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(54) **Method and system for automatic disconnection of fuel supply**

Verfahren und System für die automatische Abschaltung der Brennstoffzufuhr

Procédé et système d' arrêt automatique d'alimentation de combustible

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(73) Proprietor: **Gaveco AB**
135 02 Tyresö (SE)

(72) Inventor: **Granfelt, Claes**
135 02 Tyresö (SE)

(74) Representative: **Hopfgarten, Nils**
L.A. Groth & Co. KB
P.O. Box 6107
102 32 Stockholm (SE)

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Description

Field of Invention

[0001] The invention relates to a method for automatic disconnection of fuel supply, in particular of gas supply to a consumer at the moment of stopping the consumer, said supply being controlled by at least one cylinder valve being influenced by the pressure in a pilot line. Furthermore, the invention also relates to a system for automatic disconnection of fuel supply, in particular of gas supply, to a consumer at the moment of stopping the consumer, which system comprises one or more fuel cylinders in fuel connection with the consumer by a supply line having at least one cylinder valve, said cylinder valve or valves being activated by a pilot line.

Background of the Invention

[0002] In the field of fuel supply of consumers, such as combustion engines, there are rules for how to handle the fuel from the tank or cylinders up to the engine. Similar rules exist also with respect to other fields of fuel and gas handling. E.g. in plants for unloading or discharging of gas cylinders there are safety rules for how to connect the pipes and valves.

[0003] Specially in the field of the increasingly used systems for driving of motor vehicles and other systems where high pressures or large stocks of gas are involved, the authorities have issued regulations with respect to system design and handling. Thus, there are rules for safety systems necessary against pipe ruptures or excessive gas flows. Certain problems arise with equipment used in gas systems since the gas has varying density att different pressures.

[0004] Some of those problems mentioned have found their solution by the safety device described in US-A-6.044.863 of the same inventor. By such a device one has secured a prompt closing of the system in the event of rapture or excessive gas flows in the system.

[0005] A certain demand unsolved by systems known per se is that all the valves in the system have to be closed when the consumer is shut down.

Summary of the Invention

[0006] The problems present for solving of such a demand have been overcome by a method as claimed in Claim 1 and by a system as claimed by Claim 3.

[0007] Thus, the pressure of the pilot line activating the valves in the system has to be lowered but the fuel or gas supply line must not be emptied due to the fact that a restart of the consumer is to be done in a smooth way, i.e. pressure shocks have to be eliminated in the system. If a restart is made with an empty supply line the risks are very high for having a pressure shock in the system resulting in more or less damages of the system.

[0008] Particularly advantageous embodiments have the features defined by the subclaims.

Brief Description of the Drawings

[0009] The invention will now be described in more detail with reference to the accompanying drawings, in which

Fig. 1 shows a general arrangement of a multipel cylinder system for natural or bio gas according to the present invention,

Fig. 2 shows a time schedule for start and stop of a combustion engine according to the method of the present invention, and

Fig. 3 shows a simplified circuit diagram of the control system according to the present invention.

Detailed Description of a Preferred Embodiment

[0010] In Fig. 1 a general arrangement of a multipel cylinder system is shown involving the method of automatic disconnection of the fuel supply to a consumer M according to the present invention. The system comprises a number of fuel tanks, in the present case in form of gas cylinders 1.

[0011] The gas cylinders 1 are arranged in blocks B of two or more cylinders each. A charging unit 2 is in communication with the gas cylinders 1 through an inlet line 3 having a branch line 3' for each gas cylinder 1. To each one of said gas cylinders 1 there is a cylinder valve 4 controlling the gas supply to the gas cylinder 1 when charged and from the gas cylinder 1 when used as a supply source for driving of the consumer M. The cylinder valve 4 may be either a manually activated or a solenoid activated valve with respect to starting up the system, but for closing the gas supply it is controlled by a pilot line 11.

[0012] Each one of the gas cylinders 1 is in communication with thermal relief outputs 5.

[0013] In the preferred embodiment of the present invention a section of the inlet line 3 is used also as a feed line 6 to the consumer M. Said feed line 6 involves a supply unit 7 having a manual stop valve 8, a fine filter 9, and a solenoid valve 10.

