a second reservoir of said fuel types and said inlet manifold;

characterised in that the assembly includes at least two solenoids each capable of moving between two states of operation; wherein a first of said solenoids is located between the inlet manifold and said fuel injection pump and the second solenoid is located between said inlet manifold and said control valve;

wherein, said first solenoid responsive to a predetermined engine operating parameter moves between a first state in which pressurised air from said inlet manifold communicates with said aneroid and isolates atmospheric air and a second state in which manifold air to the fuel injection pump is interrupted and atmospheric air is in communication with the aneroid and pressurised air from said inlet manifold terminates at said first solenoid;

and wherein the second solenoid responsive to said predetermined engine operating parameter or a second parameter is located between said inlet manifold and said control valve and moves between a first state in which atmospheric air is in communication with said gas metering valve and second state in which pressurised air from said inlet manifold is in communication with said control valve and atmospheric air is isolated from the control valve;

wherein when the first solenoid is in its second state, the second solenoid is in its second state such that when first fuel is isolated from the engine by operation of the first solenoid, the operation of the second solenoid allows delivery of boost fuel from the second fuel source to the engine.

In another broad form the present invention comprises:

a system for boost fuel substitution in a turbo charged diesel engine of the high speed type;

the system including a diesel engine including an inlet manifold and an exhaust manifold, a turbocharger in communication with said inlet manifold;

a first fuel reservoir of diesel fuel and a second reservoir of gas fuel each available for delivery to said engine;

a diesel fuel injection pump including an aneroid intermediate the first reservoir and the inlet manifold;

a gas control valve intermediate the second reservoir and the inlet manifold for regulating the pressure of gas supplied from the second reservoir;

wherein the system further includes first and second solenoids each capable of movement between two states of operation; wherein the first of said solenoids is located between the inlet manifold and said diesel fuel pump and the second is located between the inlet manifold and said gas control valve;

wherein the operation of each said solenoid is responsive to a predetermined engine operating parameter;

said first solenoid moves between a first operating condition in which the inlet manifold pressure is in communication with the aneroid and fuel pump and a second operating condition in which the inlet manifold pressure is isolated from said fuel pump limiting flow of diesel to the engine to a predetermined maximum and ambient air is accessible to the aneroid;

said second solenoid moves between a first operating condition in which gas fuel is isolated from the engine and ambient air is in communication with the gas control valve and a second operating condition in which gas fuel is in communication with said diesel engine wherein when the first solenoid is in its first operating state the second solenoid is in its first operating state and when the first solenoid is in its second operating state the second solenoid is in its second operating state;

wherein the solenoids are influenced by an electrical signal or signals initiated by a sensor or sensor which detects a predetermined engine operating parameter or parameters.

In another broad form the present invention comprises;

a system for boost fuel substitution in a turbo charged diesel engine; the system including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of diesel and gas respectively selectively in communication with said engine;

a fuel injection pump including an aneroid intermediate the first reservoir of diesel and said inlet manifold;

a control valve intermediate the second reservoir of gas and said inlet manifold;

characterised in that the system includes a single solenoid capable of moving between two operational states;

wherein said single solenoid is located intermediate the inlet manifold and the fuel pump and control valve such that the solenoid is capable of allowing communication between the first or second fuel and the engine responsive to a single dictated by a predetermined engine operating parameter;

wherein said single solenoid moves between a first operational state which allows communication between pressurised air from the inlet manifold and said aneroid and isolates pressurised air access to said gas control valve and a second operational state in which communication between the inlet manifold and the aneroid of the fuel pump is isolated and communication between the inlet manifold pressurised air and the control valve is allowed;

wherein when the solenoid is in its first operational state the first fuel is delivered to the engine and when the solenoid is in its second operational state boost fuel comprising the second fuel is substituted for the first fuel wherein the solenoid operates responsive to predetermined engine operating parameters.

The advantages of the boost fuel substitution system of the present invention, when fitted to a turbo-charged diesel engine include the following:

the process of adapting a turbo-charged diesel engine to dual-fuelled operation can be achieved without disassembly of the injection pump, nor does it require any physical alteration to the internal mechanisms of the injection pump or the body of the injection pump. Because the injection pump has not been modified, any repairs or calibration of the injection pump can still be carried out according to the manufacturer's specifications.

The system can be converted back to 100% diesel operation while the engine is in operation. Through the use of a gaseous second fuel, typically liquefied petroleum gas

or natural gas, particulate emissions can be reduced. Since only the boost component of the diesel fuel is replaced with the second fuel, knock problems associated with high substitution levels of gaseous second fuels can be avoided. This occurs due to the fact that the boost fuel flow rate typically represents less than 45% of the total fuel flow rate, based on energy flow per unit time. Knock problems associated with gaseous second fuels typically occur at higher substitution levels. Rough idle problems associated with some high substitution level, duel-fuelled engines are avoided. At idle, there is no significant boost of the inlet manifold air pressure, above ambient conditions. Therefore, at idle, the engine would be operating on or very close to 100% diesel.

The present invention will now be described in more detail according to a preferred but non limiting embodiment and with reference to the accompanying illustrations:

Figure 1: shows a schematic layout of the relationship of the duel solenoid arrangement fitted to a dual fuel system;

Figure 2: shows a cross sectional elevation of a dual change over solenoid arrangement according to a preferred embodiment wherein a first solenoid prevents communication between the inlet manifold and an aneroid and the other solenoid activates boost fuel;

Figure 3: shows the arrangement of figure 2 whereby the first solenoid allows communication between the inlet manifold and the aneroid and the second solenoid allows communication between a gas control valve and ambient air thereby preventing passage of boost fuel to the engine;

Figure 4: shows an alternative to the arrangement of figures 2 and 3 with the position of the ambient air access port in the gas circuit altered and which activates the gas fuel circuit and renders the primary fuel circuit inactive;

Figure 5: shows the solenoid arrangement of figure 4 wherein the gas fuel circuit is inactivated by the second solenoid and the first solenoid allows communication between the inlet manifold and aneroid; and

Figure 6: shows a typical circuit diagram describing electrical links between the battery source and operating solenoids.

The invention will be described, by way of example only, with reference to two embodiments for interruption to the inlet manifold air pressure input to the injection pump.

The first is one in which a connection is made between the inlet manifold, downstream of the turbo-charger, and an aneroid associated with the injection pump. The second system is one in which the inlet manifold air pressure is electronically sensed, and an electrical input is made to the injection pump.

Referring to figure 1 there is shown a schematic layout of an assembly for substitution of boost fuel in a diesel engine according to one embodiment. Figure 1 shows conventional diesel engine 1 including an inlet manifold 2 in communication with turbo charger 3. Turbocharger 3 is in communication with a conventional air cleaner 4 via air line 5.

According to a preferred embodiment, the assembly comprises co-operating dual solenoids 6 and 7 the first of which is located intermediate the inlet manifold 2 and fuel pump 8. Solenoid 6 is in communication with an aneroid 9 associated with fuel pump 8 via a pressurised air line which allows according to one embodiment aneroid 8 to detect either directly or via a signal generated by a sensor at or near the inlet manifold the level of air pressure at inlet manifold 2. Fuel pump 8 is connected to a diesel fuel reservoir 10 from which diesel fuel is delivered to the engine responsive to engine operating parameters. Solenoid 7 is in communication with inlet manifold 2 and a gas metering valve 11 which regulates flow of gas along gas supply line 12 from a reservoir 13 of LP gas which comprises the second fuel. Supply line 12 further includes a conventional converter 14 wherein LP gas is converted to a vapour in a known manner. Hot water from the engine via line 15 converts the liquid to a vapour and in doing so warms the gas from stop the unit freezing as LPG when released from the liquid state to form a gaseous state. The gas travels along line 12 towards gas metering valve 11 which is operated by a switch from the foot cycle. The switch may be one of the magnetic type or alternative form of switch to suit requirements. Once the gaseous vapour engages gas metering valve 11, turbo charger 3 at this time is not generating pressure although the foot throttle switch turns the system on at the solenoid valve downstream of gas metering valve 11.

According to one form of operation, gas metering valve 11 allows LP gas to travel responsive to the action of solenoid 7 into the engine. As the LP gas is boost fuel, no gas can enter the engine until such time as the turbo charger 3 generates enough pressure to push on a diaphragm inside gas metering valve 11 which in turn activates a plunger enabling gas feed through the metering valve. If turbo pressure is low the introduction of gas into the engine is very light but as turbo pressure increases, this will have the effect of opening gas metering valve 11 in order to increase the flow rate of gas to the engine. Thus, the turbo charger does not activate until the engine is in a high torque condition at which time the turbo charger operates. When this occurs, instead of the diesel fuel pump 8 advancing boost fuel towards the engine when gas is delivered to the engine responsive to a predetermine engine operating parameter, diesel fuel cannot enter the engine. Gas cannot enter the engine until such time as turbo charger 3 starts to operate as the torque value of the engine enters its upper range. Isolating inlet manifold air pressure from aneroid 9 of fuel pump 8 isolates diesel fuel and allows LP gas to be substituted as boost fuel. Parameters employed in the interruption of the inlet manifold air pressure input to the injection pump resulting in metering of the second fuel based on some or all of the following:

engine R.P.M, inlet manifold air pressure, throttle position, flow rate of the diesel fuel and adding the second fuel to the engine.

Figures 2 to 5 describe in more detail the operation of the dual solenoid arrangement according to a preferred embodiment of the invention.

Referring to figure 2 there is shown an enlarged cross sectional view of a dual solenoid circuit 20 which establishes intermittent links between an inlet manifold of a diesel engine and two alternative fuel sources. The dual solenoid in circuit 20 to be described below corresponds to solenoids 6 and 7 of figure 1. Dual solenoid circuit 20 includes a first solenoid 21 which is placed intermediate, engine manifold 2 and fuel pump 8 with aneroid 9. Dual solenoid circuit 20 further includes second solenoid 22 disposed intermediate inlet manifold 2 and gas metering valve 11 which controls access to a second fuel from reservoir 13. First solenoid 21 controls the passage of primary diesel fuel from reservoir 10 and interrupts the primary fuel flow circuit normally responsive to

manifold air pressure such that primary fuel may be isolated responsive to a predetermined engine parameter enabling second solenoid 22 to provide substitute boost fuel to the diesel engine. In normal operation the engine is supplied with diesel fuel from fuel source 10 with the amount of fuel delivered to the engine responsive to air pressure at the inlet manifold. The dual solenoid system which also includes turbo charger 3 operates in response to increased pressure generated by the turbo charger which is delivered to the inlet manifold 2. According to one embodiment a signal is sent to the injection pump 8 to indicate that the manifold air pressure has increased. This causes interruption to the supply of diesel fuel and isolates fuel pump 8 from manifold air pressure such that ambient air is then in communication with the aneroid 9. Solenoid 21 includes solenoid body 23 having an internal chamber 24 which, subject to the position of plunger valve 25, able to communicate with air delivery line 26, chamber 27 and pressurised air chamber 28. Solenoid 21 further includes an upper body 29 housing an actuating mechanism energised by a control circuit which is linked to the control circuit via electrical linkage 30. The actuating mechanism includes biasing spring 31 which operates responsive to an electrical signal via link 30 such that plunger valve 25 moves between a location wherein gate 32 is free of orifice 33 and bears via surface 34 on shoulder 35 of orifice 36 and a second position in which plunger 25 bears via surface 37 on shoulders 38 of orifice 33. The action of plunger valve 25 is regulated by electrical signals responsive to detection of inlet manifold pressure. As shown, plunger valve 25 of first solenoid 21 restricts the flow of pressurised air along pressurised airline 39 such that pressurised air from inlet manifold is unable to travel beyond pressurised air chamber 28. This allows ambient air to enter solenoid body 23 via port 40 such that ambient air is delivered via delivery air line 26 to aneroid 9. Accordingly the configuration of first solenoid 21 and more particularly the position of plunger valve 25 indicates that boost fuel is isolated from the diesel engine from the first fuel source in favour of substitution of boost fuel from the second fuel source. Second solenoid 22 has a similar configuration to that described for first solenoid 21 but second solenoid 22 is dispersed between inlet manifold 2 and gas metering valve 11. When first solenoid 21 isolates the fuel from a first fuel source when the aneroid detects ambient air pressure, second solenoid 22 operates to establish communication between inlet manifold 2 and second fuel or boost fuel source. As shown in figure 2 second solenoid 22 is configured

similarly to first solenoid 21 and includes solenoid body 50, ambient air chamber 51 in communication with port 52 which is open to atmospheric air and orifice 53 defined by shoulder 54 which receives oscillating plunger valve 55. Plunger valve 55 includes gate 56 which when communication is open between the boost fuel source and the inlet manifold, locates on shoulder 54. Solenoid body 50 further includes pressurised air chamber 56 which is in permanent communication with inlet manifold 2. Solenoid body 55 further includes upper shoulder 57 which acts as a bearing surface for upper surface 58 of plunger 55 when pressurised air from inlet manifold is isolated from boost fuel reservoir 13. In this configuration ambient air is available via port 52 and air chamber 51 to gas metering valve 11. When that occurs, plunger valve 25 of solenoid 21 engages shoulder region 38 via surface 37 in order to open communication between inlet manifold 2 and first fuel reservoir 10 via aneroid fuel pump.

Figure 3 shows the arrangement set out in figure 2 and is numbered in accordance with the integers of figure 2. The fundamental difference between the arrangement in figure 3 and that shown in figure 2 is that in figure 3 solenoid 21 seats on shoulder 38 via gate 32 so as to enable communication between pressurised air at the inlet manifold and the first fuel source. Sealing orifice 33 prevents ambient air access to aneroid 9 which ensures that the primary diesel fuel will be delivered to the engine. Plunger valve 25 will close access to ambient air once activated by the electrical control circuit in response to inlet manifold pressure. At the same time, second solenoid 22 closes the pressurised air circuit and allows access of ambient air via chamber 51 to gas metering valve 11. Referring to figure 4 there is shown an alternative dual solenoid arrangement 50 shown in figure 4 includes solenoid 51 which is identical to solenoid 21 shown in figure 3. Furthermore, solenoid 51 operates in an identical manner to that described for solenoid 21. Where dual solenoid arrangement 50 differs from that described in figures 2 and 3 is the arrangement of solenoid 60 which is configured differently from the corresponding solenoid 22 described in the dual solenoid arrangement 20 in figure 3. Solenoid 60 includes solenoid body 61 having an internal chamber 62, which subject to the position of plunger 63 will allow communication by air delivery line 64 between gas metering valve 11 (see figure 1) and inlet manifold 2 (see figure 1). When plunger 63 is retracted there is free communication of pressurised air between inlet manifold 2 and gas metering valve

11 and in this configuration gate 65 seats on shoulder 66 of orifice 67 isolating internal chamber 68. Solenoid arrangement 50 shows solenoid 51 isolating pressurised air in pressurised air line 69 from aneroid 9. In this configuration ambient air is in direct communication with aneroid 9 preventing flow from diesel fuel to the engine. The fundamental difference between solenoid 22 and solenoid 60 is the position of the ambient air chamber and the opposite operation of valves 56 and 63 respectively in respect of their position when pressurised air is in communication with the gas moving valve and when ambient air is in communication with the gas metering valve. These differences are merely a matter of manufacturing choice or selection enabling a possible selection of solenoids which operate differently but performing a similar roll sequentially isolating or allowing access to respective fuels.

Figure 5 shows the arrangement of figure 4 this time plungers 70 and 63 respectively are both seated against corresponding orifices as distinct from opposing orifices to allow communication between inlet manifold and aneroid 9 in the case of solenoid 51 and isolate pressurised air from inlet manifold 2 to gas control valve. Figures 4 and 5 therefore illustrate an alternative configuration for the second solenoid by virtue of the alternative location of ambient air port 71.

In a more general sense one solenoid valve may be employed to control the dual fuel system. In this case a valve which has two inputs and two outputs is used whereby the inlet manifold air pressure would be connected to the one input and atmospheric pressure would be connected to the second input. This is illustrated in Figure 7. The outputs of the valve would be connected to the aneroid associated with the injection pump, and the input to the second fuel metering system. The valve could be configured in such a way that when the valve is de-energised, the inlet manifold air pressure would be connected to the injection pump aneroid, and the gas metering system would be connected to atmospheric pressure. Typically, if atmospheric pressure is input to the second fuel metering system, the second fuel would not be admitted to the engine. Therefore, with the valve in the de-energised state, the engine would be under 100% diesel operation.

When the valve is energised, the inlet manifold air pressure would be connected to the second fuel metering system and the injection pump aneroid would be connected to atmospheric pressure, and the engine would be operating in dual-fuel mode. Since the injection pump registers the manifold pressure as being atmospheric or close to atmospheric, it will behave as if there is no boost air being admitted to the engine and will not admit boost diesel fuel to the engine.

Although this embodiment has been described with only one valve, it is acknowledged that it may be achieved with more than one valve, and it may be achieved with valves with more than two inputs, and or more than two outputs. Furthermore, the valve switching may be opposite to that described above, in that the valve can be used whereby in the energised state, the inlet manifold air pressure would be connected to the injection pump aneroid. The valve would typically be electro-mechanical, such as a solenoid so that switching the valve on and off can be achieved remotely and quickly.

In the second system, the electrical connection from the manifold air pressure sensor would be interrupted as illustrated in Figure 8. A reference signal would be sent to the processor which has the electrical properties which are characteristic of the sensor output when the inlet manifold air pressure is close to ambient.

Metering of the second fuel should be constrained to maintain the overall engine operation to be lean. This is desirable to ensure that the production of particulates is not in violation of emission control legislation. The second fuel flow may be introduced to the engine in a variety of known ways, including manifold introduction (commonly referred to as fumigated introduction for gas) or by a second injection system which may or may not be direct in-cylinder injection.

The function of the system will be described below in reference to an engine that has a connection between the inlet manifold and the aneroid associated with the injection pump. The input to the injection pump could alternatively be taken from the outlet of the turbocharger compressor.

The valve is energised when some critical constraints are met. These constraints would include some or all of the following:

Sufficient fuel level in the second fuel tank
Engine oil pressure is above a present valve
Engine R.P.M. is between set limits
Throttle position is between set limits

If the valve is energised, atmospheric air pressure is exposed to the aneroid associated with the diesel injection pump and the diesel injection pump does not admit boost diesel fuel. The second fuel metering system admits the second fuel essentially to supplement the loss of the boost diesel fuel. The metering process is done according to the engine conditions as listed above. If the valve is de-energised, the diesel pump will admit the boost diesel fuel as required. This change-over between dual-fuel operation and 100% diesel fuel operation can occur with the engine in operation.

The circuit shown in figure 6 includes a power source 80 formed by a conventional battery which may be isolated by a conventional on/off switch 81. Included in the circuit is a reset switch 82 which is in electrical communication with storage reservoir 83 via actuating solenoid 84. Another part of the circuit links relays which together link the two circuits which in turn are linked to a mercury switch 85. The mercury switch is useful should a vehicle become involved in an accident altering its attitude dramatically in which case the mercury switch will immediately isolate the system immediately shutting down the flow of electricity to the solenoid 84 on gas tank 83 preventing any further flow of liquid LPG anywhere through the system. This provides a safety feature and will minimise risk in the event of a fire. In additional to the mercury switch is pressure switch 86 which enables pressure control. This switch keeps pressure from the gas bottle at a certain level and keeps the circuit open on the energising side of relays 87. If the pressure drops off by way of a ruptured line or the like or if the vehicle runs out of gas this will immediately break the circuit and will convert the relay 87 to the off position. In this position the throttle switch 88 will be isolated which in turn will shut off the solenoid on the downstream side of the gas metering valve. If the throttle switch is

not operating because there is no power to it, the system will be immediately closed down. The circuit will also close down via the coil which operates a second relay. If there is no power to the second relay such that red indicator light comes on which indicates that the gas is off and this isolates the whole system from operating. If the gas tank is full and the circuit operates relay 1 and in turn operates relay 2, this will operate change over solenoid valve 90 and 91 thus when solenoid 90 is normally open when there is no power on it the system returns from gas operation to solely diesel fuel operation. In this condition the air pressure from the turbo charger is delivered to the aneroid on the fuel pump according to normal operation. When the turbo charger is operative and pressure is on the gas tank and the on/off switch is on, this changes a relay so that a normally closed relay opens and one normally open closes. This results in air pressure from the pressure side of the turbo charger being isolated from the aneroid and being diverted back through the system and onto the metering valve of the gas. When this happens, green light 92 illuminates on the dashboard of the vehicle indicating that gas is on. Where a driver of the vehicle puts his foot on the throttle it automatically opens the shut off solenoid on the downward side of the metering valve allowing gas to flow when the turbo charger builds up enough pressure to open the metering valve. The circuit also includes reset switch 82 just in case the vehicle runs out of gas to compensate for inability to turn the gas back on as the pressure switch has opened the circuit and no power can be delivered through the line, so it is essential to have a reset button. As soon as the reset button is activated this enables power to the tank solenoid 84 which as a consequence allows liquid to flow through the line which operates pressure switch 86. Once the operator's finger is removed from the reset button the circuit remains open because relay number 1 and number 2 are activated creating an opposite circuit effect.

It will be recognised by persons skilled in the art that numerous variations and modifications may be made tot he invention as broadly described herein without departing from the overall spirit and scope of the invention.

THE CLAIMS:

1. An assembly for boost fuel substitution in turbo charged diesel engines; the assembly including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of diesel and gas respectively selectively in communication with said engine;

a fuel injection pump including an aneroid intermediate the first reservoir of diesel and said inlet manifold;

a control valve intermediate the second reservoir of gas and said inlet manifold;

characterised in that the assembly includes at least two solenoids each capable of moving between first and second operational states; wherein a first of said solenoids is located between the inlet manifold and said fuel injection pump and the second solenoid is located between said inlet manifold and said control valve;

wherein, said first solenoid responsive to a predetermined engine operating parameter moves between a first state in which pressurised air from said inlet manifold communicates with said aneroid and atmospheric air is isolated from the aneroid and a second state in which manifold air to the fuel injection pump is interrupted and atmospheric air is in communication with the aneroid and pressurised air from said inlet manifold terminates at said first solenoid;

and wherein the second solenoid responsive to said predetermined engine operating parameter and/or signal is located between said inlet manifold and said control valve and a moves between a first state in which atmospheric air is in communication with said gas metering valve and second state in which pressurised air from said inlet manifold is in communication with said control valve;

wherein when the first solenoid isolates said first fuel type, the second solenoid operates responsive to a signal to allow boost fuel provided by said second fuel type to communicate between the second fuel source and the engine.

2. An assembly for boost fuel substitution in turbo charged diesel engines; the assembly including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of diesel and LP gas respectively in communication with said engine;

a fuel injection pump including an aneroid intermediate a first reservoir of one of said two fuel types and said inlet manifold;

a control valve intermediate a second reservoir of said fuel types and said inlet manifold;

characterised in that the assembly includes at least two solenoids each capable of moving between first and second operational states; wherein a first of said solenoids is located between the inlet manifold and said fuel injection pump and the second solenoid is located between said inlet manifold and said control valve;

wherein, said first solenoid responsive to a predetermined engine operating parameter moves between a first state in which pressurised air from said inlet manifold communicates with said aneroid and atmospheric air is isolated from the aneroid and a second state in which manifold air to the fuel injection pump is interrupted and atmospheric air is in communication with the aneroid and pressurised air from said inlet manifold terminates at said first solenoid;

and wherein the second solenoid responsive to said predetermined engine operating parameter is located between said inlet manifold and said control valve and moves between a first state in which atmospheric air is in communication with said gas metering valve and a second state in which pressurised air from said inlet manifold is in communication with said control valve;

wherein when the first solenoid is in its second state, the second solenoid is in its second state such that when first fuel is isolated from the engine by operation of the first solenoid, the operation of the second solenoid allows delivery of boost fuel from the second fuel reservoir to the engine.

3. A system for boost fuel substitution in a turbo charged diesel engine of the high speed type;

the system including a diesel engine including an inlet manifold and an exhaust manifold, a turbocharger in communication with said inlet manifold;

a first fuel reservoir of diesel fuel and a second reservoir of gas fuel each available for delivery to said engine;

a diesel fuel injection pump including an aneroid intermediate the first reservoir and the inlet manifold;

a gas control valve intermediate the second reservoir and the inlet manifold for regulating the pressure of gas supplied from the second reservoir;

wherein the system further includes first and second solenoids each capable of movement between two states of operation; wherein the first of said solenoids is located between the inlet manifold and said diesel fuel pump and the second is located between the inlet manifold and said gas control valve;

wherein the operation of each said solenoid is responsive to a predetermined engine operating parameter;

said first solenoid moves between a first operating condition in which the inlet manifold pressure is in communication with the aneroid and fuel pump and a second operating condition in which the inlet manifold pressure is isolated from said fuel pump limiting flow of diesel to the engine to a predetermined maximum and ambient air is accessible to the aneroid;

said second solenoid moves between a first operating condition in which gas fuel is isolated from the engine and ambient air is in communication with the gas control valve and a second operating condition in which gas fuel is in communication with said diesel engine wherein when the first solenoid is in its first operating state the second solenoid is in its first operating state and when the first solenoid is in its second operating state the second solenoid is in its second operating state;

wherein the solenoids are influenced by an electrical signal or signals initiated by a sensor or sensor which detects a predetermined engine operating parameter or parameters.

4. An assembly according to claim 1, 2 or 3 wherein the engine operating parameters include; engine revolutions per minute, inlet manifold pressure, throttle position and diesel fuel flow rate.

5. An assembly according to claim 4 wherein the gas control valve is located intermediate the second solenoid and said LP gas fuel source; said control valve operating in response to an electrical signal dictated by said operating parameters.

6. An assembly according to claim 5 wherein inlet manifold pressure may be determined from an outlet of said turbocharger.

7. An assembly according to claim 6 wherein inlet manifold pressure is measured by a sensor electrically connected to a circuit which includes said first and second solenoids.

8. An assembly according to claim 7 wherein the air pressure of the inlet manifold is sensed electrically by means of an electronic sensor which transmits a signal to one or both said solenoids.

9. An assembly according to claim 8 wherein the air pressure of the inlet manifold is mechanically sensed at said fuel pump.

10. An assembly according to claim 9 wherein the flow of said second fuel is regulated so as to ensure a lean mix.

11. A system for boost fuel substitution in a turbo charged diesel engine; the system including;

a diesel engine including an inlet manifold and an exhaust manifold;

a turbocharger in communication with said inlet manifold;

first and second reservoirs of diesel and gas respectively selectively in communication with said engine;

a fuel injection pump including an aneroid intermediate the first reservoir of diesel and said inlet manifold;

a control valve intermediate the second reservoir of gas and said inlet manifold;

characterised in that the system includes a single solenoid capable of moving between two operational states;

wherein said single solenoid is located intermediate the inlet manifold and the fuel pump and control valve such that the solenoid is capable of allowing communication between the first or second fuel and the engine responsive to a single dictated by a predetermined engine operating parameter;

wherein said single solenoid moves between a first operational state which allows communication between pressurised air from the inlet manifold and said aneroid and isolates pressurised air access to said gas control valve and a second operational state in which communication between the inlet manifold and the aneroid of the fuel pump is isolated and communication between the inlet manifold pressurised air and the control valve is allowed;

wherein when the solenoid is in its first operational state the first fuel is delivered to the engine and when the solenoid is in its second operational state boost fuel

comprising the second fuel is substituted for the first fuel wherein the solenoid operates responsive to predetermined engine operating parameters.

