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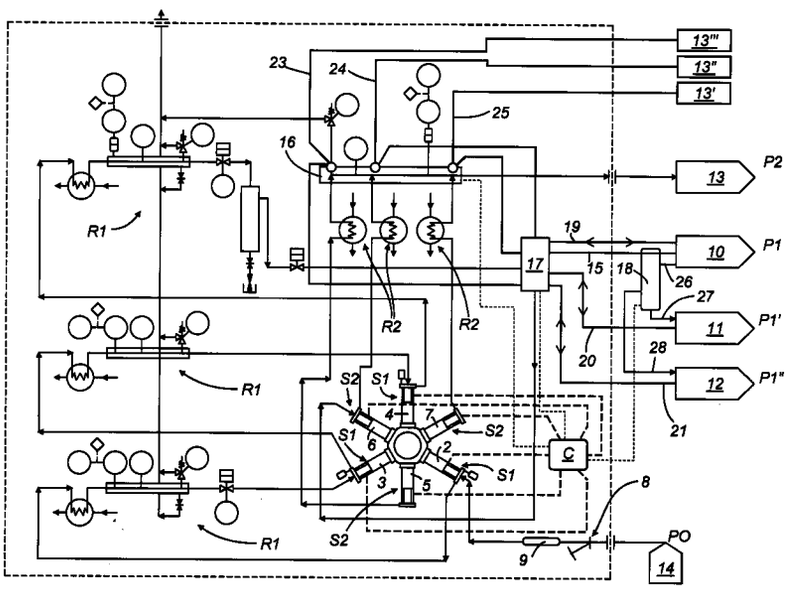
(54) A system for the distribution of gas under pressure

(57) The invention relates to a system for the distribution of gas under pressure, which can be used to supply gas at a predetermined pressure (P1), and which comprises a first compression station (S1) designed to compress the gas from an original pressure (P0) to the said predetermined value and a second compression station (S2) designed to operate in combination with or to alternate with the first compression station (S1); the first compression station (S1) and the second compression station (S2) form part of a single compression unit driven by a single motor.

FIG.1



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Description

The present invention relates to a system for the distribution of gas under pressure.

Systems of this kind are used, for example, at motor vehicle gas refuelling stations.

At refuelling stations which are connected up to a main gas supply, the gas coming in from the mains must be compressed to a pressure suitable for filling the gas storage tanks and the motor vehicles.

For this reason, gas supply systems are equipped with a first compression station with a compressor which receives incoming gas at mains pressure (of just a few BAR) and compresses it to a considerably higher pressure (of a few hundred BAR).

The compressed gas is usually stored in one or more tanks and subsequently used to refuel motor vehicles. In practice, inside the storage tanks, the gas is kept at a pressure suitable for filling the motor vehicle tanks. Usually, there is more than one storage tank and the gas in each tank has a different pressure. For example, there may be a medium-pressure tank and a high-pressure tank or a low-pressure tank, a medium-pressure tank and a high-pressure tank. When refuelling a motor vehicle, gas is initially drawn from the tank with the lower pressure and then from the one or more tanks with the higher pressure until the motor vehicle tank is completely full.

If large numbers of vehicles are refuelled at the same time, the pressure inside the storage tanks falls rapidly and the first compression station may be insufficient to satisfy the total gas demand.

For this reason, a second compression station, called "booster" in technical jargon, is necessary. The booster is a supplementary compressor which draws gas at a high pressure (that is, downstream of the compression station and of the storage tanks) so as to keep the pressure at the gas pumps at a sufficiently high level.

Thus, customary distribution systems consist essentially of a first compression station, one or more storage tanks and a second compression station (the booster) located downstream of the first compression station and connected to the pumps that supply gas to the motor vehicles.

In a structure of this kind, the gas compression means occupy a considerable amount of space because two compression stations, two motors, two casings and so on, are required.

Another disadvantage of prior art is that the second compression station usually consists of a single- (or, in some cases, double-) cylinder compressor driven by a hydraulic unit, that is, a relatively "slow" machine characterized by a low number of cycles per unit time. That means the pressure of the compressed gas cannot be maintained at a constant level at all times. In other words, by using a booster with a single cylinder (or with two cylinders), especially if driven by a hydraulic unit, it is difficult to guarantee a constant supply pressure, particularly when the gas demand from the gas pumps is very high.