[0014] At the output end of the supply unit 7 a pilot line 11 is branched off downstream the valve 10. The gas pressure in the pilot line 11 is used for automatic control of the cylinder valves 4 in such a way that the cylinder valves 4 close the gas supply when the pressure of the pilot line 11 drops beyond a predetermined low threshold level.

[0015] For service reasons the system arrangement involves manual valves 12 and 13. The manual valve 12 being used for evacuation of the fuel tanks or gas cylinders 1, and the manual valve 13 being used for interruption of the automatic control of the cylinder valves 4.

[0016] The preferred embodiment of the system according to the present invention has a method of working as is shown in Fig. 2, which is self-explanatory. However, it is to be observed that the left hand side of Fig. 2 refers to the starting procedure of the consumer M and the right hand side thereof is the time schedule for automatic disconnection procedure of the gas (fuel) supply to the consumer M.

[0017] Thus, in the case of stopping the consumer M a stop activation is started, e.g. by pressing of an electric switch 14 (Fig. 3) in a control circuit for the gas (fuel) supply to the consumer M. By pressing the switch 14 the supply valve 10 is managed to its closed position by a solenoid 10' belonging thereto. Simultaneously a timer (I) is started for a delayed activation of a switch 15 controlling, e.g. the electric feeding of the consumer M.

[0018] By closing of the supply valve 10 the pressure in the pilot line 11, branched off from the output of the supply unit 7, starts sinking due to the fact that the consumer M still is working and consumes the gas in the pilot line 11. When passing a predetermined low pressure level in the pilot line 11 the cylinder valves 4 are closed.

[0019] Due to the fact that the timer (I) imply a delayed action of the consumer control switch 15, the consumer M is still activated for a time enough to consume the rest of the gas (fuel) in the pilot line 11 after the cylinder valves 4 are closed. When the timer (I) has run out the consumer M is shut down and is ready for a new start.

[0020] Starting of the consumer M involves another activation of the switch 14 to its start position, which gives the immediate result of opening of the supply valve 10 and of activation of a further timer (II) rendering an "on" function of a pilot valve 16.

[0021] The pilot valve 16 has taken the form of a bypass pipe and a needle valve inside the cylinder valve 4 (being described in more detail in the US document mentioned above, e.g. with reference to Fig. 4 thereof). The pilot valve 16 is only working for a few seconds during the start up of the system to put the pilot line 11 under pressure for opening of the cylinder valve 4. Thus, when activating the pilot valve 16 the pressure in the pilot line 11 is raising, which means opening of the cylinder valves 4. The further timer (II) returns to its off position after a predetermined time resulting in closing of the pilot valve 16. However, since the pressure in the feed line 6 by now has obtained working level the consumer M is operating and the cylinder valve 4 remains open.

[0022] The description given above refers to a consumer M in form of a combustion engine driven by natural or bio gas. However, the very same method and system according to the invention may be applied also to other fuel or liquid or gas handling devices. Thus, the consumer M can be in form of a fuel cell, a plant for unloading or discharging of fuel tanks or gas cylinders transported by trucks or trains or being of an unmovable construction.

[0023] The feed or supply valve mentioned as a solenoid one may also take the shape of another type, such as e.g. a hydraulic or pneumatic valve function of two or three way type.

[0024] The different solenoids and timers described in connection with Fig. 3 above may be driven by one or more voltages U1 - U4.

[0025] Although an preferred embodiment of the invention has been given by way of illustration, it will be understood that the invention may be carried out with many variations, modifications and adaptions, such as hereinbefore mentioned or within the understanding and ability of skilled persons, without departing from its spirit or exceeding the scope of the claims.

Claims

1. A method for automatic disconnection of fuel supply, in particular of gas supply to a consumer (M) at the moment of stopping the consumer, said supply being controlled by at least one cylinder valve (4) being influenced by the pressure in a pilot line (11), said method being **characterized in that** a supply valve (10) is activated before the consumer (M) is to be stopped, said supply valve (10) activation rendering the pilot line (11) pressure to drop below a level for closing of said cylinder valve or valves (4), thus being closed.

2. A method for automatic disconnection of fuel supply according to Claim 1, **characterized in that** simultaneously with said activation of the supply valve (10) a timer (I) is started for delaying said stopping of the consumer (M) until the cylinder valve or valves (4) is/are closed, rendering in a shut down of the consumer (M).

