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Nyomás alatt levő gáztároló berendezés

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

PRESSURIZED GAS STORAGE DEVICE

DESCRIPTION

The invention relates to a pressurized gas storage device comprising at least two gas storage volumes that are connected to a gas transport grid.

The invention relates in particular to a gas storage power station.

The invention relates furthermore to a method for the operation of a pressurized gas store, in particular to the operation of a pressurized gas store as a gas storage power station.

Storage power stations with several storage volumes communicating with each other are known both in the form of hydroelectric power stations, for example, as pumped-storage power stations, as well as in the form of compressed air reservoirs.

In the provision of electrical energy in power supply grids a distinction is made in principle between a so-called base-load requirement and a peak-load requirement. The base-load requirement is usually provided by conventional power stations, for example, by coal-fired power stations, nuclear power plants or the like. The peak-load requirement is provided as a rule by fast-start systems such as gas-fired plants, pumped-storage power stations or the like.

With an increasing share of power from wind power and solar power an increasing need for the storage of electrical energy results, for example, in the form of potential energy, since the power available from such energy sources is relatively volatile.

The known solutions for the storage of electrical energy in the form of an electrical potential are not economical. Instead, the storage of electrical energy in the form of potential energy takes place in pumped-storage power stations or compressed air reservoirs.

Pumped-storage power stations are suitable in principle for storing and providing larger quantities of energy as required. Since pumped-storage power stations use potential energy, which results from the difference in elevation of two reservoirs, the impact of the force of gravity and the mass of the working liquid water, which is moved between the reservoirs, its construction requires appropriate topographical circumstances, which are not given in all geographical latitudes and to some extent are also already largely utilized. In addition, relatively large storage volumes are needed with regard to the quantity of energy which can be stored.

Other known methods for the storage of energy from renewable energy sources are, for example, the electrolytic generation of hydrogen or the previously mentioned compression and supply of compressed air in compressed air reservoirs. These forms of energy storage are afflicted with a relatively poor efficiency. When air is compressed heat is released, which, if necessary, must be discharged, when the air is expanded, the corresponding quantity of heat must be supplied again. This portion is dependent on the pressure difference and the working pressure. In addition, it is, for example, required, to dehumidify the expanded air, which is also accompanied by a relatively high expense.

These so-called CAES-systems (compressed air energy systems) use the pressure difference between a store and the atmosphere. Such CAES-system is known, for example, from WO 2011/059594 A2.

Another storage power station for the storage of electrical energy in the form of potential energy and pressure enthalpy is known, for example, from DE 10 2011 112 113 A1, wherein the storage power station comprises at least a first and a second storage volume, wherein the first storage volume is arranged predominantly on a higher level than the second storage volume, at least one of the storage volumes is filled at least partially with a working liquid, and the storage volumes communicate with each other via at least one compensation line, inside of which at least one pump and/or a turbine is arranged, wherein the first storage volume is closed gas-tight and is filled with a working gas in such a way that this can be filled under compression of the working gas with the working liquid.



Such a storage power station is therefore particularly advantageous, because to accommodate the needed storage volumes workings of an underground mine can, for example, be used.

A device and a method for energy storage are known from document WO 2013/064276 A2, wherein the device is also designed as a pumped-storage power station with several storage volumes arranged underground.

The problem addressed by the present invention is to provide a pressurized gas storage device in particular in the form of a gas storage power station as well as a method for the operation of a pressurized gas storage device, which is improved with respect to the use of the storage volumes and which requires in particular a lower energy expenditure for conditioning the gas to be stored.

The problem addressed by the invention is solved with the features of the independent claims. Advantageous embodiments of the invention result from the sub-claims.

According to one aspect of the invention a pressurized gas storage device is provided, which comprises at least two gas storage volumes, which are connected to a gas transport grid, wherein the gas storage volumes communicate with each other via at least one first collection line and are connected to the gas transport grid via at least one second collection line, wherein the pressurized gas storage device further comprises at least one compressor, which is arranged between the second collection line and the first collection line, as well as at least one power machine and at least one generator, wherein the power machine is arranged between the second collection line and the first collection line, wherein the compressor and the power machine are connected opposite each other in parallel between the second collection line and the first collection line and wherein the compressor and the power machine are connected such that gas can be transferred between the gas storage volumes, either using a pressure gradient in the case of the operation of the generator and generating a pressure gradient in the case of the operation of the compressor.