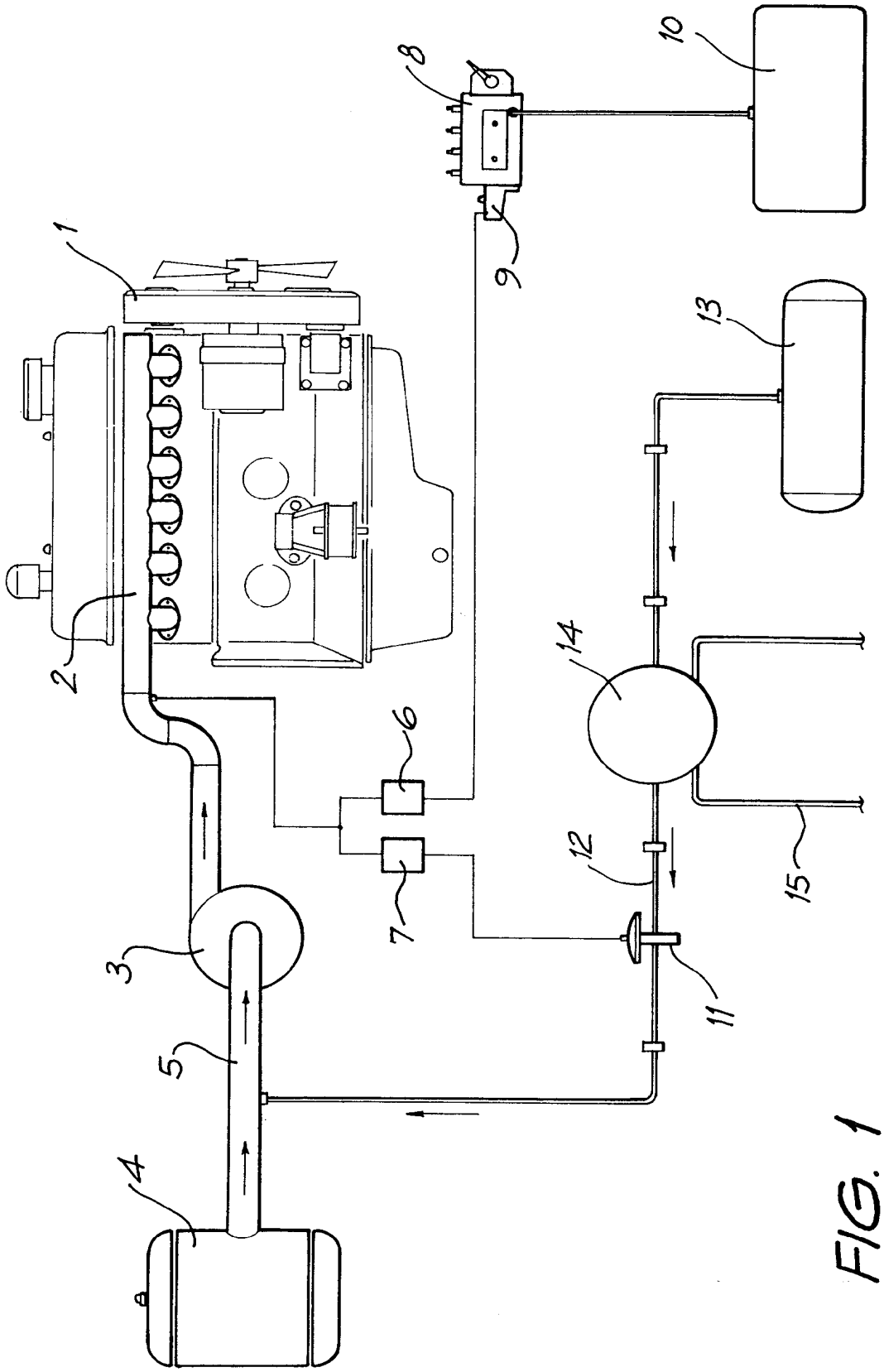


FIG. 1

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

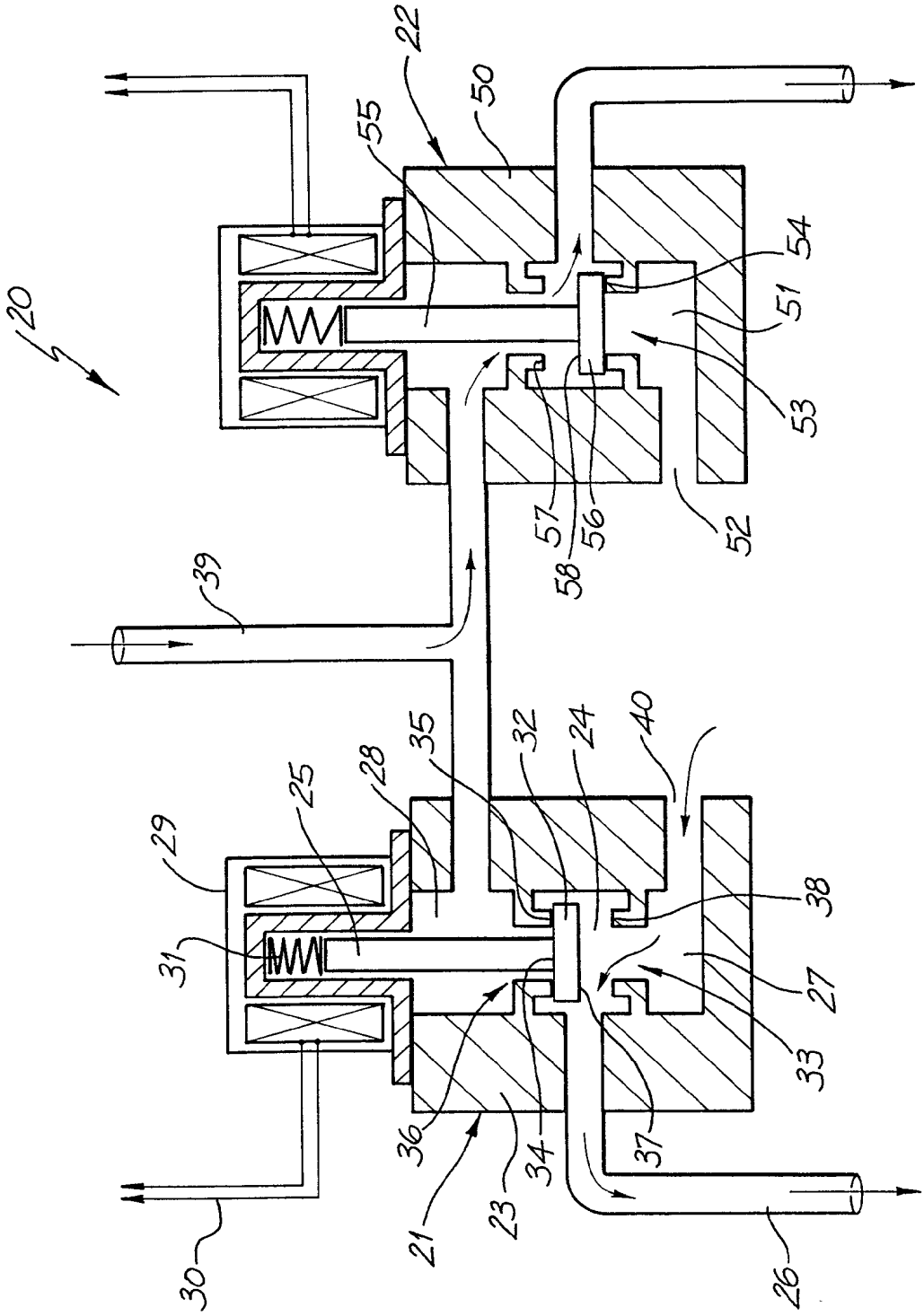


FIG. 2

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

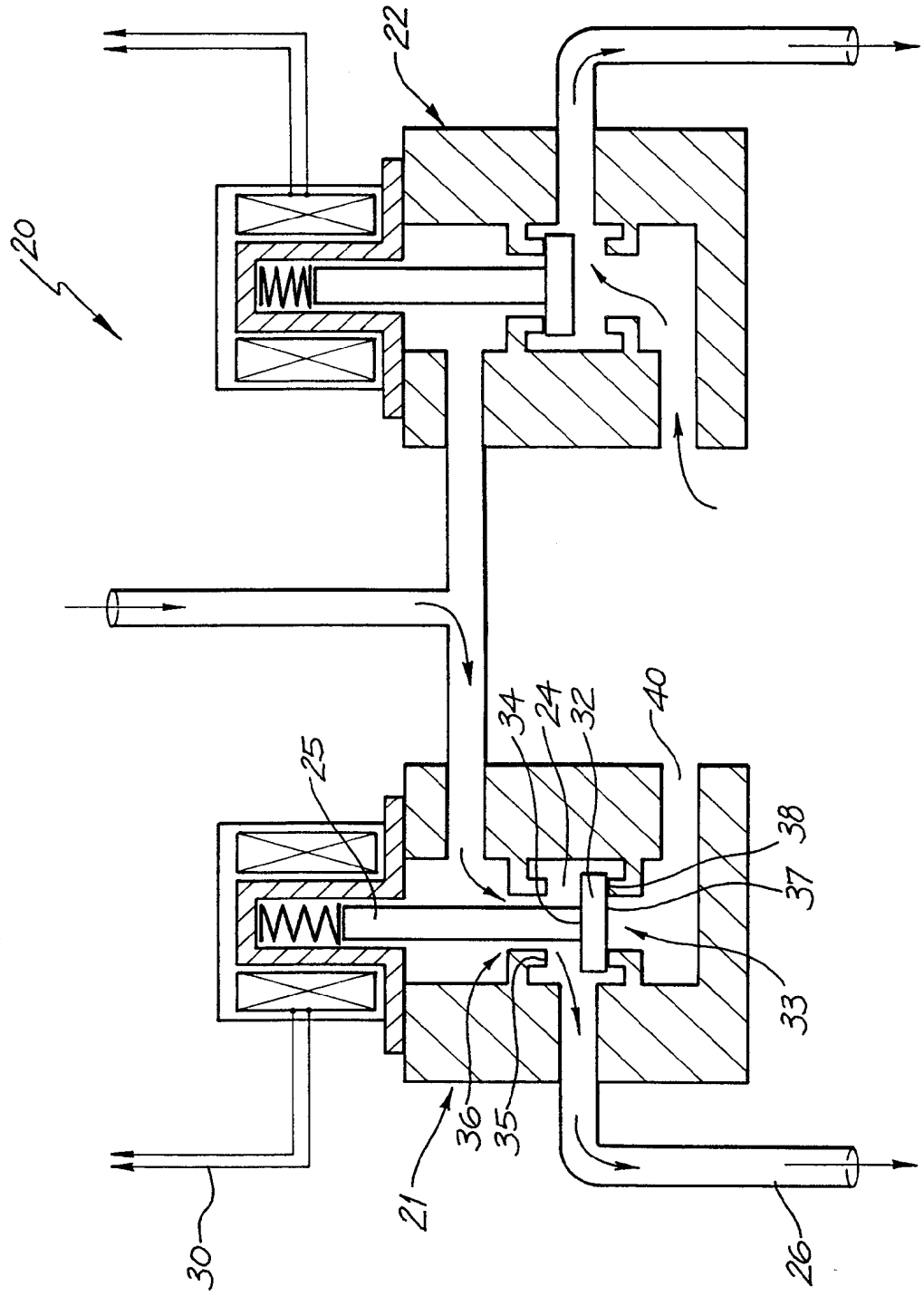


FIG. 3

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

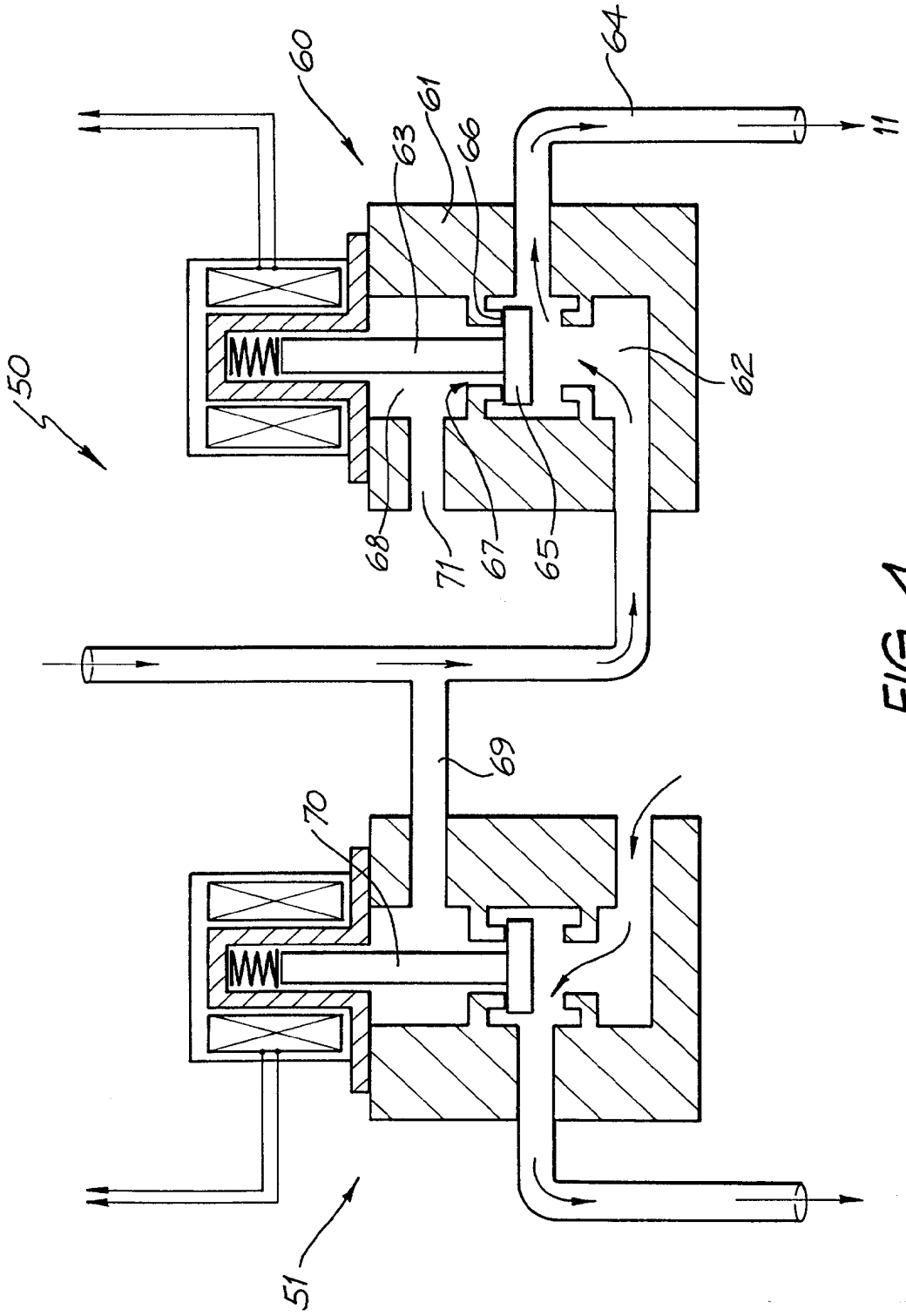


FIG. 4

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

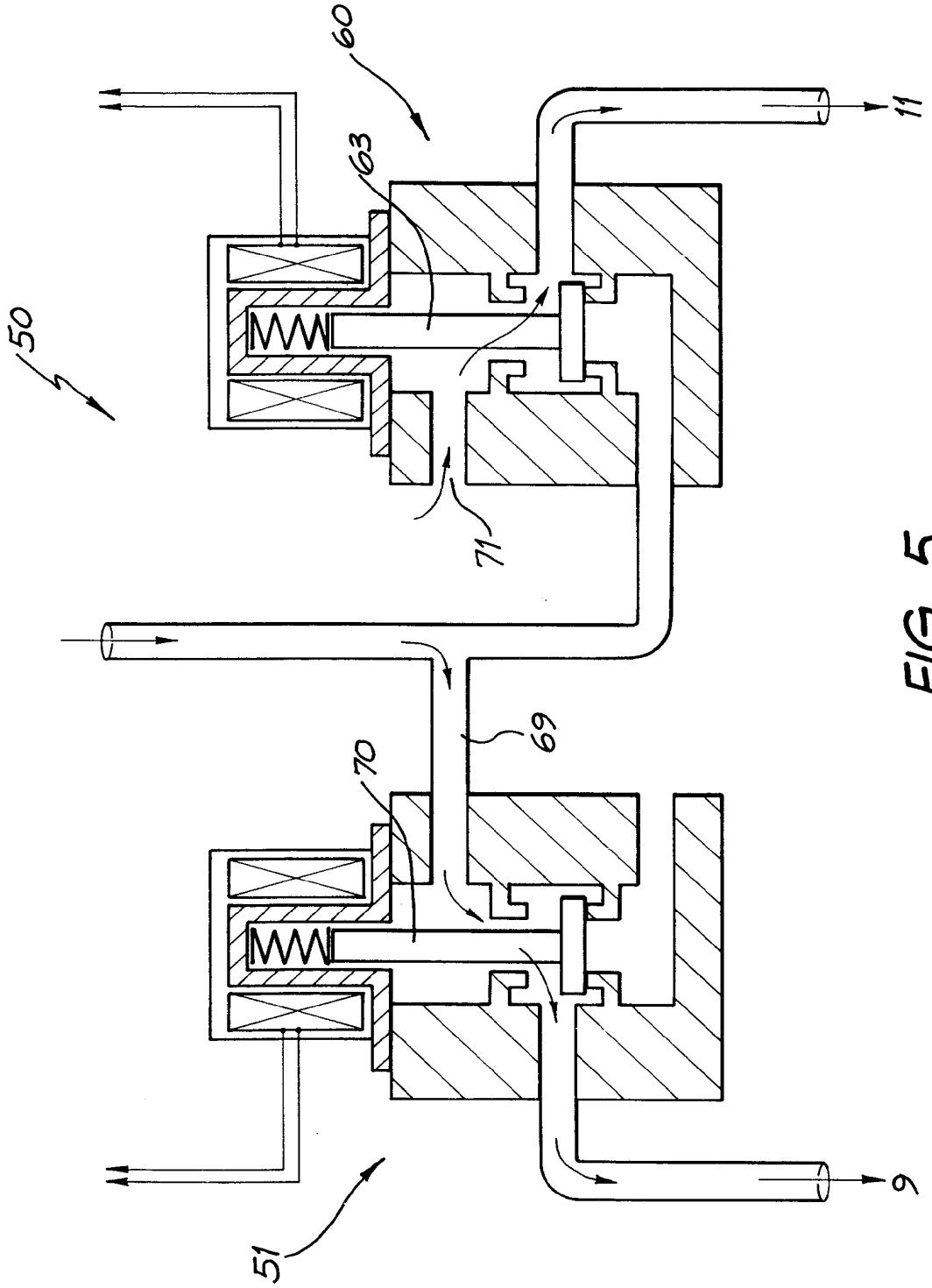


FIG. 5

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

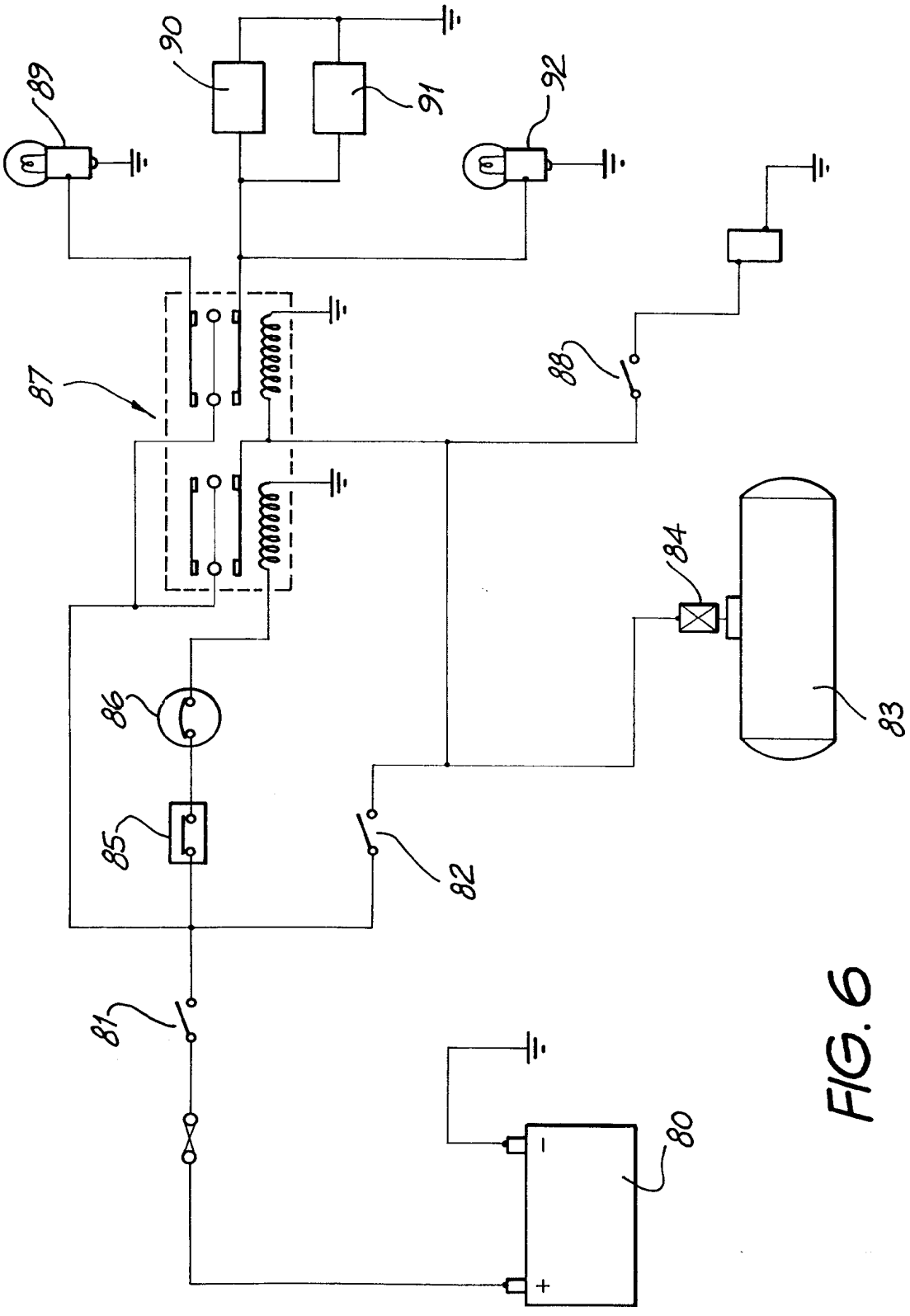


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00500

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: F02M 43/00; F02D 19/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F02M 21/02, 43/00, 02; F02D 19/08, 23/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT + keywords

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4619240 A (BEDFORD et al) 28 October 1986 whole document	
A	US 4517928 A (WOLTERS) 21 May 1985 whole document	

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 August 1998	28 AUG 1998
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **KURT TOBLER** Telephone No.: (02) 6283 2469

Form PCT/ISA/210 (second sheet) (July 1992) copbko

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 98/00500

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4619240	CA	1226183	EP	108582		
US	4517928	AU	17878/83	BR	8304334	CA	1213484
		IN	161555	NL	8203169	ZA	8305922
						EP	102119

END OF ANNEX

Form PCT/ISA/210 (extra sheet) (July 1992) copbko

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

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(43) Internationales Veröffentlichungsdatum
3. Mai 2007 (03.05.2007)

(10) Internationale Veröffentlichungsnummer
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(21) **Internationales Aktenzeichen:** PCT/EP2006/010380

(22) **Internationales Anmeldedatum:**
27. Oktober 2006 (27.10.2006)

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(26) **Veröffentlichungssprache:** Deutsch

(30) **Angaben zur Priorität:**
10 2005 051 743.9
28. Oktober 2005 (28.10.2005) DE
10 2006 000 621.6 2. Januar 2006 (02.01.2006) DE

(71) **Anmelder und**
(72) **Erfinder: DIRNHOFER, Rainer** [DE/DE]; An den Weihern 5, 92272 Freudenberg (DE).

(74) **Anwalt: WINTER BRANDL FÜRNISS HÜBNER RÖSS KAISER POLTE - PARTNERSCHAFT - PATENT- UND RECHTSANWALTSKANZLEI;** Alois-Steinecker-Strasse 22, 85354 Freising (DE).

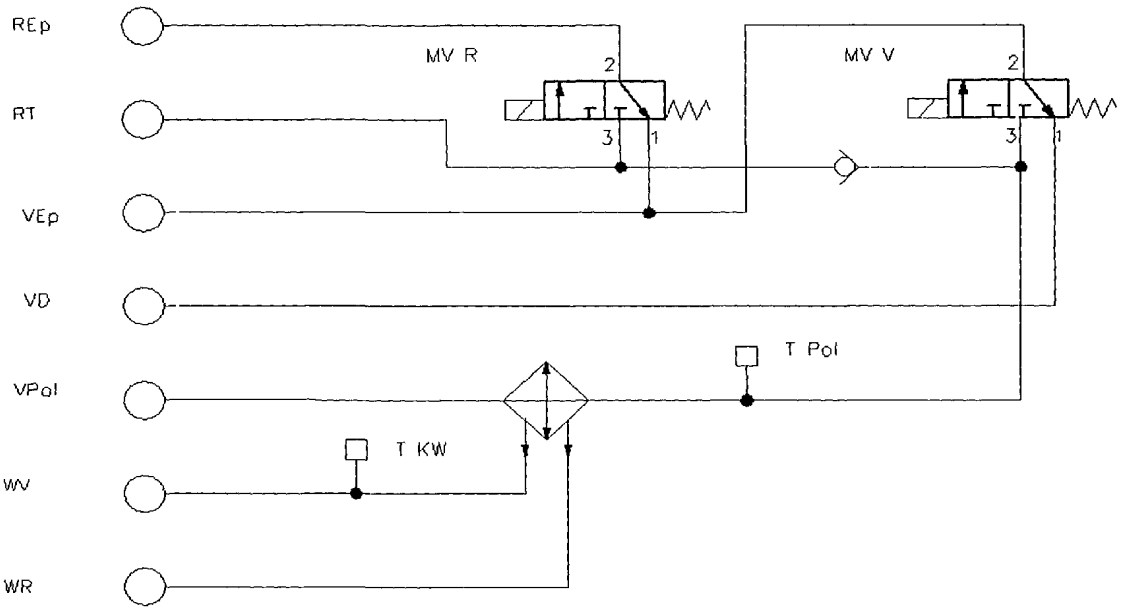
(81) **Bestimmungsstaaten** *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart):* AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DZ, EC, EE, EG, ES, FT, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Bestimmungsstaaten** *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart):* ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK,

[Fortsetzung auf der nächsten Seite]

(54) Title: RAPE/DIESEL VALVE

(54) Bezeichnung: RAPS-/DIESELVENTIL



(57) **Abstract:** In an internal combustion engine which is designed for Operation with a plurality of fuels, the entire fuel supply from at least two tanks for fuels having different flow properties is controlled in a Single valve control block. One of the fuels can be used without problems only at higher temperatures than the other one and therefore has to be heated first of all. The valve control block is arranged firstly close to the engine block of the internal combustion engine and secondly in the vicinity of a heat exchanger. As a result of the compact design, the ease of both maintenance and installation of the fuel supply System is improved and the fuel which is to be heated can be heated more rapidly.

[Fortsetzung auf der nächsten Seite]

WO 2007/048633 A1

EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Veröffentlicht:

— *mit internationalem Recherchenbericht*

— *mit geänderten Ansprüchen*

Zur Erklärung der Zweibuchstaben Codes und der anderen Abkurzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT Gazette verwiesen

(57) Zusammenfassung: In einer für den Betrieb mit mehreren unterschiedlichen Kraftstoffen ausgelegten Brennkraftmaschine wird die gesamte Kraftstoff zufuhr aus mindestens zwei Tanks für Kraftstoffe mit unterschiedlichen Fließeigenschaften in einem einzigen Ventilsteuerblock gesteuert Einer der Kraftstoffe kann erst bei höheren Temperaturen als der andere problemlos eingesetzt und muss daher zunächst aufgeheizt werden Der Ventilsteuerblock ist einerseits eng am Motorblock der Brennkraftmaσhine und andererseits in der Nahe eines Wärmetauschers angeordnet Durch den kompakten Aufbau kann sowohl die Wartungs und Monta gefreundlichkeit der Kraftstof fversorgungsanlage verbessert als auch der aufzuheizende Kraftstoff schneller aufgeheizt werden

Raps-/Dieselventil

Die Erfindung betrifft eine Kraftstoffversorgungsanlage für einen Verbrennungsmotor, der wahlweise mit unterschiedlichen Kraftstoffen betreibbar ist. Kraftstoff 1 ist der vom Hersteller vorgesehene Kraftstoff, beispielsweise Diesel, für den das Fahrzeug konstruiert wurde. Kraftstoff 2 ist ein alternativer Kraftstoff (zumeist Pflanzenöl) , der bedingt durch seine physikalischen und chemischen Eigenschaften nur dann problemlos zum Einsatz kommen kann, wenn man bestimmte Betriebszustände mit Kraftstoff 1 abdeckt.

Insbesondere betrifft die Erfindung eine Kraftstoffversorgungsanlage mit einer Ventilvorrichtung zum Umschalten zwischen herkömmlichem Dieselkraftstoff und aus nachwachsenden Rohstoffen erzeugtem Kraftstoff wie Rapsöl oder anderen pflanzlichen Ölen.

Im Stand der Technik sind Vorrichtungen bekannt, um einen Motor mit unterschiedlichen Kraftstoffen, zum Beispiel Diesel und Rapsöl, zu betreiben. Würde ein herkömmlicher Selbstzündermotor nur mit Rapsöl betrieben, träte unter anderem das Problem auf, dass Rapsöl erst bei höheren Temperaturen dünnflüssig genug ist, um in einem solchen Motor in den Brennraum gefördert zu werden. Weiterhin ist das Einspritzsystem herkömmlicher Dieselmotoren nicht für zähflüssigen Kraftstoff konzipiert. Zudem gelangt, wenn der Motor kalt ist, mehr Treibstoff in das Motoröl, weil die Spaltmaße von Kolbenringen noch nicht perfekt passen-. Pflanzenöl verdampft dann aber – im Gegensatz zu Diesel – nicht mehr, so dass das Motoröl beeinträchtigt werden kann. Bei kalten Kolbenaußenwänden ist die Verbrennung schlechter. Es könnten sich bedingt durch Pflanzenöl vermehrt Ablagerungen bilden.

Erst bei einer Kraftstofftemperatur von mindestens ungefähr 60°C sind die Fließ- und Verbrennungseigenschaften von Rapsöl als einem Beispiel für pflanzliche Kraftstoffe mit denen von Diesel vergleichbar. Daher werden herkömmliche Rapsölmotoren beim Starten mit Diesel aus einem ersten Tank betrieben, bis sie warmgelaufen sind. Gleichzeitig wird mit der Abwärme der Motoren über einen Wärmetauscher ein zweiter Tank, der Rapsöl enthält, sowie die Zuführleitungen vom zweiten Tank zum Motor aufgewärmt, beispielsweise indem das Kühlwasser vom Motor den Tank und die Zuführleitungen aufheizt. Sobald die Temperatur des Rapsöls hoch genug ist, beispielsweise bei ungefähr 60°C liegt, wird die Versorgung des Motors mit Diesel gestoppt und der Motor stattdessen mit Rapsöl versorgt. Diese Umschaltung von Diesel auf Rapsöl kann von Hand vorgenommen werden, indem ein entsprechendes Ventil in der Zuführung umgelegt wird. In modernen Anlagen wird die Umschaltung automatisch durchgeführt, sobald der pflanzliche Kraftstoff aufgeheizt ist.

Neben der Fließfähigkeit ändern sich beispielsweise auch die Verbrennungseigenschaf ten abhängig von der Betriebstemperatur des pflanzlichen Kraftstoffes. Daher reicht es nicht aus, lediglich den Kraftstoff vorzuheizen, sondern der Motor muss zunächst mit dem Kraftstoff auf Betriebstemperatur gebracht werden, für den er ursprünglich ausgelegt wurde. Dann sind alle Bestandteile auf ideale und materialschonende Betriebsbereit schaft gebracht, und das Umschalten kann erfolgen, ohne dem Motor oder anderen Bauteilen Schaden zuzufügen.

In Fahrzeugen mit derartigen für wechselnde Kraftstoffe vorgesehenen Motoren, wie beispielsweise in der DE 38 00585 A1 oder der DE 101 54 455 A1 beschrieben, werden die Kraftstoffe über getrennte Zuleitungen mög-

liehst bis an das Einspritzsystem herangeführt. Dadurch wird eine Vermischung der Kraftstoffe weitgehend vermieden. Lediglich die Einspritzpumpe selbst und eine sehr kurze gemeinsame Zuführung zu der Pumpe muss von beiden Kraftstoffen genutzt werden. Beim Abschalten des Motors wird diese gemeinsame Zuführung wieder mit Dieselkraftstoff gespült bzw. gefüllt, um sicherzustellen, dass beim nächsten Kaltstart kein zähflüssiges Rapsöl in diesem Bereich den Durchfluss von Diesel behindert .

Speziell nach der DE 101 54 455 A1, die als nächstkommender Stand der Technik angesehen wird, gegen die der Anspruch 1 der Erfindung abgegrenzt ist, wird versucht, beide Kraftstoffe möglichst weitgehend in separaten Leitungen bis zu den Einspritzdüsen zu führen. Dies soll so weit gehen, dass für jeden Kraftstoff ein Einspritzsystem inklusive Einspritzdüse pro Zylinder vorgesehen ist, um jederzeit ohne Probleme zwischen den Kraftstoffen umschalten zu können und so das Spülen der Motoren mit Diesel nach dem eigentlichen Abschalten zu unterbinden.

Falls wie üblicherweise nur ein Einspritzsystem pro Zylinder vorhanden ist, werden die Kraftstoffe über getrennte Leitungen zu einem oder mehreren Umschaltventilen zugeführt. Von den Umschaltventilen führt eine (kurze) gemeinsame Leitung zu dem Einspritzsystem je Zylinder, wie oben beschrieben. Daher müssen für jeden Motoraufbau die Ventilanordnung, Kraft Stoff leitungen und eventuelle Steuerleitungen für die automatische Umstellung der Ventile angepasst und eingebaut werden; idealerweise werden sogar zwei Einspritzsysteme pro Zylinder vorgesehen. Dies führt zu weitgehender Neukonzeption des Motors oder zumindest zu hohem Umbauaufwand. Zudem ist von Nachteil, dass derartige Systeme in der Regel mit flexiblen Schläuchen aufgebaut sind, die mehrere Zwischenstücke erforder-

lieh machen, die – zumindest bei automatisierter Montage – aufwändig zu montieren und abzudichten sind.

Daher ist es eine Aufgabe der vorliegenden Erfindung, eine Kraftstoffversorgungsanlage zu schaffen, die mindestens zwei verschiedene Kraftstoffe sicher zuführt und hilft, Leckageverluste zu vermeiden. Zudem soll der Montageaufwand deutlich reduziert werden.

Erfindungsgemäß wird diese Aufgabe dadurch gelöst, dass ein Ventilsteuerblock vorgesehen wird, in den Kraftstoff Zuleitungen von den Tanks münden und der die Kraftstoffe über weitere Leitungen an die Einspritzdüsen verteilt. Alle Ventile zum Umschalten zwischen den zwei Kraftstoffen, beispielsweise von Diesel- auf Pflanzenölbetrieb, sind in diesen Block integriert.

Dadurch wird die Anzahl der Übergänge und Schlauchanschlüsse für die Kraftstoffe deutlich reduziert, so dass die Leckagegefahr durch Risse in Schläuchen und undichte Übergänge deutlich reduziert ist.

Besonders bevorzugt wird der Ventilsteuerblock mit einer Steuerung kombiniert . Diese Steuerung kann dann die Kraftstoffversorgung automatisch steuern, wie nachstehend noch genauer erläutert wird. Wenn alle Ventile zur Umschaltung zwischen den Kraftstoffen in dem stabilen Ventilsteuerblock integriert sind, kann die Steuerung über mehr oder weniger fest verlegte Leitungen die Ventile ansteuern. Besonders bevorzugt sind auch die wesentlichen Elemente der Steuerung wie eine programmierbare Rechen¬einheit mit Speichereinheiten mit dem Ventilsteuerblock verbunden. Diese Recheneinheit kann in der Fahrgastzelle angeordnet bzw. mit Ein- und Ausgabeeinheiten in der Fahrgastzelle verbunden sein. Hier können dem Fahrzeug¬führer eventuell relevante Daten angezeigt werden, beispielsweise, mit welchem Kraftstoff er gerade fährt, die

Kraftstofftemperatur, die bisherige Fahrtdauer mit diesem Kraftstoff usw. Dadurch erhält man eine sehr kompakte und sehr zuverlässige Steuerung, bei der zudem die gesamte Verdrahtung zwischen der Steuereinheit und den Ventilen in einem einzigen Kabelbaum geführt werden kann, was ebenfalls zur Montagefreundlichkeit beiträgt.

Nach einer weiter bevorzugten Ausführungsform wird der Ventilsteuerblock aus wärmeleitendem Material, beispielsweise aus Metall, hergestellt.

Durch den Ventilsteuerblock fließen, wie vorstehend erläutert, beide Kraftstoffe. Wenn der Ventilsteuerblock möglichst nahe am Motor angebracht wird, kann die Abwärme des Motors den Block aufheizen. Wenn dieser die Wärme gut leitet, heizt er folglich auch den darin befindlichen Kraftstoff auf. Dadurch wird das Aufheizen beschleunigt und es kann schneller auf den weniger fließfähigen Kraftstoff umgeschaltet werden. Ferner kann der weniger fließfähige Kraftstoff mit einer geringeren Temperatur bis zum Ventilsteuerblock gefördert werden. Dies ist möglich, weil die Zuleitungen vor dem Ventilsteuerblock größere Querschnitte aufweisen als die Zuleitungen zu den Zylindern und insbesondere in den Einspritzdüsen nach dem Steuerblock, so dass eine Verstopfung weniger wahrscheinlich ist als in den Zuleitungen zu den Zylindern und zudem diese Zuleitungen bereits beim Umrüsten auf den zweiten Kraftstoff entsprechend ausgelegt werden können.

Nach einer weiter bevorzugten Ausführungsform ist der Ventilsteuerblock möglichst nahe bei einem Wärmetauscher angeordnet, der die Aufgabe hat, den weniger fließfähigen Kraftstoff zu erwärmen.

Standardmäßig werden in Motoren zur Verbrennung weniger fließfähiger nachwachsender Rohstoffe Wärmetauscher

eingebaut, die über das Kühlwasser des Motors den Tank mit dem weniger fließfähigen Stoff vorwärmen.

Bei der vorteilhaften Ausführungsform der Erfindung findet dieses Vorwärmen direkt an dem Ventilsteuerblock und daher teilweise auch mit dessen Abwärme statt. Da der Block bereits nach kurzer Betriebszeit aufgewärmt ist, verkürzt sich die Aufwärmzeit für den Kraftstoff weiter und es kann schneller auf den weniger fließfähigen Kraftstoff umgeschaltet werden.

Nach einer weiter bevorzugten Ausführungsform weist die Kraftstoffversorgungsanlage mindestens einen Temperatursensor auf.

Wenn eine Steuerung vorhanden ist, kann diese nach einer vorab festgelegten Zeit des Warmfahrens vom Diesel- in den Rapsölbetrieb umschalten. Allerdings muss dann diese Zeit so lange bemessen sein, dass das Rapsöl auch unter ungünstigsten Bedingungen (z.B. im Winter) aufgewärmt ist. Wird dagegen die Temperatur des Kraftstoffes gemessen, kann bei günstigen Bedingungen früher und bei ungünstigen Bedingungen später umgeschaltet werden, so dass möglichst wenig Dieselkraftstoff benötigt wird. Darüber hinaus wird die Temperatur des zweiten Kraftstoffs dann ideal ermittelt, wenn sie nicht direkt im Tank, sondern erst in den Zuführleitungen, möglichst kurz vor dem Ventilsteuerblock, geprüft wird. Sobald die Prüfung ergibt, dass die Kraftstoff- (und ebenso die Motor-) Temperatur die gewünschte Temperatur erreicht hat, kann umgeschaltet werden. Dadurch reduziert man (in Verbindung mit den anderen genannten Maßnahmen wie kurzen Wegen etc. die Betriebszeit mit dem ersten Kraftstoff. Dies trägt zur schnelleren Amortisation der Anlage bei. Ist dagegen keine automatische Steuerung vorhanden, kann dem Fahrer über

den Temperatursensor signalisiert werden, dass ein Umschalten möglich ist.

Noch weiter bevorzugt kann die Kraftstoffanlage automatisch in zwei Modi, nämlich einem Modus mit geschlossenem und einem Modus mit offenem Kreislauf mit Pflanzenöl betrieben werden.

Grundsätzlich werden Benzin- und Dieselmotoren herkömmlich in einem offenen Kreislauf betrieben, das heißt, Kraftstoff wird aus dem (drucklosen) Tank von einer Pumpe unter einem geringen Druck in einen Umlauf gefördert, aus dem der benötigte Kraftstoff entnommen wird. Der nicht benötigte Kraftstoff fließt wieder in den Tank zurück und führt dabei zusätzlich etwas Wärme aus dem Motor ab. Rapsölmotoren, die auf eine gute Erwärmung des Kraftstoffes angewiesen sind, werden dagegen herkömmlich in einem geschlossenen Kreislauf betrieben. Dabei zirkuliert das Pflanzenöl in einer Leitung im Motor, und nur das verbrauchte Öl wird von der Kraftstoffpumpe in diesen Kreislauf zugeführt. Dadurch erwärmt sich das Öl im Kreislauf sicher auf die benötigte Temperatur; das Pflanzenöl im Tank wird dagegen nur durch den Wärmetauscher erwärmt. Allerdings besteht bei dem geschlossenen Kreislauf die Gefahr, dass an undichten Stellen Luft in den Kreislauf gelangt, was zu Zündaussetzern und schließlich zum Liegenbleiben des Fahrzeugs führt. Durch Spülen des Kreislaufes muss in einem solchen Fall die Luft ersetzt werden.

Erfindungsgemäß wird der Motor beim Umschalten in den Pflanzenölbetrieb ebenfalls zunächst im geschlossenen Kreislauf betrieben. Aufgrund der vorstehend beschriebenen Effekte bezüglich Wärmeleitung, Kompaktheit und Integration wird jedoch erfindungsgemäß der Kraftstoff besser als im Stand der Technik erwärmt. Zudem wird die Tem-

peratur des Kraftstoffs im Umlauf gemessen. Daher kann automatisch auf den offenen Umlauf umgeschaltet werden, wenn die Pflanzenöltemperatur ausreichend hoch, d.h. um einen Sicherheitsfaktor höher als der Wert für die Fahrt mit Öl im geschlossenen Umlauf ist. Dadurch wird das Öl im Tank erwärmt, und der (ebenfalls Leistung benötigende) Wärmetauscher kann eventuell abgestellt werden. Fällt die Öltemperatur durch diese Maßnahmen zu stark, wird (automatisch) im geschlossenen Kreislauf weitergefahren. Durch die Fahrt im offenen Kreislauf wird zuverlässig Luft aus dem System entfernt, so dass die Zuverlässigkeit höher wird.

Nach einer weiter bevorzugten Ausführungsform weist die Kraftstoffversorgungsanlage starre Kraftstoffleitungen zwischen dem Ventilsteuerblock und der Brennkraftmaschine auf, die noch weiter bevorzugt eng am Zylinderblock anliegend angeordnet sind.

Während im Stand der Technik kurze, flexible Leitungen zwischen den einzelnen Ventilen und den Zylindern sowie lange, flexible Leitungen von den Tanks zu den Zylindern verwendet werden, wird nach dieser bevorzugten Ausführungsform der Erfindung mit festen Rohren gearbeitet, die idealerweise am Motorblock oder am Zylinderkopf anliegen. Die festen, beispielsweise aus Metall gefertigten Rohre können die Wärme des Motors gut aufnehmen. Zudem sind sie eng am Motor anliegend gegen Fahrtwind und andere kühlende Einflüsse geschützt. Dadurch wird der Kraftstoff in den Rohren schnell erwärmt. Dies wurde im Stand der Technik bisher aus zwei Gründen nicht verwirklicht: Zum einen werden herkömmlich flexible Kunststoffschlauche verwendet, um bei einer Nachrüstung von Hand mehrere ähnliche Motoren umrüsten zu können, wobei die Automatisierbarkeit keine Rolle spielt, dafür aber mit ähnlichen Bauteilen unterschiedliche Abstände zwischen

Teilen des Einspritzsystems realisiert werden können, und zum zweiten ist vor allem von Ottomotoren bekannt, dass der in zu heißen Zuleitungen befindliche Kraftstoff Gasblasen bildet, die die Versorgung des Motors behindern können. Diese Gefahr besteht jedoch bei den hier bevorzugt verwendeten Kraftstoffen Rapsöl und Diesel nicht, so dass eine effektive Aufheizung des Kraftstoffs möglich ist. Die festen Rohre sind bei automatisierter Montage, beispielsweise bei einem serienmäßigen Einbau, deutlich einfacher handhabbar und praktisch wartungsfrei, da die bei Schläuchen möglichen Leckstellen weitgehend vermieden werden .

Wie vorstehend beschrieben, arbeitet die erfindungsgemäße Kraftstoffversorgungsanlage idealerweise gemeinsam mit einer Steuervorrichtung.

Nach einer bevorzugten Ausführungsform übernimmt die Steuervorrichtung der Kraftstoffanlage den kompletten Betrieb zum Umschalten von einem Kraftstoff auf den anderen. Insbesondere veranlasst die Steuervorrichtung, dass die Kraftstoffleitungen beim Abstellen des Motors nach Betrieb mit dem weniger fließfähigen Kraftstoff mit dem fließfähigen Kraftstoff gespült werden, um sicherzustellen, dass der Motor beim darauffolgenden Kaltstart problemlos starten kann.

Nach einer weiter bevorzugten Ausführungsform kann das Spülen wie im Stand der Technik durch den Fahrer ausgelöst werden, der einen Wahlschalter in der Fahrerkabine betätigt .

Wenn der Fahrer beabsichtigt, demnächst eine längere Rast einzulegen, bei der der Motor abkühlt, kann er die Spülung rechtzeitig selbst auslösen. Dann können die Zuleitungen noch während der Fahrt gespült werden, so dass

keine Nachlaufzeit des Motors zu diesem Zweck nötig ist. Dazu kann dem Fahrer ein einbauspezifischer Wert, wie lange Diesel durchgespült werden muss, mitgeteilt werden. Stellt der Fahrer das Fahrzeug ohne vorheriges (oder nach nicht ausreichendem) Spülen ab, sorgt die Steuerung dafür, dass der Motor weiterläuft, bis das System gespült ist und problemlos wieder starten kann.

Umgekehrt kann es auch zweckmäßig sein, wenn der Fahrer veranlassen kann, dass das Spülen beim Abstellen des Motors unterdrückt wird, wenn nur eine kurze Pause zu erwarten ist, beispielsweise an einem geschlossenen Bahnübergang. Daher kann der Fahrer nach einer weiter bevorzugten Ausführungsform der Kraftstoffversorgungsanlage über einen Wahlschalter das Spülen (zunächst) umgehen.

Nach einer noch weiter bevorzugten Ausführungsform überwacht dabei die Steuerung die Kraftstofftemperatur und führt das Spülen trotz der Unterdrückung selbständig durch, falls die Temperatur unter einen bestimmten Wert fällt, d.h. die Gefahr besteht, dass sich die Fließfähigkeit verschlechtert, so dass der Motor nicht mehr gestartet werden kann.

Vorteilhafte Weiterbildungen finden sich in weiteren Unteransprüchen .

Die Erfindung wird nachfolgend anhand eines Ausführungsbeispiels unter Bezugnahme auf die Zeichnung näher erläutert .

Fig. 1 zeigt einen Hydraulikschaltplan für das Ausführungsbeispiel der Erfindung.

Fig. 2 zeigt ein Ablaufdiagramm einer bevorzugten Ausführungsforms der erfindungsgemäßen Steuerung.

Die Figuren 3 bis 9 zeigen Ablaufpläne von Unterprogrammen des Hauptprogramms nach Fig. 2.

Als Ausführungsbeispiel wird, wie vorstehend erwähnt, ein Fahrzeug mit Dieselmotor verwendet, das zum Betrieb mit Rapsöl als Alternativkraftstoff umgerüstet wurde.

Beim Start des Fahrzeugs sind beide Ventile zunächst stromlos. Dadurch fließt Diesel vom Tankanschluss VD des Ventilsteuerblocks über die Anschlüsse 1 und 3 des MV V und den Anschluss VEp des Ventilsteuerblocks in Richtung des Einspritzsystems bzw. der Einspritzpumpe. Wie im Stand der Technik wird der Einspritzpumpe über diesen Vorlauf eine größere Menge an Diesel angeboten, als sie benötigt. Der überschüssige Dieselkraftstoff fließt aus dem Rücklauf des Einspritzsystems sowie die Anschlüsse 2 und 1 des MV R im sogenannten „geschlossenen Kreislauf" über den Anschluss REp des Ventilsteuerblocks.

Wenn der Motor betriebswarm ist, wird das MV V umgeschaltet (bestromt). Dadurch wird die Zufuhr von Dieselkraftstoff gestoppt und die Zufuhr von Rapsöl im „geschlossenen Kreislauf" (über die Anschlüsse 3 und 2 des MV V zu VEp, von dort zurück über REp und die Anschlüsse 2 und 1 des MV R) gestartet. Da das Rapsöl zu diesem Zeitpunkt in vorgewärmten Leitungen auf bereits warmen Dieselkraftstoff trifft, den es nach und nach ersetzt, erwärmt sich auch die vergleichsweise kleine Menge an Rapsöl bei stromlosem MV R im Vor- und Rücklauf des Einspritzsystems schnell in ausreichendem Maße. Das nicht verbrauchte Rapsöl zirkuliert weiter und kann daher das nachgeförderte Rapsöl, das das verbrannte Öl ersetzt, ebenfalls erwärmen. Damit steht während der Fahrt stets ausreichend warmes Rapsöl zur Verfügung.

Erhöht sich die Temperatur des Rapsöls im Ventilsteuerblock während der Fahrt weiter, kann das MV R umgeschaltet (bestromt) werden. Dann fließt das von dem Einspritzsystem nicht verbrauchte Rapsöl im „offenen Kreislauf" über die Anschlüsse 2 und 3 des MV R zurück in den Rapsöltank. Dadurch wird das im Tank befindliche Rapsöl schneller aufgeheizt als bei der alleinigen Heizung durch den Wärmetauscher. Zudem können Luftansammlungen, die durch Undichtigkeiten im vorstehend erörterten geschlossenen Kreislauf dazu führen können, dass Luft in den Zulauf zum Einspritzsystem gelangt, im offenen Kreislauf in den Tank zurückgegeben werden. Geschieht dies nicht, könnte es bei zu großen Luftblasen aufgrund einer Undichtigkeit im geschlossenen Kreislauf geschehen, dass das Einspritzsystem Luft statt Kraftstoff ansaugt und das Fahrzeug deshalb liegenbleibt.

Wenn erkannt wird, dass die Kraftstoff anläge gespült werden muss (weil der Fahrer den Motor abstellt oder einen entsprechenden Schalter der Steuerung betätigt, um anzuzeigen, dass der Motor demnächst abgestellt wird) , wird das MV V stromlos geschaltet und Diesel fließt wie vorstehend beschrieben vom Anschluss 1 des MV V über den Anschluss 2 in den Umlauf zur Einspritzpumpe (Anschlüsse VEp und REp) , um diesen zu spülen. Über die Anschlüsse 2 und 3 des noch bestromten MV R wird zudem der Rücklauf zum Rapstank (RT) mit Diesel gespült .

Das vorstehend erläuterte Grundprinzip kann je nach Auslegung des Motors modifiziert werden. Beispielsweise ist es möglich, das Rapsöl durch eine (nicht gezeigte) elektrische Hilfspumpe zirkulieren zu lassen, bevor das Fahrzeug startet, beispielsweise um es mittels einer (ebenfalls nicht gezeigten) Heizwendel aufzuwärmen. In diesem Fall wird das Rapsöl vom Anschluss VPöl durch den Ventilsteuerblock über das gezeigte Rückschlagventil zum

Anschluss RT gepumpt, ohne in den Umlauf des Einspritz - Systems zu gelangen, während der Umlauf mit Diesel ge¬ spült wird (beide MV stromlos) .

Falls eine solche Maßnahme bei einem gegebenen Motor nicht notwendig erscheint (weil z.Bsp. der zweite Kraft- stoff im Steuerblock ausreichend erwärmt wird) , kann die Leitung über das Rückschlagventil deaktiviert bleiben bzw. einfach weggelassen werden.

Im folgenden werden mögliche Steuerungsprogramme für den vorstehend erläuterten Ventilsteuerblock anhand der Figuren 2 bis 7 erörtert.

Figur 2 zeigt den allgemeinen Ablauf der Motorüberwa- chung. Sobald der Fahrschalter eingeschaltet ist (S200) , wird zunächst (S300) geprüft, ob alle Bauteile der Kraft- stoffVersorgung normal arbeiten. Falls nicht, wird dem Fahrer im Schritt S400 eine Fehlfunktion gemeldet, bei- spielsweise über ein Display, eine Warnlampe und/oder ein akustisches Signal und das Programm geht wieder an den Anfang zurück .

Falls zunächst keine Fehlfunktion festgestellt wird, wird in Schritt S500 ein (nicht gezeigtes) Programm zur Drehzahlüberwachung gestartet. Dieses Programm prüft wäh- rend einer vorab festgelegten Zeit, ob die Motordrehzahl über einen festgelegten Wert steigt, d.h. ob der Motor innerhalb dieser Zeit gestartet wird. Falls nicht, geht die Steuerung zum Schritt S400, um einen Fehler zu mel¬ den, und anschließend wieder wie vorstehend beschrieben zurück .

Anschließend wird der Motor im Schritt S600 auf her- kömmliche Weise gestartet. Wie aus der nachfolgenden Be¬ schreibung der Steuerung, insbesondere der Fig. 9, noch

klar wird, startet der Motor stets mit Dieselkraftstoff, d.h. beide Magnetventile sind ausgeschaltet.

Nach dem erfolgreichen Starten des Motors geht die Steuerung im Schritt S700 zum in Figur 3 gezeigten Unterprogramm zum Umschalten zwischen Kurzstrecken- und Automatikbetrieb. Dabei prüft das Programm, ob der Fahrer eine Taste „P/D" („Pflanzenöl/Diesel") der Steuerung gedrückt hat, um die Steuerung vom automatischen Umschalten auf Pflanzenöl abzuhalten, weil beispielsweise nur eine kurze Strecke zu fahren ist. Ist die Taste nicht gedrückt, geht das Programm zurück und fährt in der derzeitigen Betriebsart fort. Ist die Taste gedrückt, wird die Betriebsart in den Schritten S720 bis S740 in die jeweils andere Betriebsart umgeschaltet.

Ist im Schritt S710 beispielsweise die P/D-Taste gedrückt und wird im S720 festgestellt, dass die Steuerung im Automatikbetrieb ist, schaltet die Steuerung in den Kurzstreckenbetrieb. Dieses Umschalten wird anhand der Fig. 4 näher erläutert.

Im Schritt S731 der Fig. 4 werden beide Magnetventile MV_V, MV_R des Ventilsteuerblocks stromlos geschaltet. Wie vorstehend erläutert, wird der Motor daher ausschließlich mit Dieselkraftstoff versorgt. Im Schritt S732 wird geprüft, ob ein Umschalten auf Pflanzenölbetrieb möglich ist. Dazu wird (hier nicht gezeigt) der beim Automatikbetrieb erläuterte Programmschritt S742 durchgeführt. Wenn dieser Schritt ergibt, dass ein Betrieb mit Pflanzenöl möglich ist, wird im Schritt S732 jedoch nicht unmittelbar in den Pflanzenölbetrieb umgeschaltet, sondern lediglich der Fahrer beispielsweise optisch oder akustisch daran erinnert, dass ein solcher Betrieb möglich ist. Der Fahrer kann dann durch Drücken der „P/D"-Taste in den Automatikbetrieb umschalten, wie mit

Bezug auf Fig. 3 beschrieben. Im Schritt S733 geht die Steuerung zurück zum „Umschalt "-Programm.