3. A system for automatic disconnection of fuel supply, in particular of gas supply to a consumer (M) at the moment of stopping the consumer, said system comprising one or more fuel cylinders (1) in fuel connection with the consumer (M) by a supply line (6) having at least one cylinder valve (4), said cylinder valve or valves (4) being activated by a pilot line (11), said system being **characterized by** a supply valve (10) included in the supply line (6) to be closed before stopping of the consumer (M) and rendering the pilot line (11) pressure to drop below a level for closing said cylinder valve or valves (4).

4. A system for automatic disconnection of fuel supply according to Claim 3, **characterized by** a timer (I) started by closing of the supply valve (10) for a delayed stopping of the consumer (M) until said cylinder valve or valves (4) is/are closed.

5. A system for automatic disconnection of fuel supply according to Claims 3 or 4, **characterized in that** the consumer (M) is a combustion engine.

6. A system for automatic disconnection of fuel supply according to Claims 3 or 4, **characterized in that** the consumer (M) is a fuel cell.

7. A system for automatic disconnection of fuel supply according to Claims 3 or 4, **characterized in that** the consumer (M) is a plant for unloading or discharging of fuel cylinders.

8. A system for automatic disconnection of fuel supply according to Claims 3 or 4, **characterized in that** the supply valve (10) is a solenoid valve.

9. A system for automatic disconnection of fuel supply according to Claims 3 or 4, **characterized in that** the supply valve (10) is of a hydraulic or pneumatic controlled type.

10. A system for automatic disconnection of fuel supply according to Claims 8, **characterized in that** said solenoid valve (10) is controlled through an electric control device of the consumer (M).

11. A system for automatic disconnection of fuel supply according to Claims 10, **characterized by** a switch (14) included in said electric control device for starting and stopping of the consumer (M).

12. A system for automatic disconnection of fuel supply according to Claims 11, **characterized in that** said switch (14) in its stop position is activating said delay timer (I) and said supply valve (10), and in its start position is activating a further timer (II) for controlling said cylinder valve or valves (4).

Patentansprüche

1. Verfahren zum selbsttätigen Trennen einer Brennstoffzufuhr, insbesondere einer Gaszufuhr zu einem Verbraucher (M) im Augenblick der Abschaltung des Verbrauchers, wobei die Zufuhr durch mindestens ein Zylinderventil (4) geregelt wird, das seinerseits durch den Druck in einer Überwachungsleitung (11) beeinflusst wird, und das Verfahren **dadurch gekennzeichnet ist, dass** ein Zufuhrventil (10) aktiviert wird, bevor der Verbraucher (M) abgeschaltet werden soll, und dass die Aktivierung des Zufuhrventils (10) bewirkt, dass der Druck in der Überwachungsleitung (11) unter einen zum Schließen des Zylinderventils oder der Zylinderventile (4) ausreichenden Wert abfällt, die folglich geschlossen werden.

2. Verfahren zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 1, **dadurch gekennzeichnet, dass** zugleich mit der Aktivierung des Zufuhrventils (10) ein Zeitglied (I) gestartet wird, um die Abschaltung des Verbrauchers (M) zu verzögern, bis das Zylinderventil oder die Zylinderventile (4) geschlossen ist bzw. sind, die eine Stillegung des Verbrauchers (M) bewirken.

3. System zum selbsttätigen Trennen einer Brennstoffzufuhr, insbesondere einer Gaszufuhr zu einem Verbraucher (M) im Augenblick der Abschaltung des Verbrauchers, wobei das System einen oder mehrere Brennstoffzylinder (1) aufweist, die mit dem Verbraucher (M) über eine Versorgungsleitung (6) für den Brennstoff verbunden sind, wobei die Versorgungsleitung (6) mit mindestens einem Zylinderventil (4) versehen ist und das Zylinderventil oder die Zylinderventile (4) mittels einer Überwachungsleitung (11) aktiviert werden, und ferner das System **gekennzeichnet ist durch** ein in die Versorgungsleitung (6) geschaltetes Zufuhrventil (10), zum Schließen vor der Abschaltung des Verbrauchers (M), und zum Bewirken eines Abfalls des Druckes in der Überwachungsleitung (11) unter einen zum Schließen des Zylinderventils oder der Zylinderventile (4) ausreichenden Wert.

4. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3, **gekennzeichnet durch** ein Zeitglied (I), das **durch** das Schließen des Zufuhrventils (10) gestartet wird, um die Abschaltung des Verbrauchers (M) zu verzögern, bis das Zylinderventil oder die Zylinderventile (4) geschlossen ist bzw. sind.

5. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** der Verbraucher (M) eine Verbrennungsmaschine ist.

6. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** der Verbraucher (M) eine Brennstoffzelle ist.

7. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** der Verbraucher (M) eine Anlage zum Abladen oder zum Entladen von Brennstoffzylindern ist.

8. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** das Zufuhrventil (10) ein Magnetventil ist.

9. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** das Zufuhrventil (10) von einer hydraulisch oder von einer pneumatisch gesteuerten Bauart ist.

10. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 8, **dadurch gekennzeichnet, dass** das Magnetventil (10) über eine elektrische Regelvorrichtung des Verbrauchers (M) geregelt wird.

11. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 10, **gekennzeichnet durch** einen in der elektrischen Regelvorrichtung enthaltenen Schalter (14) zum Einschalten und zum Abschalten des Verbrauchers (M).

12. System zum selbsttätigen Trennen einer Brennstoffzufuhr nach Anspruch 11, **dadurch gekennzeichnet, dass** der Schalter (14) in seiner Abschaltstellung das VerzögerungsZeitglied (I) und das Zufuhrventil (10), und in seiner Einschaltstellung ein weiteres Zeitglied (II) zum Steuern des Zylinderventils oder der Zylinderventile (4) aktiviert.

Revendications

1. Procédé pour une déconnexion automatique d'une alimentation en carburant, en particulier d'une alimentation en carburant pour un dispositif consommateur (M) au moment où s'arrête le dispositif consommateur, ladite alimentation étant commandée par au moins une valve de cylindre (4) étant influencée par la pression dans une ligne pilote (11), ledit procédé étant **caractérisé en ce qu'**une vanne d'alimentation (10) est activée avant que le dispositif consommateur (M) soit arrêté, ladite activation de la vanne d'alimentation (10) entraînant la chute de la pression de la ligne pilote (11) au-dessous d'un niveau pour fermer ladite ou lesdites valve(s) de cylindre (4)

2. Procédé pour une déconnexion automatique d'une alimentation en carburant selon la revendication 1, **caractérisé en ce que** de manière simultanée avec ladite activation de la vanne d'alimentation (10), un compteur de temps (I) est mis en route pour retarder ledit arrêt du dispositif consommateur (M) jusqu'à ce que la ou les valve(s) de cylindre (4) soient fermées, entraînant l'arrêt du dispositif consommateur (M).

3. Système pour une déconnexion automatique d'une alimentation en carburant, en particulier d'une alimentation en gaz pour un dispositif consommateur (M) au moment d'arrêter le dispositif consommateur, ledit système comprenant un ou plusieurs cylindres de carburants (1) dans une connexion en carburant avec le dispositif consommateur (M) par une ligne d'alimentation (6) ayant au moins une valve de cylindre (4), la ou lesdites valves de cylindre (4) étant activées par une ligne pilote (11), ledit système étant **caractérisé par** une vanne d'alimentation (10) comprise dans la ligne d'alimentation (6) devant être fermée avant que le dispositif consommateur (M) soit arrêté et entraînant la chute de la pression de la ligne pilote (11) au-dessous d'un niveau pour fermer la ou lesdites valve(s) de cylindre (4)

4. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3, **caractérisé en ce que** un compteur de temps (I) est mis en route à la fermeture de la vanne d'alimentation (10) pour un arrêt retardé du dispositif consommateur (M) jusqu'à ce que la ou les valve(s) de cylindre (4) soient fermées.

5. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3 ou 4, **caractérisé en ce que** le dispositif consommateur (M) est un moteur à combustion.

6. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3 ou 4, **caractérisé en ce que** le dispositif consommateur (M) est une pile à combustible.

7. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3 ou 4, **caractérisé en ce que** le dispositif consommateur (M) est une installation pour charger ou décharger les cylindres de carburants.

8. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3 ou 4, **caractérisé en ce que** la vanne d'alimentation (10) est une valve à solénoïde.

9. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 3 ou 4, **caractérisé en ce que** la vanne d'alimentation (10) est du type contrôlée de manière hydraulique ou pneumatique.

10. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 8, **caractérisé en ce que** ladite valve à solénoïde (10) est commandée par l'intermédiaire d'un organe de commande électrique du dispositif consommateur (M).

11. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 10, **caractérisé par** un interrupteur (14) compris dans ledit organe de commande électrique pour faire démarrer et arrêter le dispositif consommateur (M).

12. Système pour une déconnexion automatique d'une alimentation en carburant selon la revendication 11, **caractérisé en ce que** ledit interrupteur (14) dans sa position d'arrêt, active ledit compteur de retardement (I) et ladite vanne d'alimentation (10) et dans

sa position de départ active un autre compteur de temps (II) pour commander ladite ou lesdites valves de cylindre.

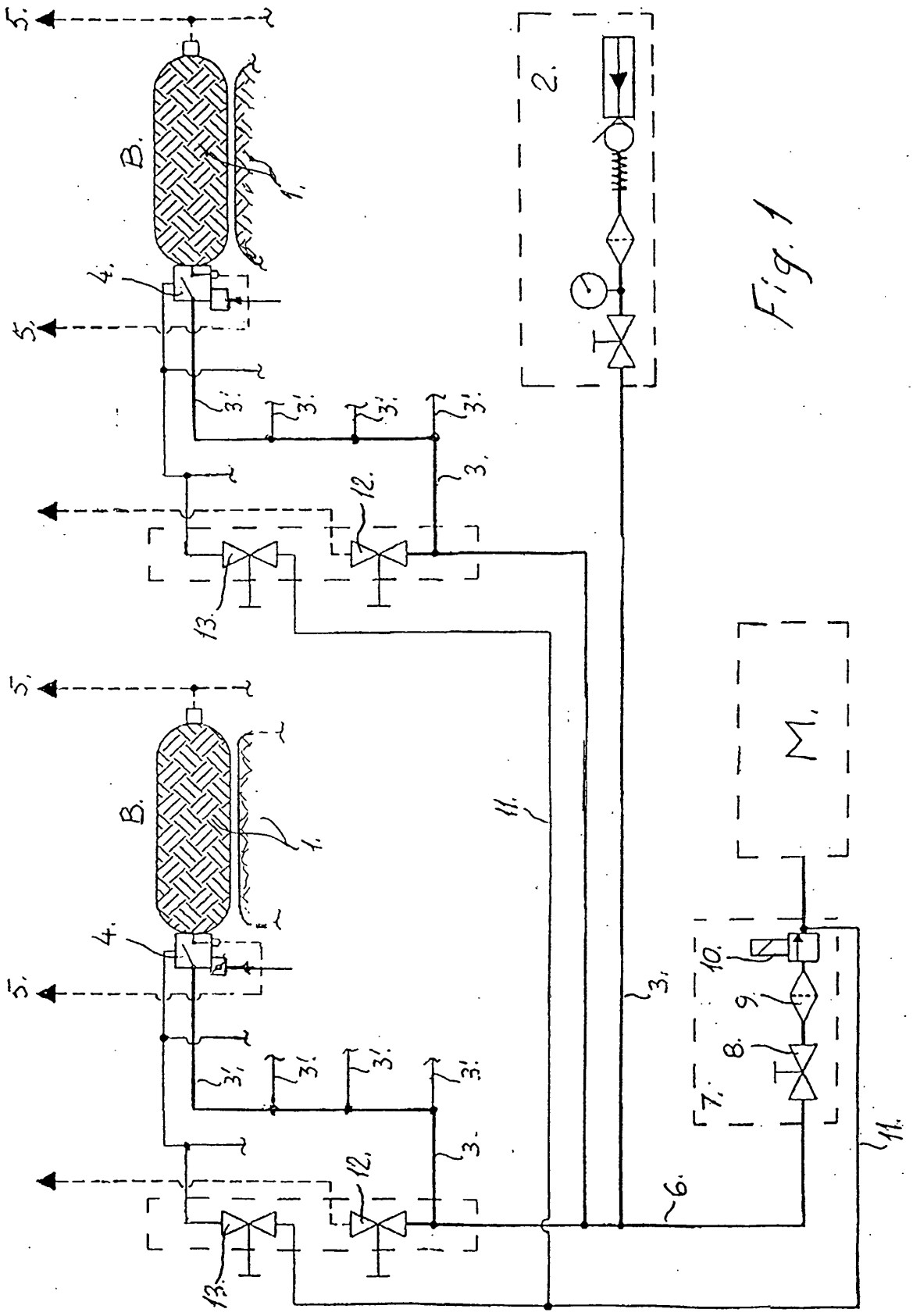

Fig. 1

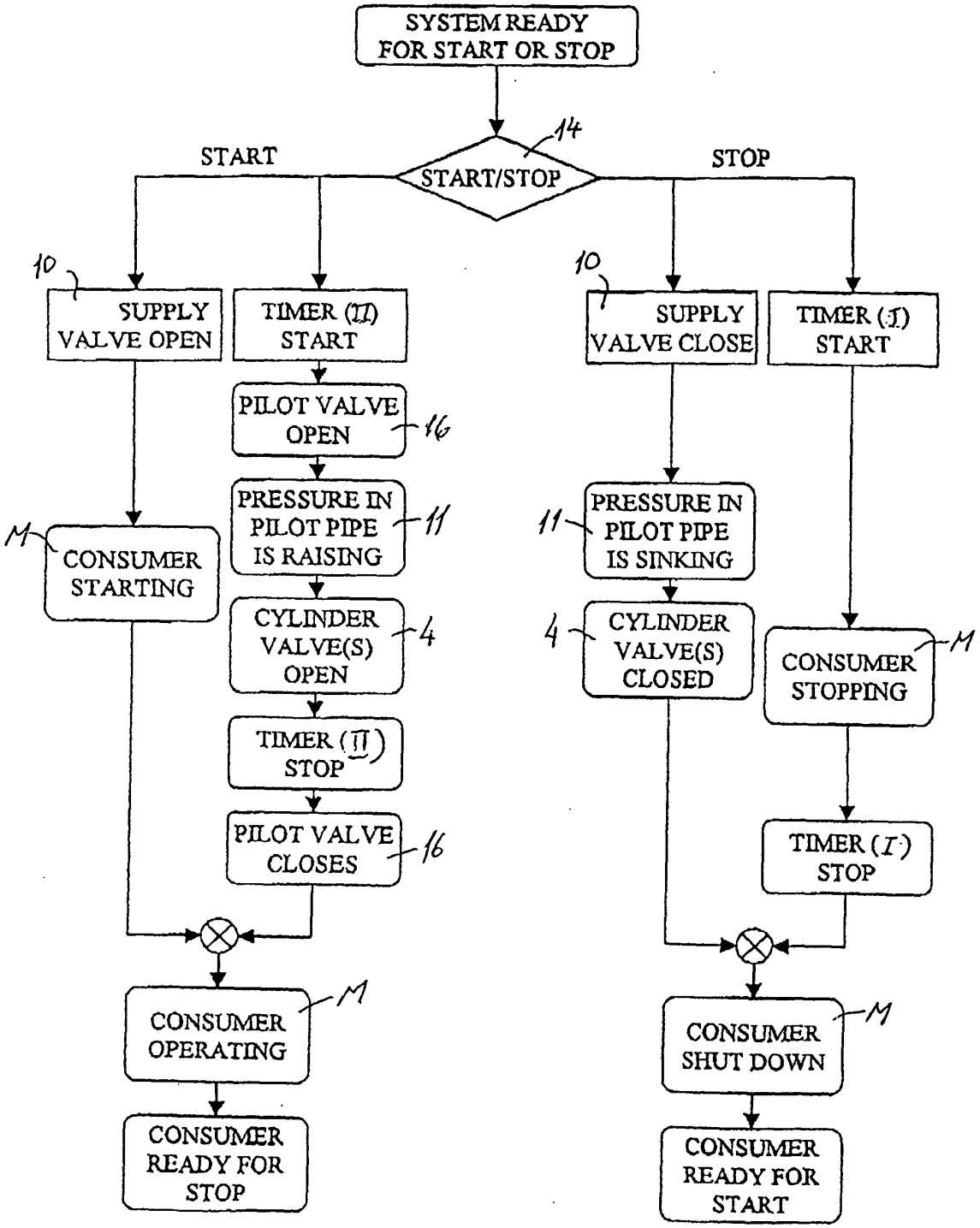
SYSTEM READY FOR START OR STOP
14
START/STOP
START
STOP
10
SUPPLY VALVE OPEN
TIMER (II) START
PILOT VALVE OPEN
16
PRESSURE IN PILOT PIPE IS RAISING
11
M
CONSUMER STARTING
CYLINDER VALVE(S) OPEN
4
TIMER (II) STOP
PILOT VALVE CLOSES
16
CONSUMER OPERATING
M
CONSUMER READY FOR STOP
10
SUPPLY VALVE CLOSE
TIMER (I) START
11
PRESSURE IN PILOT PIPE IS SINKING
4
CYLINDER VALVE(S) CLOSED
CONSUMER STOPPING
M
TIMER (I) STOP
CONSUMER SHUT DOWN
M
CONSUMER READY FOR START