The invention can therefore be summarized in that a pressurized gas storage device is provided with a compressor and at least one power machine and several gas storage volumes, which is connected such that, for example, at off-peak periods by expending electrical energy a loading and compression of the gas in a gas storage volume can occur when discharging a further storage volume and simultaneous pressure reduction in the further storage volume. At heavy load periods the pressure compensation between the two gas storage volumes can then occur, wherein the compensation of the pressure gradient during operation of a power machine is used when feeding the electrical energy into the power grid.

Such compensation can thereby occur in an advantageous manner such that the entire stored quantity of gas of all of the total storage volumes does not necessarily have to be changed, so that it is not required, for the gas storage device according to the present invention to provide separate gas volumes. Rather, already available pressurized gas stores are used for the supply of natural gas/methane. For this purpose it is only required to upgrade available gas storage volumes accordingly.

A further advantage of such a pressurized gas storage device can be seen in that the working pressure can be kept at a relatively high level, i.e., for example, between 70 and 200 bar. From this it follows, that the demand for electrical energy for the heating of expanded gas or for the cooling of compressed gas remains within acceptable limits.

The basic idea of such a gas storage power station consists in using the caverns of large gas stores in addition to the storage of potential energy in the form of a pressure difference.

If, for example, two gas storage volumes of the same size are available, these can, for example, in the case of equal quantity of gas in each case be half-full or the one full and the other empty. In the first case no pressure difference prevails, which in the case of a given quantity of gas corresponds to an energy level of 0%. The second case describes the maximum possible technical pressure difference and corresponds to an energy level of 100% of potential energy in the case of an unchanged quantity of gas.

Thus, it is in principle possible to store electrical power in the form of potential energy in gas stores available anyway, without having to touch the stored quantity of gas.

A power machine is understood to mean in terms of the existing invention a machine, which converts potential, thermal or electrical energy into mechanical energy, for example, mechanical work. In general, so-called work machines as driven machines, which absorb energy in the form of mechanical work, are distinguished therefrom. A power machine in terms of the present invention is understood to mean in particular a turbo-machine or a displacement machine. Exceptions to this are so-called thermal engines, which are not suitable for the conversion of potential energy into mechanical work.

Preferably a turbo-machine or a displacement machine is provided as a power machine chosen from a group comprising piston machines, screw machines and expansion turbines. Expansion turbines in terms of the present application are such turbines, which exclusively convert the energy from the expansion of a working gas into mechanical work, from which in general so-called gas turbines are distinguished, which function at least partially as thermal engines.

In the case of a preferred variant of the pressurized gas storage device according to the invention it is provided, that the gas storage volumes in each case are connected both to the second collection line as well as to the first collection line.

Advantageously, the gas storage volumes are designed in each case as cavern stores. Alternatively, the use of other storage volumes is of course also possible. Cavern stores are, however, available in sufficient number, so that a relatively simple retrofitting of existing storage caverns for pressurized gas storage devices according to the invention is possible.

Advantageously, the compressor and the power machine are in each case connected to at least one heat store on a high pressure side. Due to the relatively high working pressure between the states of 100% potential energy and 0% potential energy, in the case of the compression of the compressed gas, which already has a certain pressure level, relatively low temperatures arise, conversely in the case of expansion of the compressed gas a relatively small drop in temperature arises, so that, for example, a heat store with water as the heat storage medium can be provided as a heat store.

Since the pressurized gas storage device according to the invention is connected to a gas transport grid, the lower pressure level as a rule will be specified through the gas transport grid and will be in the order of magnitude of approximately 70 bar, the higher pressure level will be specified through the state of the storage volume and the compressor capacity, this can be approximately 200 bar, so that the usable energy gradient corresponds approximately to a pressure difference of 130 bar.

In principle the compressor and a power machine, which is designed, for example, as an expansion machine, can be realized in a single aggregate. In addition, the power machine or an expansion machine and a generator can be combined spatially and functionally in a single aggregate.

According to another aspect of the present invention, a method for the operation of a pressurized gas store is provided with at least two gas storage volumes, wherein the gas storage volumes are connected to a gas transport grid and the method comprises the following steps:

- feeding compressed gas from the gas transport grid in at least one gas storage volume in dependence on a demand for gas linked to the time of the year, and/or
- discharging the compressed gas from at least one gas storage volume into the gas transport grid in dependence on a demand for gas linked to the time of the year, and/or
- transferring of compressed gas from at least one first gas storage volume into at least a second gas storage volume, using a pressure gradient between the gas storage volumes using at least one power machine and at least one generator in dependence on a demand for electricity that varies with the time of day, and/or
- transferring compressed gas from at least one first gas storage volume into at least one second gas storage volume, generating a pressure gradient and using at least one compressor in dependence on a demand for electricity that varies with the time of day.