Wird bei gedrückter P/D-Taste im Schritt S720 festgestellt, dass die Steuerung im Kurzstreckenbetrieb ist, schaltet die Steuerung in den Automatikbetrieb. Dieses Umschalten wird anhand der Fig. 5 näher erläutert.

In Fig. 5 wird im Schritt S7410 zunächst geprüft, ob die Bedingungen für Nebenantrieb oder Nurdieselbetrieb vorliegen. Diese Bedingungen liegen vor, wenn entweder ein ungünstiges Drehzahl -/Drehmomentverhältnis vorliegt („Nebenantrieb") oder beide Tanks mit Diesel gefüllt sind („Nurdieselantrieb") .

Es ist bei einem Dieselmotor zu bevorzugen, den Motor auch dann nicht im gesamten Leistungsbereich mit Pflanzenöl zu betreiben, wenn er warmgefahren ist, da sich die Verbrennungstemperaturen und damit die Verbrennungseigenschaften des Pflanzenöls ändern. Daher ist die Steuerung so angepasst, dass der Motor nur in einem für die Verbrennung von Pflanzenöl optimalen Bereich mit dem Öl betrieben wird, während er ansonsten mit Diesel betrieben wird. Beispielsweise liegt bei einem Motor zur Verbrennung von Diesel und Pflanzenöl dieser optimale Bereich der sauberen Verbrennung, besten Kompression und optimalen Haltbarkeit bei 40 bis 85 Prozent der Nennlast. Wird der Motor dagegen (im Stau oder ausschließlich zum Betrieb von Nebenaggregaten) mit minimaler Last oder (z.B. an Steigungen) mit hoher Last betrieben, ist es von Vorteil, in diesen Betriebzuständen ausschließlich mit Diesel zu fahren.

Daher prüft die Steuerung im Unterprogramm „Nebenantrieb" zunächst (Schritt *S1I1)* , ob die Drehzahl oder das Drehmoment in dem vorstehend genannten für den Pflan-

zenöleinsatz ungünstigen Bereich liegen. Dies kann durch direkten Abgriff der Daten aus dem Motormanagement erfolgen. Falls nicht, geht die Steuerung zum Schritt S7410 (Fig. 5) zurück. Liegen Drehzahl und/oder Drehmoment im genannten ungünstigen Bereich, werden im Schritt S772 beide Magnetventile ausgeschaltet. Dadurch wird der Motor mit Dieselkraftstoff versorgt. Ferner wird im Schritt S773 geprüft, ob ausreichend Pflanzenöl im Tank ist. Falls ja, wälzt die Pflanzenölpumpe das Öl um (Schritt S774) , damit es warm bleibt bzw. wird, bis die ungünstigen Verbrennungsbedingungen nicht mehr vorliegen. Wenn nicht (Schritt S775) , wird die Pflanzenölpumpe abgeschaltet. Anschließend kehrt das Programm zum Schritt S7410 zurück .

Ferner kann es sein, dass bei geringem Angebot an Pflanzenöl, beispielsweise bei Fahrten ins Ausland mit geringerer Dichte an Pflanzenöltankstellen oder schlicht anderen (steuerlichen) Gegebenheiten im Ausland nur mit Diesel gefahren werden soll. Für diesen Fall kann auch der (vergleichsweise große) für Pflanzenöl ausgelegte Tank mit Dieselkraftstoff befüllt werden. Diese Dieselbefüllung wird der Steuerung mitgeteilt, beispielsweise über einen Schalter am Pflanzenöltank.

Falls die beiden Tanks mit Diesel gefüllt sind, geht die Steuerung über die Schritte S7410, S7420 zum nachstehend mit Bezug auf Fig. 8 beschriebenen Nurdieselbetrieb (Schritt S780) . Dieser unterscheidet sich vom „Nebenantrieb" dadurch, dass der Dieselkraftstoff aus dem für Pflanzenöl vorgesehenen Tank zugeführt wird. Daher kann auf die Vorwärmung für den Pflanzenöltank verzichtet werden. Zunächst wrd geprüft, ob der Motor abgeschaltet ist.

Ist jedoch sowohl Pflanzenöl im Tank als auch eine für den Pflanzenölbetrieb geeignete Motorlast (Dreh-

zahl/Drehmoment) vorhanden, geht die Steuerung zum Schritt S741 weiter, in dem zunächst beide Ventile MV V, MV R des Ventilsteuerblocks stromlos geschaltet sind, so dass der Motor mit Diesel läuft. Im Schritt S742 wird dann geprüft, ob die Kühlwasser temperatur KW eine Umschalttemperatur Ums, beispielsweise 60°C (zuzüglich eines eventuellen Sicherheitszuschlags Ws, beispielsweise 5°C) überschritten hat, mit anderen Worten, ob der Motor bereits warmgefahren ist. So lange die Kühlwassertemperatur zu niedrig ist, wird diese Abfrage wiederholt, d.h. das Programm geht zum Schritt S7410 zurück. Steigt die Kühlwassertemperatur über den genannten Wert, so wird im Schritt S743 das MV V eingeschaltet, d.h. Pflanzenöl wird in den Kreislauf der Einspritzpumpe zugeführt und verdrängt allmählich den zugeführten Dieselkraftstoff, wobei es weiter erwärmt wird. Im Schritt S744 prüft die Steuerung, ob eine vorab festgelegte Zeit VentzeitRü verstrichen ist, nach der nur Pflanzenöl im Einspritzsystem sein sollte. Wenn diese Zeit noch nicht verstrichen ist (JA im Schritt S744) geht das Programm zum Schritt S742 zurück, um zu prüfen, ob die Temperatur des Pflanzenöls ausreichend hoch bleibt. Bleibt die Temperatur hoch genug, bis VentzeitRü abgelaufen ist, („NEIN" im Schritt S744) geht das Programm zum Schritt S7450 und somit zum Unterprogramm „Reiner Pflanzenölbetrieb" weiter, das in Fig. 6 erläutert ist.

Im Schritt S7451 in Fig. 6 wird das MV R eingeschaltet, so dass nun Rapsöl im Zulauf der Einspritzpumpe zirkuliert. Im Schritt S7452 wird geprüft, ob die Temperatur an der Einspritzpumpe größer als eine Temperatur TRückauto zum automatischen Rückschalten in den Dieselbetrieb ist. Dies kann beispielsweise der Fall sein, wenn bei niedriger Last und hoher Wärmeabfuhr die Temperatur der Einspritzpumpe sinkt. Bei einem positiven Ergebnis dieser Abfrage wird in den in Fig. 7 beschriebenen Nebenantrieb

(Schritt S770) geschaltet, d.h. der Motor wird wie bei geringer Auslastung ausschließlich mit Diesel betrieben. Bleibt die Temperatur der Einspritzpumpe hoch genug, wird im Schritt S7453 geprüft, ob die P/D-Umschalttaste gedrückt ist, d.h., ob auf Wunsch des Fahrers in den Dieselbetrieb umgeschaltet werden soll. Der Fahrer kann dies beispielsweise wünschen, um ein späteres Spülen zu vermeiden. Ist die Taste gedrückt, geht das Programm zum Schritt S730 (Fig. 4); ansonsten geht es im S7454 zum Automatikbetrieb nach Fig. 5 zurück.

In Fig. 5 prüft das Programm dann im Schritt S746, ob der Motor auf Wunsch des Fahrers auszuschalten ist. Wenn nicht, geht das Programm zum Schritt S7450 zurück und wiederholt den Ablauf für den reinen Pflanzenölbetrieb.

Soll der Motor ausgeschaltet werden, geht das Programm im Schritt S7460 der Fig. 5 zum in Fig. 9 gezeigten Unterprogramm. In diesem Programm wird zunächst im Schritt S7461 geprüft, ob der Motor bereits ausreichend lange (ca. 1 min) im Dieselbetrieb arbeitet. Wenn ja, wird der Motor abgestellt (Schritt S7466) und das Programm beendet.

Wenn der Motor noch nicht lange genug mit Diesel betrieben wird, werden zunächst (Schritte S7462, S7463) die Pflanzenöl-Umlaufpumpe und die Magnetventile abgeschaltet, so dass dem Einspritzsystem nur noch Dieselkraftstoff zugeführt wird. Anschließend wird das Einspritzsystem für ca. eine Minute mit Dieselkraftstoff gespült (Schritt S7464), so dass kein Pflanzenöl im Einspritzsystem mehr vorhanden ist, und anschließend der Motor abgestellt (Schritt S7464). Danach (Schritt S7467) wird geprüft, ob die „Kurzstop"-Taste gedrückt wurde, d.h. der Fahrer beabsichtigt, in Kürze mit warmem Motor weiterzufahren. Falls ja, startet der Motor im Automatikbetrieb

neu, d.h. , wenn die Voraussetzungen (Wärme, Belastung etc.) erfüllt sind, wird wieder in den reinen Pflanzenölbetrieb geschaltet. Wenn dagegen die „Kurzstop"-Taste nicht gedrückt wurde, wird das Programm beendet, d.h. der Motor startet beim nächsten Anfahren in dem herkömmlichen Steuermodus .

Weiterhin kann die Steuerung so ausgelegt sein, dass sie die Kraftstoffversorgung auf den vom Hersteller vorgesehenen Kraftstoff, beispielsweise Diesel, umschaltet, wenn die Motorlast für eine vorab bestimmte Zeit unterhalb einer vorab bestimmten Last bleibt (und/oder umgekehrt auch so, dass umgeschaltet wird, wenn die Motorlast für eine vorab bestimmte Zeit eine maximale Last überschreitet) . Statt der Motorlast, die man aus Daten eines Motormanagements erhalten kann, ist es bei einer einfacheren Ausführungsform auch möglich, ausgehend von der Motordrehzahl umzuschalten. Ein Diesel fährt am besten mit einer konstanten Last von 40-85 %, dabei hält er mit Abstand am längsten, weist die besten Verbrennungswerte, eine saubere Kompression usw. auf. Bei einer geringen Motordrehzahl, wenn beispielsweise nur Nebenaggregate des Fahrzeugs wie Klimaanlagen, Silopumpen, Betonmischer, hydraulische Anlagen usw. betrieben werden, können sich verstärkt Ablagerungen durch unvollständige Verbrennung bilden. Dies kann vermieden oder zumindest stark reduziert werden, wenn unter solchen Umständen auf den vom Hersteller vorgesehenen Kraftstoff umgeschaltet wird. Fig. 7 zeigt ein Beispiel eines Unterprogramms zu diesem Zweck. Zunächst wird von der Steuerung entweder über zusätzliche Sensoren oder über direkten Zugriff auf Motormanagementdaten festgestellt, ob die Motorlast in einem ungünstigen Bereich liegt, d.h. Drehzahl und/oder Drehmoment außerhalb des o.g. Bereichs liegen (Schritt S771) . Falls ja, werden beide Magnetventile abgeschaltet (Schritt S772) . Anschließend wird geprüft, ob mindestens

eine bestimmte Menge, beispielsweise rund 10 Prozent einer Tankfüllung an Pflanzenöl im Tank ist (Schritt S773). Falls ja, wird das Öl umgewälzt, um es mit der Abwärme des Motors aufzuwärmen (Schritt *S11A)*. Ist die Ölmenge jedoch gering, wird die Pumpe abgeschaltet, um nicht eventuelle Verunreinigungen am Boden des Tanks aufzuwirbeln und zu fördern (Schritt S775). Anschließend kehrt das Programm zum Hauptprogramm zurück.

Natürlich ist der vorstehend beschriebene Aufbau nicht auf das Umschalten von Raps- oder anderem Pflanzenöl auf Diesel beschränkt, sondern kann bei entsprechender Anpassung für alle denkbaren Kraftstoffpaarungen eines Zweistoffmotors verwendet werden. Beispiele für weitere Kraftstoffpaarungen sind Benzin / Ethanol, Benzin / Flüssiggas, Benzin / Flüssigwasserstoff oder Flüssigwasserstoff / Flüssiggas. Obwohl bei diesen Paarungen die Probleme unterschiedlich von den hier beschriebenen sind (so muss beispielsweise wahrscheinlich nicht bei jeder dieser Paarungen gespült werden), kann das gezeigte Konzept eines Ventilsteuerblocks, in den alle zum Umschalten nötigen Ventile integriert sind und der von einer Steuereinheit angesteuert wird, vorteilhaft für verschiedene Kraftstoffpaarungen verwendet werden.

Ansprüche

1. Kraftstoffversorgungsanlage zur Versorgung einer Brennkraftmaschine über verschiedene Kraftstoffleitungen mit wahlweise einem Kraftstoff A oder einem Kraftstoff B, mit einer steuerbaren Ventilanordnung zur Umschaltung zwischen den Kraftstoffen,
gekennzeichnet durch
einen Ventilsteuerblock, in den die Ventilanordnung integriert ist.

2. Kraftstoffversorgungsanlage nach Anspruch 1, dadurch gekennzeichnet, dass der Ventilsteuerblock aus einem wärmeleitenden Material hergestellt ist.

3. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Ventilsteuerblock benachbart zu einem Wärmetauscher zum Aufheizen eines der Kraftstoffe angeordnet ist.

4. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, gekennzeichnet durch eine Steuereinrichtung, welche die Kraftstoffversorgung durch Ansteuern des Ventilsteuerblocks steuert.

5. Kraftstoffversorgungsanlage nach Anspruch 4, dadurch gekennzeichnet, dass die Steuervorrichtung zumindest eine Ein-/Ausgabeeinheit aufweist, die in der Fahrgastzelle angeordnet ist.

6. Kraftstoff Versorgungsanlage nach Anspruch 4 oder 5, dadurch gekennzeichnet, dass die Steuervorrichtung veranlasst, dass mindestens eine der Kraftstoffzuleitungen vor einem endgültigen Abstellen der Brennkraftmaschine mit dem anderen Kraftstoff gespült werden.

7. Kraftstoff Versorgungsanlage nach Anspruch 6, dadurch gekennzeichnet, dass eine Spülung auch durch Drücken eines Wahlschalters in der Fahrerkabine auslösbar ist.

8. Kraftstoff Versorgungsanlage nach Anspruch 6 oder 7, dadurch gekennzeichnet, dass das Spülen durch Drücken eines Wahlschalters in der Fahrerkabine unterdrückbar ist.

9. Kraft Stoff Versorgungsanlage nach Anspruch 8, dadurch gekennzeichnet, dass die Unterdrückung des Spülen automatisch aufgehoben und das Spülen durchgeführt wird, wenn ein Sensor meldet, dass die Temperatur eines der Kraftstoffe unter einen vorab festgelegten Wert gefallen ist.

10. Brennkraftmaschine mit einer Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, gekennzeichnet durch mindestens einen Temperatursensor zum Feststellen der Temperatur mindestens eines Mediums, das eine Aussage über den Betriebszustand der Brennkraftmaschine zulässt.

11. Brennkraftmaschine mit einer Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, gekennzeichnet durch starre Kraftstoffleitungen zwischen dem Ventilsteuerblock und der Brennkraftmaschine.

12. Brennkraftmaschine mit einer Kraftstoffversorgungsanlage nach Anspruch 11, dadurch gekennzeichnet, dass die Kraftstoffleitungen zumindest für einen der Kraftstoffe eng an einem Motorblock und/oder Zylinderkopf der Brennkraftmaschine entlang geführt werden

13. Steuervorrichtung für eine Kraftstoffversorgungsanlage nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Steuervorrichtung die Kraftstoffversorgungsanlage abhängig von der Last des Motors steuert.

14. Steuervorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass die Steuervorrichtung die Last des Motors abschätzt und veranlasst, dass die Kraftstoff Versorgung umschaltet, wenn die Last des Motors für eine vorab bestimmte Zeit unterhalb einer vorab bestimmten Last liegt.

15. Steuervorrichtung nach Anspruch 13, dadurch gekennzeichnet, dass sie die Last des Motors aufgrund von Motormanagementdaten ermittelt und die Kraftstoffversorgungsanläge aufgrund der ermittelten Werte umschaltet.

16. Steuervorrichtung nach einem der Ansprüche 13 bis 15, dadurch gekennzeichnet, dass sie die Kraftstoffversorgungsanlage umschaltet, wenn nur Nebenaggregate laufen.

17. Steuervorrichtung nach einem der Ansprüche 13 bis 16, dadurch gekennzeichnet, dass sie durch Öffnen eines in der Ventilanordnung angeordneten Rücklaufventils (MV R) veranlasst, dass im Betrieb mit Kraftstoff B von der Einspritzpumpe nicht verbrauchter Kraftstoff in den entsprechenden Tank zurückgeführt wird.

18. Steuervorrichtung nach einem der Ansprüche 13 bis 17, dadurch gekennzeichnet, dass sie einem Bediener eine Möglichkeit bietet, manuell auf Kraftstoff A umzuschalten bzw. die Umschaltung auf Kraftstoff B manuell zu verhindern.

19. Steuervorrichtung nach Anspruch 18, gekennzeichnet durch eine Vorrichtung, um den Bediener daran zu erinnern, dass mit Kraftstoff B gefahren werden könnte, wenn die dafür erforderlichen Bedingungen vorliegen, der Bediener die Umschaltung auf Kraftstoff B jedoch manuell verhindert hat.

20. Steuervorrichtung nach einem der Ansprüche 13 bis 19, dadurch gekennzeichnet, dass sie zunächst ein in der Ventilanordnung angeordnetes Vorlaufventil (MV V) einschaltet, sobald ein Merkmal des Kraftstoffs B einen ersten vorab

festgelegten Wert aufweist oder überschreitet, und später das in der Ventilanordnung angeordnete Rücklaufventil (MV R) des Ventilsteuerblocks einschaltet, sobald das Merkmal des Kraftstoffs B einen zweiten vorab festgelegten Wert aufweist oder überschreitet .

21. Steuervorrichtung nach Anspruch 20, dadurch gekennzeichnet, dass sie das Umschalten des Rücklaufventils rückgängig macht, sobald das Merkmal des Kraftstoffs B den ersten vorab festgelegten Wert wieder unterschreitet.

GEÄNDERTE ANSPRÜCHE
beim Internationalen Büro eingegangen am 10 April 2007 (10.04.2007)

1. Kraftstoffversorgungsanlage zur Versorgung einer Brennkraftmaschine über verschiedene Kraftstoffl θitungen mit wahlweise einem Kraftstoff aus einem ersten Tank oder einem Kraftstoff aus einem zweiten Tank,

mit einer steuerbaren Ventilanordnung zur Umschaltung zwischen den Kraftstoffen aus dem ersten Tank und aus dem zweiten Tank,

einem Ventilsteuerblock, in den die Ventilanordnung integriert ist, und in den Kraftstoffzuleitungen von den Tanks münden und der die Kraftstoffe über weitere Leitungen an die Einspritzanlage verteilt, und

einer Steuervorrichtung zur Steuerung der Kraftstoffversorgungsanlage durch Steuern der Ventilanordnung abhängig von der Belastung des Motors, dadurch gekennzeichnet, dass

die Steuervorrichtung so aufgebaut ist, dass sie zunächst ein in der Ventilanopdnung angeordnetes Vorlaufventil (MV V) einschaltet, sobald ein Merkmal des Kraftstoffs aus dem zweiten Tank einen ersten vorab festgelegten Wert aufweist oder überschreitet, und später das in der Ventilanordnung angeordnete Rücklaufventil (MV R) des Vβntilsteuerblocks einschaltet, sobald das Merkmal des Kraftstoffs aus dem zweiten Tank einen zweiten vorab festgelegten Wert aufweist oder überschreitet.

2. Kraftstoffversorgungsanlage nach Anspruch 1, dadurch gekennzeichnet, dass sie das in der Ventilanordnung angeordnete Vorlaufventil (MV V) wieder ausschaltet, sobald ein Merkmal des Kraftstoffs aus dem zweiten Tank den ersten vorab festgelegten Wert wieder unterschreitet.

3. Kraftstoffversorgungsanlage nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Steuervorrichtung so aufgebaut ist, dass sie das Umschalten des Rücklaufventils (MV R) rückgängig macht, sobald das Merkmal des Kraftstoffs aus dem zweiten Tank den zweiten vorab festgelegten Wert wieder unterschreitet

4. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass der Ventilsteuerblock benachbart zu einem Wärmetauscher zum Aufheizen eines der Kraftstoffe angeordnet ist.

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5. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, gekennzeichnet durch eine Steuereinrichtung, welche die Kraftstoffversorgung und den Ventilsteuerblock automatisch steuert.

6. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Steuervorrichtung zumindest eine Ein-/Ausgabeeinheit mit einem Display aufweist, die in der Fahrgastzelle angeordnet ist.

7. Kraftstoffversorgungsanlage nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass die Steuervorrichtung veranlasse dass mindestens das Motor-Einspritzsystem vor einem endgültigen Abstellen der Brennkraftmaschine mit dem anderen Kraftstoff gespült wird.

8. Kraftstoffversorgungsanlage nach Anspruch 7, dadurch gekennzeichnet, dass eine Spülung auch durch Drücken eines Wahlschalters in der Fahrerkabine auslösbar ist.

9. Kraftstoffversorgungsanlage nach Anspruch 7 oder 8, dadurch gekennzeichnet, dass das Spülen durch Drücken eines Wahlschalters in der Fahrerkabine unterdrückbar ist.

10. Kraftstoffversorgungsanlage nach Anspruch 9, dadurch gekennzeichnet, dass die Unterdrückung des Spülen automatisch aufgehoben und das Spülen durchgeführt wird, wenn ein Sensor meldet, dass die Temperatur eines der Kraftstoffe unter einen vorab festgelegten Wert gefallen ist.

11. Brennkraftmaschine mit einer Kraftstoffversorgungsa πlage nach einem der vorhergehenden Ansprüche, gekennzeichnet durch mindestens einen Temperatursensor zum Feststellen der Temperatur mindestens eines Mediums, das eine Aussage über den Betriebszustand der Brennkraftmaschine zulässt

12. Steuervorrichtung zur Steuerung der Kraftstoffversorgungsanlage nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, dass die Steuervorrichtung die Last des Motors abschätzt und veranlasst, dass die Kraftstoffversorgung umschaltet, wenn die Last des Motors für eine vorab bestimmte Zeit unterhalb einer vorab bestimmten Last liegt.

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13. Steuervorrichtung nach Anspruch 12, dadurch gekennzeichnet, dass sie die Last des Motors aufgrund von Motorrnanagementdaten ermittelt und die Kraftstoffversorgungsanlage aufgrund der ermittelten Werte umschaltet.

14. Steuervorrichtung nach einem der Ansprüche 12 oder 13, dadurch gekennzeichnet, dass sie die Kraftstoffversorgungsa πlage umschalten kann, wenn nur Nebenaggregate laufen.

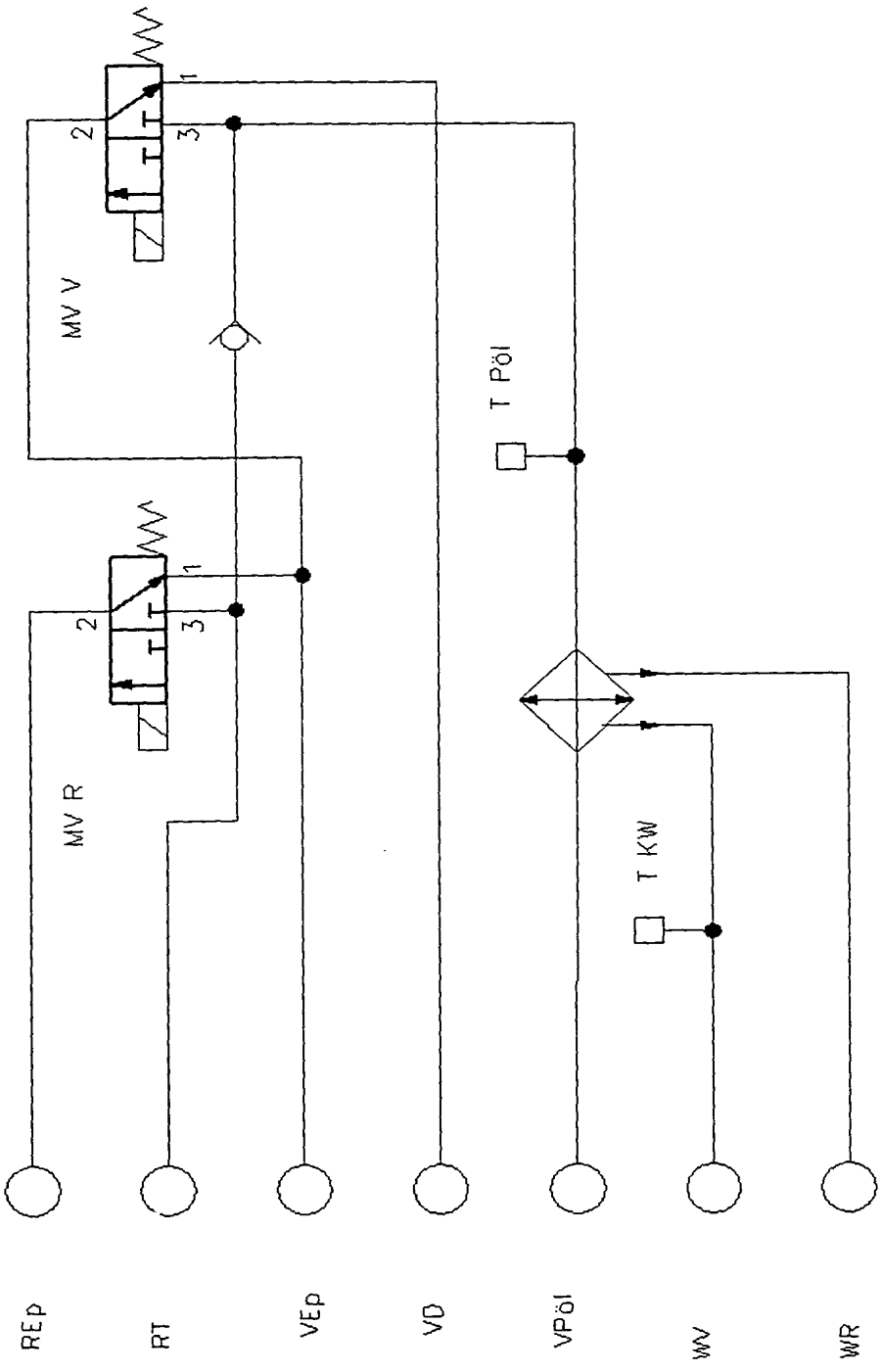
15. Steuervorrichtung nach einem der Ansprüche 12 bis 14, dadurch gekennzeichnet, dass sie durch Öffnen eines in der Ventilanordnung angeordneten Rücklaufventils (MV R) veranlasst, dass im Betrieb mit Kraftstoff aus dem zweiten Tank von der Einspritzpumpe nicht verbrauchter Kraftstoff in den entsprechenden Tank zurückgeführt wird.

16. Steuervorrichtung nach einem der Ansprüche 12 bis 15, dadurch gekennzeichnet, dass sie einem Bediener eine Möglichkeit bietet, manuell auf Kraftstoff aus dem ersten Tank umzuschalten bzw. die Umschaltung auf Kraftstoff aus dem zweiten Tank manuell zu verhindern.

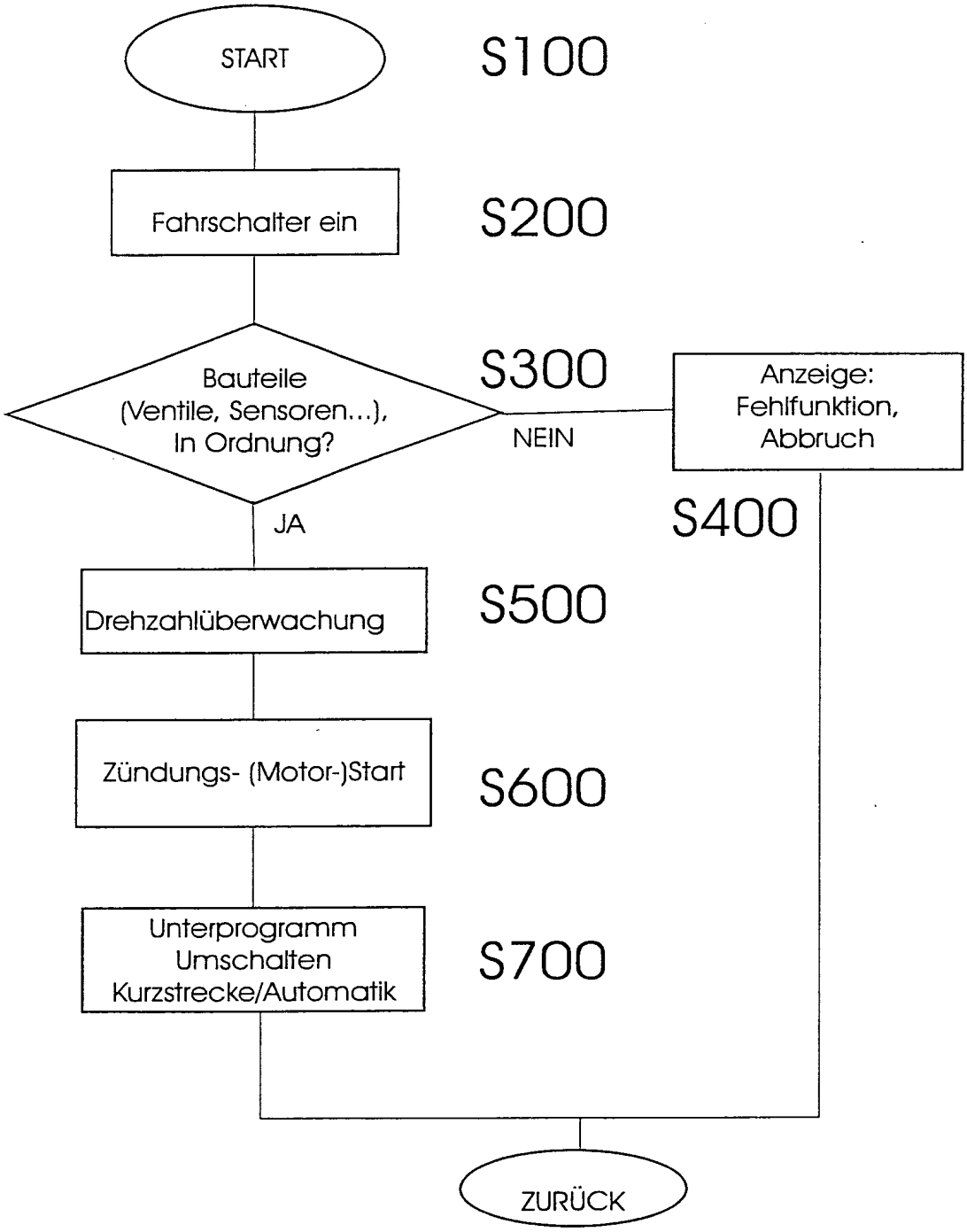
17. Steuervorrichtung nach Anspruch 16, gekennzeichnet durch eine Vorrichtung, um den Bediener daran zu erinnern, dass mit Kraftstoff aus dem zweiten Tank gefahren werden könnte, wenn die dafür erforderlichen Bedingungen vorliegen, der Bediener die Umschaltung auf Kraftstoff aus dem zweiten Tank jedoch manuell verhindert hat.

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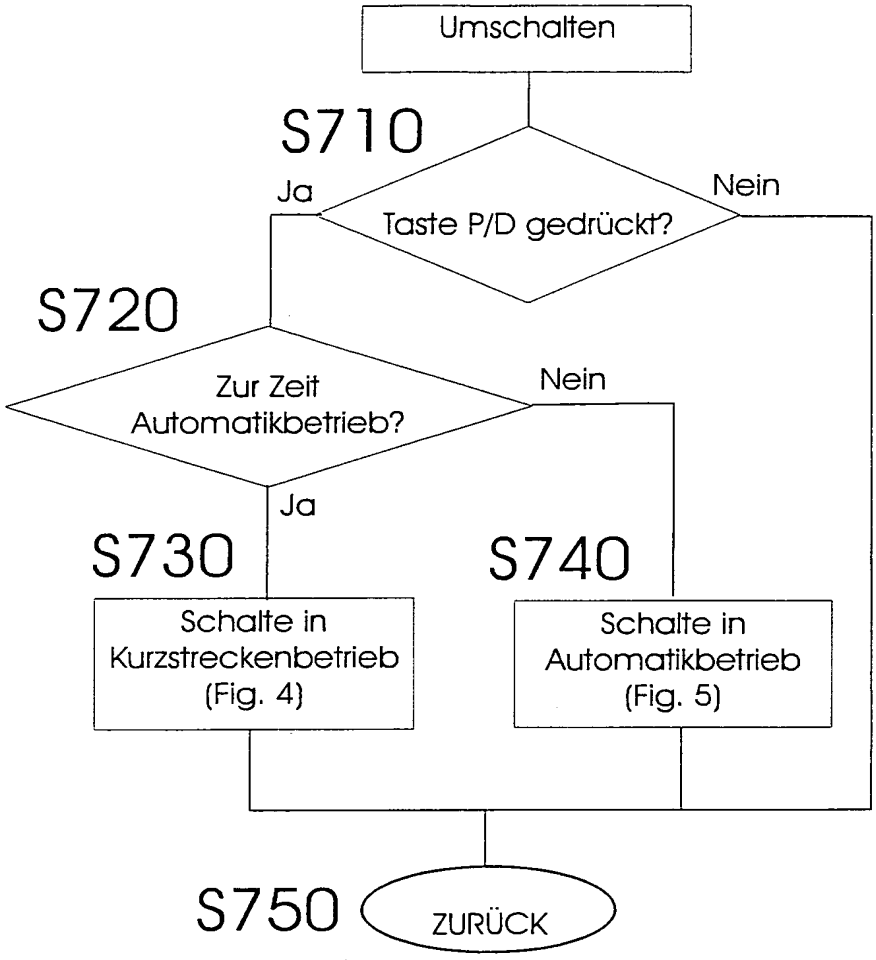
Figur 1



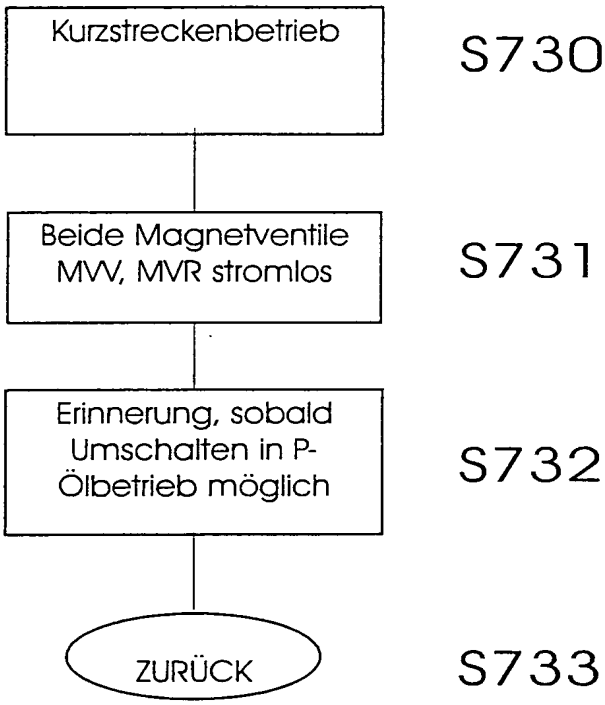
FIGUR 2


START
S100
Fahrschalter ein
S200
Bauteile (Ventile, Sensoren...), In Ordnung?
S300
NEIN
Anzeige: Fehlfunktion, Abbruch
S400
JA
Drehzahlüberwachung
S500
Zündungs- (Motor-)Start
S600
Unterprogramm Umschalten Kurzstrecke/Automatik
S700
ZURÜCK

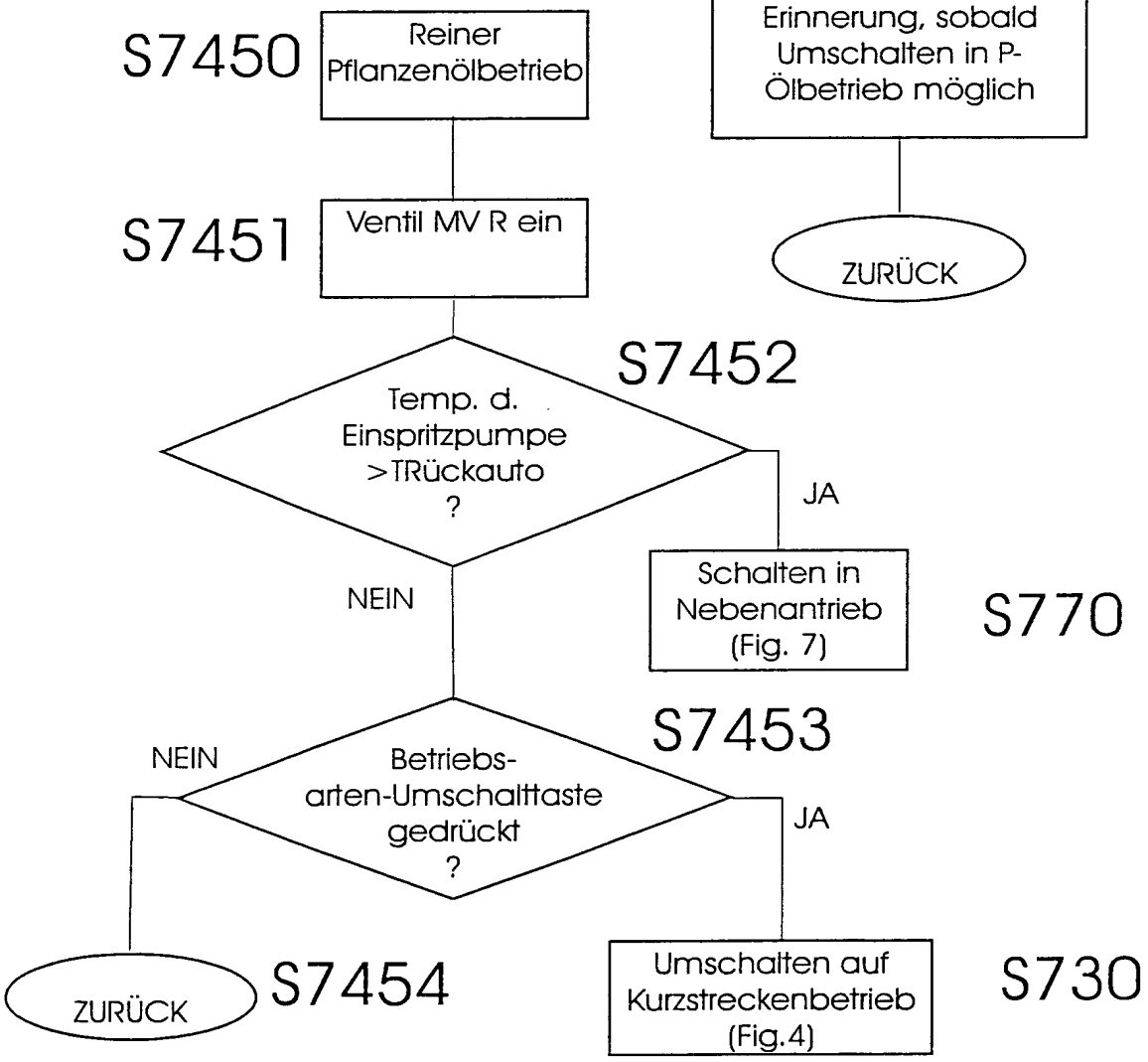
FIGUR 3


Umschalten
S710
Ja
Taste P/D gedrückt?
Nein
S720
Zur Zeit Automatikbetrieb?
Nein
Ja
S730
Schalte in Kurzstreckenbetrieb (Fig. 4)
S740
Schalte in Automatikbetrieb (Fig. 5)
S750
ZURÜCK