Yet another negative aspect presented by currently used gas distribution systems is due to the fact that the second compression station is usually permanently connected to one storage tank. That means that the problem of an insufficient flow rate is likely to occur when large numbers of motor vehicles are refuelled from the same storage tank at the same time.

Moreover, it is sometimes convenient to be able to refuel two or more motor vehicles independently of each other. This can only be achieved by using a compression station (booster) with one cylinder for each motor vehicle.

The aim of the present invention is to overcome the disadvantages just mentioned by providing a gas distribution system where the two compression stations are combined in a single block, that is to say, are driven by the same motor and housed in a single casing.

The invention essentially envisages a single casing to house a compressor, preferably a mechanical, reciprocating compressor with cylinders in star-shaped arrangement and connected to each other in such a way as to form two separate compressors constituting the first and second compression stations.

One advantage of the present invention is that the system occupies considerably less space than conventional systems used for the same purpose.

Another advantage of the invention is that the second compression station may consist of a plurality of cylinders. This feature improves gas flow control both in terms of the quantity of gas passing through the system and constancy of the flow rate.

Moreover, according to the present invention, the second compression station may consist of a plurality of cylinders whose delivery ends are connected, independently of each other, to different motor vehicles.

Also in accordance with the present invention, the second compression station may consist of a plurality of cylinders whose intake ends are connected, independently of each other, to different storage tanks. That means that when many motor vehicles draw gas from the same storage tank, the second compression station can be connected mainly to that tank.

The cylinders of the second compression station may also be connected with their delivery ends to different storage tanks independently of each other.

In addition, in a preferred embodiment of the invention, the system may comprise a single casing that houses a plurality of cylinders that may be connected to each other in series or in parallel in different, selectable combinations that form the two compression stations. The two compression stations may therefore include a variable number of cylinders arranged differently, depending on the selected combination.

The characteristics of the invention according to the abovementioned objects are laid out in the claims below

and the advantages of the disclosure are apparent from the detailed description which follows, with reference to the accompanying drawing, which illustrates a preferred embodiment of the invention and where:

- Figure 1 is a diagram of an embodiment of the present invention where the various components are illustrated symbolically and the parts that do not fall strictly within the scope of the inventive concept are not illustrated.

With reference to the accompanying drawing, a system for the distribution of gas under pressure made in accordance with the present invention can be used to supply gas at a certain pressure P2, for example, a value equal to (or lower than) the pressure used for filling mobile tanks, that is to say, tanks with which motor vehicles are equipped.

As already mentioned, this type of system comprises a first compression station designed to compress the gas from an original pressure P0 (for example, the pressure of the gas mains, labelled 14 in Fig. 1) to a second value P1 that may or may not be the same as the said filling pressure P2. A second compression station (or booster) S2 is also envisaged to operate in combination with or to alternate with the first compression station (S1), by drawing gas at pressure P1 (a variable value) and recompressing it into the motor vehicles at the filling pressure.

In practice, the first compression station S1 compresses the gas, drawn at mains pressure, to a certain value which may be the same as the motor vehicle filling pressure or different from it, for example, lower, and stores it in one or more storage tanks. The gas is then drawn from the storage tanks and further modified by the compression station S2 whose delivery end is connected directly or through dampening tanks to filler pumps, illustrated schematically by the blocks labelled 13 as a whole.

The present invention envisages, to good advantage, that the first compression station S1 and the second compression station S2 form part of a single compressor unit driven by a single motor and mounted in a single casing.

The single compressor unit may consist of a star compressor 1, of the mechanical, reciprocating type equipped with a first set of cylinders (2, 3, 4 in the preferred embodiment illustrated) forming the first compression station S1 and a second set of cylinders (5, 6, 7 in the preferred embodiment illustrated) forming the second compression station S2.

Looking in more detail at the accompanying drawing, we can see that the cylinders 2, 3 and 4 are connected to each other in series to form a multistage compressor.