Fig. 2

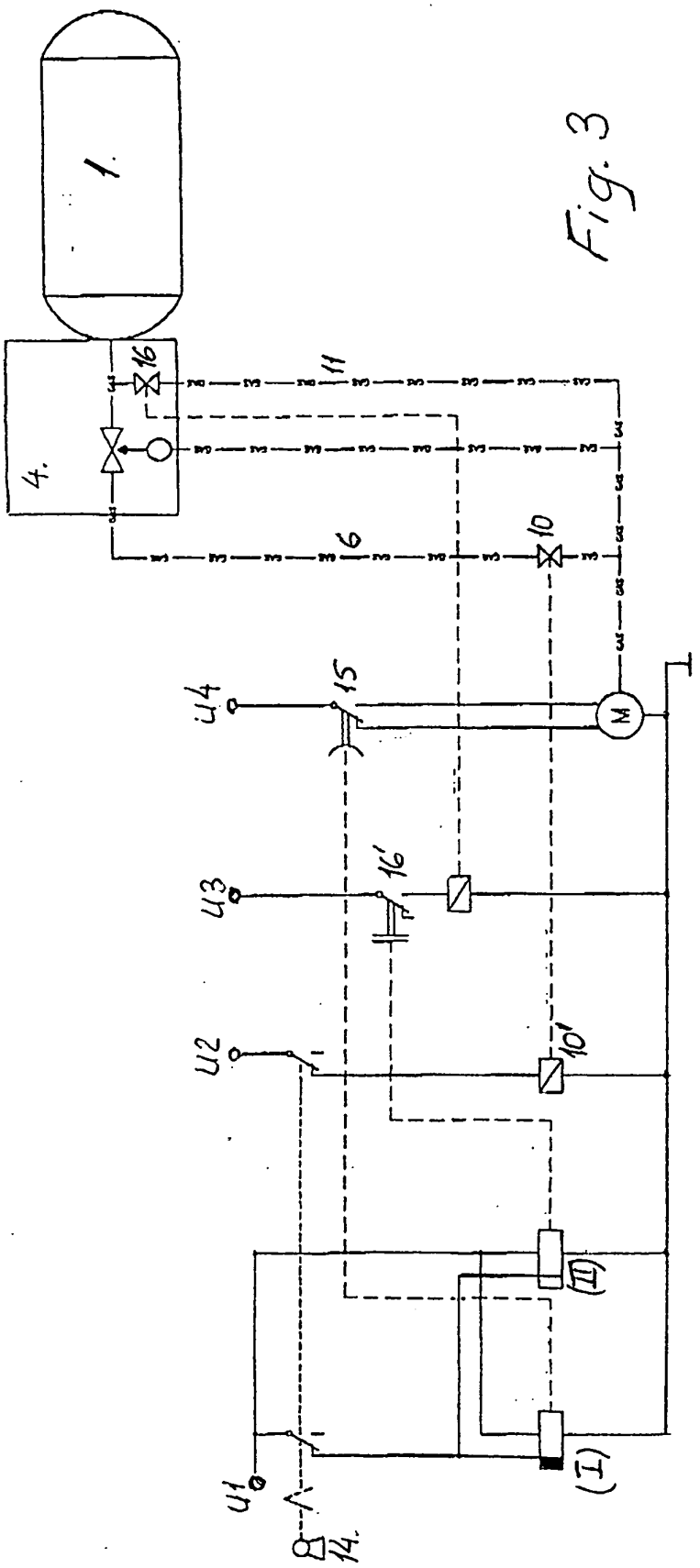

Fig. 3