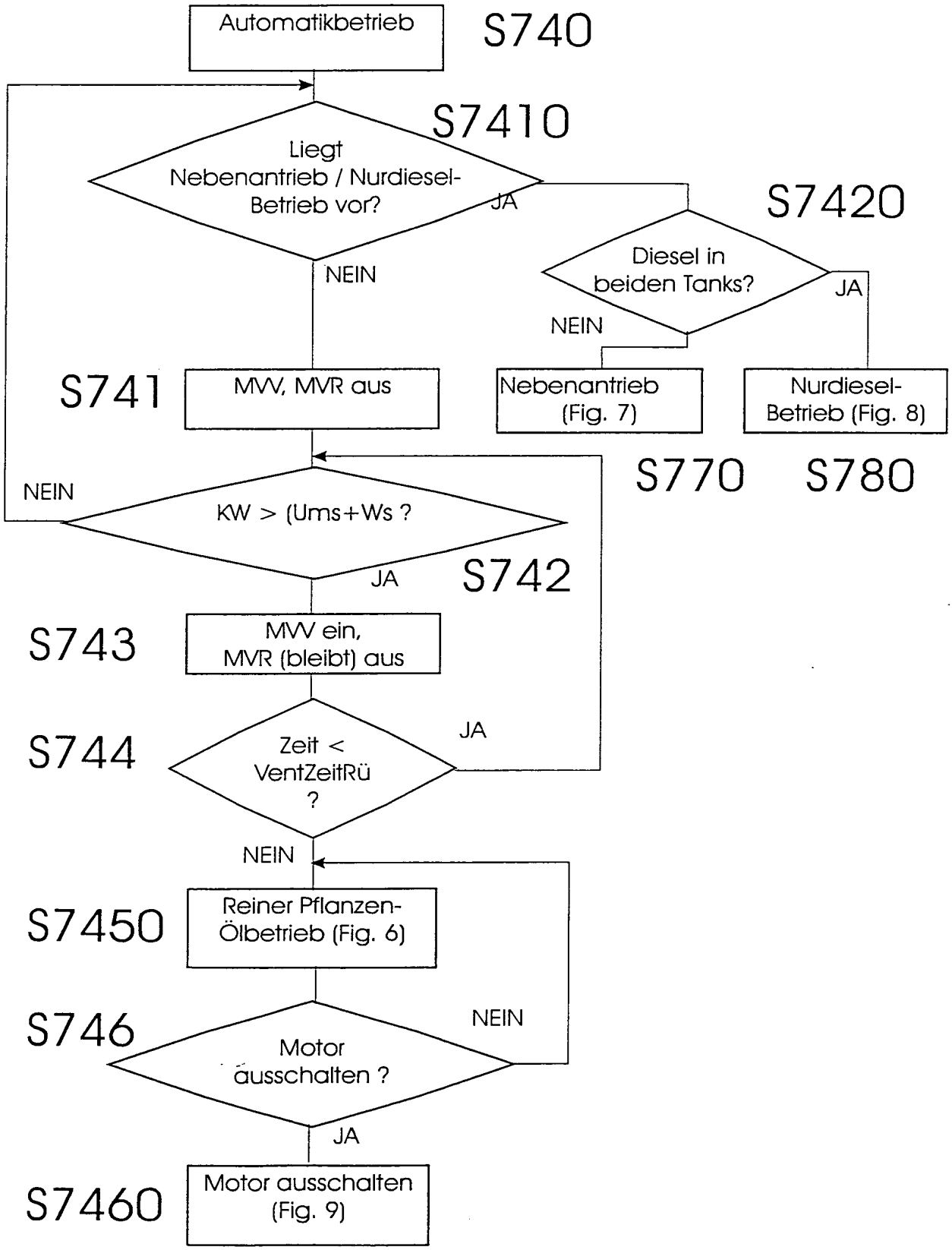
Figur 4



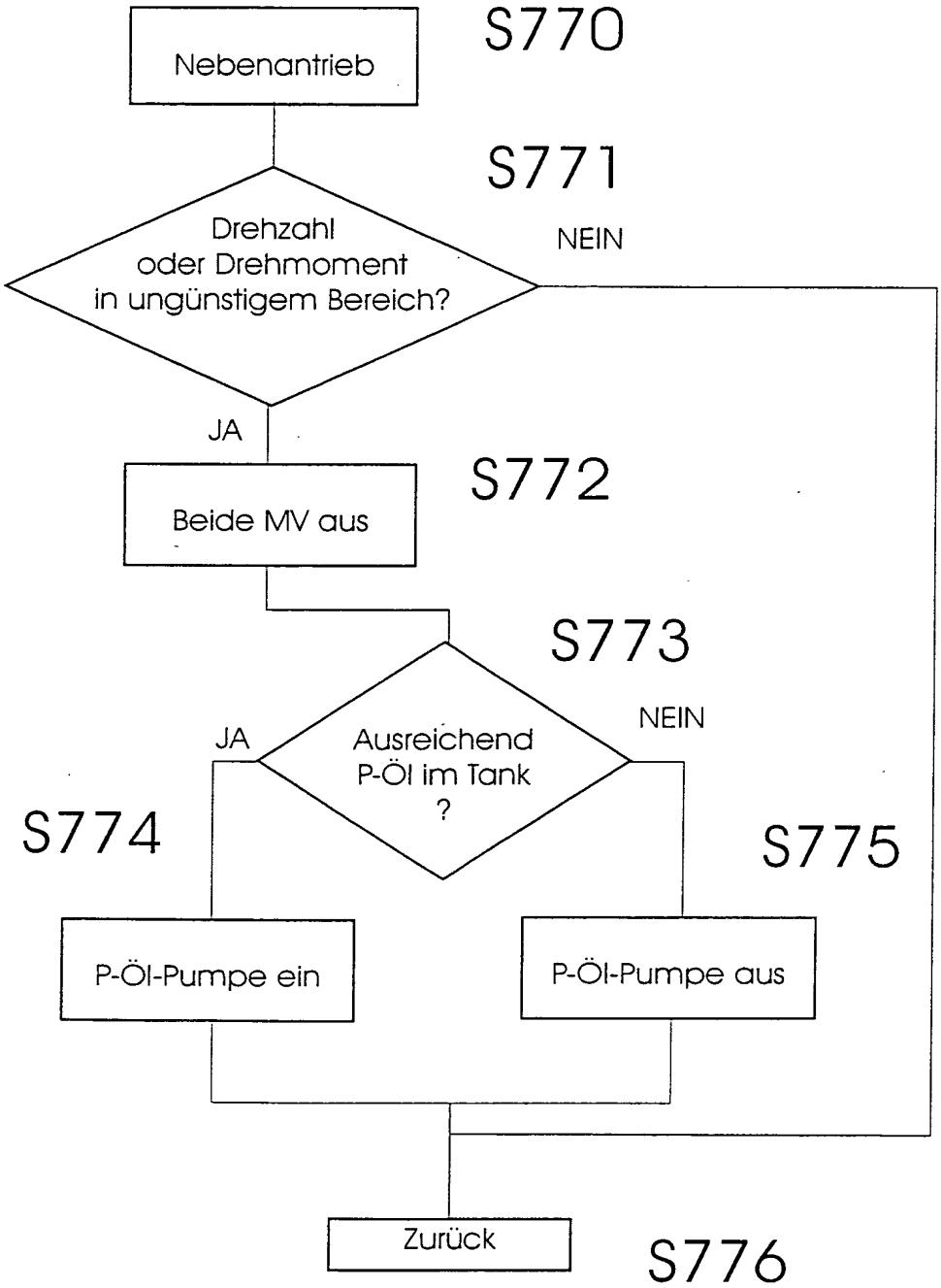
Figur 6



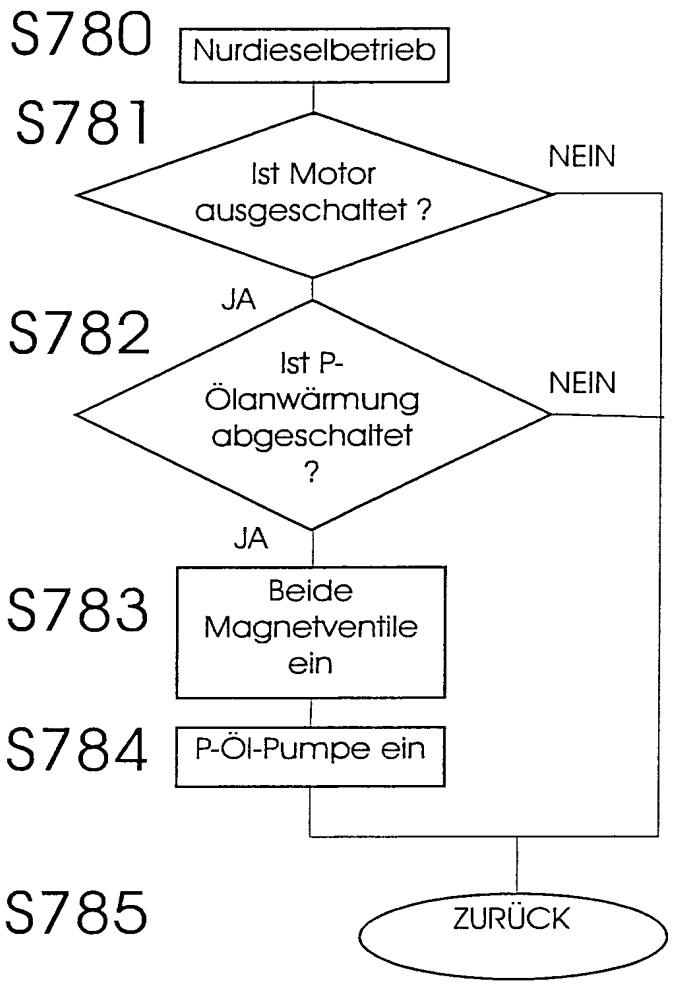
Figur 5


Automatikbetrieb
S740
S7410
Liegt Nebenantrieb / Nurdiesel-Betrieb vor?
JA
S7420
Diesel in beiden Tanks?
JA
NEIN
NEIN
S741
MVV, MVR aus
Nebenantrieb (Fig. 7)
Nurdiesel-Betrieb (Fig. 8)
S770
S780
NEIN
KW > (Ums+Ws ?
JA
S742
S743
MVV ein, MVR (bleibt) aus
S744
Zeit < VentZeitRü ?
JA
NEIN
S7450
Reiner Pflanzen-Ölbetrieb (Fig. 6)
S746
Motor ausschalten ?
NEIN
JA
S7460
Motor ausschalten (Fig. 9)

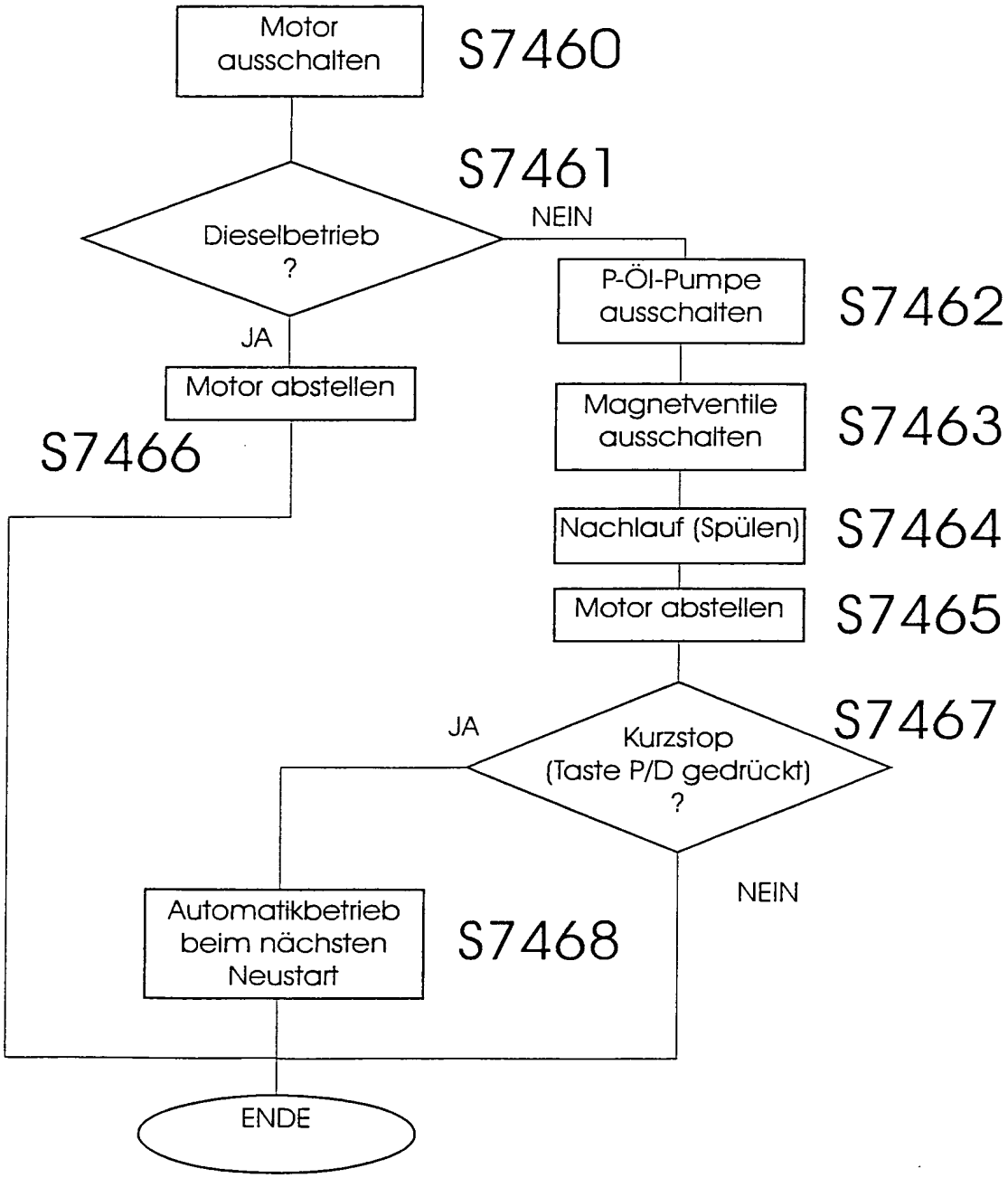
Figur 7


Nebenantrieb
S770
S771
Drehzahl
oder Drehmoment
in ungünstigem Bereich?
NEIN
JA
Beide MV aus
S772
S773
Ausreichend
P-Öl im Tank
?
JA
NEIN
S774
S775
P-Öl-Pumpe ein
P-Öl-Pumpe aus
Zurück
S776

Figur 8


S780
Nurdieselbetrieb
S781
Ist Motor ausgeschaltet ?
NEIN
JA
S782
Ist P-Ölanwärmung abgeschaltet ?
NEIN
JA
S783
Beide Magnetventile ein
S784
P-Öl-Pumpe ein
S785
ZURÜCK

Figur 9


Motor ausschalten
S7460
S7461
Dieselbetrieb ?
NEIN
JA
P-ÖI-Pumpe ausschalten
S7462
Motor abstellen
S7466
Magnetventile ausschalten
S7463
Nachlauf (Spülen)
S7464
Motor abstellen
S7465
S7467
JA
Kurzstop (Taste P/D gedrückt) ?
NEIN
Automatikbetrieb beim nächsten Neustart
S7468
ENDE

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/010380

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02D19/06
ADD. F02M37/00 F02M31/16 F02M55/02

According to International Patent Classification (IPC) orto both national Classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (Classification System followed by Classification Symbols)
F02D F02M

Documontation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X Y	US 2 984 229 A (VAUGHAN PAUL S) 16 May 1961 (1961-05-16) figures column 1, line 15 - line 47	1,2,4-6, 10,13,18 8,9,11, 12
A	column 1, line 66 - column 4, line 29	3,7, 14-17, 19-21
Y	DE 100 60 573 A1 (FINGER RALPH) 6 September 2001 (2001-09-06) abstract; figures column 2, line 16 - line 47 column 2, line 63 - column 3, line 3	8,9
A	column 3, line 37 - column 4, line 25	1-7, 10-21

-/-

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general State of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which maythrow doubts on priority claim(s) or which is cited b establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosur β, use, exhibition or other means

"P" document published priorto the international filing date but laterthan the priority date claimed

[1]"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such docu¬ments, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 February 2007	14/02/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswi)k Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Döring, Marcus

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/010380

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	DE 12 03 046 B (WILLY SOSSIAUX) 14 October 1965 (1965-10-14) figures col umn 1, line 1 - line 51 col umn 3, line 20 - line 35	11, 12
A	col umn 4, line 43 - line 63	1-10, 13-21

X	DE 196 35 220 Al (LOHMANN GEORG) 14 May 1998 (1998-05-14) abstract ; figures	1,4-6, 10, 13
A	col umn 1, line 3 - col umn 3, line 64	2,3,7-9 , 11, 12, 14-21

X	DE 39 29 115 Al (ELSBETT LUDWIG ET AL.) 7 March 1991 (1991-03-07) abstract ; figure col umn 1, line 3 - col umn 2, line 7	1,4-7, 10, 13-15
A	col umn 2, line 55 - col umn 3, line 8	2,3,8,9 , 11, 12, 16-21

X	EP 1 462 636 A2 (AFHYMAT) 29 September 2004 (2004-09-29)	1,4-6, 10, 13, 16, 17
Y	abstract ; figures	2, 3
A	col umn 3, line 12 - col umn 6, line 44	7-9, 11, 12, 14, 15, 18-21

Y	DE 44 33 500 Al (LOHMANN GEORG) 28 March 1996 (1996-03-28) abstract ; figure	2,3
A	col umn 1, line 19 - line 32	1,4-21

P, X	EP 1 647 699 A (KANGLER WOLFRAM) 19 Apri l 2006 (2006-04-19) abstract ; figures col umn 1, paragraph 1 - col umn 2, Paragraph 7 col umn 3, paragraph 14 - col umn 5, paragraph 24 col umn 6, paragraph 29 - col umn 10, paragraph 51	1,2,4, 10

A	DE 44 18 856 Al (ROBUR WERKE GMBH I. L.) 7 December 1995 (1995-12-07) abstract ; figures col umn 2, line 13 - line 54	1-21

	-/--	

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/010380

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	DE 101 54 455 A1 (GENTSCH DIETMAR) 15 May 2003 (2003-05-15) cited in the application abstract ; figures column 1, paragraph 4 - column 3, Paragraph 14	1-21
A	DE 38 00 585 Al (KLÖCKNER-HUMBOLDT-DEUTZ AG) 28 July 1988 (1988-07-28) cited in the application abstract; figures column 2, line 2 - line 23 column 2, line 66 - column 4, line 53	1-21

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IPR2025-01271

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2006/010380

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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DE 3800585 A1	28-07-1988	NONE	

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP2006/010380

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. F02D19/06
ADD. F02M37/00 F02M31/16 F02M55/02

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
F02D F02M

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C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X Y	US 2 984 229 A (VAUGHAN PAUL S) 16. Mai 1961 (1961-05-16) Abbildungen Spalte 1, Zeile 15 - Zeile 47	1,2,4-6, 10,13,18 8,9,11, 12
A	Spalte 1, Zeile 66 - Spalte 4, Zeile 29	3,7, 14-17, 19-21

Y	DE 100 60 573 A1 (FINGER RALPH) 6. September 2001 (2001-09-06) Zusammenfassung; Abbildungen Spalte 2, Zeile 16 - Zeile 47 Spalte 2, Zeile 63 - Spalte 3, Zeile 3	8,9
A	Spalte 3, Zeile 37 - Spalte 4, Zeile 25	1-7, 10-21

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7. Februar 2007	14/02/2007

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL - 2280 HV RIJSWIJK Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Döring, Marcus

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C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
Y	DE 12 03 046 B (WILLY GOSSIAUX) 14. Oktober 1965 (1965-10-14) Abbildungen Spalte 1, Zeile 1 - Zeile 51 Spalte 3, Zeile 20 - Zeile 35	11,12
A	Spalte 4, Zeile 43 - Zeile 63	1-10, 13-21
X	DE 196 35 220 A1 (LOHMANN GEORG) 14. Mai 1998 (1998-05-14) Zusammenfassung; Abbildungen	1,4-6, 10, 13
A	Spalte 1, Zeile 3 - Spalte 3, Zeile 64	2,3,7-9, 11,12, 14-21
X	DE 39 29 115 A1 (ELSBETT LUDWIG ET AL.) 7. März 1991 (1991-03-07) Zusammenfassung; Abbildung Spalte 1, Zeile 3 - Spalte 2, Zeile 7	1,4-7, 10, 13-15
A	Spalte 2, Zeile 55 - Spalte 3, Zeile 8	2,3,8,9, 11,12, 16-21
X	EP 1 462 636 A2 (AFHYMAT) 29. September 2004 (2004-09-29)	1,4-6, 10, 13, 16, 17
Y	Zusammenfassung; Abbildungen	2,3
A	Spalte 3, Zeile 12 - Spalte 6, Zeile 44	7-9, 11, 12, 14, 15, 18-21
Y	DE 44 33 500 A1 (LOHMANN GEORG) 28. März 1996 (1996-03-28) Zusammenfassung; Abbildung	2,3
A	Spalte 1, Zeile 19 - Zeile 32	1,4-21
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A	DE 44 18 856 A1 (ROBUR WERKE GMBH I. L.) 7. Dezember 1995 (1995-12-07) Zusammenfassung; Abbildungen Spalte 2, Zeile 13 - Zeile 54	1-21
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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
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C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
A	DE 38 00 585 A1 (KLÖCKNER-HUMBOLDT-DEUTZ AG) 28. Juli 1988 (1988-07-28) in der Anmeldung erwähnt Zusammenfassung; Abbildungen Spalte 2, Zeile 2 - Zeile 23 Spalte 2, Zeile 66 - Spalte 4, Zeile 53	1-21

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/EP2006/010380

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
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IPR2025-01271

Espacenet

Bibliographic data: FR2220679 (A1) — 1974-10-04

Fuel control system for I.C. engine - supplies light or heavy fuel, according to use of engine, to injection pump

Inventor(s):

Applicant(s): SERVEQUIP [FR] ± (SERVEQUIP,FR, ; SERVEQUIP)

Classification:
- **international:** ***F02D19/06;*** (IPC1-7): F02D19/06
- **cooperative:** **F02D19/0618 (EP)**; **F02D19/0676 (EP)**; Y02T10/30 (EP)

Application number: FR19730008061 19730307

Priority number(s): FR19730008061 19730307

Also published as: FR2220679 (B1)

Abstract of FR2220679 (A1)

The engine fuel pump is supplied from either of two fuel tanks through an electromagnetic three-way valve. Excess fuel from the pump is returned to either tank through another three way valve. The valve motors are energised by a circuit containing a switch controlled by a manual lever. The flow valve is operated immediately by the controls but the return valve is operated through an adjustable delay timer. This ensures that fuel already in the pipes is returned to the correct tank.

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(11) N° de publication : **2.220.679**
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DEMANDE DE BREVET D'INVENTION

1re PUBLICATION

(22) Date de dépôt ..... 7 mars 1973, à 14 h 14 mn.
(41) Date de la mise à la disposition du public de la demande..... B.O.P.I. — «Listes» n. 40 du 4-10-1974.

(51) Classification internationale (Int. Cl.) **F 02 d 19/06.**

(71) Déposant : Société anonyme dite : SERVEQUIP, résidant en France.

(73) Titulaire : *Idem* (71)

(74) Mandataire : Cabinet Faber.

(54) **Installation de contrôle de l'alimentation d'un moteur sélectivement en gas-oil et en fuel-oil.**

(72) Invention de :

(33) (32) (31) Priorité conventionnelle :

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

L'invention concerne le contrôle de l'alimentation d'un moteur à combustion interne sélectivement en gas-oil et en fuel-oil, notamment les moteurs de pompes à béton montées sur véhicules automobiles.

Lorsqu'une pompe à béton est installée d'une manière immobile sur un chantier, il est autorisé de l'actionner au moyen d'un moteur alimenté en fuel-oil, c'est-à-dire, un carburant détaxé et par conséquent bon marché. Mais lorsque cette même pompe est montée sur un véhicule automobile, il n'est pas permis que le moteur d'entrainement de ce véhicule soit alimenté également en fuel-oil, on l'alimente donc en général en gas-oil, c'est-à-dire en carburant non détaxé, et par conséquent onéreux.

En moyenne, on a constaté que les temps d'utilisation d'une pompe à béton se partagent approximativement en 3/5 pour le travail de pompage du béton à poste fixe et 2/5 pour les déplacements de la pompe.

Au lieu d'avoir un moteur alimenté à partir d'un réservoir de fuel-oil pour l'actionnement de la pompe et un autre moteur alimenté à partir d'un réservoir de gas-oil pour l'entrainement du véhicule, il serait intéressant d'avoir un moteur unique que l'on puisse accoupler sélectivement à la pompe ou à la transmission d'entrainement des roues du véhicule pourvu que l'on soit assuré que l'alimentation du moteur se fasse dans chacune des deux utilisations, à partir du réservoir de carburant correspondant et qu'au début du fonctionnement au gas-oil le reliquat de fuel-oil demeuré dans les diverses tuyauteries et accessoires, tels que filtres et injecteurs, retourne bien dans le réservoir de fuel-oil.

A cet effet, on va donc utiliser une installation de contrôle de l'alimentation d'une pompe à injection d'un moteur unique sélectivement à partir d'un réservoir de gas-oil ou d'un réservoir de fuel-oil, selon que le moteur est accouplé à un premier ou à un second appareil d'utilisation, notamment d'un moteur de pompe à béton montée sur un véhicule automobile mû par le même moteur, accouplé sélectivement à la pompe ou à une transmission d'entrainement des roues motrices du véhicule par un embrayage sélectif à commande manuelle et, suivant l'invention, l'entrée de la pompe d'alimentation du moteur est reliée

aux deux réservoirs de carburant par l'intermédiaire d'une première électro-valve d'amenée à trois voies et la sortie de ladite pompe est reliée semblablement aux deux réservoirs de carburant par l'intermédiaire d'une seconde électro-valve de retour à trois voies, les deux électro-valves étant placées sous le contrôle de l'organe de commande manuelle de l'embrayage sélectif du moteur, la première directement et la seconde par l'intermédiaire d'un relais temporisé, de façon telle que le retour de fuel-oil se fasse vers le réservoir de fuel-oil, non seulement lorsque l'alimentation de la pompe du moteur est assurée en fuel-oil, mais aussi pendant la durée de la temporisation dudit relais au début de l'alimentation de la pompe du moteur en gas-oil.

Grâce à une telle installation, le fait même d'accoupler le moteur à la pompe à béton ou bien à la transmission d'entraînement des roues du véhicule assure automatiquement l'alimentation de la pompe à injection du moteur à partir du réservoir de carburant approprié et, de plus, le reliquat de fuel-oil demeuré dans les conduites et accessoires ne risque pas de retourner dans le réservoir de gas-oil pendant le début du fonctionnement du moteur au gas-oil.

L'invention sera mieux comprise à la lecture de la description qui va suivre et à l'examen du dessin annexé dont la figure unique est un schéma d'une installation de contrôle de l'alimentation d'un moteur de pompe à béton suivant l'invention.

Sur le schéma, on a indiqué en 1 un moteur qui peut être accouplé, sélectivement, à une pompe à béton et aux roues d'un véhicule sur lequel est montée ladite pompe, au moyen d'un embrayage sélectif placé sous le contrôle d'un levier à commande manuelle 2 que l'on peut placer, sélectivement, dans l'une ou l'autre de deux positions correspondantes désignées respectivement par 2C et 2R sur le schéma, à savoir une position "chantier" pour l'entrainement de la pompe et une position "route" pour les déplacements.

Lorsque le moteur 1 est accouplé à la pompe à béton, sa pompe à injection 4 est alimentée à partir d'un réservoir 5 de fuel-oil par l'intermédiaire d'une électro-valve d'amenée à trois voies 6, dans sa position de repos, le levier 2 de sélection étant dans la position 2C. Lorsque le moteur 1 est accou-

plé aux roues du véhicule par la mise enposition du levier de sélection 2 dans la position 2R, la pompe à injection 4 du moteur est alimentée à partir d'un autre réservoir 7 de gas-oil, par l'intermédiaire de la même électro-valve 6en position de travail.

L'électro-valve est donc reliée d'une part, à l'entrée de la pompe à injection 4 par une conduite 11 et, d'autre part, aux deux réservoirs de carburant 5 et 7 par deux conduites 13 et 14, respectivement.

La sortie de la pompe à injection 4 est reliée par une conduite 16 à une électro-valve de retour 17 qui est reliée, à son tour, aussi aux deux réservoirs de carburant 5 et 7 par deux conduites 18 et 19 respectivement.

Dans sa position de repos l'électro-valve de retour 17 met la sortie de la pompe à injection 4 en communication avec le réservoir de fuel-oil 5, tandis que lorsqu'elle est excitée elle la met en communication avec le réservoir de gas-oil 7.

Les deux électro-valves 6 et 17 sont alimentées à partir d'une source de courant appropriée, telle qu'une batterie d'accumulateuns 21, par l'intermédiaire d'un interrupteur 22 fermé lorsque le levier de sélection 2 est dans la position 2R de déplacement du véhicule, de préférence sous le contrôle du contact 24 de marche du moteur 1, muni d'un témoin lumineux 25. Toutefois, l'alimentation de l'électro-valve d'amenée 6 se fait directement à partir de l'interrupteur 22, tandis que celle de l'électro-valve de retour 17 se fait par l'intermédiaire d'un relais 26 temporisé par exemple pour une durée de deux minutes. On peut avantageusement utiliser à cet effet, un relais à temporisation réglable par exemple de 0 à 180 secondes.

Le fonctionnement de l'installation est le suivant :

pour faire fonctionner la pompe à béton, on place le levier sélecteur 2 dans la position "chantier" 2C. Le contact 24 étant fermé, le moteur 1 en fonctionnement entraine par conséquent la pompe à béton et sa pompe à injection 4 est alimentée en fuel-oil bon marché à partir du réservoir 5 par la conduite 13, l'électro-valve d'amenée 6 au repos et la conduite 11. Le retour de carburant de la pompe à injection 4 se fait par la conduite 16, l'électro-valve de retour 17en position de repos et la conduite 18.

Si l'on a besoin de déplacer la pompe à béton, on doit

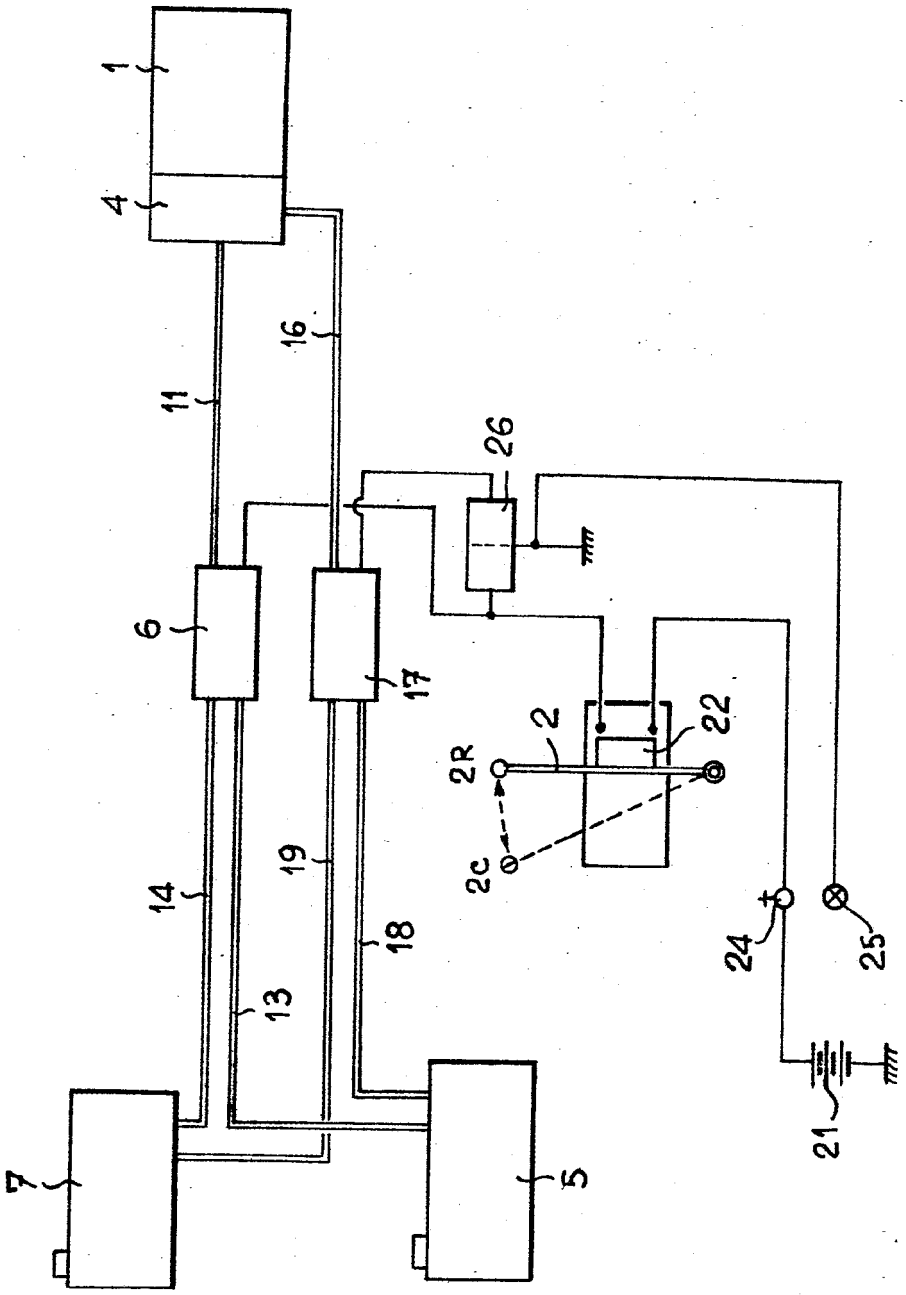
amener le levier sélecteur 2 dans la position "route" 2R de manière à assurer l'accouplement du moteur 1 aux roues du véhicule. Dans cette position, l'électro-valve d'amenée 6 est immédiatement mise en position de travail et la pompe à injection 4 du moteur est alimentée en gas-oil cher par la conduite 14, l'électro-valve d'amenée 6 en position de travail, et la conduite 11. Dès le début du fonctionnement du moteur dans cette condition, le relais temporisé 26, bien qu'alimenté aussi, laisse encore, pendant une durée d'environ deux minutes l'électro-valve de retour 17 en position de repos, de sorte que le reliquat du carburant précédemment utilisé, c'est-à-dire du fuel-oil bon marché qui se trouvait encore dans les conduites et accessoires retourne par la conduite 16, l'électro-valve 17 de retour au repos et la conduite 18, au réservoir 5 de fuel-oil. A l'expiration du temps de temporisation, on est certain que tout le circuit de retour est purgé de fuel-oil bon marché et, à ce moment, le relais 26 assure la mise de l'électro-valve de retour 17 en position de travail pour permettre le retour de gas-oil de la pompe à injection, par la conduite 19, au réservoir 7 de gas-oil cher.

Bien entendu, l'invention n'est pas limitée au mode de réalisation décrit et représenté ; on peut y apporter des modifications, suivant les applications envisagées, sans sortir, pour cela, du cadre de l'invention.

REVENDICATION

Installation de contrôle de l'alimentation d'une pompe à injection de moteur sélectivement à partir d'un réservoir de gas-oil ou d'un réservoir de fuel-oil, selon que le moteur est accouplé à un premier ou à un second appareil d'utilisation, notamment d'un moteur de pompe à béton monté sur un véhicule automobile mû par le même moteur, accouplé sélectivement à la pompe ou à une transmission d'entrainement des roues motrices du véhicule par un embrayage sélectif à commande manuelle, ladite installation étant caractérisée en ce que l'entrée de la pompe d'alimentation du moteur est reliée aux deux réservoirs de carburant par l'intermédiaire d'une électro-valve d'amenée à trois voies et la sortie de ladite pompe est reliée semblablement aux deux réservoirs de carburant par l'intermédiaire d'une électro-valve de retour à trois voies également, les deux électro-valves étant placées sous le contrôle de l'organe de commande manuelle de l'embrayage sélectif du moteur, la première directement et la seconde par l'intermédiaire d'un relais temporisé, de façon telle que le retour de fuel-oil se fasse vers le réservoir de fuel-oil, non suelement lorsque l'alimentation de la pompe du moteur est assurée en fuel-oil, mais aussi pendant la durée de la temporisation dudit relais au début de l'alimentation de la pompe du moteur en gas-oil.

Pl. unique 2220679



PTO/SB/30 (11-17)
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Request for Continued Examination (RCE) Transmittal

Address to:
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Alexandria, VA 22313-1450

Application Number	16/946,439
Filing Date	6/22/2020
First Named Inventor	Collie et al.
Art Unit	3747
Examiner Name	Long T. Tran
Attorney Docket Number	CET1090.077

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).
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2. Miscellaneous
   - a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)
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3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
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(54) Fuel change-over system and change-over method for motorcycle or motor-assisted bicycle

(57) The invention discloses a fuel change-over system for a motorcycle or motor assisted bicycle. The system comprises a solenoid-actuated gasoline valve (70) for controlling opening/closing of a gasoline supply passage, a solenoid-actuated LPG valve (40) for controlling opening/closing of a LPG supply passage, a gasoline pump (80), a change-over switch (140), a control device (100), and a indication device (150). During a change-over from gasoline to LPG, the control device (100) makes the pump (80) starting and operating so that any rest gasoline in a carburetor (60) of the vehicle can be drawn by the pump (80) back to a tank (90) of the vehicle. Moreover, the invention provides a fuel change-over method for conducting a smooth fuel change-over between gasoline and LPG in a dual-fuel motorcycle or motor assisted bicycle during its running or stop time. This will be contributive to popularize motorcycles and motor assisted bicycles.

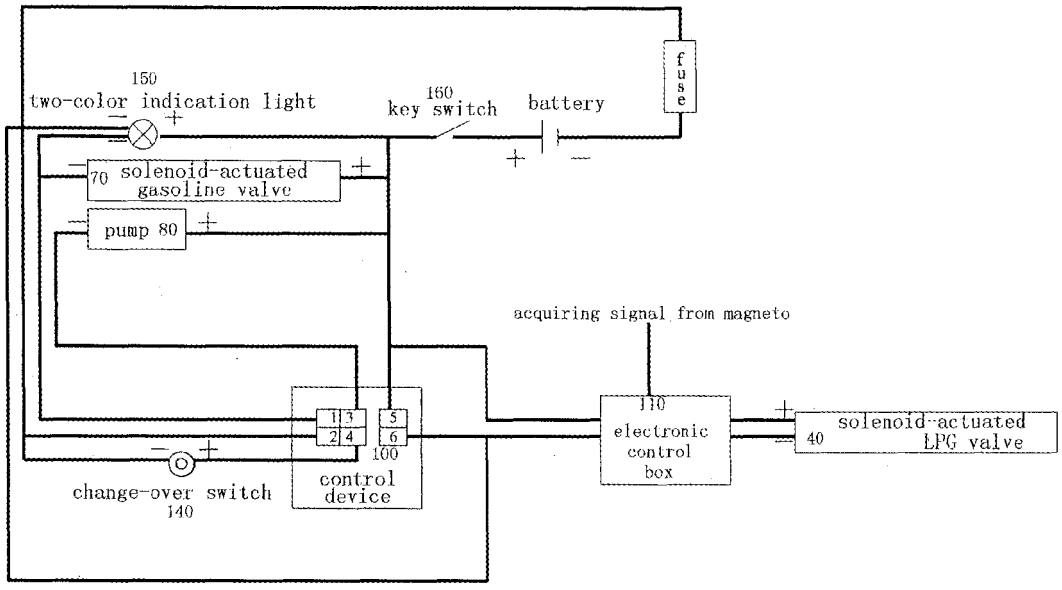


FIG. 2

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Description

Technical field

[0001] The present invention relates generally to a fuel change-over system and a corresponding change-over method thereto for a motorcycle or motor-assisted bicycle (called jointly by motorcycle(s) hereafter).

Background of the invention

[0002] Nowadays, a motorcycle which uses clean energy sources such as LPG is becoming a new popular traffic vehicle, for the emissions of the gasoline-burning motorcycles have polluted the atmosphere heavily. Therefore, a LPG-burning motorcycle is and will be in a great demand in the world market. The gas refilling of LPG motorcycles, however, is a big problem in some countries, which needs the public administrations concerned to invest finance to build sufficient LPG refilling stations and service facilities associated with them. This is a big obstacle for popularizing LPG motorcycles in some countries. If a dual-fuel motorcycle can be developed that uses LPG as a primary fuel and gasoline as a secondary one, the dual-fuel motorcycle of this type will be adopted in large amounts in the cities where there are less LPG refilling stations, it will make its users unnecessary to worry about the trouble in gas refilling, harmful emissions will be reduced, and the environmental atmosphere will be less polluted accordingly. At present, there have existed sophisticated single-fuel motorcycles, that is, gasoline burning ones and LPG burning ones, in wide use. A gasoline-burning motorcycle uses a carburetor to mix fuel with air and to form a combustible mixture, while a LPG-burning motorcycle uses a mixer to mix LPG with air. It is a difficult problem to combine a carburetor and a mixer together in a volume-limited motorcycle body, and it is another difficult problem to make a smooth change-over between the two fuels under a precondition not to influence user's riding. So far, in this field, there has not been a technology capable of solving the problems. Though some technologies for change-over between two fuels have been successfully used in the fields of cars and buses, the difference between a four-wheel vehicle and a two-wheel one is rather great, and most cars and buses are electronically fuel-injected, therefore, there is also a great difference in fuel change-over between a car and a motorcycle.

Summary of the invention

[0003] The object of the invention is to provide a fuel change-over system for conducting smooth and save changing-over between gasoline and LPG in a motorcycle.

[0004] The another object of the invention is to provide a fuel change-over system for conducting smooth and safe changing-over between gasoline and LPG during user's riding or in stop time.

[0005] The still another object of the invention is to provide a fuel change-over method for conducting smooth and safe changing-over between gasoline and LPG in a motorcycle.

[0006] In one aspect of the invention, the invention provides a fuel change-over system for conducting fuel change-over of a dual-fuel motorcycle. The system is used to conduct changing-over between gasoline supply and LPG supply and comprises: a solenoid-actuated gasoline valve for controlling opening/closing of a gasoline supply passage, it is connected at its one end to a gasoline tank and at its the other end to a carburetor; a solenoid-actuated LPG valve for controlling opening/closing of a LPG supply passage, it is connected at its one end to a LPG source and at its the other end to a mixer, and a outlet of the mixer is connected to a inlet of the carburetor; a change-over switch for conducting changing-over operation. The change-over system further comprises: a pump whose inlet is connected to the carburetor for drawing any rest gasoline in the carburetor back to the gasoline tank; a control device which is electrically connected to the pump, the change-over switch, the solenoid-actuated gasoline valve, and the solenoid-actuated LPG valve, respectively. In changing-over from gasoline to LPG, the control device makes the pump starting so as to draw any rest gasoline in the carburetor back to the gasoline tank.