In practice, the gas drawn from the mains 14 where its pressure is P0 passes through a filter 8 and a pulsation dampening 9 to reach a first cylinder 2. It then passes through customary cooling means R1 to reach the second cylinder 3. From the second cylinder 3, still cooled by cooling means R1, similar to the previous ones, the gas reaches a third cylinder 4 and from there, passing through cooling means R1, it reaches a pipe 15 leading into the storage tank 10, where the gas is kept at the second pressure P1 whose value varies according to the demand. The value of pressure P1 may be less than or equal to the pressure P2 at which the refuelling pumps fill the gas into the motor vehicles.

The casing of the compressor unit 1 also includes the second set of three cylinders 5, 6 and 7, driven by the same motor as the first set.

The three cylinders 5, 6 and 7 are connected to each other in parallel and have independent actuation means to control them in such a way that they form the second compression station S2.

The intake ends of the cylinders 5, 6 and 7 can be connected to a storage tank 10. The gas drawn from this tank and subjected to the action of the second compression station S2, is used to fill the motor vehicle tanks through appropriate refuelling means 13 (namely, 13, 13', 13", 13'"), dampening tanks, which are not illustrated, being fitted if necessary. There are appropriate cooling means R2 also at the delivery ends of the second set of cylinders. As mentioned above, the parts that do not fall strictly within the scope of the inventive concept are not shown in detail.

In the preferred embodiment illustrated, the system has three storage tanks, namely, the tanks 10, 11 and 12.

Without departing from the scope of the inventive concept, the various different components of the system, namely, the two compression stations S1 and S2, the storage tanks 10, 11 and 12 and the gas pumps 13, 13', 13", 13'" can be connected in different ways, as described below.

For example, thanks to appropriate gas flow deflection means, represented schematically by the block 18 in Fig. 1, the first compression station S1 can be connected at its delivery end to the three storage tanks 10, 11 and 12 through corresponding pipes 26, 27 and 28. Obviously, the pressure at which the tanks will be filled by the first compression station will depend on the delivery specifications of the station itself.

The cylinders of the second set 5, 6 and 7 (again in the case of multiple storage tanks 10, 11 and 12) are also equipped with independent means for connecting their intake ends to one or more storage tanks. In the preferred embodiment illustrated, there are three tanks, labelled 10, 11 and 12, corresponding to pressures P1, P1' and P1". In other words, the system may have medium- and high-pressure storage tanks or low-, medium- and high-pressure storage tanks, as in the embodiment illustrated, or any other number of storage tanks.

The second compression station S2 may be connected to the three storage tanks at its delivery end as

well as at its intake end. In practice, gas flow deflection means, schematically represented by block 17, may be envisaged to create a two-way connection between the cylinders 5, 6 and 7 and the pipes 19, 20 and 21 which lead into the tanks 10, 11, and 12.

Since each single cylinder can be connected to the second compression station S2 independently of the others, the system can be adjusted to the gas demand of the motor vehicles being refuelled.

In other words, when a large number of motor vehicles are being refuelled from the same tank, the system operator or the automatic control unit 17 (that is to say, the gas flow deflection means mentioned above) can connect one or more cylinders 5, 6 or 7 of the second compression station S2 to the tank which needs a boost charge.

Therefore, in the embodiment described above, the three cylinders 5, 6 and 7 can be connected at their delivery ends either to a generic, single gas pump 13 or to separate gas pumps 13', 13'' and 13''' or even to the storage tanks 10, 11 and 12. At the intake end, the three cylinders 5, 6 and 7 can be connected to one or more of the storage tanks 10, 11 and 12.

To control delivery to the gas pumps, there is a control unit 16 designed to deflect the gas flow from the cylinders 5, 6, 7 to the gas pumps 13', 13'' and 13''', respectively, through the related pipes 23, 24 and 25.

Delivery to the tanks 10, 11 and 12 and intake from the same are controlled by the control unit 17, in combination with the control unit 18 (which drives delivery from the first compression station S1 to the storage tanks) and which is connected to the said control unit 16 and to the pipes 19, 20 and 21 which lead into the tanks 10, 11 and 12.

It is also envisaged by the present invention, without departing from the scope of the inventive concept, that all the cylinders mounted in the casing can be connected to each other in different ways to form compression stations of different shapes and sizes. For example, under certain working conditions of the embodiment illustrated in the drawing, where there are six cylinders altogether, two cylinders (for example, those labelled 2 and 3) might form the first compression station S1 and the remaining four (those labelled 4, 5, 6 and 7) the second compression station S2.