[0007] In another aspect of the invention, the solenoid-actuated LPG valve is attached on a pressure reducing valve which is connected at its one end to the LPG source and at its the other end to the mixer.

[0008] In still another aspect of the invention, the mixer is connected at its outlet to an inlet of the carburetor and is provided with an air cleaner at its inlet.

[0009] In yet another aspect of the invention, the fuel change-over system is provided with an electronic control box for acquiring a signal from the magneto of a motorcycle. The electronic control box is connected with the solenoid-actuated LPG valve. When the magneto is stopped, the electronic control box transmits a control signal to make the solenoid-actuated LPG valve closed and thereby to shut off LPG supply passage.

[0010] In a further aspect of the invention, the control device further includes a condition memory device which is able to remember if gasoline or LPG is used before electrical power supply is turned off until the motorcycle and its magneto is power on and started again. The change-over switch is a two-position button switch and can be triggered by a voltage signal. The change-over switch is not triggered when the power supply of a motorcycle is turned off.

[0011] In a further aspect of the invention, the fuel change-over system further includes a fuel attribute indicator for indicating if gasoline or LPG is used at that right time. The fuel attribute indicator is electrically connected with the control device.

[0012] In a further aspect of the invention, the control

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device can control the gasoline pump so that the operation time length of the pump is proportional to the gasoline chamber volume of the carburetor.

[0013] In a further aspect of the invention, during a changing-over from LPG to gasoline, the control device controls the solenoid-actuated LPG valve so as to make it closed at a time delay; and during a changing-over from gasoline to LPG, the control device controls the solenoid-actuated gasoline valve so as to make it open at a time delay.

[0014] In a further aspect of the invention, the control device is provided with a change-over disabling device which is used to disable any following changing-over operation in a predetermined period after the last changing-over is triggered.

[0015] Furthermore, the invention provides a fuel change-over method for conducting fuel change-over in a dual-fuel motorcycle. The method comprises: during a changing-over from LPG to gasoline, as soon as the change-over switch of the change-over system is operated, the control device of the change-over system makes the solenoid-actuated gasoline valve open immediately so as to make gasoline passage through, and at the same time, the solenoid-actuated LPG valve is closed at a time delay; during a changing-over from gasoline to LPG, as soon as the change-over switch of the change-over system is operated, the control device of the change-over system makes the solenoid-actuated gasoline valve closed immediately so as to shut off gasoline passage, and at the same time, the gasoline pump in the fuel change-over system is started, and the solenoid-actuated LPG valve is opened at a time delay.

[0016] With the fuel change-over system and the fuel change-over method according to the invention, a rider can conduct a smooth fuel changing-over between gasoline and LPG during whose running or in stop time. This will be contributive to popularize motorcycles.

Brief description of drawings

[0017]

Fig. 1 is a schematic diagram of a general layout of the fuel change-over system according to the invention; and

Fig. 2 is a wiring principle diagram of the control device of the fuel change-over system according to the invention.

Detailed description of the invention

[0018] The invention is described below in detail in reference to the accompanying drawings.

[0019] Fig.1 is a schematic diagram of a general layout of the fuel change-over system for a motorcycle according to the invention, which is used for conducting changing-over between gasoline and LPG. The fuel change-over system comprises a solenoid-actuated gasoline valve 70 for opening/closing a gasoline supply passage and a solenoid-actuated LPG valve 40 for opening/closing a LPG supply passage. The solenoid-actuated gasoline valve 70 is connected at its one end to a gasoline tank 90 and at its the other end to a carburetor 60. The solenoid-actuated LPG valve 40 is attached on a pressure-reducing valve 120 which is used for adjusting LPG pressure into a mixer 50. The pressure-reducing valve 120 is connected at its one end to a LPG container 20 and at its other end to the mixer 50 which is used for mixing LPG and air. An outlet of the mixer 50 is connected to an inlet of the carburetor 60, and thereby it is possible to use a common fuel throttle wire, and an air cleaner (not shown) is provided at an inlet of the mixer 50. As shown in Fig. 1, a combination valve 30 is provided in the LPG container 20 and is connected to a LPG refilling valve 10 which is used for filling LPG into LPG container 20.

[0020] The fuel change-over system comprises a change-over switch for triggering a changing-over operation. Preferably, the change-over switch is a two-position button switch and can be triggered by a voltage signal. Thus, the change-over switch will not be triggered by a mal-operation in the case that the main power supply is turned off.

[0021] The fuel change-over system of the invention further comprises a gasoline pump 80 which is connected at its inlet to a discharge port at the bottom of the carburetor 60 and at its outlet to a gasoline tank 90 so that it can draw any rest gasoline in the carburetor 60 back to the gasoline tank 90.

[0022] Furthermore, the fuel change-over system includes a control device 100. As shown in Fig. 2, the control device 100 has six control legs, wherein leg 1 is connected to the solenoid-actuated gasoline valve 70 and can be connected in parallel with a double-color indication light 150 for indicating the condition of the solenoid-actuated gasoline valve 70, e.g. red light's lighting up indicates that the solenoid-actuated gasoline valve 70 is open and gasoline is used; leg 6 is connected to solenoid-actuated LPG valve 40 and also connected with the double-color indication light 150 for indicating the condition of the solenoid-actuated LPG valve 40, e.g. green light's lighting up indicates that the solenoid-actuated LPG valve 40 is open and LPG is used; leg 2 is connected to the negative of the battery; leg 3 to gasoline pump 80; leg 4 to the change-over switch 140; and leg 5 to the key switch 160 of a motorcycle.

[0023] The control device 100 carries out its control functions as follows: in a changing over from LPG to gasoline, as soon as the change-over switch 140 is pressed down, the control device 100 makes solenoid-actuated gasoline valve 70 open immediately so that the gasoline supply passage becomes through; meanwhile the solenoid-actuated LPG valve 40 on the pressure-reducing valve 120 is closed at a time delay and the LPG supply passage is closed at a time delay accordingly. The double-color indication light 150 gives out a red light

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in the time a motorcycle runs on gasoline. In a changing over from gasoline to LPG, as soon as the change-over switch 140 is pressed again, the control device 100 makes solenoid-actuated gasoline valve 70 closed immediately so that the gasoline supply passage shut off, and the pump 80 is put into operation for a suitable predetermined period to draw any rest gasoline in the carburetor 60 back to the gasoline tank 90 and then is stopped; meanwhile the solenoid-actuated LPG valve 40 on the pressure-reducing valve 120 is opened at a time delay and the LPG supply passage becomes through accordingly. The double-color indication light 150 gives out a green light in the time a motorcycle runs on gasoline.

[0024] In the control process described above, the length of the time delay at which the solenoid-actuated LPG valve 40 is closed or opened is dependent on the displacement volume of a specific motorcycle and on the internal configuration of the carburetor 60; the length of the period for which the gasoline pump 80 works is dependent on the size of the carburetor gasoline chamber. Generally, the larger the gasoline chamber is the longer the period for which the gasoline pump 80 shall work after the solenoid-actuated gasoline valve 70 is closed.

[0025] Preferably, the control device 100 further includes a condition memory device which is able to remember the condition in which if gasoline or LPG is used before electrical power supply is turned off until power supply is turned on again, thereby, when the motorcycle is restarted, the control device 100 can hold the motorcycle to use the fuel that was used before its electrical power supply is turned off. In the case that the change-over switch 140 is a voltage triggered button-type switch, in combination with the condition memory device, a program malfunction or mal-operation which may cause the two fuel burned simultaneously can be avoided.

[0026] Furthermore, the control system 100 includes a change-over disabling device which is used to disable any following changing-over operation in a predetermined period (e.g. 10 seconds) after the change-over switch 140 is pressed down last-time, this is to ensure that two successive fuel change-overs can not be conducted in a stipulated time length so as to avoid the program out of order and the two fuels burned simultaneously.

[0027] Moreover, in order to ensure motorcycle's stability and safety, the control device 100 of the fuel change-over system of the invention is provided with an electronic control box 110 for acquiring a signal from a magneto of the motorcycle. The electronic control box 110 is connected with the solenoid-actuated LPG valve 40. As soon as the motorcycle stops traveling and its magneto stops as well, the electronic control box 110 transmits a control signal to make the solenoid-actuated LPG valve 40 closed so as to shut off LPG passage.

[0028] In addition, as shown in Fig. 1, an additional solenoid-actuated LPG valve 130 is provided in the container which is LPG source. The valve, together and at the same time with the solenoid-actuated LPG valve 40 attached on the pressure-reducing valve 120, is controlled by the control device 100. This is advantageous to raise the safety of the whole system.

[0029] While the preferred embodiment of the invention has been described and illustrated, it is obvious that those who are skillful in this technical field can make many changes and modifications without departing from the spirit and principle of the invention. For example, the fuel change-over system according to the invention can be modified to suit motorcycles of different displacements and carburetors of different sizes by adjusting the time delay of the solenoid-actuated LPG valve 40 in the system. Therefore, the scope of the invention is only defined by the claims.

Claims

1. A fuel change-over system which is used on a dual-fuel motorcycle or motor assisted bicycle for conducting its fuel change-over, more particularly for conducting change-over between gasoline supply and LPG supply, is **characterized in that** the fuel change-over system comprises:

   a solenoid-actuated gasoline valve for controlling opening/closing of a gasoline supply passage, the solenoid-actuated gasoline valve being connected at its one end to a gasoline tank and at its the other end to a carburetor;
   a solenoid-actuated LPG valve for controlling opening/closing of a LPG supply passage, the solenoid-actuated LPG valve being connected at its one end to a LPG source and at its the other end to a mixer;
   a change-over switch for conducting changing-over operation;
   a gasoline pump which is connected at its inlet to the carburetor and at its outlet to the gasoline tank so that the pump can draw the gasoline in the carburetor back to the tank;
   a control device which is electrically connected to the pump, the change-over switch, the solenoid-actuated gasoline valve, and the solenoid-actuated LPG valve, respectively, the control device is configured to start the pump to draw the gasoline in the carburetor back to the tank as soon as the change-over switch is triggered when a changing-over from gasoline to LPG is conducted.

2. The fuel change-over system according to claim 1, wherein the solenoid-actuated LPG valve is attached on a pressure-reducing valve, and the pressure-reducing valve is connected at its one end to the LPG source and at its the other end to the mixer.

3. The fuel change-over system according to claim 1,

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wherein the mixer is connected at its outlet to an inlet of the carburetor and is provided with an air cleaner at its inlet.

4. The fuel change-over system according to claim 1, wherein the fuel change-over system is provided with an electronic control box for acquiring a signal from a magneto of a motorcycle and motor assisted bicycle, the electronic control box is connected with the solenoid-actuated LPG valve, the electronic control box transmits a control signal to make the solenoid-actuated LPG valve closed and thereby to shut off LPG passage as soon as the magneto stops.

5. The fuel change-over system according to claim 1, wherein further comprising a condition memory device which is able to remember the condition in which if gasoline or LPG is used before the electrical power supply of the control device is turned off until the power supply is turned on again, thereby, when the motorcycle or motor assisted bicycle is restarted, the control device can hold it to use the fuel that was used before its electrical power supply is turned off, the change-over switch is a voltage triggered button-type switch, which is not triggered when the electrical power supply of the motorcycle or motor assisted bicycle is turned off.

6. The fuel change-over system according to claim 1, wherein the fuel change-over system comprises a fuel attribute indicator for indicating if gasoline or LPG is used by the vehicle at that right time, the indicator is connected with the control device.

7. The fuel change-over system according to claim 1, wherein the control device can control the gasoline pump so that the length of its operation time is proportional to the gasoline chamber volume of the carburetor.

8. The fuel change-over system according to claim 1, wherein during a changing-over from LPG to gasoline, the control device controls the solenoid-actuated LPG valve so as to make it closed at a time delay; and during a changing-over from gasoline to LPG, the control device controls the solenoid-actuated gasoline valve so as to make it open at a time delay.

9. The fuel change-over system according to claim 1, wherein the fuel change-over system includes a change-over disabling device which is used to disable any following changing-over operation in a predetermined period after the last-time change-over is carried out.

10. A fuel change-over method for conducting fuel change-over of a dual-fuel motorcycle or motor assisted bicycle via a fuel change-over system, comprising:

during a changing-over from LPG to gasoline, as soon as a change-over switch of the change-over system is operated, a control device of the change-over system makes a solenoid-actuated gasoline valve thereof open immediately so as to make gasoline supply passage through, and at the same time, a solenoid-actuated LPG valve thereof is closed at a time delay; during a changing-over from gasoline to LPG, as soon as the change-over switch of the change-over system is operated, the control device of the change-over system makes the solenoid-actuated gasoline valve closed immediately so as to shut off the gasoline supply passage, and at the same time, the gasoline pump in the fuel change-over system is started to work and the solenoid-actuated LPG valve is opened at a time delay.

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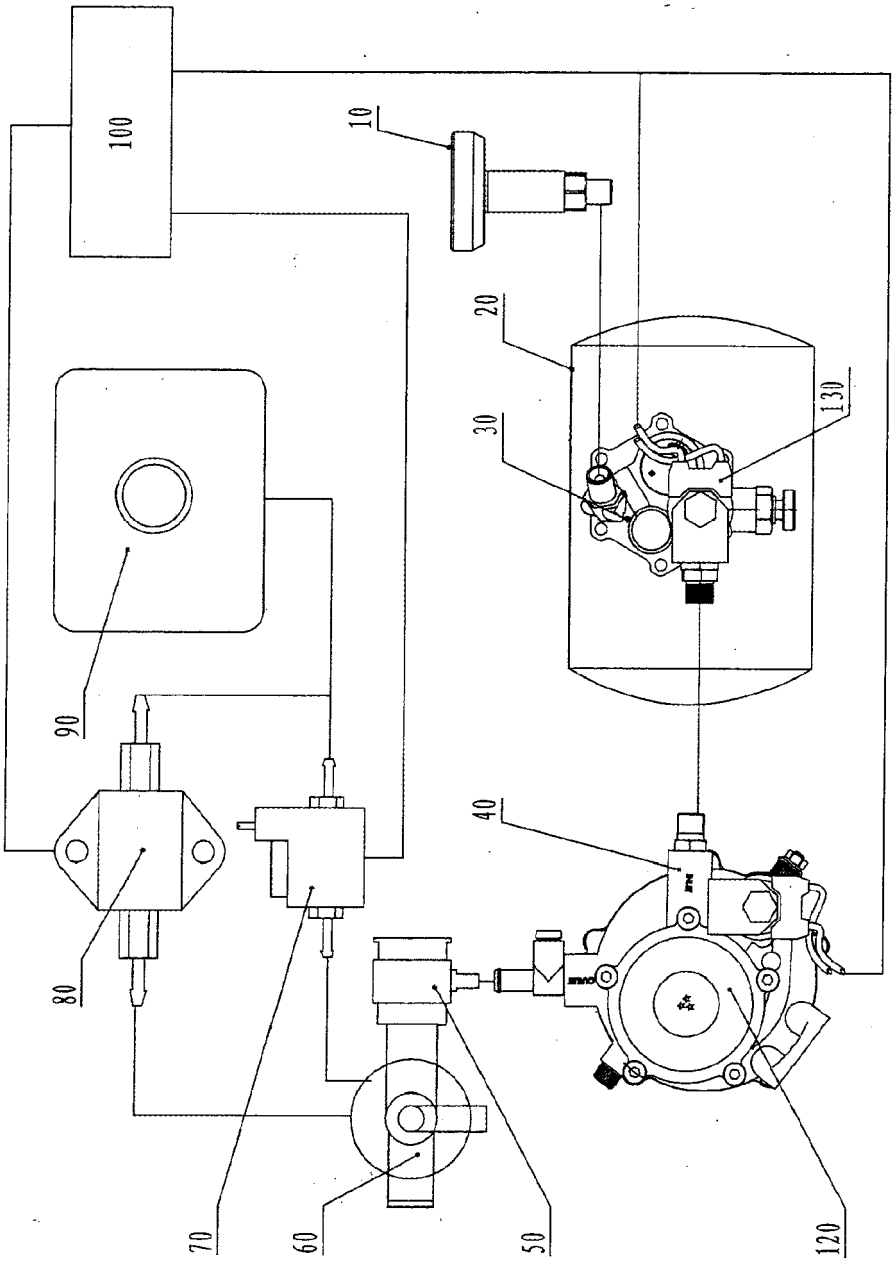


FIG. 1

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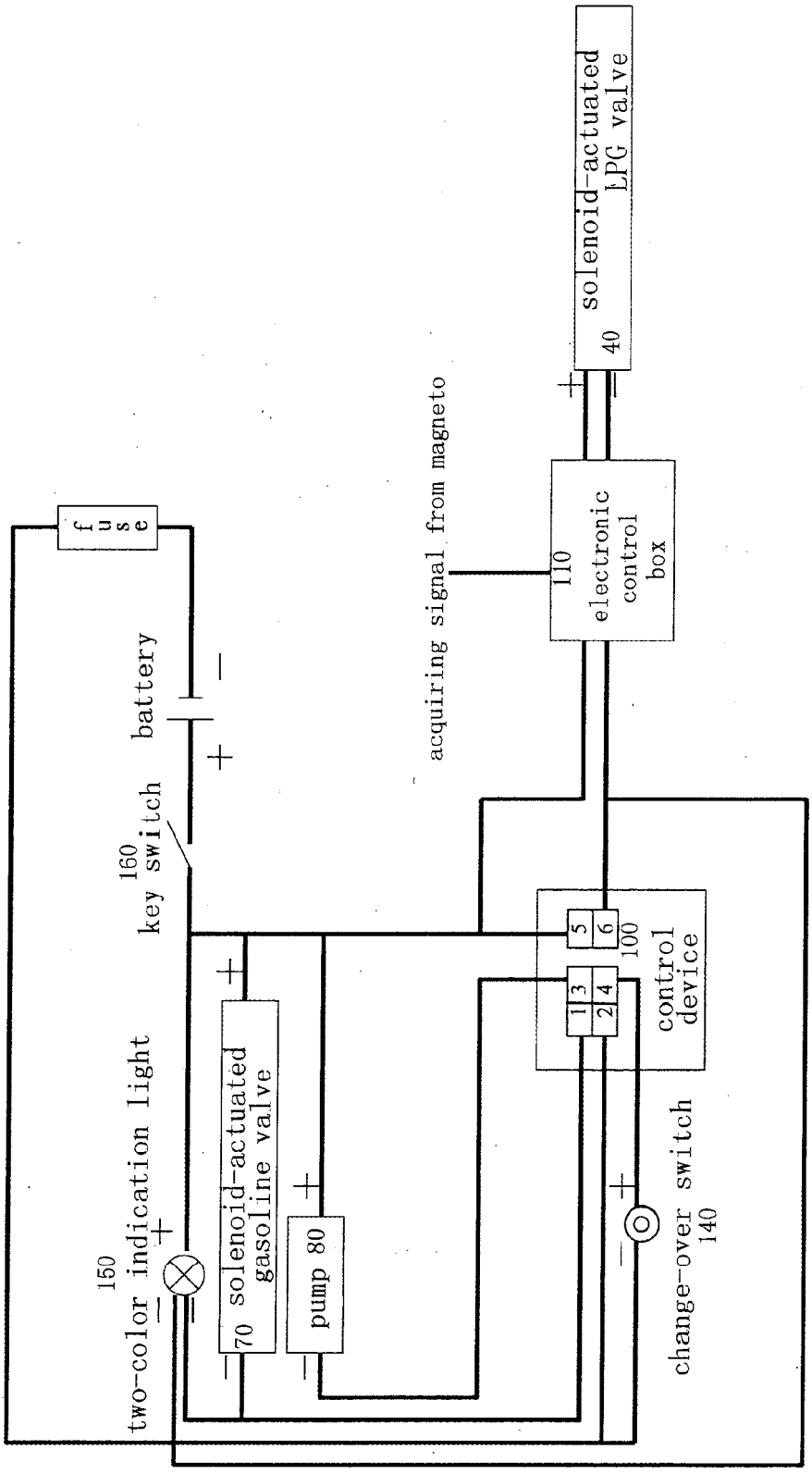


FIG. 2

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Espacenet

Bibliographic data: JPH0466743 (A) — 1992-03-03

TWO-SORT FUEL ENGINE

Inventor(s): MAEDA TADAMASA ± (MAEDA TADAMASA)

Applicant(s): SUZUKI MOTOR CO ± (SUZUKI MOTOR CORP)

Classification: **- international:** ***F02D19/06; F02D41/14;*** (IPC1-7): F02D19/06; F02D41/14

- cooperative:

Application number: JP19900180942 19900709

Priority number(s): JP19900180942 19900709

Abstract of JPH0466743 (A)

PURPOSE:To realize a control suitable for the properties of fuels in a simple system by using a whole scope air-fuel ratio sensor, and feedback-controlling the air-fuel ratio, the ignition timing, and the like, of the other side fuel while making one side fuel as a standard, in an engine to select and use the fuel from two sorts of different fuels. CONSTITUTION:The first fuel tank 1 and the second fuel tank 2 to store the first fuel (LPG) and the second fuel (LNG) separately are provided, and at the outlets of the fuel tanks 1 and 2, the first and the second electromagnetic valves 4 and 5 converted by a manual changeover switch 3 (S1) are provided respectively. A fuel passage 6 downstream of the electromagnetic valves 4 and 5 is linked to a two-way electromagnetic valve 8 interlocked with the change-over switch 3 through a vaporizer 7, and regulators 9 and 10 to regulate the pressure of the fuels are connected to the two parts of the two-way solenoid valve 8. These regulators 9 and 10 are connected to an injector 16 through a fuel passage 13. And the output signal of a whole scope air-fuel ratio sensor S2 provided at an exhaust passage 20 are input to the ECU 24, and the control is carried out to correct the other side fuel making one side fuel as a standard.

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⑫公開特許公報（A）　平4－66743

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F 02 D 41/14	310 D	9039－3G	
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審査請求　未請求　請求項の数 1　（全4頁）

⑤4発明の名称　2種燃料エンジン

⑳特　願　平2－180942
㉒出　願　平2(1990)7月9日

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明　細　書

1．発明の名称

2種燃料エンジン

2．特許請求の範囲

2種の燃料タンクと、燃料の選択により各燃料タンクから選択的に燃料を供給する切換弁と、選択された燃料を調圧してエンジンの燃焼室へ燃料を供給する燃料通路と、エンジンの排気系に設けられた全領域空燃比センサと、一方の燃料を基準として他方の燃料の最適値にセッティングしたROMとを有し、前記センサの出力信号により使用燃料による空燃比を制御するようにしたことを特徴とする2種燃料エンジン。

3．発明の詳細な説明

（産業上の利用分野）

本発明は、2種の燃料を切換えて使用する2種燃料エンジンに関する。

（従来の技術）

例えば、LPG（液化石油ガス）とLNG（液化天然ガス）、LPGとH_2、H_2とLNG（またはCNG）のように2種の異なる燃料を切換えて使用するエンジンがある。

このように2種類の燃料を使用する場合、一般に両燃料ともエンジンの負圧により吸入するキャブレタ方式を採用するか、あるいは一方の燃料はインジェクションを用いて制御し、他方の燃料はキャブレタ方式を用いて制御することが多い。

また、両燃料を電子制御する場合は、既存のO_2センサを用いて制御するようにしている。このO_2センサは、試験管状のジルコニア素子の内外面に薄い白金をメッキして電極とし、素子の内外の酸素濃度差に応じて起動力が発生するようにしたものである。

（発明が解決しようとする課題）

しかるに上記の従来技術では、一方の燃料について最適に電子制御しても、他方の燃料はあくまで緊急用としてしかとらえられていないためこれ

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を最適空燃比に制御することはなされていず、またO_2センサを用いたものは、双方の燃料によってエンジンの回転数、負荷に応じた理論空燃比以外の空燃比にフィードバック制御することができなかった。

本発明はこれに鑑み、同一の全領域空燃比センサを用い、エンジンの負荷に応じた空燃比のフィードバック制御および点火時期制御を、各々セッティングされたマップおよび補正係数を使い分けて最適な空燃比制御を可能とする２種燃料エンジンを提供することを目的としてなされたものである。

（課題を解決するための手段）

上記従来技術が有する問題点を解決するため、本発明は、２種の燃料タンクと、燃料の選択により各燃料タンクから選択的に燃料を供給する切換弁と、選択された燃料を調圧してエンジンの燃焼室へ燃料を供給する燃料通路と、エンジンの排気系に設けられた全領域空燃比センサと、一方の燃料を基準として他方の燃料の最適値にセッティングしたＲＯＭとを有し、前記センサの出力信号により使用燃料による空燃比を制御するようにしたことを特徴とするものである。

（作　用）

手動切換スイッチを切換えて燃料を選択すると、選択された燃料が調圧されて燃料通路を通じエンジンの燃焼室に送られる。このとき全領域での排気中のO_2量の検出結果に基づき他方の燃料の空燃比に補正がかけられてその燃料の最適空燃比が決定される。したがって全領域の空燃比を測定するので、負荷により適切な空燃比が違ってもそれぞれの燃料に対し適切なマップ制御ができる。

（実施例）

以下、本発明を図面に示す実施例を参照して説明する。

図示の実施例はインジェクション方式のエンジンに適用した場合を示し、燃料としてＬＰＧとＬＮＧの２種の燃料を選択使用する場合を示している。すなわち第１燃料（ＬＰＧ）と第２燃料（ＬＮＧ）を別個に収納する第１燃料タンク１と第２燃料タンク２を有し、これら第１，第２燃料タンク１，２の出口部には、運転席の手動切換スイッチ３（S_1）により切換え作動され緊急遮断弁を兼ねる切換弁としての第１電磁弁４および第２電磁弁５がそれぞれ設けられている。

これら電磁弁４，５より後流側の燃料通路６はベーパーライザ７を経て前記切換スイッチ３に連動する２方電磁弁８に至り、この２方電磁弁８の一方のポートには第１燃料を整圧するレギュレータ９が接続され、他方のポートには第２燃料を整圧するレギュレータ１０が接続されており、これらレギュレータ９，１０はそれぞれ逆止弁１１，１２を介して燃料通路１３に接続され、この燃料通路１３はエンジン１４の燃焼室１５に燃料を噴射するインジェクタ１６に接続されている。前記各レギュレータ９，１０はダイヤフラム式のものが用いられ、その加圧室９ａ，１０ａにはエンジン１４の吸気通路１７の吸気圧が導入通路１８，１９を通じて導入されるようになっている。

エンジン１４の排気通路２０には、エンジン１４の回転の全領域においてO_2量を検出することのできる全領域空燃比センサS_2が設けられている。このセンサS_2は、例えば理論空燃比検出センサとジルコニア素子イオン伝導性を利用した酸素ポンプとの組合せからなっている。

第１図においてS_3は燃料通路１３に設けられた燃料温度センサ、S_4は燃料圧センサであり、またS_5は吸気通路１７に設けられた吸気圧センサ、S_6は同じく吸気通路１７に設けられた吸気温センサ、S_7は水温センサ、S_8はスロットルセンサである。また第２図において２１はディストリビュータであり、S_9はその気筒判別センサ、S_{10}はクランク角センサを示し、さらに２２はバッテリ、２３はイグニッションスイッチを示している。

ＥＣＵ２４は、全領域空燃比センサS_2により燃料の違いによる実際の空燃比から他方の燃料の空燃比センサ出力信号に補正をかけるためのＲＯＭを有している。この補正は、一方の燃料を基準とし、他方の燃料を補正するようにしている。

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いま、運転席の手動切換スイッチ３（S_1）を切換えて第１または第２燃料のいずれかを選択すると、選択された燃料の燃料タンク１または２の電磁弁４または５が開き、その燃料は燃料通路６、ベーパーライザ７を通ってその燃料用のレギュレータ９または１０を通り、こゝで整圧されて燃料通路１３へ流れ、インジェクタ１６からエンジン１４の燃焼室１５へ噴射される。このときの基本噴射量は、吸気圧センサS_5、気筒判別センサS_9により定められ、燃料温度センサS_3、スロットルセンサS_8、水温センサS_7、吸気温センサS_6、燃料圧センサS_7等により補正され、噴射量が決定される。またこれと併せてディストリビュータ２１の点火時期の決定がなされる。これらの補正は、全領域空燃比センサS_2の検出信号に基づきＥＣＵ２４により行なわれる。

そのフローは、第３図に示すように、全領域空燃比センサS_2の出力を読込み、燃料が第１燃料か否かが判断され、第１燃料であれば、その空燃比を算出し、第２燃料である場合には補正がかけられる。ついで吸気圧センサS_4、気筒判別センサS_9のデータを読込み、ブースト圧、エンジン回転数に応じ第１燃料、第２燃料それぞれの目標空燃比の選定、点火進角マップ、各種補正が行なわれ、インジェクタ操作量が決定される。

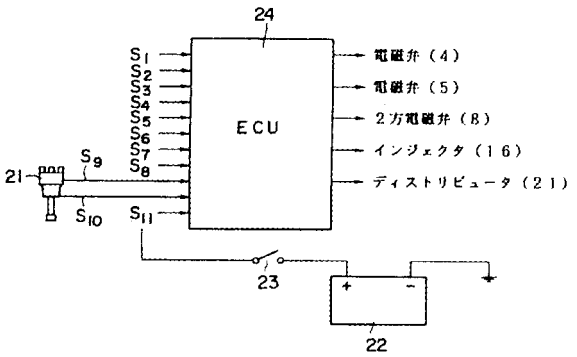
〔発明の効果〕

以上説明したように本発明によれば、２種の異なる燃料を選択して用いるエンジンにおいて、全領域空燃比センサを用い、一方の燃料を基準として他方の燃料の空燃比、点火時期等をフィードバック制御するようにしたので、各センサ、アクチュエータ等は同一で各燃料にセッティングしたマップ、補正係数を燃料切換スイッチの信号によって切換使用することが可能となり、簡単なシステムによりそれぞれの燃料の特性に合った空燃比、点火時期を決定することができる。

４．図面の簡単な説明

第１図は本発明を適用した２種燃料エンジンのシステム図、第２図は同ＥＣＵの入出力信号を示す説明図、第３図は同フローチャートである。

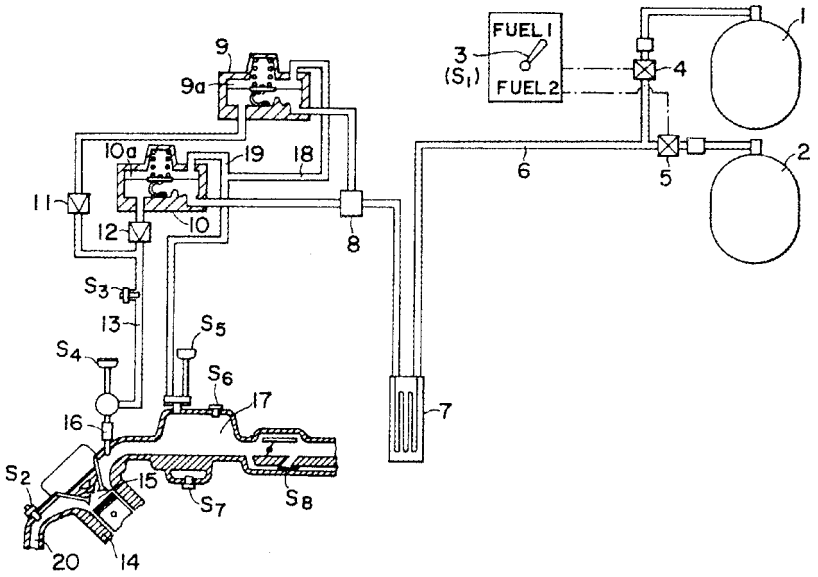
１…第１燃料タンク、２…第２燃料タンク、３（S_1）…燃料切換スイッチ、４，５…電磁弁、６，１３…燃料通路、７…ベーパーライザ、８…２方切換弁、９，１０…レギュレータ，１４…エンジン、１５…燃焼室、１６…インジェクタ、１７…吸気通路、２０…排気通路、２１…ディストリビュータ、S_2全領域空燃比センサ、S_3…燃料温度センサ、S_4…燃料圧センサ、S_5…吸気圧センサ、S_6…吸気温センサ、S_7…水温センサ、S_8…スロットルセンサ、S_9…気筒判別センサ、S_{10}…クランク角センサ。



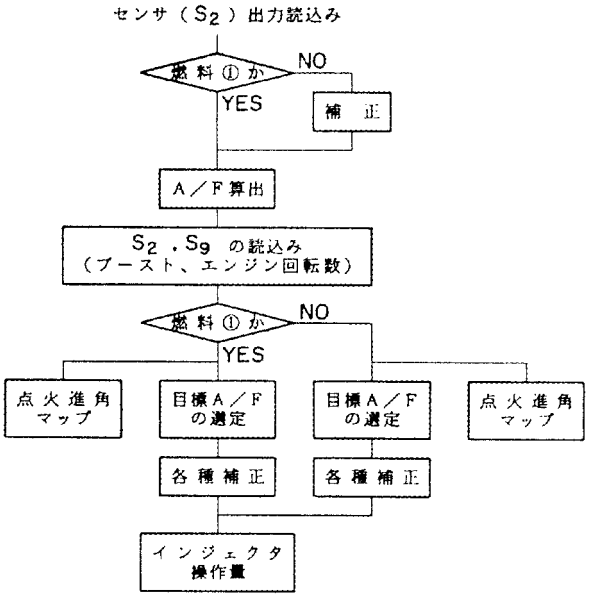
第２図

出願人代理人　佐　藤　一　雄

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第１図



第３図

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/946,439	**07/01/2021 09:14:35 AM ET**	**CET1090.077**

Title of Invention

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2699	FILED BY	Robyn Templin
PATENT CENTER #	60230303	FILING DATE	06/22/2020
CUSTOMER #	26629	FIRST NAMED INVENTOR	Kendall J. Collie
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Andrew Stark

Documents

TOTAL DOCUMENTS: 9

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
2021.07.01 RCE Transmittal.pdf	1	Request for Continued Examination (RCE)	127 KB
Warning: This is not a USPTO supplied RCE fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
2021.07.01 Supp IDS.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	985 KB
FPD1-EP1826377A2.pdf	7	Foreign Reference	3583 KB
FPD2-FR2510660A1.pdf	9	Foreign Reference	959 KB
FPD3-JPH0466743A.pdf	5	Foreign Reference	704 KB

FPD4-WO1999001659A1.pdf	31	Foreign Reference	1262 KB
FPD5-WO2007048633A1.pdf	45	Foreign Reference	404 KB
FPD6-FR2220679A1.pdf	8	Foreign Reference	931 KB
NPL1-Yamaha EF2000iS Tri Fuel Conversion Overview and Installation Tips.pdf	9	Non Patent Literature	669 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2021.07.01 RCE Transmittal.pdf	3176243336898E5B5FAE2EDC091916C16E5A4A04A05EF077ED17BA62F6B3D71EFD8DC02AD8A91497F89C7197C6C30CC6FE43A3AA1B8C2E59EFFEA543EE2C4B59
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If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/946,439	07/01/2021 09:14:35 AM ET	CET1090.077

Title of Invention

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2699	FILED BY	Robyn Templin
PATENT CENTER #	60230303	AUTHORIZED BY	Andrew Stark
CUSTOMER #	26629	FILING DATE	06/22/2020
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Kendall J. Collie

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 4529	E202171015532769	Robyn Templin

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	680.00	1	680.00
			TOTAL AMOUNT:	$680.00

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NOTICE OF ALLOWANCE AND FEE(S) DUE

26629 7590 05/21/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER
TRAN, LONG T

ART UNIT	PAPER NUMBER
3747	

DATE MAILED: 05/21/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

TITLE OF INVENTION: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	08/23/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

26629 7590 05/21/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

TITLE OF INVENTION: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	08/23/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRAN, LONG T	3747	123-525000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

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❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077	2699

26629 7590 05/21/2021

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074

EXAMINER	
TRAN, LONG T	

ART UNIT	PAPER NUMBER
3747	

DATE MAILED: 05/21/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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Harbor Freight Tools USA, Inc. et al v. Champion Power Equip., Inc.
IPR2025-01271

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/946,439	Applicant(s) Collie et al.	
	Examiner LONG T TRAN	Art Unit 3747	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 22 June 2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-19 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/LONG T TRAN/
Primary Examiner, Art Unit 3747

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

2. Claims 1 – 19 are allowed.

3. The following is an examiner's statement of reasons for allowance: The prior art references fail to disclose or teach in combination a multi-fuel engine comprising an engine operable on a liquid fuel and a gaseous fuel; a carburetor attached to an intake of the engine to mix air and fuel and connect a liquid fuel source to the intake, the carburetor comprising a float bowl; a liquid cutoff solenoid coupled to open and close a liquid fuel path to the engine; a gaseous cutoff solenoid coupled to open and close a gaseous fuel source to the engine; a switch selectively coupling a power source to the liquid cutoff solenoid and the gaseous cutoff solenoid to open and close the liquid fuel path and the gaseous fuel path; and one or more timing circuits electrically coupled to the liquid cutoff solenoid and the gaseous cutoff solenoid that operate to control an actuation time of the liquid cutoff solenoid and the gaseous cutoff solenoid. While bi fuel systems are well known in the art, the further optimization of timing the fuel cutoff valves as claimed for a carburetor assisted fuel injection is considered a novel approach for such engine types.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG T TRAN whose telephone number is (571)270-1899. The examiner can normally be reached on Mon - Fri 9:00 - 5:00.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lindsay Low can be reached on 571-272-1196. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-

my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/LONG T TRAN/
Primary Examiner, Art Unit 3747

Notice of References Cited	Application/Control No. 16/946,439	Applicant(s)/Patent Under Reexamination Collie et al.	
	Examiner LONG T TRAN	Art Unit 3747	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20140238340-A1	08-2014	Dunn; Mark E.	F02D19/0615	123/299
*	B	US-20130221000-A1	08-2013	IWAYA; Norifumi	F02M25/0836	220/86.2
*	C	US-20110290203-A1	12-2011	Pursifull; Ross Dykstra	F02D19/0605	123/41.08
*	D	US-4878475-A	11-1989	Birsa; Ludwig	F02D19/0642	123/525
*	E	US-4811720-A	03-1989	Katumata; Shoji	F02D19/0647	123/527
*	F	US-3807377-A	04-1974	Hirschler, Jr.; Daniel A.	F02M31/18	123/575
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	**Art Unit**
	LONG T TRAN	3747

CPC						
Symbol					**Type**	**Version**
F02D	/	19	/	0613	F	2013-01-01
F02B	/	63	/	04	I	2013-01-01
F02D	/	19	/	0647	I	2013-01-01
F02M	/	19	/	06	I	2013-01-01
F02D	/	19	/	0678	I	2013-01-01
F02D	/	19	/	0681	I	2013-01-01
F02M	/	19	/	08	I	2013-01-01
F02M	/	13	/	08	I	2013-01-01
F02B	/	43	/	00	I	2013-01-01
F02D	/	29	/	06	I	2013-01-01
F02D	/	41	/	062	A	2013-01-01
F02N	/	3	/	02	A	2013-01-01
F02D	/	41	/	0025	A	2013-01-01
Y02T	/	10	/	30	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	17 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20210517

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IPR2025-01271

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

INTERNATIONAL CLASSIFICATION				
CLAIMED				
F02D	/	19	/	06
F02D	/	19	/	08
F02M	/	13	/	08

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	17 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

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IPR2025-01271

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/LONG T TRAN/ Primary Examiner, Art Unit 3747	17 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

CPC - Searched*		
Symbol	Date	Examiner
F02M13/08; F02M21/0254; F02M21/0215; F02M63/0015; F02M17/10; F02D19/0647; F02D19/0613; F02D41/0025; F02D41/0027; F02B63/048; F02B69/02; F02B69/04	05/17/2021	LT

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor search	05/17/2021	LT
PLUS search	05/17/2021	LT
Text search	05/17/2021	LT

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	F02M13/08; F02M21/0254; F02M21/0215; F02M63/0015; F02M17/10; F02D19/0647; F02D19/0613; F02D41/0025; F02D41/0027; F02B63/048; F02B69/02; F02B69/04	05/17/2021	LT

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/946,439	Collie et al.
	Examiner	Art Unit
	LONG T TRAN	3747

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
	LONG T TRAN	3747

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	05/17/2021								
	1	=								
	2	=								
	3	=								
	4	=								
	5	=								
	6	=								
	7	=								
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	12	=								
	13	=								
	14	=								
	15	=								
	16	=								
	17	=								
	18	=								
	19	=								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	"16946439"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/17 10:18
L2	79	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 select$4) near3 fuel) and ((time timing period duration cycle) near5 fuel near20 (solenoid valve) near20 (cut cuttoff on off shut$4))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/17 10:18
L3	231	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel) and (fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and ((switch$4 select$4) near3 fuel) and ((time timing period duration cycle) near5 fuel near20 (solenoid valve)) and (carburetor carbureter carburretor carburetter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/17 10:18
L4	322	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel) and (fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and ((switch$4 select$4) near3 fuel) and ((time timing period duration cycle) near20 fuel near20 (solenoid valve)) and (carburetor carbureter carburretor carburetter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/17 10:18
L5	2,603	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel) and (fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and ((switch$4 select$4) near3 fuel) and ((time timing period duration cycle) near20 fuel near20 (solenoid valve))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/17 10:19
S2	5	"20070137591"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/05/13 08:19

			DERWENT; IBM_TDB			
S3	31	"2398437"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 08:19
S4	48	"5934320"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 08:20
S5	1,631	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 chang$4 between) near3 fuel) and ((time timing period duration cycle) near5 fuel same (solenoid valve))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 08:32
S6	546	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 chang$4 between) near3 fuel) and ((time timing period duration cycle) near5 fuel same (solenoid valve) same (cut cuttoff on off))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 08:44
S7	95	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 chang$4 between) near3 fuel) and ((time timing period duration cycle) near5 fuel same (solenoid valve) same (cut cuttoff on off)) and (carburetor carbureter carburretor carburetter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 08:45
S8	27	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 chang$4 between)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 09:02

		near3 fuel) and ((time timing period duration cycle) near5 fuel near20 (solenoid valve) near20 (cut cuttoff on off shut$4)) and (carburetor carbureter carburretor carburetter)				
S9	24	engine and ((bi two dual second$4 multi multiple plural$4) near2 fuel same (gas$4 propane cng lpg ng)) and ((gasoline liquid) near2 fuel) and (fuel same valve same (electric$4 solenoid)) and ((switch$4 select$4) near3 fuel) and ((time timing period duration cycle) near5 fuel near20 (solenoid valve) near20 (cut cuttoff on off shut$4)) and (carburetor carbureter carburretor carburetter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/13 09:04

5/17/2021 10:25:32 AM
C:\Users\ltran2\Documents\EAST\Workspaces\16946439.wsp

Bibliographic Data

Application No: 16/946,439

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /LONG T TRAN/ (Examiner's Signature) | LT (Initials)

Title: FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
06/22/2020	123	3747	CET1090.077
RULE			

APPLICANTS

Champion Power Equipment, Inc., Santa Fe Springs, CA, UNITED STATES

INVENTORS

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James J. Dehn, Brookfield, WI, UNITED STATES

Leigh A. Jenison, Hartland, WI, UNITED STATES

CONTINUING DATA

This application is a CON of 16358822 03/20/2019 PAT 10697379

16358822 is a CON of 15285215 10/04/2016 PAT 10393034

15285215 is a CIP of 14925441 10/28/2015 PAT 10697398

14925441 is a CIP of 14738060 06/12/2015 PAT 10221780

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

07/01/2020

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

ZIOLKOWSKI PATENT SOLUTIONS GROUP, SC (ZPS)
136 S WISCONSIN ST
PORT WASHINGTON, WI 53074
UNITED STATES

FILING FEE RECEIVED

$785

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16946439
Filing Date	2020-06-22
First Named Inventor	Kendall J. Collie et al.
Art Unit	3747
Examiner Name	
Attorney Docket Number	CET1090.077

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/L.T.T/	1	2398437		1946-04-16	McGill et al.	
/L.T.T/	2	3911956		1975-10-14	LeBreton et al.	
/L.T.T/	3	4323046		1982-04-06	Barber	
/L.T.T/	4	4375795		1983-03-08	Billingsley	
/L.T.T/	5	4471805		1984-09-18	Solie et al.	
/L.T.T/	6	4492207		1985-01-08	Hallberg	
/L.T.T/	7	4750514		1988-06-14	Omori et al.	
/L.T.T/	8	4788960		1988-12-06	Oshizawa	

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/L.T.T/	9	5934320		1999-08-10	O'Reilly et al.		
/L.T.T/	10	6543395	B2	2003-04-08	Green		
/L.T.T/	11	6591817	B2	2003-07-15	Deutsch		
/L.T.T/	12	7591257	B2	2009-09-22	Bayer et al.		
/L.T.T/	13	7802562	B2	2010-09-28	Lippa et al.		
/L.T.T/	14	7905469	B2	2011-03-15	Nickels et al.		
/L.T.T/	15	8042569	B2	2011-10-25	Morris		
/L.T.T/	16	8757139	B2	2014-06-24	Deng		
/L.T.T/	17	8944027	B2	2015-02-03	Montgomery		
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/L.T.T/	1	20070137591	A1	2007-06-21	Sugimoto et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/L.T.T/	1	2401704	CN	Y	2000-10-18	Zhejiang University		
/L.T.T/	2	102006008524	DE	A1	2006-08-31	Voss Automotive GMBH		
/L.T.T/	3	189800	GB	A	1923-10-11	Sonderegger		
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/L.T.T/	1	Multi-Power Ltd., MODELMP5500DF 13 HP Generator Owner's Manual, July 2006, pp. 1-38	

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/L.T.T/	3	Winco Inc., HPS9000VE/E and HPS9000VE-03/A Generator Installation and Operators Manual, August 9, 2013, pp. 1-16	
/L.T.T/	4	Winco Inc., Dyna ME5000VA Installation, Operation, and Maintenance Instructions, November 21, 2017, pp. 1-12	
/L.T.T/	5	Winco Inc., Dyna DL9000E, DL5000H, and D3000 Portable Generators Installation, Operation, and Maintenance Instructions, November 21, 2017, pp. 1-12	
/L.T.T/	6	PowerLand Industrial Tools, Powerland Tri Fuel Generator Owner's Manual, December 24, 2015, pp. 1-41	
/L.T.T/	7	Winco Inc., HPS6000HE/I Bi-Fuel Generator Installation and Operators Manual, March 8, 2010, pp. 1-20	

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Examiner Signature	/LONG T TRAN/	Date Considered	05/17/2021

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Kevin R. Rosin/	Date (YYYY-MM-DD)	2020-12-15
Name/Print	Kevin R. Rosin	Registration Number	55584

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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PLUS Search Results for S/N 16946439, Searched Thu May 13 09:20:23 EDT 2021

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6045352 99
9890731 99
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10697379 99
20160273472 99
20170022910 99
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Art Unit	3747
Examiner Name	
Attorney Docket Number	CET1090.077

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	1	2398437		1946-04-16	McGill et al.	
	2	3911956		1975-10-14	LeBreton et al.	
	3	4323046		1982-04-06	Barber	
	4	4375795		1983-03-08	Billingsley	
	5	4471805		1984-09-18	Solie et al.	
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	10	6543395	B2	2003-04-08	Green	
	11	6591817	B2	2003-07-15	Deutsch	
	12	7591257	B2	2009-09-22	Bayer et al.	
	13	7802562	B2	2010-09-28	Lippa et al.	
	14	7905469	B2	2011-03-15	Nickels et al.	
	15	8042569	B2	2011-10-25	Morris	
	16	8757139	B2	2014-06-24	Deng	
	17	8944027	B2	2015-02-03	Montgomery	
	18	9175601	B2	2015-11-03	Markoski	

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	1	20070137591	A1	2007-06-21	Sugimoto et al.	

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	1	2401704	CN	Y	2000-10-18	Zhejiang University		
	2	102006008524	DE	A1	2006-08-31	Voss Automotive GMBH		
	3	189800	GB	A	1923-10-11	Sonderegger		
	4	532903	GB	A	1941-02-03	Henderson et al.		

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Name/Print	Kevin R. Rosin	Registration Number	55584

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Espacenet

Bibliographic data: GB532903 (A) — 1941-02-03

Improvements relating to fuel control mechanism for internal combustion engines using alternative fuels

Inventor(s):

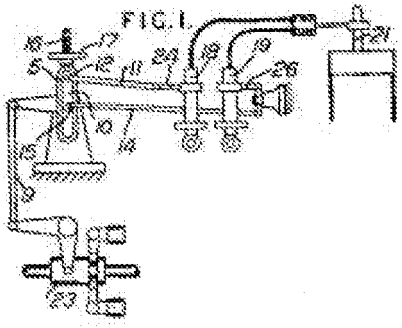
Applicant(s): ALEXANDER HENDERSON; FREDERICK ERNEST REBECK ± (ALEXANDER HENDERSON, ; FREDERICK ERNEST REBECK)

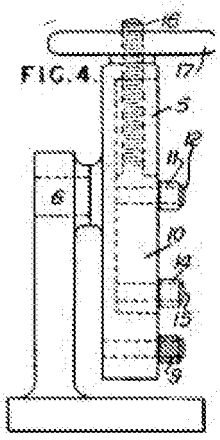
Classification: **- international:** ***F02D19/08; F02D19/10***
- cooperative: F02D19/0607 (EP); F02D19/0684 (EP); F02D19/08 (EP); F02D19/10 (EP); Y02T10/30 (EP)

Application number: GB19390026528 19390923

Priority number(s): GB19390026528 19390923

Abstract of GB532903 (A)





532,903. Regulating. HENDERSON, A., and REBBECK, F. E. Sept; 23, 1939, No. 26528. [Class 7 (vi)] The alternative supply of two fuels to an engine is regulated by means of a link 5 pivoted at 6 and in which slides a block 10 connected at 12, 15 to rods 11, 14 leading to the regulating- means of the two fuels, the block being adjustable along the link to vary the proportions of the two fuels. As shown in Fig; 1, the rods 11, 14 actuate the controlling-rods 24, 26 of two fuel pumps 18, 19 supplying an injector 21 or separate injectors ; but one of the fuel pumps may be replaced by a throttle valve in a pipe supplying gaseous fuel to the engine. The block 10 is adjusted by means of a screw 16 and hand-wheel 17, and is arranged so that when the block is at one end of the link 5 one of the rods 11 and 14 is inoperative, and when the block is at the other end of the link the other rod is inoperative ; in intermediate positions, both rods operate to adjust the supplies of both fuels. The link 5 may be connected by a link 9 to a hand control; or to an automatic regulator such as a speed governor 23. If one fuel is to be ignited by spark ignition, this may be automatically brought into operation when the block 10 is moved to its extreme position for supplying the fuel.

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PATENT SPECIFICATION

532,903

Application Date: Sept. 23, 1939. No. 26528/39.

Complete Specification Accepted: Feb. 3, 1941.

COMPLETE SPECIFICATION

Improvements relating to Fuel Control Mechanism for Internal Combustion Engines using Alternative Fuels

We, ALEXANDER HENDERSON, of 133, Marlborough Avenue, Broomhill, Glasgow, W.1, and FREDERICK ERNEST REBBECK, of Harland and Wolff, Limited, Queen's Island, Belfast, both British Subjects, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improved mechanism for controlling the supply of fuel to the cylinders of internal combustion engines constructed for use with alternative fuels, which may be different liquid fuels, or liquid fuel and gaseous fuel, or liquid fuel and a mixture of liquid and gaseous fuel, such as, for example, compression - ignition internal combustion engines adapted to use alternative liquid fuels, or adapted for the alternative use of liquid fuel and gaseous fuel, with or without admixture of the gaseous fuel with liquid fuel to assist combustion.

The invention is concerned with an engine according to the preceding paragraph provided with two fuel supply devices, one for supplying one fuel and the other for separately supplying another fuel to the engine cylinder or cylinders, each fuel supply device being controlled by transmission members connected to a slide element slidable on an oscillatory link or like member adapted to be oscillated about a fixed pivotal axis, the amplitude of oscillation being variable to vary the movement of said transmission members and thus to vary the amount of fuel supplied to the engine without varying the proportions of the fuels, and the slide element being manually adjustable on the link to move one transmission member relatively to the other, thereby to vary the proportions of the fuels supplied by the two fuel supply devices. An engine conforming to the preceding statement is hereinafter referred to as an engine " of the character described ".

Such mechanism enables the change of fuel to be effected without stopping the engine and also provides for the control of the supply of both fuels at all times. It further provides a means whereby the amount of the charge of fuel supplied to the engine can be regulated either automatically by the engine speed governor or by actuation of a fuel supply regulator, while further providing control means for the control of the relative proportions of the two fuels when a mixture of fuels is supplied to the engine.

Heretofore an engine of the character described had the two transmission members connected one to each pump plunger of a pair of fuel pumps and the link carrying the adjustable slide element was oscillated by articulating it to the end of an eccentric rod reciprocated by an eccentric on a shaft driven by the engine; consequently a continuous oscillatory movement of constant amplitude was imparted to the link during the running of the engine, thus continuously reciprocating either or both of the transmission members and pump plungers to supply fuel to the engine; in order to vary the total amount of fuel supplied to the engine, the amplitude of oscillation of the link could be varied by varying the point of articulation of the link to the engine-driven eccentric rod either by hand or by means of a governor, without varying the proportions of the fuels supplied by the two pumps. To vary the proportions of the fuels, the strokes of the transmission members were varied relatively to one another by adjusting the slide element on the link in order to vary the pump strokes; alternatively, the transmission members were arranged to control by-pass passages in the pumps in order to vary the effective action of the pumps.

According to the present invention an engine of the character described has the oscillatory link or like member oscillated only by the movement of a regulating member and only when the latter is actuated by hand or by an engine speed governor or by a mechanically or electrically-controlled engine regulator, so that the oscillatory link or like member and the transmission members remain stationary at any constant engine speed. The invention is further characterized by the feature that the fuel supply is effected

[Price

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either through independently driven fuel pumps or through fuel supply pipes controlled by valves, the supply of fuel through said pumps or valves being varied by any movement of the said transmission members. If the engine is adapted for using liquid fuel and gaseous fuel alternatively, one of the transmission members will be operatively connected to the liquid fuel pump or other means for controlling the liquid fuel supply to the engine and the other transmission member will be operatively connected to the means for controlling the gaseous fuel supply to the engine.

The invention will be more clearly understood by reference to the accompanying drawings whereon Fig. 1 is a diagrammatic illustration of the application of one form of the invention to the control of alternative liquid fuel supplies to the fuel injection nozzle of an engine cylinder. Fig. 2 is a similarly diagrammatic illustration of another form of the invention for the control of alternative liquid and gaseous fuel supplies to an engine cylinder. Figs. 3 and 4 are views taken at right angles to one another showing a slightly modified form of linkage to a larger scale than Figs. 1 and 2.

Referring firstly to Figs. 3 and 4, the linkage there shown comprises a slotted link 5 at the back of which is a pin 6 for pivotally mounting the link 5 on a fixed bracket 7. The link 5 is pivotally attached at 8 to one end of an actuating rod 9. Slidable in the slot in the link 5 is a slide block 10. A rod 11 is attached by a pivot pin 12 to one end of the block 10 and a similar rod 14 is attached by a pivot pin 15 to the other end of the block, which is of such a length that, when the block is at either end of the slot in the link 5, one or other of the pivot pins 12 and 15 is in a neutral position on the link and is coaxial with the axis of the pin 6, which is the axis about which the link 5 is free to swivel on the bracket 7. The slide block 10 is attached to a screw-threaded spindle 16 upon which is fitted an internally screw-threaded hand wheel 17. It will be apparent that the hand wheel 17 serves to adjust the slide block in the link.

With the slide block in its lower extreme position shown in Figs. 3 and 4, any longitudinal movement of the actuating rod 9 will result in corresponding movement of the rod 14, but the rod 11 will remain motionless, since the pivot pin 12 is coaxial with the axis about which the link 5 is adapted to swivel. If the slide block 10 is moved upwards and locked in its other extreme position by rotation of the hand wheel 17 until the latter again abuts against the upper end of the link 5, the pivot pin 15 will be brought into the position in which it is coaxial with the axis about which the link swings; in this position, longitudinal movement of the actuating rod 9 will transmit no movement to the rod 14, while the rod 11 will move with the rod 9.

If the slide block 10 is moved to a position between the two extreme positions above-mentioned, the rod 9 will transmit motion to both rods 11 and 14 and the displacement of the rods 11 and 14 will depend upon the distances of their pivot pins 12 and 15 from the axis of swing of the link 5.

Fig. 1 of the drawings shows a somewhat similar linkage for controlling either or both of two alternative liquid fuels supplied by separate fuel pumps 18 and 19 through a non-return valve chest 20 to a fuel injection nozzle 21 arranged to inject fuel into the combustion space 22 of an internal combustion engine cylinder. In Fig. 1 the link 5, instead of being directly attached to an actuating rod 9 as in Figs. 1 and 2, has a lateral arm 5*a* to which the actuating rod 9 is attached and the latter is pivotally attached at its other end to and controlled by any known type of centrifugal engine speed governor 23. The rod 11 of the linkage is attached to a pump control rod 24 which controls the pump 18, and the rod 14 of the linkage is connected through the medium of a rocking arm 25 to a pump control rod 26 which controls the pump 19. The fuel-injection pumps 18 and 19 are driven in known manner from the engine, as by means of engine-driven cams 27.

Displacement of the governor 23, due to engine speed variation, will transmit motion through the rod 9 to the link 5 and from thence to either or both of the rods 11 and 14 according to the position of the slide block 10 in the link 5, and will thus control either or both of the liquid fuel pumps 18 and 19 to control the liquid fuel supply to the engine. In either extreme position of the slide block 10, one or other of the rods 11 and 14 will remain motionless, so that the fuel pump 18 or 19 to which it is connected will either supply no fuel to the valve chest 20 or only a predetermined minimum quantity, while the other rod 11 or 14 will be fully responsive to any movements of the rod 9 and will thus control the fuel pump supplying the whole or main fuel charge to the injection nozzle 21. In any intermediate position of the slide block 10, both rods 11 and 14 will move with the rod 9 and thus control the supply of fuel by both fuel pumps 18 and 19.

The fuel pumps 18 and 19 may supply fuel to two separate fuel injection nozzles

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in place of the single fuel nozzle 21.

Instead of operatively connecting the link 5 to an engine speed governor as in Fig. 1, the link 5 may be connected to any known form of hand regulator lever or to a mechanically or electrically controlled regulator. Fig. 2 shows the arm 5*a* of the link 5 connected by the rod 9 to a hand regulator lever 28; in this case the linkage is turned through 90 degrees so that the screw-threaded spindle 16 is horizontal instead of being vertical as in Figs. 1, 3 and 4. Fig. 2 also illustrates the invention applied to an engine adapted to use either liquid or gaseous fuel or both. In this case, the rod 11 of the linkage is connected to an arm 29 on the spindle of a throttle valve 30 in a gas supply pipe 31 which opens through a mixing chamber 32 and inlet valve 33 into the combustion space 22 of the engine cylinder, air for combustion being supplied to the mixing chamber 32 through an air inlet pipe 34. The rod 14 of the linkage is connected through a bell-crank lever 35 to a pump control rod 36 which controls an engine-driven liquid fuel pump 37 supplying liquid fuel to a fuel injection nozzle 38 arranged to inject liquid fuel into the engine cylinder.

In either of the arrangements shown in Figs. 1 and 2, displacement of the sliding block 10 can be effected by turning the hand wheel 17 without stopping the engine; it is thus possible to change over from one fuel to the other while the engine is running. Moreover, the supply of either or both fuels may be at all times under the control of the engine speed governor, if the linkage is governor-controlled, so that the total quantity of fuel supplied is automatically kept within predetermined limits by the action of the governor. Similarly, if the linkage is connected to an engine regulator, other than an automatic speed governor, the supply of either or both fuels will be under the control of the engine regulator and the total quantity of fuel supplied can be controlled by actuating the engine regulator by hand or by mechanical or electrical means. When the engine is running on a mixture of two fuels, the relative proportions of the two fuels can be manually controlled by turning the hand wheel 17 to adjust the position of the slide block 10.

It is to be understood that the screw-threaded spindle 16 and hand wheel 17 are given only as an example of a convenient means of adjusting the slide block 10, and that any other means of adjusting the slide block may be provided.

If it is desirable for one fuel to be ignited by electrical spark ignition, the slide block 10 may be arranged so that, when it is moved to its extreme position in which the fuel supplied requires electrical spark ignition, the slide block 10 will cause electrical spark ignition apparatus to come into operation, e.g. the slide block may actuate an electrical contact to complete an electrical ignition actuating circuit.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An internal combustion engine of the character described wherein the oscillatory link or like member is oscillated only by the movement of a regulating member and only when the latter is actuated by hand or by an engine speed governor or by a mechanically or electrically-controlled engine regulator, so that the oscillatory member and the transmission members remain stationary at any constant engine speed.

2. An engine as claimed in claim 1 in which the fuel supply is effected through independently driven fuel pumps or fuel supply pipes controlled by valves and the supply of fuel through said pumps or valves is varied by any movement of the transmission members.

3. An internal combustion engine according to claim 1 or 2 wherein the link or equivalent member oscillates about a fixed pivotal axis situated in the length of the link member, and the slide element is such that, in either extreme position, one of its pivotal connections to the transmission members is in a neutral position coinciding with the said pivotal axis.

4. An internal combustion engine according to claim 3 wherein the slide element is adjustable by means of a hand wheel and a screw-threaded rod, substantially as described.

5. In an internal combustion engine using alternative fuels, fuel control mechanism arranged and operating substantially as herein described with reference to the accompanying drawings.

Dated this 22nd day of September, 1939.

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[This Drawing is a reproduction of the Original on a reduced scale.]

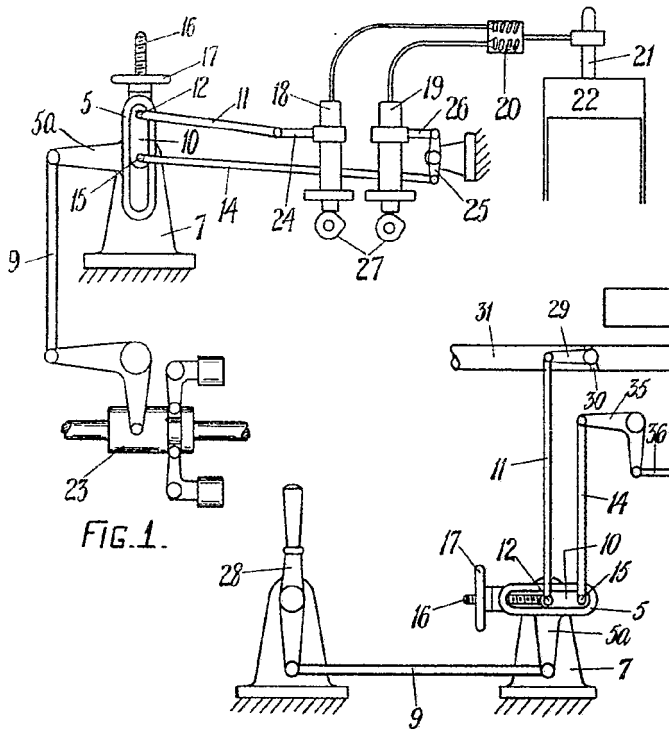


FIG. 1.

FIG. 2.

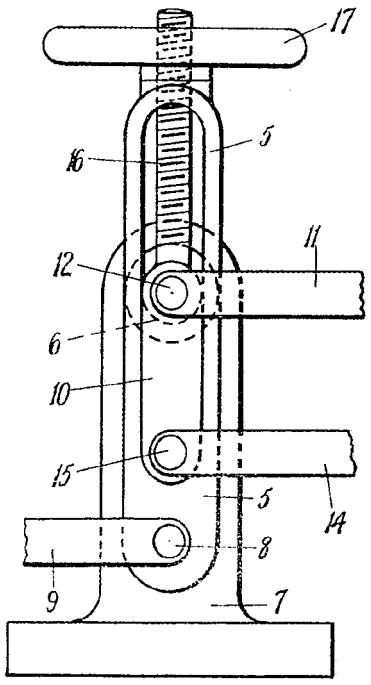


FIG. 3.

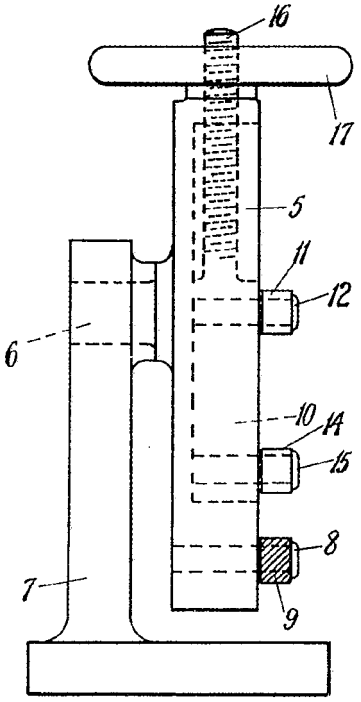


FIG. 4.

Malby & Sons, Photo-Lith.

Espacenet

Bibliographic data: DE102006008524 (A1) — 2006-08-31

Multi-way valve arrangement for use as fuel tank-change-over-valve, has valve device including two multi-way partial valves, which are symmetrical and co-operating with one another, where partial valves are designed as gate valves

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Classification: **- international:** ***F16K11/22***
- cooperative: F16K11/07 (EP); F16K11/22 (EP)

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Abstract of DE102006008524 (A1)

The arrangement has valve device provided such that supply-tank connections (A1, B1) are alternatively connected with supply-engine connection (M1) and return-tank connections (A2, B2) are alternatively connected with return-engine connection (M2). The valve device includes a two multi-way partial valves (V1, V2), which are symmetrical and co-operating with one another. The partial valves are designed as gate valves.

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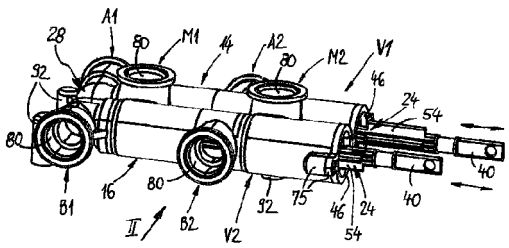
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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **Mehrwege-Ventilanordnung**

(57) Zusammenfassung: Die Erfindung betrifft eine Mehrwege-Ventilanordnung (1) zur Verwendung als Kraftstofftank-Umschaltventil zwischen mindestens zwei Kraftstofftanks (A, B) und einem Motor (M) in einem Kraftfahrzeug, mit mindestens zweimal zwei Tankanschlüssen (A1, A2; B1, B2) jeweils für Vorlauf und Rücklauf und zwei Motoranschlüssen (M1, M2) für Vorlauf und Rücklauf sowie mit einer Ventileinrichtung, derart, dass die Vorlauf-Tankanschlüsse (A1, B1) alternativ oder gemeinsam mit dem Vorlauf-Motoranschluss (M1) und die Rücklauf-Tankanschlüsse (A2, B2) alternativ oder gemeinsam mit dem Rücklauf-Motoranschluss (M2) verbindbar sind. Die Ventileinrichtung besteht aus mindestens zwei zusammenwirkenden, schalttechnisch symmetrischen Mehrwege-Teilventilen (V1, V2), insbesondere 4/2-Wege-Ventilen, die insbesondere als zusammenwirkende Schieberventile (14, 16) ausgebildet sind.



Beschreibung

[0001] Die vorliegende Erfindung betrifft eine Mehrwege-Ventilanordnung zur Verwendung als Kraftstofftank-Umschaltventil zwischen zwei Kraftstofftanks und einem Motor in einem Kraftfahrzeug, mit zweimal zwei Tankanschlüssen jeweils für Vorlauf und Rücklauf und zwei Motoranschlüssen für Vorlauf und Rücklauf sowie mit einer Ventileinrichtung derart, dass die Vorlauf-Tankanschlüsse alternativ oder gemeinsam mit dem Vorlauf-Motoranschluss und die Rücklauf-Tankanschlüsse alternativ oder gemeinsam mit dem Rücklauf-Motoranschluss verbindbar sind.

Stand der Technik

[0002] In bestimmten Regionen der Erde, beispielsweise in den U.S.A., werden im Fernverkehr mit Lastkraftwagen große Strecken zwischen Gebieten mit hohen Durchschnittstemperaturen und Gebieten mit sehr niedrigen Temperaturen zurückgelegt. Da LKW's üblicherweise mit Diesel-Kraftstoff betrieben werden, tritt dabei das Problem auf, dass "Normal-Diesel" bei etwa –15°C einfriert. Deshalb müssen Diesel-Fahrzeuge bei niedrigeren Temperaturen mit einem anderen, speziellen Kraftstoff betrieben werden, dem sogenannten "Arktic-Diesel", der auch bei Temperaturen bis –40°C noch flüssig bleibt. Arktic-Diesel ist allerdings um ca. 10 % bis 15 % teuerer als Normal-Diesel und verursacht zudem auch einen um etwa 10 % bis 15 % höheren Kraftstoff Verbrauch. Deshalb soll vermieden werden, das Fahrzeug nur, d. h. auch in wärmeren Regionen, mit Arktic-Diesel zu betreiben. Allerdings ist es nicht praktikabel und auch nicht rentabel, das gesamte Kraftstoffsystem mit Tanks) und Leitungen bei einem Wechsel zwischen warmen und kalten Regionen umzustellen, d. h. vollständig zu entleeren und neu zu befüllen.

[0003] Schwere LKW's sind heute üblicherweise mit (mindestens) zwei Kraftstofftanks ausgerüstet. Daraus ergibt sich die Möglichkeit, je nach Einsatzfall die Tanks mit gleicher oder unterschiedlicher Kraftstoffart zu betanken. Mit Hilfe einer Ventilanordnung der eingangs beschriebenen Art können dann die Tanks einzeln oder gemeinsam mit dem Motor verbunden werden.

[0004] Eine bekannte Ventilanordnung der genannten, gattungsgemäßen Art ist als Mehrfachventil aus Metall ausgebildet und besteht aus vielen miteinander verschraubten Einzelteilen, und zwar aus vier 2/2-Wege-Ventilen, die über zwei T-Verteiler verbunden sind. Jedes Einzelventil ist als Kugelventil ausgebildet und wird mechanisch über Zug/Schub-Stangen bedient. Dabei treten einige bedeutende Nachteile auf:

- lange Betätigungswege der Hebel-Gestänge (150 bis 160 mm)
- hohes Gewicht (ca. 2, 5 kg)
- verschraubte Anschlüsse sind nicht oder nur schwer richtungsverstellbar (bezüglich der Verlaufsrichtung von angeschlossenen Leitungen)
- hoher Material- und Montageaufwand
- hohe Betätigungskraft
- nur direkte manuelle Betätigung möglich, wozu der Fahrer anhalten und das Führerhaus verlassen muß.

Aufgabenstellung

[0005] Der vorliegenden Erfindung liegt die Aufgabe zugrunde, eine zur Vermeidung der beschriebenen Nachteile verbesserte Mehrwege-Ventilanordnung der genannten Art zu schaffen, die sich insbesondere durch reduzierten Material- und Montageaufwand, geringes Gewicht und geringe Betätigungskraft mit der daraus resultierenden Möglichkeit einer automatischen (Fern-) Betätigung auszeichnet.

[0006] Erfindungsgemäß wird dies durch die Merkmale des Anspruchs 1 erreicht. Vorteilhafte Ausgestaltungen der Erfindung sind in den abhängigen Ansprüchen enthalten.

[0007] Demnach besteht die Ventileinrichtung erfindungsgemäß aus (mindestens) zwei schaltungstechnisch bezüglich der vorhandenen Anschlüsse symmetrischen Teilventilen, die insbesondere als 4/2-Wege-Ventile beliebiger Bauart, bevorzugt aber als Schieberventile ausgebildet sind. Somit handelt es sich vorzugsweise um ein Doppel-Schieberventil mit zwei zusammenwirkenden Schieberventilen. Dies stellt eine kostengünstige Lösung dar, die mit minimalem Aufwand alle Funktionen der bekannten Ventilanordnung erfüllt, dabei aber aus sehr wenigen Einzelkomponenten besteht. Daraus resultiert auch ein geringer Herstellungs- und Montageaufwand. Der Einsatz von Schieberventilen ist auch bezüglich der Durchflusseigenschaften sehr vorteilhaft, weil große Strömungsquerschnitte realisiert werden können. So müssen keine Dichtungen umströmt werden, so dass die Strömungsquerschnitte innerhalb der Ventilanordnung sogar um etwa 20 % größer sein können, als in den angeschlossenen Leitungen, und dies sogar ohne größere Einbaumaße der Ventilanordnung. Die zur Betätigung notwendigen Schaltwege können kleiner als 30 mm gehalten werden.

[0008] Die Betätigungskräfte sind derart gering, dass auch ein Schalten mit automatischen Mitteln, insbesondere elektromagnetisch oder pneumatisch, möglich ist. Zudem kann gegenüber der bekannten Ausführung eine Gewichtsreduzierung von mindestens 50 % (bei manueller Betätigung) bzw. von mindestens 20 % (bei automatischer Betätigung) erreicht werden. Schließlich können alle Anschlüsse auf recht einfache Weise, insbesondere durch Verwendung von Steckverbindungen, richtungseinstellbar, ausgelegt sein.

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[0009] Jedes Teilventil weist zwei Tankanschlüsse für Vor- und Rücklauf und zwei Motoranschlüsse für Vor- und Rücklauf auf, wobei die Vorlauf-Motoranschlüsse der Teilventile miteinander zu einem gemeinsamen Vorlauf-Motoranschluss sowie die Rücklauf-Motoranschlüsse der Teilventile miteinander zu einem gemeinsamen Rücklauf-Motoranschluss verbunden sind.

[0010] Es sei an dieser Stelle bemerkt, dass das bevorzugte Doppel-Schieberventil grundsätzlich auch unabhängig von der speziellen Anwendung eingesetzt werden kann, und zwar als 6/3- bzw. 6/4-Wege-Ventil.

Ausführungsbeispiel

[0011] Anhand von in der Zeichnung veranschaulichten, bevorzugten Ausführungsbeispielen soll die Erfindung genauer erläutert werden. Dabei zeigen:

[0012] Fig. 1 eine Perspektivansicht einer erfindungsgemäßen Ventilanordnung (ohne endseitige Deckelelemente),

[0013] Fig. 2 eine Seitenansicht der Ventilanordnung in Pfeilrichtung II gemäß Fig. 1,

[0014] Fig. 3 einen Axialschnitt in der Ebene III-III gemäß Fig. 2,

[0015] Fig. 4 einen weiteren Axialschnitt in der zur Ansicht nach Fig. 3 senkrechten Schnittebene IV-IV gemäß Fig. 3,

[0016] Fig. 5 eine Ausschnittvergrößerung des Bereichs V in Fig. 4,

[0017] Fig. 6 eine vergrößerte Ansicht eines Deckelelementes in Pfeilrichtung VI gemäß Fig. 7,

[0018] Fig. 7 einen Schnitt in der Ebene VII-VII in Fig. 6,

[0019] Fig. 8 eine teilweise geschnittene Seitenansicht eines Einzelteils, und zwar eines Schiebers, der erfindungsgemäßen Ventilanordnung,

[0020] Fig. 9 einen Querschnitt in der Ebene IX-IX gemäß Fig. 8,

[0021] Fig. 10 bis Fig. 13 Darstellungen analog zu Fig. 3 in verschiedenen Schaltstellungen der erfindungsgemäßen Ventilanordnung,

[0022] Fig. 14 eine Seitenansicht der Ventilanordnung in einer vorteilhaften Ausgestaltung mit einer Druckmittel-Betätigungseinrichtung,

[0023] Fig. 15 einen Axialschnitt in der Ebene XV-XV in Fig. 14,

[0024] Fig. 16 eine vergrößerte Darstellung des Bereichs XVI der Betätigungseinrichtung in Fig. 15,

[0025] Fig. 17 eine vergrößerte Axialschnittansicht eines Einzelteils, und zwar eines Betätigungskolbens, der Betätigungseinrichtung gemäß Fig. 15 bzw. Fig. 16,

[0026] Fig. 18 eine Stirnansicht des Betätigungskolbens in Pfeilrichtung XVIII gemäß Fig. 17,

[0027] Fig. 19 eine Seitenansicht in Pfeilrichtung XIX in Fig. 18,

[0028] Fig. 20 einen weiteren Axialschnitt in der Ebene XX-XX in Fig. 18,

[0029] Fig. 21 eine weitere Ansicht eines Deckelelementes in einer gegenüber Fig. 6 alternativen Ausführung,

[0030] Fig. 22 einen Teilschnitt der Ventilanordnung entsprechend der Schnittlinie XII-XII in Fig. 15 mit zusätzlicher Darstellung von Anschlußsteckern und

[0031] Fig. 23 ein vereinfachtes Schaltbild der erfindungsgemäßen Ventilanordnung als Umschaltventil zwischen zwei Kraftstofftanks und einem Motor, beispielhaft in einer Schaltstellung wie in Fig. 13.

[0032] In den verschiedenen Figuren der Zeichnung sind gleiche Teile stets mit den gleichen Bezugszeichen versehen.

[0033] Wie sich zunächst aus Fig. 23 ergibt, wird eine erfindungsgemäße Mehrwege-Ventilanordnung **1** insbesondere als Kraftstofftank-Umschaltventil zwischen zwei Kraftstofftanks A und B und einem nur schematisch angedeuteten Motor M in einem Kraftfahrzeug (LKW) eingesetzt. Die Ventilanordnung **1** weist dazu zweimal zwei Tankanschlüsse A1, A2 für den Tank A und B1, B2 für den Tank B auf, wobei die Anschlüsse A1 und B1 als Vorlauf-Tankanschlüsse für je eine vom Tank A bzw. B zur Ventilanordnung **1** führende Tank-Saugleitung **2**, **4** und die Anschlüsse A2 und B2 als Rücklauf-Tankanschlüsse für je eine zurück in Richtung Tank A bzw. B führende Rücklaufleitung **6**, **8** fungieren. Ferner weist die Ventilanordnung **1** zwei Motoranschlüsse M1 und M2 auf, wobei der Anschluss M1 als Vorlauf-Motoranschluss für eine zum Motor M führende Vorlaufleitung **10** und der Anschluss M2 als Rücklauf-Motoranschluss für eine vom Motor M kommende Rücklaufleitung **12** vorgesehen sind. Die Ventilanordnung **1** weist weiterhin eine Ventileinrichtung derart auf, dass die Vorlauf-Tankanschlüsse A1, B1 alternativ oder gemeinsam mit dem Vorlauf-Motoranschluss M1 und die Rücklauf-Tankanschlüsse A2, B2 alternativ oder ge-

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meinsam mit dem Rücklauf-Motoranschluss M2 verbindbar sind. Dadurch kann alternativ entweder der Tank A oder der Tank B mit dem Motor verbunden werden, oder es können beide Tanks A und B parallel mit dem Motor verbunden werden. Vorzugsweise ist noch eine vierte Schaltstellung vorgesehen, wobei beide Tanks A und B vom Motor M getrennt, d. h. abgesperrt sind. Diese vierte Schaftstellung (siehe Fig. 10) kann beispielsweise – durch eine geeignete Steuerung betätigt – den Kraftstoff zwangsweise absperren, um als Wegfahrsperre zu dienen oder als Sicherheitsventil bei einem Unfall einen ungewollten Kraftstoffaustritt aus beschädigten Leitungen oder Aggregaten zu verhindern. In Fig. 23 ist beispielhaft die Schaltstellung dargestellt, wobei der Tank B mit dem Motor M verbunden ist, während der andere Tank A abgesperrt ist. Zu den anderen Schaltstellungen wird bereits an dieser Stelle auf die Fig. 10 bis Fig. 13 verwiesen.

[0034] Erfindungsgemäß besteht nun die Ventileinrichtung **1** aus zwei zusammenwirkenden, Mehrwege-Teilventilen V1, V2, insbesondere Schieberventilen **14** und **16**. Jedes Teilventil V1, V2 bzw. Schieberventil **14**, **16** ist als 4/2-Wege-Ventil ausgebildet und weist zwei der Tankanschlüsse, und zwar einerseits A1 und A2 und andererseits B1 und B2, für Vor- und Rücklauf auf. Die Motoranschlüsse M1 und M2 sind mit beiden Schieberventilen **14**, **16** verbunden. Daraus resultiert insgesamt ein Aufbau als 6/3- oder 6/4-Wege-Ventil mit sechs Anschlüssen und mindestens drei, vorzugsweise vier Schaltstellungen.

[0035] Jedes Schieberventil **14**, **16** weist ein Ventilgehäuse **18** und einen in einem länglichen, zylinderartigen Schieberraum **20** innerhalb des Ventilgehäuses **18** in Richtung einer Schieberachse **22** kolbenartig zwischen (mindestens) zwei Schaltstellungen längsverschiebbaren Schieber **24** auf (vgl. hierzu auch die gesonderte Darstellung in Fig. 8). Jeder Schieberraum **20** weist an axial, d. h. in Richtung der Schieberachse **22** versetzten Stellen vier Steueröffnungen **26** auf, die jeweils mit einem der Tankanschlüsse A1, A2 bzw. B1, B2 bzw. einem der Motoranschlüsse M1 bzw. M2 verbunden sind. Je nach Stellung der Schieber **24** können die Steueröffnungen **26** paarweise verbunden oder gegeneinander abgesperrt werden.

[0036] In der bevorzugten Ausführung sind die zwei Schieberventile **14**, **16** direkt benachbart und bezüglich ihrer Schieberachsen **22** parallel zueinander angeordnet. In weiterer vorteilhafter Ausgestaltung sind dabei die beiden Ventilgehäuse **18** zu einem monolithisch einstückigen Gehäuse-Formteil **28** zusammengefasst. Dieses Formteil **28** ist insbesondere als Kunststoff-Spritzteil oder als Druckgussteil beispielsweise aus Aluminium oder Zink ausgebildet. Auch dies trägt zu einer wirtschaftlichen Herstellung bei. Grundsätzlich kann aber das Formteil **28** auch aus Vollmaterial durch eine spanende Bearbeitung hergestellt werden.

[0037] Das einstückige Gehäuse-Formteil **28** mit den beiden Ventilgehäusen **18** ist bezüglich einer mittigen Symmetrieebene **30** spiegelsymmetrisch ausgebildet. Dabei erstrecken sich die Tankanschlüsse A1, A2 und B1 und B2 jeweils mit zur Symmetrieebene **30** paralleler oder senkrechter Verlaufsrichtung von dieser weg nach außen. Die Motoranschlüsse M1, M2 sind mittig mit einer der Symmetrieebene **30** entsprechenden Verlaufsrichtung angeordnet. Somit liegen die Motoranschlüsse M1, M2 mittig zwischen den beiden Schieberventilen **14**, **16**. Jeder Motoranschluss M1, M2 geht in einen Kanal über, der zur Bildung der zugehörigen Steueröffnungen **26** die Schieberräume **20** beider Schieberventile **14**, **16** anschneidet. Dadurch sind auf einfache Weise die Motoranschlüsse M1, M2 mit beiden Schieberventilen **14** und **16** verbunden.