Obviously, there may be a different number of cylinders and they may be combined in different ways.

In this case, too, as in the one described earlier, the different combinations of cylinders can be created manually by an operator or automatically by appropriate control means C, also represented by a function block connected by a dashed line to the different components of the system.

The invention described can be subject to modifications and variations without thereby departing from the scope of the inventive concept. Moreover, all the details of the invention may be substituted by technically equivalent elements.

Claims

1. A system for the distribution of gas under pressure which can be used to supply gas at a predetermined pressure (P2), of the type comprising a first compression station (S1) designed to compress the gas from an original pressure (P0) to a second pressure value (P1), which may or may not coincide with the said predetermined value (P2), and a second compression station (S2) designed to operate in combination with or to alternate with the first compression station (S1), the said system being characterized in that the said first compression station (S1) and the said second compression station (S2) form part of a single compressor unit driven by a single motor.

2. The system for the distribution of gas under pressure according to claim 1 characterized in that the said single compressor unit is a star compressor (1) equipped with a first set of cylinders (2, 3, 4) forming the said first compression station (S1) and a second set of cylinders (5, 6, 7) forming the said second compression station (S2).

3. The system for the distribution of gas under pressure according to claim 2 characterized in that the cylinders of the first set (2, 3, 4) are connected in series with each other so as to form a multistage compressor.

4. The system for the distribution of gas under pressure according to claim 2 characterized in that the cylinders of the second set (5, 6, 7) are connected in parallel with each other.

5. The system for the distribution of gas under pressure according to claim 2 characterized in that the cylinders of the second set (5, 6, 7) are equipped with independent actuation means.

6. The system for the distribution of gas under pressure according to claim 2 comprising at least two gas storage tanks (10, 11) in which the gas is kept at different pressure values (P1, P1') depending on the times and methods of filling of the mobile fuel tanks, characterized in that the cylinders of the second set (5, 6, 7) are equipped with independent means (17, 19, 20) to connect their intake ends to at least one of the two storage tanks (10, 11) so that they can be actuated independently of each other in accordance with the demand created by the refuelling of the said mobile tanks.

7. The system for the distribution of gas under pressure according to claim 2 comprising at least three gas storage tanks (10, 11, 12) in which the gas is kept at different pressure values (P1, P1', P1'')

depending on the times and methods of filling of the mobile fuel tanks, characterized in that the cylinders of the second set (5, 6, 7) are equipped with independent means (17, 19, 20, 21) to connect their intake ends to at least one of the two storage tanks (10, 11) so that they can be actuated independently of each other in accordance with the demand created by the refuelling of the said mobile tanks.

8. The system for the distribution of gas under pressure according to claim 2 comprising at least two gas storage tanks (10, 11) in which the gas is kept at different pressure values (P1, P1') depending on the times and methods of filling of the mobile fuel tanks, characterized in that it comprises automatic control means (C) designed to connect the delivery end of one or more of the cylinders of the second set (5, 6, 7) to the said storage tanks (10, 11) in accordance with the demand created by the refuelling of the said mobile tanks.

9. The system for the distribution of gas under pressure according to claim 2 characterized in that it comprises automatic control means (C) designed to actuate one or more cylinders of the second set (5, 6, 7) forming the said second compression station (S2) in accordance with the detected gas demand of the system.

10. The system for the distribution of gas under pressure according to claim 1 characterized in that the said single compressor unit is a star compressor (1) equipped with a plurality of cylinders (2, 3, 4, 5, 6, 7) and corresponding means designed to connect the cylinders to each other in different combinations in such a way as to form the said first compression station (S1) and the said second compression station (S2).

11. The system for the distribution of gas under pressure according to claim 10 characterized in that it also comprises automatic control means (C) designed to connect the cylinders to each other in accordance with the detected gas demand of the system.

12. The system for the distribution of gas under pressure according to claim 2 comprising a plurality of gas storage tanks (10, 11, 12) characterized in that the said first set of cylinders (2, 3, 4) forming the said first compression station (S1) is equipped with gas flow deflection means (18) designed to direct the gas to one or more of the said storage tanks (10, 11, 12).