[0038] Jeder Schieber **24** weist an axial beabstandeten Stellen Umfangsdichtungen **32** auf, die mit inneren Dichtflächen des jeweiligen Ventilgehäuses **18** zusammenwirken. Dabei besteht jeder Schieber **24** – siehe insbesondere Fig. 8 – aus einem zentrischen, axialen Kern **36** und mehreren, in der dargestellten Ausführung vier, radialen tellerartigen Ventilscheiben **38** sowie einem einseitig aus dem jeweiligen Ventilgehäuse **18** nach außen geführten Betätigungsende **40**. Jede Ventilscheibe **38** trägt auf ihrem Außenumfang vorzugsweise in einer Ringnut **42** eine der Umfangsdichtungen **32**. Die Umfangsdichtungen **32** können von elastischen O-Ringen gebildet sein. Gemäß Fig. 8 ist es vorteilhaft, wenn die Ventilscheiben **38** im Bereich radial zwischen dem Kern **36** und dem äußeren Umfang axiale Hinterschneidungen **44** aufweisen. Bei einer bevorzugten Herstellung der Schieber **24** als einstückige Kunststoff-Formteile werden durch die Hinterschneidungen **44** vorteilhafterweise Materialanhäufungen und damit ein Verzug vermieden. Diese Hinterschneidungen **44** werden bei der Fertigung durch eine sogenannte Springkerntechnik entformt.

[0039] In weiterer vorteilhafter Ausgestaltung der Erfindung ist hierbei vorgesehen, dass die Umfangsdichtungen **32** bezüglich ihrer Außendurchmesser D1, D2, D3 (siehe hierzu Fig. 8) sowie die Dichtflächen **34** bezüglich ihrer Innendurchmesser D'1, D'2 und D'3 (siehe Fig. 4) in Anpassung aneinander derart ausgelegt sind, dass jede Umfangsdichtung **32**, die sich bei einem Schaltvorgang axial über den Bereich einer der Steueröffnungen **26** hinweg bewegt (im dargestellten Beispiel sind dies die Dichtungen **32b** und **32d**; siehe Fig. 4 und Fig. 8), in ihrem sich axial über die jeweilige Steueröffnungen **26** hinweg erstreckenden Bewegungsbereich radial im Wesentlichen unverpresst ist und erst in einem jeweils axial zwischen zwei voneinander zu trennenden Steueröffnungen **26** liegenden Dichtbereich radial verpresst

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wird. Durch diese vorteilhafte Maßnahme wird vermieden, dass eine der Umfangsdichtungen **32** bei ihrer Bewegung über eine seitlich in den Schieberraum **20** mündende Steueröffnung **26** hinweg beschädigt werden könnte, denn in einem verpressten Zustand könnte sich die Dichtung in die Steueröffnung **26** hinein ausdehnen und bei der weiteren Bewegung am Öffnungsrand hängenbleiben und so beschädigt werden. Dies wird durch die erfindungsgemäße Maßnahme vermieden. Konkret ist bei der bevorzugten Ausführung vorgesehen, dass der Schieberraum **20** jedes Ventilgehäuses **18** ausgehend von einem für das Betätigungsende **40** des Schiebers **24** offenen Ende **46** mehrere axial über konische Übergänge **48** ineinander übergehende, im Wesentlichen zylindrische Dichtflächen **34a** bis c aufweist, deren Innendurchmesser D'1 bis D'3 sich sukzessive über die konischen Übergänge **48** verkleinern (siehe nochmals Fig. 4). Es sei bemerkt, dass die Dichtflächen **34** auch jeweils schwach konisch, d. h. mit einem kleinen Konuswinkel ≤ 1°, ausgebildet sein können. Dies ermöglicht eine vereinfachte Entformbarkeit bei der Herstellung als Spritz- oder Druckgussteil. Die Auslegung der Durchmesser muss dabei in Relation zu den zugehörigen Umfangsdichtungen natürlich so sein, dass jede Umfangsdichtung **32** in ihrer Dichtstellung im Bereich der zugehörigen Dichtfläche **34** eine sichere Abdichtung gewährleistet. Was den Schieber **24** betrifft (siehe Fig. 8), so weist die – ausgehend vom Betätigungsende **40** – erste Umfangsdichtung **32a** einen Durchmesser D1 auf, der an den Innendurchmesser D'1 der ersten Dichtfläche **34a** so angepasst ist, dass diese Umfangsdichtung **32a** zur Abdichtung verpresst ist. Damit dient diese erste Umfangsdichtung **32a** zur ständigen Abdichtung des Schieberraums **20** nach außen in Richtung des offenen Endes **46**. Die nächste, zweite Umfangsdichtung **32b** weist demgegenüber einen reduzierten Durchmesser D2 auf, so dass diese zweite Umfangsdichtung **32b** im Bereich der ersten Dichtfläche **34a** nicht oder zumindest nicht vollständig radial verpresst ist. Dadurch kann sie sich über den Bereich der ersten Steueröffnung **26** hinweg schadlos bewegen. Im Anschluss daran wird diese zweite Umfangsdichtung **32b** über den konischen Übergang **48** radial verpresst, bis sie dann dichtend auf der zweiten Dichtfläche **34b** mit dem Innendurchmesser D'2 anliegt. In analoger Weise verhält sich dies auch mit der dritten und vierten Umfangsdichtung **32**. So liegt die dritte Umfangsdichtung **32c** in jeder Stellung radial verpresst und dadurch dichtend an der Dichtfläche **34b** an. Ihr Durchmesser D2 entspricht demgemäß etwa dem Innendurchmesser D'2. Die vierte und letzte Umfangsdichtung **32d** weist einen weiter reduzierten Durchmesser D3 auf, so dass sie folglich im Bereich dieser Dichtfläche **34b** mit dem Innendurchmesser D'2 nicht oder nur unwesentlich radial verpresst ist. Sie kann sich dadurch über den Bereich der weiteren Steueröffnung **26** schadlos hinweg bewegen und wird dann über den weiteren konischen Übergang **48** radial verpresst, und zwar entsprechend dem Innendurchmesser D'3 der sich anschließenden Dichtfläche **34c**.

[0040] Es ist zweckmäßig, wenn die Ventilgehäuse **18** an ihren offenen Enden **46** mit einem Deckelelement **50** verschlossen bzw. verschließbar sind. Vorzugsweise dient das Deckelelement **50** auch zur Führung des Betätigungsendes **40** des jeweiligen Schiebers **24**. Dazu weist das Deckelelement **50** jeweils eine Führungsöffnung **52** mit einer dem Querschnitt des Kerns **36** bzw. eines zusätzlichen Führungsabschnittes **54** entsprechenden Öffnungskontur auf. Im dargestellten Beispiel handelt es sich um einen von der Kreisform abweichenden, insbesondere etwa kreuzförmigen Querschnitt, siehe insbesondere Fig. 6, so dass auch eine Führung gegen Verdrehen um die Schieberachse **22** erreicht wird. Durch eine spezielle, insbesondere gegeneinander „verdrehte" Anordnung der Führungsöffnungen **52** (vgl. Fig. 6 und Fig. 21) wird eine definierte Einbaulage der Schieber **24** zur Korrektur von eventuellen, herstellungsbedingten Formabweichungen im Gehäuse **18** erreicht. Hierzu kann der Schieber **24** in der Form dem Gehäuse und dessen Formabweichung angepasst werden. Es ist dabei zudem vorteilhaft, wenn die einzelnen Deckelelemente **50** der beiden Ventilgehäuse **18** über einen Verbindungsabschnitt **56** zu einem einstückigen Teil, insbesondere einem einstückigen Kunststoff-Formteil, zusammengefasst sind.

[0041] In weiterer bevorzugter Ausgestaltung ist jeder Schieber **24** in jeder von zwei Schaltstellungen insbesondere über Rastmittel **58** kraftformschlüssig fixiert. Wie sich insbesondere aus Fig. 5 ergibt, kann als Rastmittel **58** jeweils ein Rastarm **60** im Bereich der Führungsöffnung **52** des Deckelelementes **50** vorgesehen sein, der mit einer Rastnase jeweils in eine Rastausnehmung **62** des Schiebers **24** bzw. des Führungsabschnittes **54** eingreift.

[0042] Wie nur in Fig. 3 stark schematisch angedeutet ist, ist es weiterhin vorteilhaft, wenn zur Schmutzabdichtung zwischen dem Betätigungsende **40** jedes Schiebers **24** und dem Ventilgehäuse **18** bzw. dem damit verbundenen Deckelelement **50** eine faltenbalgartig längenvariable Hülle **64** angeordnet ist.

[0043] In den Ausführungen gemäß Fig. 1 bis Fig. 13 sind die Schieber **24** manuell, insbesondere über nicht dargestellte mechanische Verbindungen, wie Gestänge oder Seilzüge, betätigbar.

[0044] Alternativ oder auch zusätzlich kann eine Betätigungseinrichtung **66** zur motorischen, insbesondere pneumatischen oder hydraulischen oder elektromagnetischen Betätigung der Schieber **24** vorgesehen sein.

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[0045] Hierzu wird auf das Ausführungsbeispiel gemäß Fig. 14 bis Fig. 16 verwiesen, wobei die Ventilgehäuse **18** auf der Seite der Betätigungsenden **40** der Schieber **24** – vorzugsweise zusätzlich zu dem Deckelelement **50** – mit jeweils einem Zylindergehäuse **68** verbunden sind. Die Schieber-Betätigungsenden **40** sind mit jeweils einem in dem Zylindergehäuse **68** geführten Betätigungskolben **70** verbunden. Jedes Zylindergehäuse **68** weist einen Steuerdruckanschluß S1 bzw. S2 auf. Dadurch kann der jeweilige Betätigungskolben **70** auf der Seite eines Arbeitsraums **71** mit einem Druckmittel beaufschlagt werden, um den zugehörigen Schieber **24** insbesondere gegen die Rückstellkraft einer Rückstellfeder **72** zu verschieben. Vorzugsweise ist dabei jeder Betätigungskolben **70** über Rastmittel **74** mit dem Betätigungsende **40** des zugehörigen Schiebers **24** verbunden. Hierzu wird auch auf die gesonderten Darstellungen des Betätigungskolbens **70** in Fig. 17 bis Fig. 20 hingewiesen. Um auf der dem Arbeitsraum **71** gegenüberliegenden Seite des Betätigungskolbens **70** bei der Druck-Betätigung innerhalb des Zylindergehäuses **68** einen Überdruck zu vermeiden bzw. abzubauen, weist das/jedes Zylindergehäuse **68** in diesem Bereich (mindestens) eine Lüftungsöffnung **67** auf, die vorzugsweise außen von einer membranventilartigen, ringbandförmigen Schmutzdichtung **69** überdeckt ist (siehe insbesondere Fig. 16).

[0046] Weiterhin ist es vorteilhaft, wenn die beiden Zylindergehäuse **68** der Betätigungseinrichtung **66** zu einem einstückigen Formteil zusammengefasst sind. Dieses Zylinder-Formteil wird bevorzugt im Bereich von seitlichen Montageansätzen **75** mit dem Gehäuse-Formteil **28** verschraubt, und zwar unter Zwischenlage des einteiligen Deckelelementes **50**. Dieses weist dann gemäß Fig. 21 korrespondierende Montageansätzen **75** mit Schraubenlöchern **76** auf. Zur Positionierung und Montagehilfe sind bevorzugt im Anlagebereich zwischen der Betätigungseinrichtung **66** und dem Deckelelement **50** sowie zwischen letzterem und dem Gehäuse **18** bzw. dem Gehäuse-Formteil **28** Positionsansätze **77** vorgesehen, die in korrespondierende Öffnungen eingreifen (siehe insbesondere Fig. 16). Durch eine unterschiedliche Anordnung und/oder Form, z.B. unterschiedliche Durchmesser, der Positionseinsätze **77** können die Teile nur korrekt und lagerichtig miteinander verbunden werden, so dass vorteilhafterweise eine Fehlmontage praktisch ausgeschlossen ist.

[0047] Bei der Alternative gemäß Fig. 2 bis Fig. 13 ist das Deckelelement **50** gemäß Fig. 6 über Rastmittel **78** mit den Ventilgehäusen **18** bzw. dem Gehäuse-Formteil **28** verrastbar.

[0048] Dabei kann auch die Betätigungseinrichtung **66** über Rastmittel befestigt werden (nicht dargestellt).

[0049] Es ist weiterhin zweckmäßig, wenn alle vorgesehenen Anschlüsse A1/2, B1/2, M1/2 und S1/2 als Kupplungsteile zum insbesondere richtungsvariablen Steckanschluss von Leitungen ausgebildet sind. Hierzu wird auf Fig. 22 verwiesen, wonach jeder Anschluss als muffenartige Aufnahmeöffnung **80** zum Einstecken eines Steckerteils **82** ausgebildet ist. Dabei sind zudem geeignete Arretiermittel **84** zum lösbaren Arretieren des eingesteckten Steckerteils **82** vorgesehen. Im dargestellten Beispiel weist jeder Anschluss im Mündungsbereich der Aufnahmeöffnung **80** einen radial nach außen ragenden Umfangsrand **86** auf, der im eingesteckten Zustand von äußeren, sich axial erstreckenden Rastarmen **88** des jeweiligen Steckerteils **82** rastend übergriffen wird. Zum Lösen können die Rastarme **88** radial nach außen gespreizt werden. Vorteil dieser Anschlussart ist, dass die Verlaufsrichtung der angeschlossenen Leitung (selbst nicht dargestellt) variabel ist, weil sich die Steckerteile **82** relativ zu den Anschlüssen verdrehen lassen. Im dargestellten Beispiel gemäß Fig. 22 weist jedes Steckerteil 82 zum Leitungsanschluss einen üblichen Anschlussdorn **90** auf.

[0050] Die Bestandteile der erfindungsgemäßen Ventilanordnung **1**, und zwar insbesondere die Ventilgehäuse **18** bzw. das einstückige Gehäuse-Formteil **28**, die Schieber **24** und vorzugsweise auch die Deckelelemente **50** und optional die Zylindergehäuse **68** und die Betätigungskolben **70**, bestehen vorzugsweise aus dem gleichen Material, und zwar insbesondere aus einem faserverstärkten Kunststoff, wie PA12-GF50. Dieses bevorzugte Material weist eine geringe Wasseraufnahme auf und eignet sich gut zur Anwendung mit Kraftstoffen, insbesondere Diesel. Durch Verwendung von gleichen Materialien für die Bestandteile werden Undichtigkeiten, die durch thermische Dehnung entstehen könnten, vermieden.

[0051] Das Gehäuse-Formteil **28** weist zur Montagebefestigung an einem nicht dargestellten Träger in einem Kraftfahrzeug mindestens zwei, bevorzugt drei außen angeformte Befestigungselemente **92** auf, die insbesondere derart gegenüber den Bereichen der Dichtflächen **34** axial und/oder radial versetzt angeordnet sind, dass bei der Montage ein Verzug des Formteils und daraus resultierende Formveränderungen im Bereich der Dichtflächen **34** weitgehend ausgeschlossen sind. Dies gewährleistet eine gute Funktionsfähigkeit und dauerhafte Dichtwirkung im Bereich der Umfangsdichtungen **32** und Dichtflächen **34**.

[0052] Die Funktion der erfindungsgemäßen Ventilanordnung **1** dürfte durch die obigen Erläuterungen des konstruktiven Aufbaus bereits hinreichend klar sein. Ergänzend wird auf die Darstellungen in den Fig. 10 bis Fig. 13 verwiesen. In Fig. 10 ist eine optionale Absperrstellung dargestellt, in der alle vorhandenen Anschlüsse voneinander getrennt sind.

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Fig. 11 zeigt die Ventilstellung zur Verbindung des Tanks A mit dem Motor M, indem A1 mit M1 und A2 mit M2 verbunden sind. Der Tank B ist vom Motor M abgesperrt. Die umgekehrte Schaltstellung ist in Fig. 13 dargestellt, wobei der Tank A abgesperrt und der Tank B mit dem Motor M verbunden ist. Schließlich zeigt Fig. 12 eine Stellung, in der beide Tanks A und B mit dem Motor M verbunden sind. Diese Schaltstellung ist vorgesehen für den Fall, dass beide Tanks mit dem selben Kraftstoff befüllt sind.

[0053] Die Absperrstellung gemäß Fig. 10 kann als Prüfstellung zur Dichtheitsprüfung vorgesehen sein. Dabei bilden sich im Ventil zwei Prüfkammern, die über die beiden Motoranschlüsse M1 und M2 mit einem Prüfdruck beaufschlagt werden können. Diese Prüfkammern werden von den Umfangsdichtungen **32** der Schieber **24** gedichtet. Im Falle eines gemessenen Druckabfalls des Prüfdruckes kann auf eine beschädigte oder gar fehlende Umfangsdichtung geschlossen werden.

[0054] Durch die beschriebene Ausgestaltung der Ventilanordnung **1** bzw. der beiden Schieberventile **14**, **16** werden Vor- und Rücklauf eines Tanks stets nur gemeinsam geschaltet. Dadurch sind Vertauschungen ausgeschlossen.

[0055] Es sei nochmals bemerkt, dass ein Schieberventil **14** bzw. **16** der beschriebenen Art bzw. ein Doppel-Schieberventil der bevorzugten Art auch unabhängig von der beschriebenen, speziellen Anwendung als Tank-Umschaltventil als allgemeines 4/2-bzw. 6/3- oder 6/4-Wege-Ventil verwendet werden kann.

[0056] Im Übrigen ist die Erfindung ohnehin nicht auf die beschriebenen Ausführungsbeispiele beschränkt, sondern erstreckt sich auch auf gleichwirkende Ausführungen. Ferner ist die Erfindung bislang auch noch nicht auf die im jeweils unabhängigen Anspruch definierte Merkmalskombination beschränkt, sondern kann auch durch jede beliebige andere Kombination von bestimmten Merkmalen aller insgesamt offenbarten Einzelmerkmalen definiert sein. Dies bedeutet, daß grundsätzlich praktisch jedes Einzelmerkmal des jeweils unabhängigen Anspruchs weggelassen bzw. durch mindestens ein an anderer Stelle der Anmeldung offenbartes Einzelmerkmal ersetzt werden kann. Insofern sind die Ansprüche lediglich als ein erster Formulierungsversuch für eine Erfindung zu verstehen.

Patentansprüche

1. Mehrwege-Ventilanordnung (**1**) zur Verwendung als Kraftstofftank-Umschaltventil zwischen mindestens zwei Kraftstofftanks (A, B) und einem Motor (M) in einem Kraftfahrzeug, mit mindestens zweimal zwei Tankanschlüssen (A1, A2; B1, B2). jeweils für Vorlauf und Rücklauf und zwei Motoranschlüssen (M1, M2) für Vorlauf und Rücklauf sowie mit einer Ventileinrichtung derart, dass die Vorlauf-Tankanschlüsse (A1, B1) alternativ oder gemeinsam mit dem Vorlauf-Motoranschluss (M1) und die Rücklauf-Tankanschlüsse (A2, B2) alternativ oder gemeinsam mit dem Rücklauf-Motoranschluss (M2) verbindbar sind, **dadurch gekennzeichnet**, dass die Ventileinrichtung aus mindestens zwei zusammenwirkenden, schalttechnisch symmetrischen Mehrwege-Teilventilen (V1, V2), insbesondere 4/2-Wege-Ventilen, besteht.

2. Ventilanordnung nach Anspruch 1, dadurch gekennzeichnet, dass die Teilventile (V1, V2) als zusammenwirkende Schieberventile (**14**, **16**) ausgebildet sind.

3. Ventilanordnung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass jedes Teilventil (V1, V2) zwei Tankanschlüsse (A1 und A2 bzw. B1 und B2) für Vor- und Rücklauf und zwei Motoranschlüsse für Vor- und Rücklauf aufweist, wobei die Vorlauf-Motoranschlüsse der Teilventile (V1, V2) miteinander zu einem gemeinsamen Vorlauf-Motoranschluss (M1) sowie die Rücklauf-Motoranschlüsse der Teilventile (V1, V2) miteinander zu einem gemeinsamen Rücklauf-Motoranschluss (M2) verbunden sind.

4. Ventilanordnung nach Anspruch 2 oder 3, dadurch gekennzeichnet, dass jedes Schieberventil (**14**, **16**) ein Ventilgehäuse (**18**) und einen in einem zylinderartigen Schieberraum (**20**) innerhalb des Ventilgehäuses (**18**) in Richtung einer Schieberachse (**22**) kolbenartig zwischen mindestens zwei Schaltstellungen längsverschiebbaren Schieber (**24**) aufweist, wobei jeder Schieberraum (**20**) an axial versetzten Stellen vier Steueröffnungen (**26**) aufweist, die jeweils mit einem der Tankanschlüsse (A1, A2 bzw. B1, B2) bzw. einem der Motoranschlüsse (M1 bzw. M2) verbunden sind.

5. Ventilanordnung nach einem der Ansprüche 2 bis 4, dadurch gekennzeichnet, dass die Schieberventile (**14**, **16**) direkt benachbart und bezüglich ihrer Schieberachsen (**22**) parallel zueinander angeordnet sind.

6. Ventilanordnung nach Anspruch 4 oder 5, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) der Schieberventile (**14**, **16**) zu einem monolithisch einstückigen Formteil (**28**) zuammengefasst sind.

7. Ventilanordnung nach Anspruch 6, dadurch gekennzeichnet, dass das Formteil (**28**) als Kunststoff-Spritzteil oder als Druckgussteil z.B. aus Aluminium oder Zink oder als spanend bearbeitetes Metall- oder Kunststoffteil ausgebildet ist.

8. Ventilanordnung nach einem der Ansprüche 4

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bis 7, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) bezüglich einer mittigen Symmetrieebene (**30**) spiegelsymmetrisch ausgebildet sind, wobei sich die Tankanschlüsse (A1, A2; B1, B2) jeweils mit zur Symmetrieebene (**30**) senkrechter oder paralleler Verlaufsrichtung von dieser weg nach außen erstrecken, und wobei die Motoranschlüsse (M1, M2) mittig mit einer der Symmetrieebene (**30**) entsprechenden Verlaufsrichtung angeordnet sind.

9. Ventilanordnung nach Anspruch 8, dadurch gekennzeichnet, dass jeder Motoranschluss (M1, M2) einen Kanal aufweist, der zur Bildung der zugehörigen Steueröffnungen (**26**) die Schieberräume (**20**) beider Schieberventile (**14**, **16**) anschneidet.

10. Ventilanordnung nach einem der Ansprüche 4 bis 9, dadurch gekennzeichnet, dass jeder Schieber (**24**) axial beabstandete Umfangsdichtungen (**32a**–d) aufweist, die mit inneren Dichtflächen (**34**) des jeweiligen Ventilgehäuses (**18**) zusammenwirken.

11. Ventilanordnung nach Anspruch 10, dadurch gekennzeichnet, dass jeder Schieber (**24**) aus einem zentrischen, axialen Kern (**36**) und mehreren, insbesondere vier, radialen, tellerartigen Ventilscheiben (**38**) sowie einem einseitig aus dem Ventilgehäuse (**18**) nach außen geführten Betätigungsende (**40**) besteht, wobei jede Ventilscheibe (**38**) auf ihrem Außenumfang in einer Ringnut (**42**) eine der Umfangsdichtungen (**32a**–d) trägt.

12. Ventilanordnung nach Anspruch 10 oder 11, dadurch gekennzeichnet, dass die Umfangsdichtungen (**32a**–d) bezüglich ihrer Außendurchmesser (D1–D3) sowie die Dichtflächen (**34a**–c) bezüglich ihrer Innendurchmesser (D'1–D'3) in Anpassung aneinander derart ausgelegt sind, dass jede Umfangsdichtung (**32b**, d), die sich bei einem Schaltvorgang axial über den Bereich einer der Steueröffnungen (**26**) bewegt, in ihrem sich axial über die Steueröffnung (**26**) hinweg erstreckenden Bewegungsbereich radial unverpresst und erst in einem jeweils axial zwischen zwei Steueröffnungen (**26**) liegenden Dichtbereich radial verpresst ist.

13. Ventilanordnung nach Anspruch 12, dadurch gekennzeichnet, dass der Schieberraum (**20**) jedes Ventilgehäuses (**18**) ausgehend von einem offenen Ende (**46**) mehrere axial über konische Übergänge (**48**) ineinander übergehende, zylindrische oder schwach konische Dichtflächen (**34a**–c) aufweist, deren Innendurchmesser (D'1 bis D'3) sich sukzessive über die konischen Übergänge (**48**) verkleinern.

14. Ventilanordnung nach einem der Ansprüche 4 bis 13, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) an ihren offenen Enden (**46**) mit einem Deckelelement (**50**) verschließbar sind, wobei vorzugsweise das Deckelelement (**50**) auch zur Führung des Betätigungsendes (**40**) des jeweiligen Schiebers (**24**) dient.

15. Ventilanordnung nach Anspruch 14, dadurch gekennzeichnet, dass das Deckelelement (**50**) jeweils eine Führungsöffnung (**52**) für einen Führungsabschnitt (**54**) des jeweiligen Schiebers (**24**) aufweist, wobei vorzugsweise eine bestimmte Drehlage mit Sicherung gegen Verdrehen der Schieber (**24**) vorgegeben ist.

16. Ventilanordnung nach einem der Ansprüche 4 bis 15, dadurch gekennzeichnet, dass jeder Schieber (**24**) in jeder von zwei Schaltstellungen insbesondere über Rastmittel (**58**) kraftformschlüssig fixiert ist.

17. Ventilanordnung nach einem der Ansprüche 4 bis 16, dadurch gekennzeichnet, dass zur Schmutzabdichtung zwischen dem Betätigungsende (**40**) jedes Schiebers (**24**) und dem Ventilgehäuse (**18**) bzw. dem damit verbundenen Deckelelement (**50**) eine faltenbalgartige Hülle (**64**) angeordnet ist.

18. Ventilanordnung nach einem der Ansprüche 4 bis 17, gekennzeichnet durch eine den Schiebern (**24**) zugeordnete Betätigungseinrichtung (**66**) zur manuellen oder motorischen, insbesondere pneumatischen oder hydraulischen oder elektromagnetischen Betätigung der Schieber (**24**).

19. Ventilanordnung nach einem der Ansprüche 3 bis 18, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) auf der Seite der Betätigungsenden (**40**) der Schieber (**24**) mit jeweils einem Zylindergehäuse (**68**) sowie die Schieber-Betätigungsenden (**40**) mit jeweils einem Betätigungskolben (**70**) verbunden bzw. verbindbar sind, wobei jedes Zylindergehäuse (**68**) einen zur Druckbeaufschlagung des Betätigungskolbens (**70**) in einen Arbeitsraum (**71**) mündenden Steuerdruckanschluss (S1, S2) aufweist.

20. Ventilanordnung nach Anspruch 19, dadurch gekennzeichnet, dass jedes Zylindergehäuse (**68**) auf der dem Arbeitsraum (**71**) gegenüberliegenden Seite des Betätigungskolbens (**70**) mindestens eine vorzugsweise mit einer ventilartigen Schmutzdichtung (**69**) ausgestattete Lüftungsöffnung (**67**) aufweist.

21. Ventilanordnung nach einem der Ansprüche 1 bis 20, dadurch gekennzeichnet, dass alle vorgesehenen Anschlüsse (A, B, M, S) als Kupplungsteile zum Steckanschluss von Leitungen ausgebildet sind, wobei vorzugsweise jeder Anschluss als muffenartige Aufnahmeöffnung (**80**) zum Einstecken eines Steckerteils (**82**) ausgebildet ist und Arretiermittel (**84**) zum lösbaren Arretieren des eingesteckten Steckerteils (**82**) vorgesehen sind.

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22. Ventilanordnung nach einem der Ansprüche 4 bis 21, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) bzw. das einstückige Formteil (**28**) und die Schieber (**24**) aus dem gleichen Material bestehen, insbesondere aus einem faserverstärkten Kunststoff, wie PA12-GF50.

23. Ventilanordnung nach einem der Ansprüche 4 bis 22, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) bzw. das Gehäuse-Formteil (**28**) mindestens zwei, insbesondere drei Befestigungselemente (**92**) aufweisen/aufweist, die insbesondere derart außerhalb der Bereiche der Dichtflächen (**34**) angeordnet sind, dass bei der Montage und/oder beim Herstellprozess verzugbedingte Verformungen im Bereich der Dichtflächen (**34**) vermieden werden.

24. Ventilanordnung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass im Verbindungsbereich zwischen dem Deckelelement (**50**) und dem Ventilgehäuse (**18**) bzw. dem Gehäuse-Formteil (**28**) und/oder im Verbindungsbereich zwischen der Betätigungseinrichtung (**66**) und dem Deckelelement (**50**) in korrespondierende Öffnungen eingreifende Positionsansätze (**77**) insbesondere derart vorgesehen sind, dass nur eine korrekte, lagerichtige Montage möglich ist.

25. Schieberventil (**14**, **16**) insbesondere für eine Ventilanordnung (**1**) nach einem der Ansprüche 1 bis 24, bestehend aus einem Ventilgehäuse (**18**) und einem in einem zylinderartigen Schieberraum (**20**) innerhalb des Ventilgehäuses (**18**) in Richtung einer Schieberachse (**22**) kolbenartig zwischen mindestens zwei Schaltstellungen längsverschiebbaren Schieber (**24**), der axial beabstandete Umfangsdichtungen (**32**) aufweist, die mit inneren Dichtflächen (**34**) des Schieberraums (**20**) zusammenwirken, um in den Schieberraum (**20**) mündende Steueröffnungen (**26**) und damit verbundene Anschlüsse (A1, A2, B1, B2, M1, M2) entweder zumindest paarweise zu verbinden oder gegeneinander abzusperren, dadurch gekennzeichnet, dass die Umfangsdichtungen (**32a**–d) bezüglich ihrer Außendurchmesser (D1–D3) sowie die Dichtflächen (**34a**–c) bezüglich ihrer Innendurchmesser (D'1–D'3) in Anpassung aneinander derart ausgelegt sind, dass jede sich bei einem Schaltvorgang axial über eine der Steueröffnungen (**26**) hinweg bewegende Umfangsdichtung (**32b**, d) in ihrem sich über die Steueröffnung (**26**) hinweg erstreckenden Bewegungsbereich radial unverpresst und erst in einem jeweils axial zwischen zwei Steueröffnungen (**26**) liegenden Dichtbereich radial verpresst ist.

26. Schieberventil nach Anspruch 25, dadurch gekennzeichnet, dass der Schieberaum (**20**) des insbesondere als einstückiges Formteil ausgebildeten Ventilgehäuses (**18**) ausgehend von einem offenen Ende (**46**) mehrere axial über konische Übergänge (**48**) ineinander übergehende, zylindrische oder schwach konische Dichtflächen (**34a**–c) aufweist, deren Innendurchmesser (D'1 bis D'3) sich sukzessive über die konischen Übergänge (**48**) verkleinern.

27. Schieberventil-Anordnung, gekennzeichnet durch zwei direkt benachbart und bezüglich ihrer Schieberachsen (**22**) parallel zueinander angeordnete Schieberventile (**14**, **16**) nach Anspruch **25** oder **26**.

28. Schieberventil-Anordnung nach Anspruch 27, dadurch gekennzeichnet, dass die beiden Ventilgehäuse (**18**) der Schieberventile (**14**, **16**) zu einem monolithisch einstückigen Formteil (**28**), insbesondere einem Kunststoff-Spritzteil oder einem Druckgussteil z.B. aus Aluminium oder Zink oder einem spanend bearbeiteten Metall- oder Kunststoffteil, zuammengefasst sind.

29. Schieberventil-Anordnung nach Anspruch 27 oder 28, dadurch gekennzeichnet, dass die Ventilgehäuse (**18**) bezüglich einer mittigen Symmetrieebene (**30**) spiegelsymmetrisch ausgebildet sind, wobei sich je zwei separate Anschlüsse (A1, A2; B1, B2) jeweils mit zur Symmetrieebene (**30**) senkrechter oder paralleler Verlaufsrichtung von dieser weg nach außen erstrecken, und wobei zwei gemeinsame Anschlüsse (M1, M2) mittig mit einer der Symmetrieebene (**30**) entsprechenden Verlaufsrichtung angeordnet sind.

30. Schieberventil nach Anspruch 25 oder 26 oder Anordnung nach einem der Ansprüche 27 bis 29, gekennzeichnet durch mindestens ein weiteres Merkmal der Ansprüche 1 bis 24.

31. Ventilgehäuse (**18**) für eine Ventilanordnung (**1**) nach einem der Ansprüche 1 bis 24 oder für ein Schieberventil (**14**, **16**) nach Anspruch 25 oder 26 oder 30.

32. Gehäuse-Formteil (**28**) für eine Ventilanordnung (**1**) nach einem der Ansprüche 1 bis 24 oder für eine Schieberventil-Anordnung nach einem der Ansprüche 27 bis 30.

33. Schieber (**24**) für eine Ventilanordnung (**1**) nach einem der Ansprüche 1 bis 24 oder für ein Schieberventil (**14**, **16**) nach Anspruch 25, 26 oder 30 oder für eine Schieberventil-Anordnung nach einem der Ansprüche 27 bis 30.

Es folgen 6 Blatt Zeichnungen

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Anhängende Zeichnungen

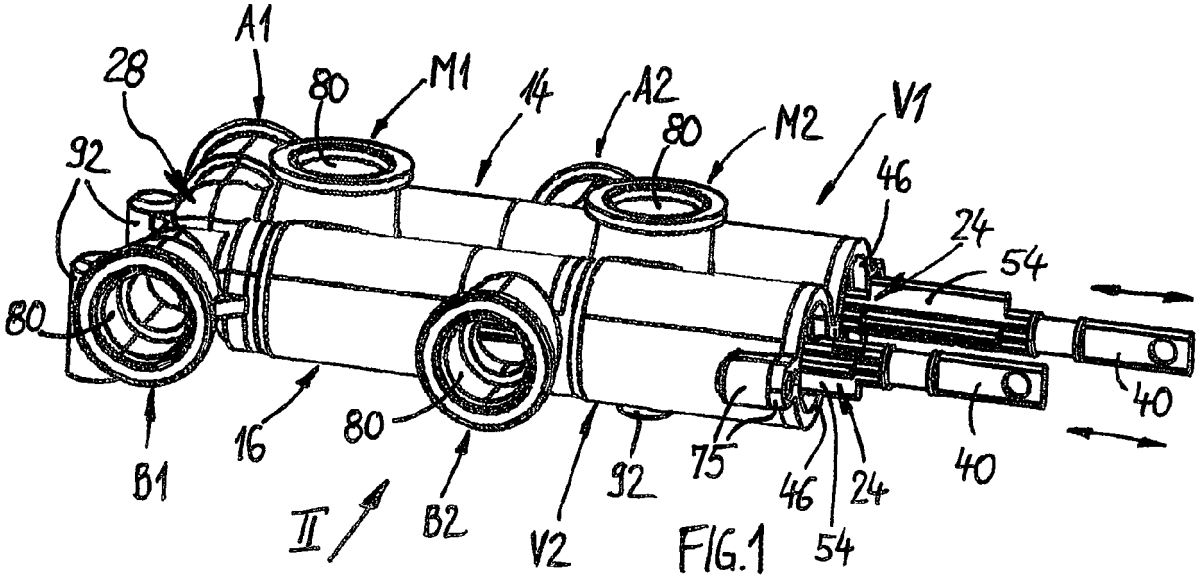


FIG.1

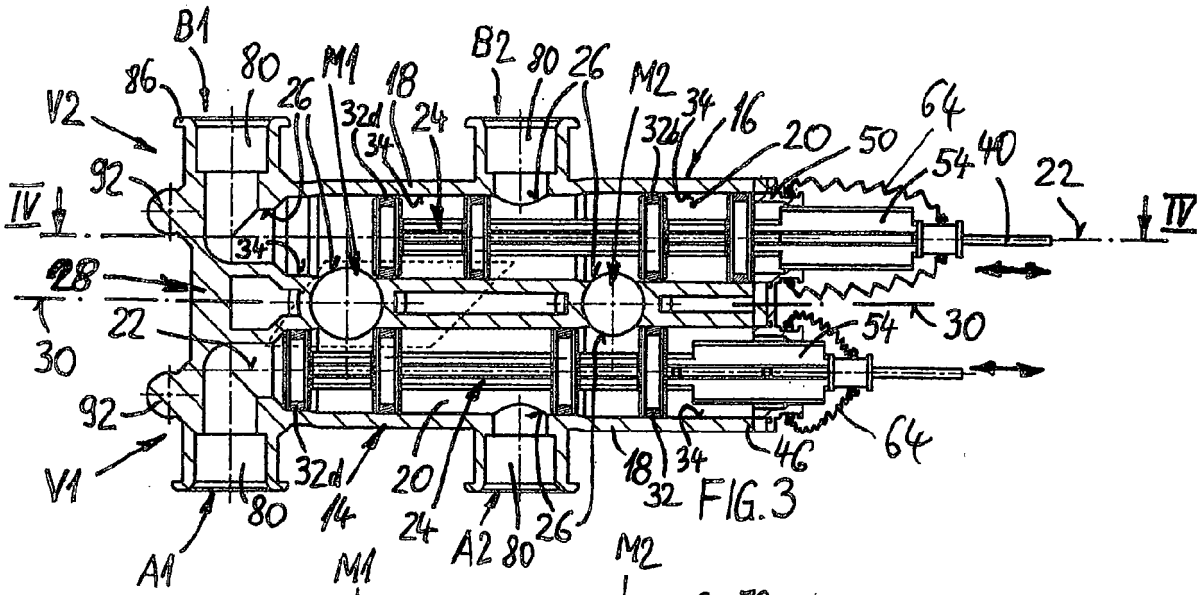


FIG.2

FIG.3

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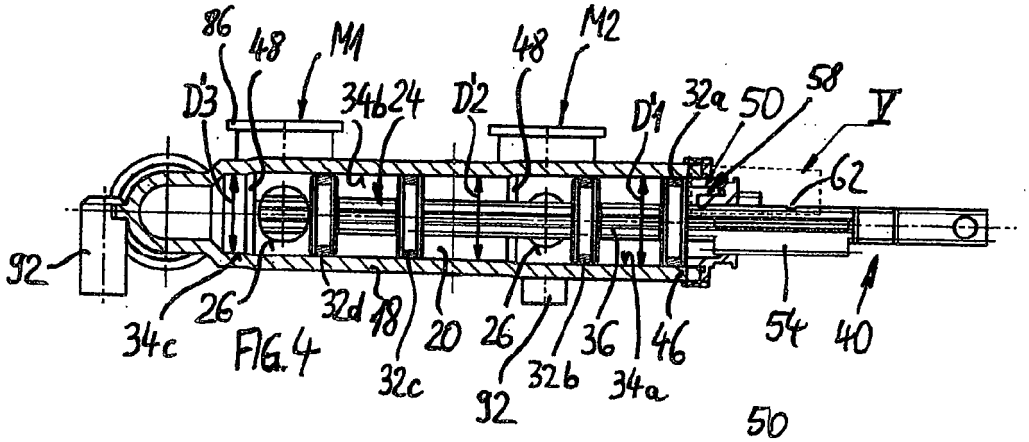


FIG.4

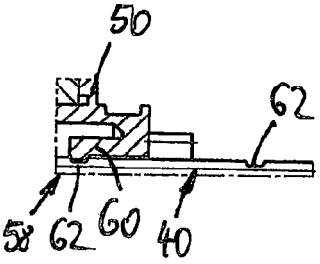


FIG.5

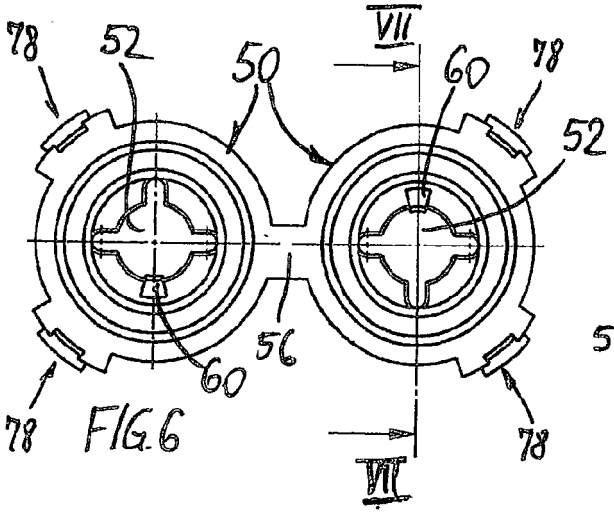


FIG.6

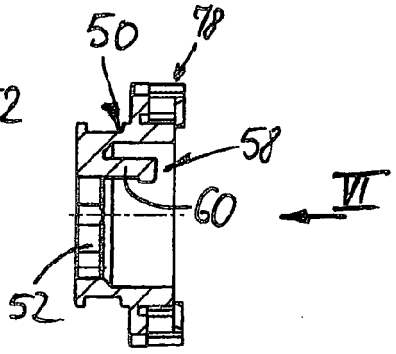


FIG.7

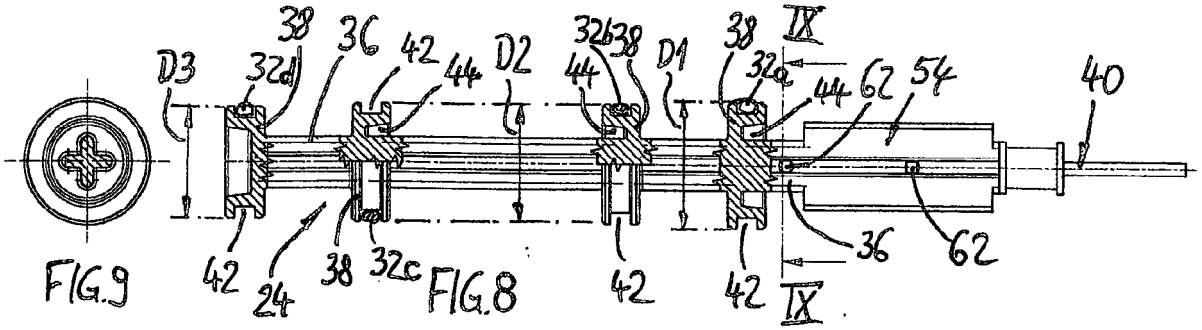


FIG.9

FIG.8

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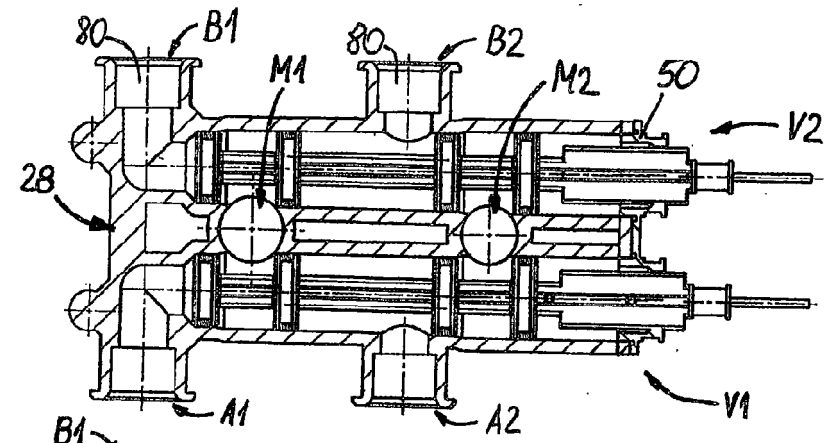