13. The system for the distribution of gas under pressure according to any of the foregoing claims characterized in that the said single compressor unit is a mechanical, reciprocating compressor.

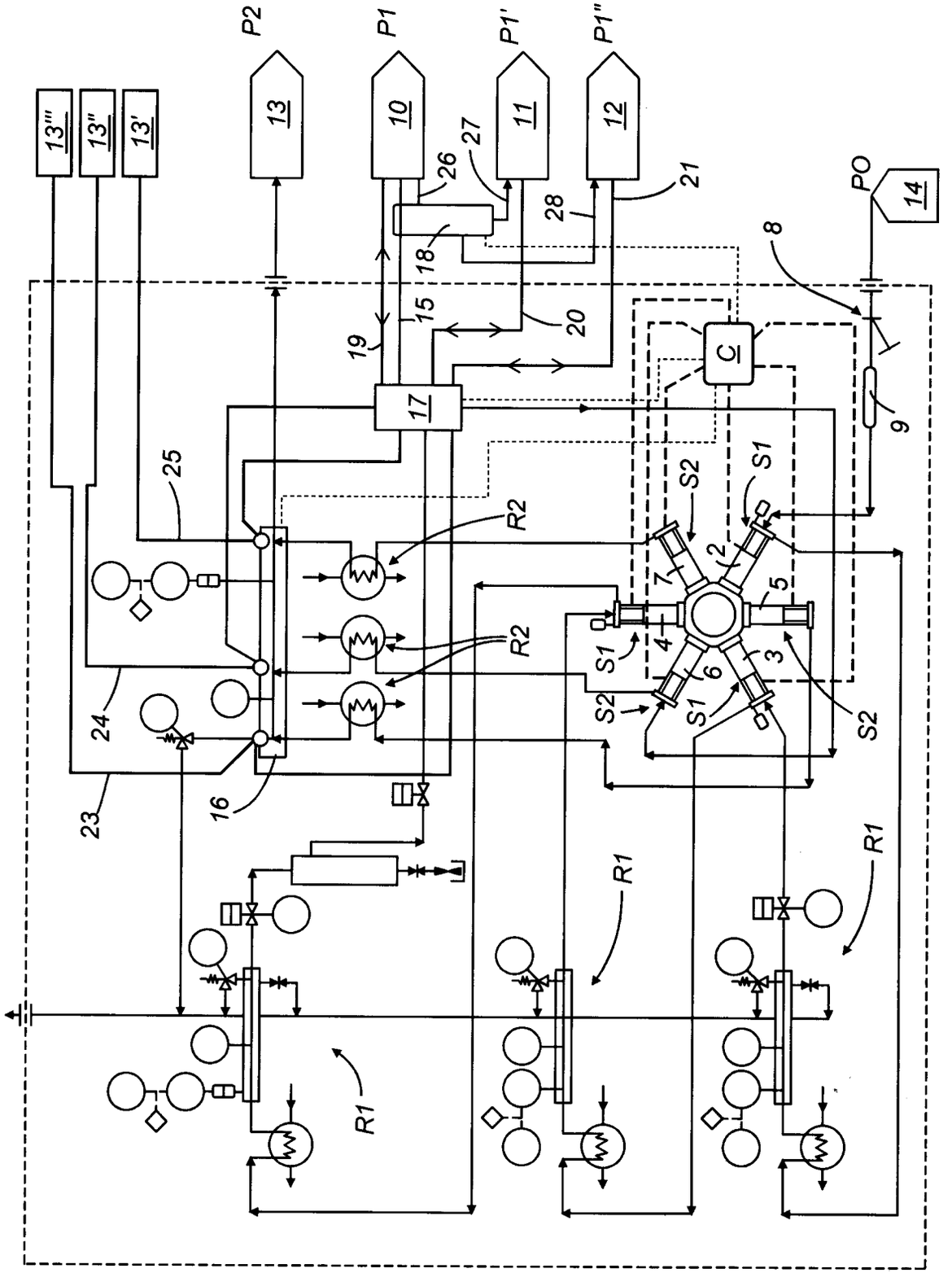
P2
P1
P1'
P1"
PO
13'''
13''
13'
13
10
11
12
14
C
17
R1
R2
S1
S2
1
2
3
4
5
6
7
8
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FIG.1