FIG. 10

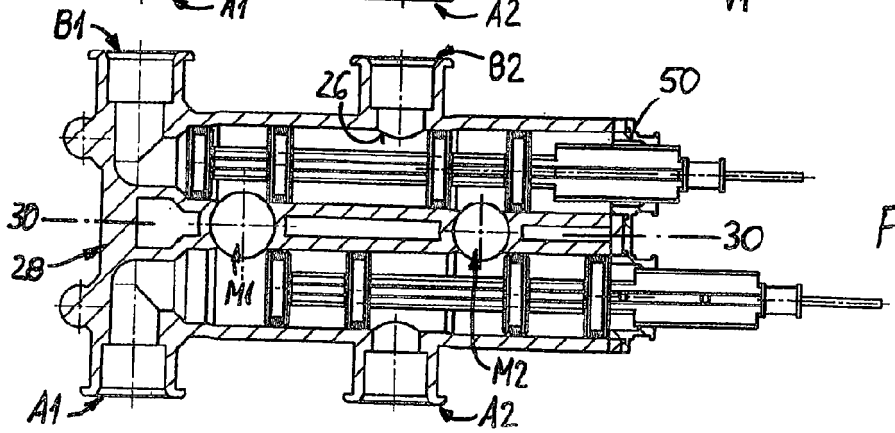


FIG. 11

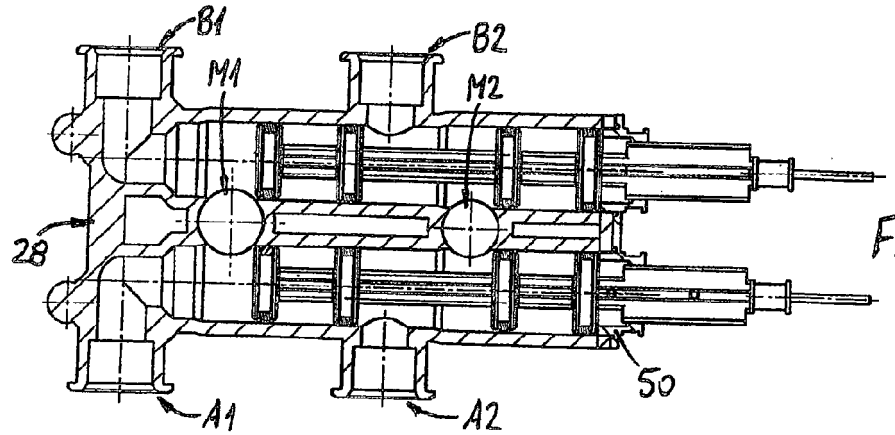


FIG. 12

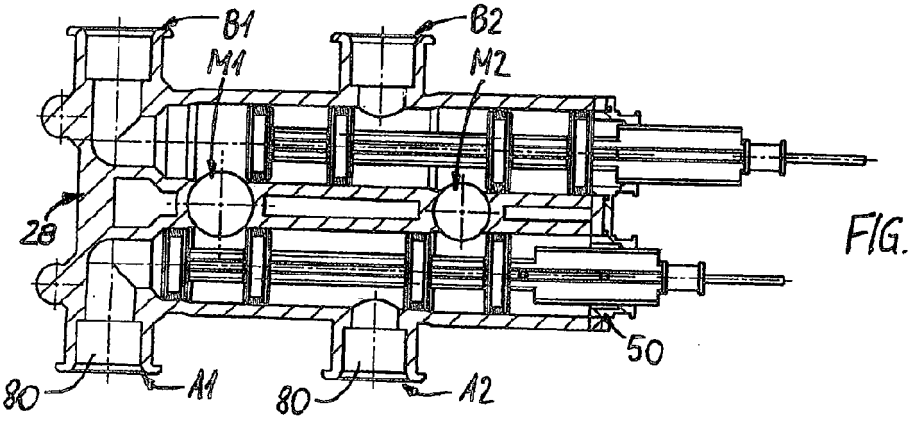


FIG. 13

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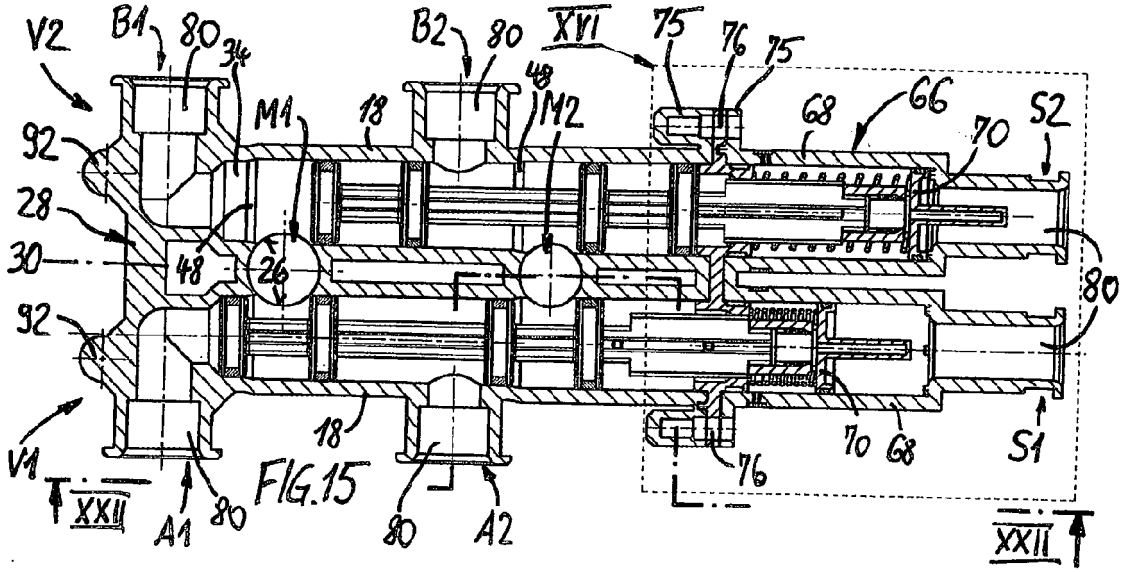


FIG.15

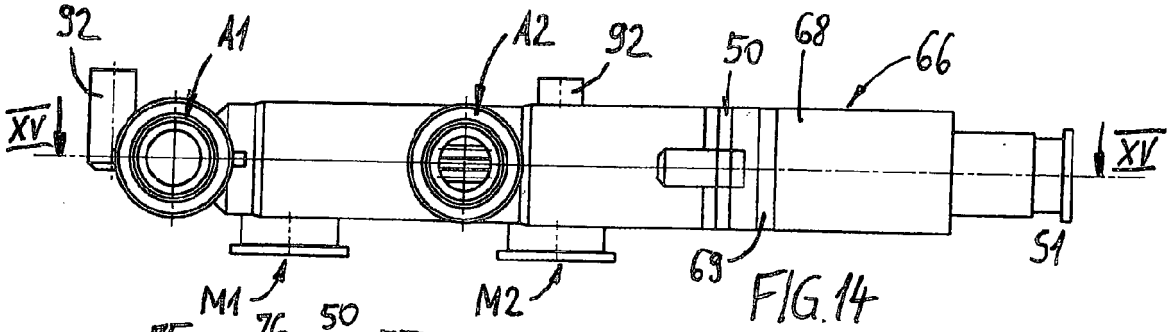


FIG.14

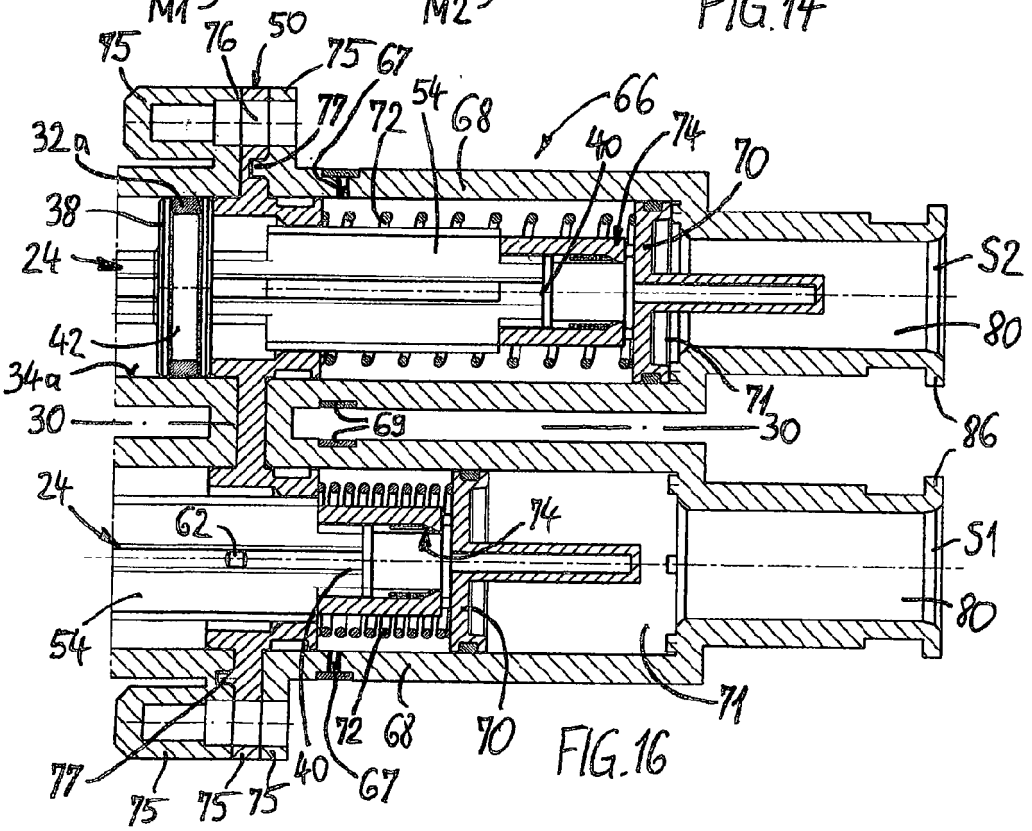


FIG.16

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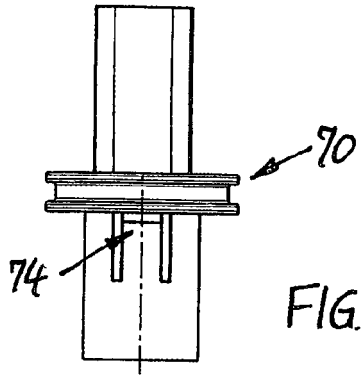


FIG. 19

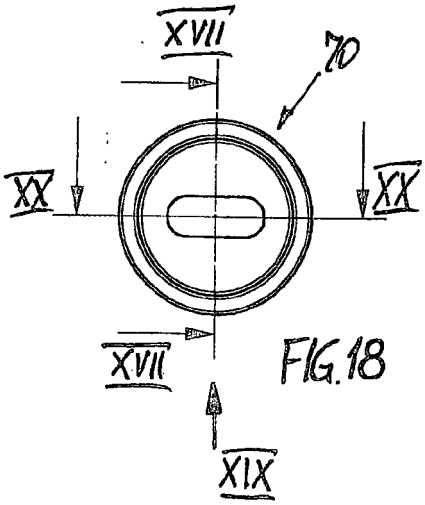


FIG. 18

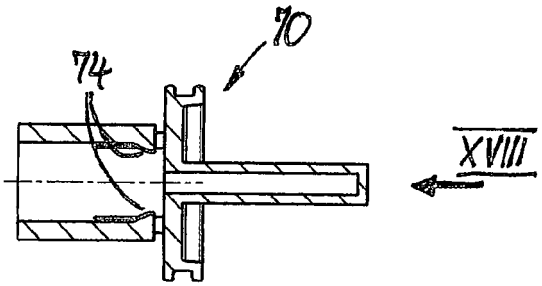


FIG. 17

FIG. 20

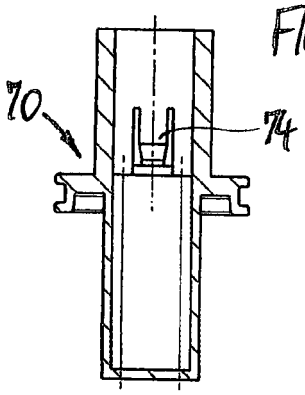
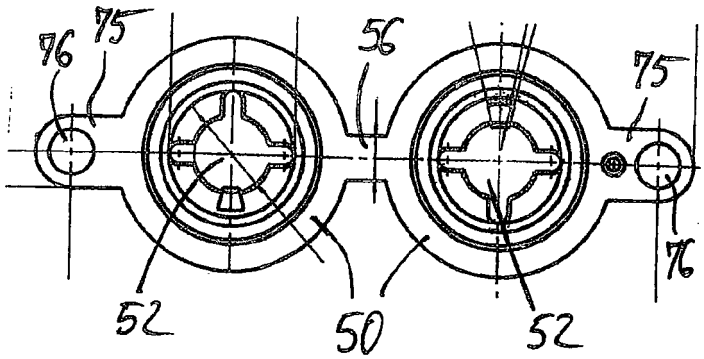


FIG. 21



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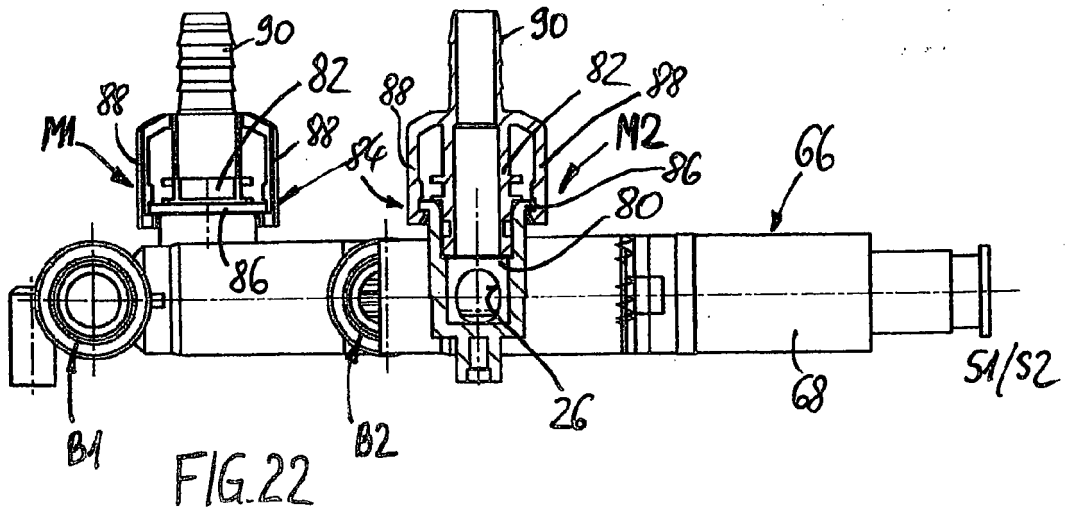


FIG.22

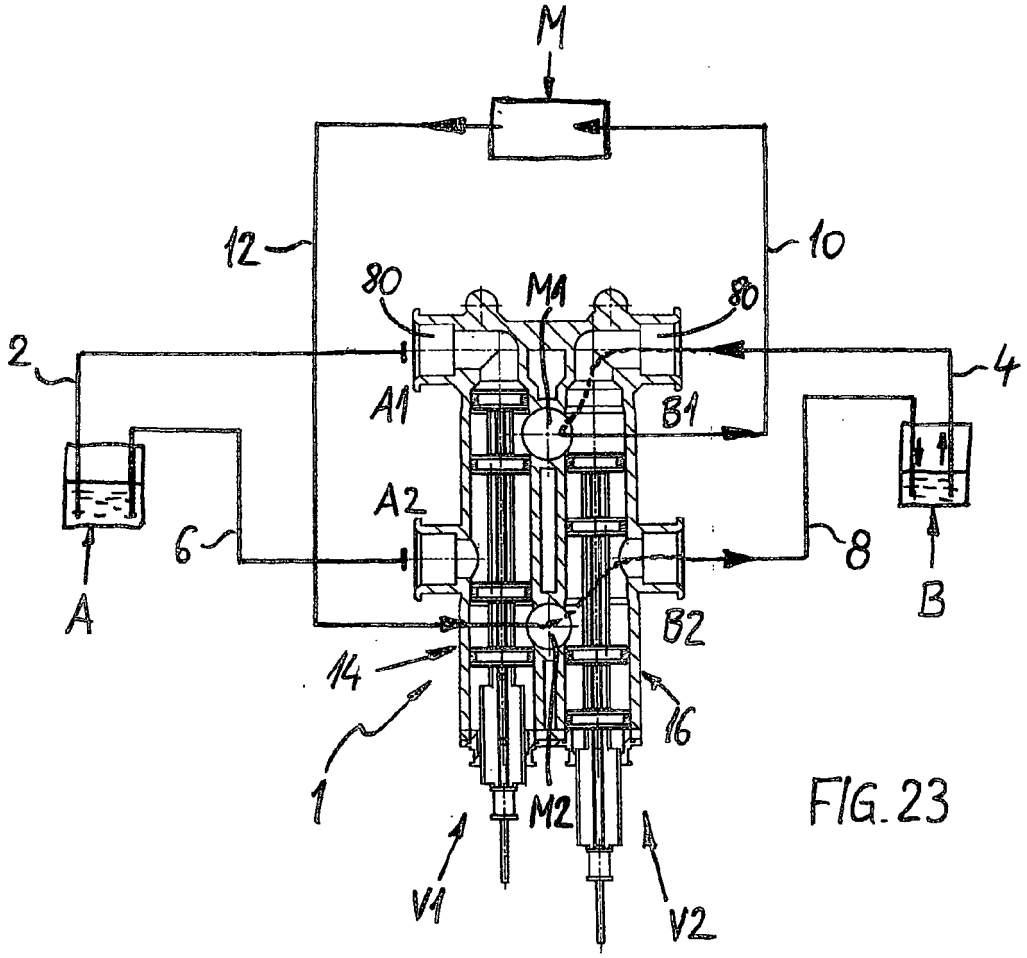


FIG.23

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Espacenet

Bibliographic data: CN2401704 (Y) — 2000-10-18

Gas power booster for dual-fuel gasoline engine

Inventor(s): XIA LAIQING [CN]; XIONG SHUSHENG [CN]; WANG JUNPEI [CN] ± (LAIQING XIA, ; SHUSHENG XIONG, ; JUNPEI WANG)

Applicant(s): UNIV ZHEJIANG [CN] ± (ZHEJIANG UNIV)

Classification: **- international:** ***F02M43/00;*** (IPC1-7): F02M43/00
- cooperative:

Application number: CN19992050994U 19991123

Priority number(s): CN19992050994U 19991123

Abstract of CN2401704 (Y)

The utility model discloses a gas power booster for a double-fuel gasoline engine. A gasoline cut-off electromagnetic valve of the original double-fuel engine is connected in parallel with an electromagnetic valve for controlling the flow quantity of gasoline, and meanwhile, a throttle valve of a carburetor of the original engine is provided with a travel switch, wherein the on-off of the travel switch is automatically controlled by the opening degree of the throttle valve of the carburetor, and the travel switch is used for controlling to open and close the electromagnetic valve. The utility model has the advantages that the structure is simple and reliable, the power of the double-fuel gasoline engine when in the combustion of gas can be close to or even reach the level when in the combustion of fuel by using the gas power booster, and the good exhaust performance and the economic performance index of the engine when in the combustion of gas can not be affected.

[19]中华人民共和国国家知识产权局

[51]Int. Cl[7]
F02M 43/00

[12]实用新型专利说明书

[21] ZL 专利号 99250994.7

[45]授权公告日 2000 年 10 月 18 日

[11]授权公告号 CN 2401704Y

[22]申请日 1999.11.23 [24]颁证日 2000.8.12

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金 晖 陈 勇 谢瑞燕

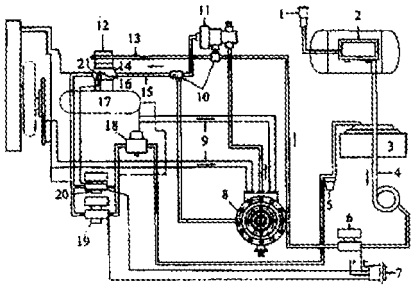
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代理人 张法高

权利要求书 1 页 说明书 2 页 附图页数 1 页

[54]实用新型名称 双燃料汽油发动机燃气动力提高装置

[57]摘要

本实用新型公开了一种双燃料汽油发动机燃气动力提高装置。它在原双燃料发 动机汽油截断电磁阀上，并联一个控制汽油流量的电磁阀，同时在原发动机化 油器节气门上，设置一个通断由化油器节气门的开度自动控制的，并用来控制 电磁阀启闭的行程开关。本实用新型的优点：结构简便可靠，使用它能使双燃 料发动机燃气时的动力接近，甚至达到燃油时的水平，而不影响发动机燃气时 的良好排放性能及经济性能指标。



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权 利 要 求 书

1．一种双燃料汽油发动机燃气动力提高装置，其特征在于在原双燃料发动机汽油截断电磁阀[19]上，并联一个控制汽油流量的电磁阀[20]，同时在原发动机化油器[14]节气门[16]上，设置一个通断由化油器节气门的开度自动控制的，并用来控制电磁阀启闭的行程开关[21]。

2．根据权利要求 1 所述的一种双燃料汽油发动机燃气动力提高装置，其特征在于控制汽油流量的电磁阀[20]，其负极接到行程开关的活动端上，正极与电磁阀[6]的正极相连。

3．根据权利要求 1 或 2 所述的一种双燃料汽油发动机燃气动力提高装置，其特征在于所说的行程开关[21]为柱塞型行程开关，该开关的活动端与控制汽油流量的电磁阀[20]的负极相连，固定端搭铁。

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说 明 书

双燃料汽油发动机燃气动力提高装置

本实用新型涉及一种双燃料汽油发动机燃气动力提高装置。

如图所示，原双燃料供给系统有一汽油—LPG（或 CNG）转换开关 7，当发动机燃用气体燃料时，汽油电磁阀 19 关闭，所有的气体燃料电磁阀打开。利用 LPG 容器内的压力压出液态的石油气，通过过滤器滤除杂质，经过电磁阀 6 进入减压阀 8，在此减压、气化、调压（对 CNG 需要经过三级减压）后，成为具有一定压力的气体燃料，在混合器 12 里和空气混合后进入发动机燃烧室。

现在普遍使用的 LPG（或 CNG）—汽油双燃料发动机供气系统，使得发动机在燃用气体燃料时，动力下降显著，大大影响双燃料发动机汽车的行驶性能。共主要原因是：气体燃料比汽油要占据的体积大，相同发动机排量下，影响发动机的充量，以及气体燃料的体积热值低，燃烧速度慢等。

本实用新型的目的是提供一种结构简便可靠，使用它能使双燃料发动机燃气时的动力接近，甚至达到燃油时水平的双燃料汽油发动机燃气动力提高装置。

为了达到上述目的，本实用新型采取下列措施：

在原双燃料发动机汽油截断电磁阀上，并联一个控制汽油流量的电磁阀，同时在原发动机化油器节气门上，设置一个通断由化油器节气门的开度自动控制的，并用来控制电磁阀启闭的行程开关。

本实用新型的优点：结构简便可靠，使用它能使双燃料发动机燃气时的动力接近，甚至达到燃油时的水平，而不影响发动机燃气时的良好排放性能及经济性能指标。

下面结合附图作详细说明：

附图是车用双燃料供给装置结构示意图。

图中，加气口 1、组合阀 2、汽油箱 3、高压铜管 4、汽油滤清器 5、LPG 或 CNG 电磁阀 6、LPG/汽油转换开关 7、减压阀 8、水箱水管 9、三通 10、怠速器 11、混合器 12、燃气软管 13、化油器 14、真空管 15、节气门 16、发动机 17、汽油泵 18、汽油电磁阀 19、控制汽油流量电磁阀 20、栓塞型行程开关 21。

双燃料汽油发动机燃气动力提高装置，它在原双燃料发动机汽油截断电磁阀 19 上，并联一个控制汽油流量的电磁阀 20，同时在原发动机化油器 14 节气门 16 上，设置一个通断由化油器节气门的开度自动控制的，并用来控制电磁

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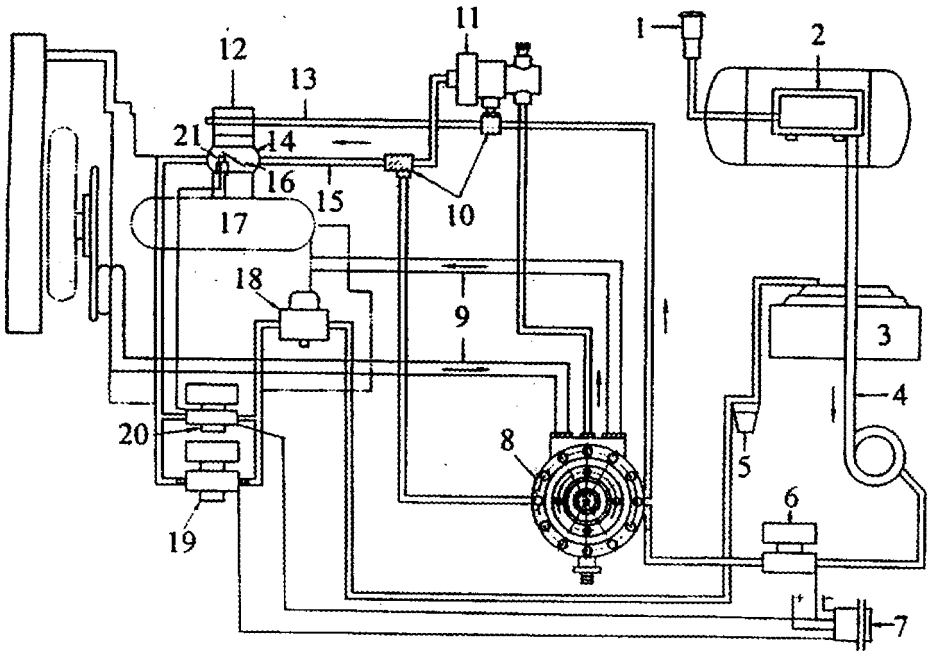
阀启闭的行程开关 21。控制汽油流量的电磁阀 20，其负极接到行程开关的活动端上，正极与电磁阀 6 的正极相连。行程开关 21 为柱塞型行程开关，该开关的活动端与控制汽油流量的电磁阀 20 的负极相连，固定端搭铁。

当发动机燃用气体燃料时，汽油电磁阀 19 关闭，所有的气体燃料电磁阀打开。利用 LPG 容器内的压力压出液态的石油气，通过过滤器滤除杂质，经过电磁阀 6 进入减压阀 8，在此减压、气化、调压（对 CNG 需要经过三级减压）后，成为具有一定压力的气体燃料，在混合器 12 里和空气混合后进入发动机燃烧室。本实用新型在汽油电磁阀 19 上并联一个常闭的控制汽油流量电磁阀 20，使得发动机在高速或大负荷时，可以有一小部分特定时的汽油通过该电磁阀，经化油器 14，进入发动机 17，实现两种燃料联供、燃气掺烧汽的目的，从而大大提高发动机燃气时的动力。而低负荷和怠速时，通过设置在化油器 14 上的一个行程开关 21，及时将这一小部分特定量的汽油切断。该行程开关的活动端与控制汽油流量电磁阀 20 的负极相连，固定端搭铁。行程开关的通断完全由节气门 16 控制。当节气门 16 开度变小到一定程度，即发动机过渡到低负荷或怠速时，触及行程开关的柱塞，使行程开关断开，控制汽油流量电磁阀 20 断电，额外汽油的供给切断，发动机 17 处于完全燃气状态；而高转速或大负荷时，节气门 16 开度变大，行程开关 21 自动导通，控制汽油流量电磁阀 20 通电导通，一小部分特定流量的汽油便通过该电磁阀进入发动机与燃气共烧，从而大大提高发动机的动力。

当发动机工作在燃油状态时，LPG（或 CNG）电磁阀 6 的正极没有电压，而控制汽油流量电磁阀 20 的正极是与 LPG（或 CNG）电磁阀 6 的正极相连的，所以控制汽油流量电磁阀 20 上也没有电流输入，不管节气门 16 上的特种行程开关 21 如何动作，控制汽油流量电磁阀 20 都不导通，这与原供给系统燃油时状况完全一致，对发动机燃油时的性能不会产生任何影响。

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说 明 书 附 图



Espacenet

Bibliographic data: GB189800 (A) — 1923-10-11

Improvements in or relating to internal combustion engines

Inventor(s):

Applicant(s): ARNOLD SONDEREGGER ± (ARNOLD SONDEREGGER)

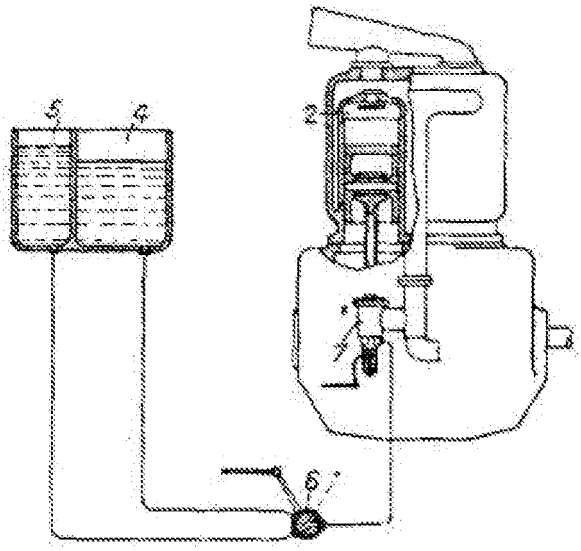
Classification: **- international:** ***F02M1/00***
- cooperative: **F02M1/00 (EP)**; F02M2700/4316 (EP)

Application number: GB19220032868 19221201

Priority number(s): CHX189800 19211202

Abstract of GB189800 (A)

189,800. Sonderegger, A. Dec. 2, 1921, [Convention date]. Spray carburettors - Either light fuel from the compartment 5 of the fuel tank, or a mixture of light and heavy fuel from the compartment 4, according to the position of the three-way cock 6, is supplied to the carburetting apparatus 7, the jet of which is adjustable and may be interconnected with the cock 6 to compensate automatically for the change of fuel. The light fuel may be petrol and it may be used with an equal quantity of naphtha or other raw oil.. Cylinders receiving liquid fuel.-Plates 2 for vaporizing the fuel are provided in the combustion space.



BEST AVAILABLE COPY

PATENT SPECIFICATION

Convention Date (Switzerland): Dec. 2, 1921. **189,800**

Application Date (in United Kingdom): Dec. 1, 1922. No. 32,868/22.

Complete Accepted: Oct. 11, 1923.

COMPLETE SPECIFICATION.

Improvements in or relating to Internal Combustion Engines.

I, ARNOLD SONDEREGGER, of 30, Rotstrasse, Zurich, Switzerland, a citizen of the Swiss Conferation, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to internal combustion engines more especially for motor cars, the main object of the invention being to provide means whereby the engines can be run on liquid fuel of two different qualities, say ordinary petrol and petrol mixed with a heavier or cheaper fluid which latter would in an ordinary way not be suitable alone (although it may in some cases be used without the petrol) in conjunction with means for preheating.

The preheating means is of that kind in which hot plates or equivalents are arranged in the combustion chambers of the engine said heater being used also with the petrol if so desired.

Briefly the invention consists in providing a double tank having outlets to a valve through which the contents of either tank can be allowed to pass to the carburetter of the engine both the said valve and the carburetter being capable of adjustment to select the desired fuel and to suit the fuel selected.

A suitable valve is one having two inlets and one outlet and provided with a plug or the like by turning which either inlet can be put into communication with the outlet, or of course the valve can be closed. The valve and the variation or adjustment of the carburetter can be effected by suitable mechanism, say levers and links of the kind operated from the dash board of the engine of the vehicle to which the invention is applied.

By means of the device operating in accordance with the method above described it is possible with a constant or even increased efficiency of the engine to operate the engine by means of a mixture of petrol and raw oil, for example 50% raw naphtha, and thus to effect a considerable saving in working expenses, and to obtain an almost smokeless combustion. It is also possible when travelling through localities where there are restrictions as to the emission of the fumes of heavy oils, to operate the engine with petrol by changing over the supply of fuel to the carburetter so as to obviate the trouble which is caused by the exhaust gases from the mixtures of petrol and raw oil.

The heating body for heating the fuel is preferably of the kind which consists of heating plates which are secured in the interior of the cylinder head and which are of such dimensions that they do not heat the mixture right up to the ignition point.

In the accompanying drawing is shown by way of example a form of construction of the subject of the invention, the example being a two cylinder engine, one cylinder being shown in section whilst the fuel tank together with the piping connecting this with the engine and the change-over cock are shown diagrammatically.

In the compression space of the cylinder 1 are provided heating plates 2 which are secured in the interior of the cylinder head. These heating plates store a portion of the heat of combustion and thus heat the freshly incoming mixture to a high temperature below the ignition temperature, whereupon after the completion of the compression stroke the ignition is effected by the usual ignition plug. The two part fuel tank 3 contains in the compartment 4 a mixture of petrol and any kind of raw or heavy oil and in the com-

[Price 1/-]

partment 5 pure petrol. The fuel supply pipes of both compartments are connected by a single pipe by the change over cock 6, which is operated from the driver's seat by suitable link work and from which a pipe leads to the carburettor 7. The carburettor illustrated is an apparatus of the known type having an adjustable jet for the fuel and the opening thereof is controlled from the driver's seat by link-work. For changing over from petrol to the mixture and *vice versa* it suffices to operate the cock 6 and simultaneously to regulate the carburettor 7, these, for simplicity, being coupled together or even combined as a unit. The latter construction has the advantage that it is impossible to effect an incorrect adjustment. In the linkwork for the cock and for the carburettor adjusting mechanisms may be provided so as to enable a very fine adjustment to be made.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An internal combustion engine of the kind provided with heaters in the combustion chambers in combination with two fuel tanks connected to a valve so that the contents of either tank can be allowed to pass through the valve to the carburettor of the engine said carburettor being adjustable for use with different liquid fuels.

2. In combination with the engine having two fuel tanks and a valve according to Claim 1 means whereby the two tanks can be selectively connected to the carburettor of the engine and in which the carburetter can be adjusted to suit either fuel, the said selection and the said adjustment being made by suitable mechanism such as links and levers, substantially as herein described.

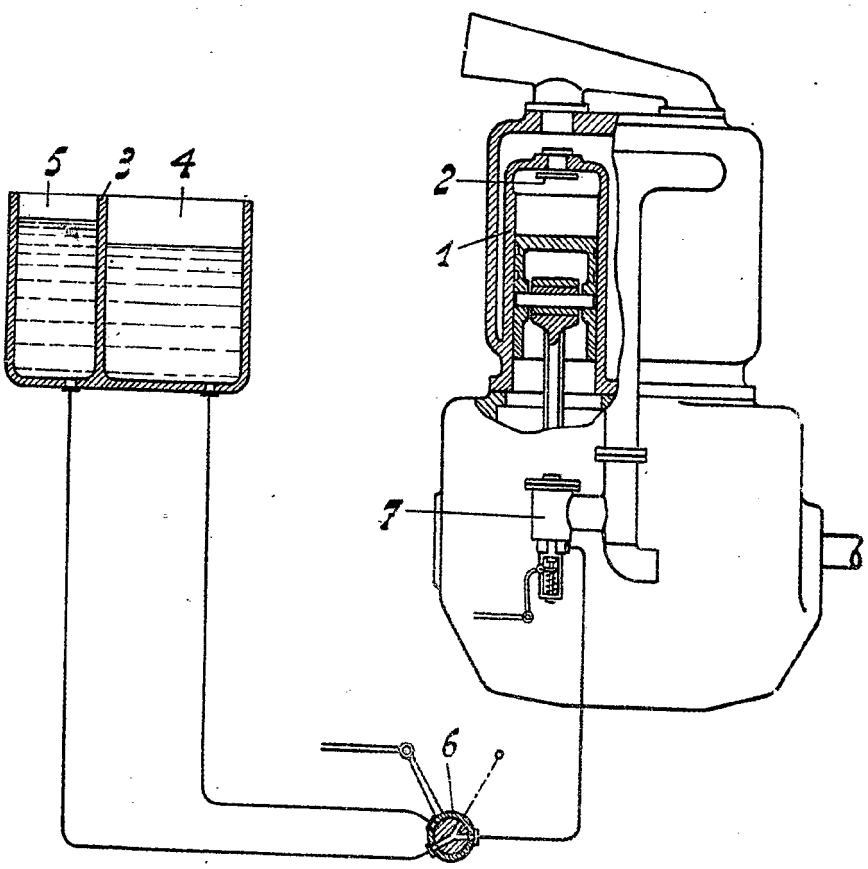
Dated this 1st day of December, 1922.

HY. FAIRBROTHER,
Chartered Patent Agent,
30 and 32, Ludgate Hill, London, E.C. 4.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1923.

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[This Drawing is a reproduction of the Original on a reduced scale.]



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PATENT AND TRADEMARK OFFICE

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
16/946,439	**12/15/2020 12:08:59 PM ET**	**CET1090.077**

Title of Invention

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2699	FILED BY	Robyn Templin
PATENT CENTER #	60119805	FILING DATE	06/22/2020
CUSTOMER #	26629	FIRST NAMED INVENTOR	Kendall J. Collie
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Kevin Rosin

Documents

TOTAL DOCUMENTS: 12

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
2020.12.15 Supp IDS.pdf	6	Information Disclosure Statement (IDS) Form (SB08)	984 KB
FPD1-CN2401704Y.pdf	6	Foreign Reference	1808 KB
FPD2-DE102006008524A1.pdf	16	Foreign Reference	2597 KB
FPD3-GB189800A.pdf	4	Foreign Reference	690 KB
FPD4-GB532903A.pdf	5	Foreign Reference	1211 KB
NPL1-Multi-Power MODELMP5500DF 13 HP	38	Non Patent Literature	23502 KB

Generator Owner's Manual.pdf			
NPL2-Winco Home Power TRI-FUEL Portable Generators Owners Manual.pdf	16	Non Patent Literature	730 KB
NPL3-Winco HPS9000VEE and HPS9000VE-03A Manual.pdf	16	Non Patent Literature	1961 KB
NPL4-Winco Dyna ME5000VA.pdf	12	Non Patent Literature	118 KB
NPL5-Dyna Portable Generators.pdf	12	Non Patent Literature	104 KB
NPL6-PowerLand Tri Fuel Generator Owner's Manual.pdf	41	Non Patent Literature	7016 KB
NPL7-Winco HPS6000HEI Manual.pdf	20	Non Patent Literature	8337 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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NPL1-Multi-Power MODELMP5500DF 13 HP Generator Owner's Manual.pdf	19927D91AF1E70EE0A256411F51C8CFD3D7C65FE96D0032BE42914FEC82F2C30D2345D659E89C4967D60BD1B6C26A32964186CC99AE49149BCEC6EDB1C8F173E
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NPL3-Winco HPS9000VEE and HPS9000VE-03A Manual.pdf	BAE4D902E0B325CCB1879F1ED0380AB272BBB496B4EB2B8B3E7AA784C5D626D71923A344FB6D99DDA4F025EF919C2715C1FB16FF38C71E697D0C45A059963889
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NPL5-Dyna Portable Generators.pdf	AE368FA7D80F9CD099493863F4DDB2F03FF5D15884D65947E5A483CC9665F8416314728C87380F2D9C13AD4910E6325EFE624E21E34391F8529F8C42563318E4
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by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/946,439	06/22/2020	Kendall J. Collie	CET1090.077

CONFIRMATION NO. 2699

26629
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PUBLICATION NOTICE

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Title:FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Publication No.US-2020-0318557-A1
Publication Date:10/08/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/946,439

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	19 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 230 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	785		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/946,439	06/22/2020	3747	785	CET1090.077	19	3

CONFIRMATION NO. 2699

26629
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FILING RECEIPT



Date Mailed: 07/06/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Domestic Priority data as claimed by applicant

This application is a CON of 16/358,822 03/20/2019 PAT 10697379
which is a CON of 15/285,215 10/04/2016 PAT 10393034
which is a CIP of 14/925,441 10/28/2015 PAT 10697398
which is a CIP of 14/738,060 06/12/2015 PAT 10221780

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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Projected Publication Date: 10/08/2020
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

FUEL SYSTEM FOR A MULTI-FUEL INTERNAL COMBUSTION ENGINE

Preliminary Class

123

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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IPR2025-01271