According to the invention the storage of compressed gas from the gas transport grid can occur once, whereas the transfer of compressed gas from a gas storage volume into a further gas storage volume occurs cyclically in dependence on the demand for electricity that varies daily or from day to day. Preferably, a discharging of compressed gas also occurs according to demand for gas linked to the time of the year, wherein such a discharging is not necessarily required.

The demand for gas linked to the time of the year results from a fluctuation of the ambient temperature linked to the time of the year, whereas the daytime demand for electricity arises largely from the consumer behavior.

The method according to the present invention makes possible the overlapping of the stocking of gas, for example, as heating gas and the peak-load electricity storage by using potential energy or off-peak electricity storage, wherein the pressurized gas stores existing anyhow are operated analogously to a water pump storage power station.

The substantial advantage of such storage is that the method according to the invention can be operated based on a relatively high basic pressure level, which in particular in the case of a gaseous storage medium has the advantage that lower temperature differences arise between expansion and compression.

The gas storage volume in terms of the present invention can be any suitable volume which can be tightly closed and pressurized. In this sense the gas transport grid itself can also serve as a usable gas storage volume.

The fact that the transfer cycles between the gas storage volumes are largely decoupled from the stocking cycles conditioned by the gas consumption, can be used so that larger quantities of gas can be borrowed in the short term from the gas transport grid, for example, outside of the heating period, which can then be returned again into the gas transport grid cost-neutral.

According to the present invention it is provided, to generate in each case a pressure gradient between the gas storage volumes also when feeding in the gas storage volumes or when discharging from the gas storage volumes. For this purpose it is provided, that the gas storage volumes contrary to the usual practice are emptied or filled in series when feeding-in or discharging. In particular, if cavern stores are used as gas volumes, the gas volumes are advantageously operated with a minimum filling pressure of 10 bar, preferably of 30 bar to 50 bar and/or a maximum filling pressure of 300 bar, preferably of 200 bar to 220 bar.

Methane or another combustible gas is preferably used as the compressed gas.

As already mentioned at the beginning, it is preferably provided to carry out the method using a cavern storage arrangement.

At the same time, it is quite possible and makes sense to use more than two storage volumes.

Advantageously, the compressed gas is cooled after the compression and heated prior to an expansion.

This can occur advantageously by using at least one heat store operated with water as a heat transfer medium.

Since according to the invention the use of the pressure difference between the gas volumes or the generation of the pressure difference between the gas volumes occurs cyclically in the course of the day and the temperature differences between the different states of the compressed gas are relatively moderate, it is possible to use water as a heat transfer medium. Of course, other regenerative heat exchangers can also be used.

The invention is explained below by means of an embodiment depicted in the drawings.

Figure 1 shows a pressurized gas storage device according to the prior art.

Figure 2 shows two wiring diagrams, which basically illustrate the method according to the invention.

Figure 3 shows a pressurized gas storage device according to the present invention.

Figure 4 shows an illustration of the gas transfer within the pressurized gas storage device according to Figure 3 using the gas available in the gas storage volumes.

Figure 5 shows a view corresponding to Figure 4 of the pressurized gas storage device when generating electricity from the pressure difference between the gas storage volumes.

Figure 6 shows a view of the pressurized gas storage device in the case of gas storage and electricity generation from a pressure difference between the gas storage volumes and the gas transport grid.

Figure 7 shows a pressurized gas storage device according to the invention in the case of gas in-feeding by generating a pressure difference between the caverns and

Figure 8 shows a pressurized gas storage device according to the invention in the case of gas discharging.

Initially reference is made to Figure 1, which illustrates a pressurized gas store according to the prior art. The pressured gas store according to the prior art comprises a first cavern 1 and a second cavern 2, which in each case are connected with each other via a first collection line 3. In each case a compressor 4 and a gas pressure regulator device 5 is connected to the first collection line 3. The compressor 4 and the gas pressure regulator device 5 are connected to the gas transport grid 7 via a second collection line 6.

The gas transport grid 7 is in this case a combustion gas transport grid for transporting methane at a pressure of approximately 70 bar and a temperature of approximately 15 °C. In the case of such a pressurized gas storage device usually the caverns 1, 2 are emptied during the heating period, wherein the methane stored temporarily in the latter is preheated via a heating device 8 and is expanded via a regulator valve 9 to the pressure of the gas transport grid 7. The heating device 8 and the regulator valve 9 are part of the previously mentioned gas pressure regulator device 5. The expanded methane is fed into the gas transport grid 7 via the second collection line 6, wherein the second collection line 6, if necessary, connects several gas stores with each other.

Outside of the heating period methane is more or less continuously taken from the gas transport grid 7, fed to the compressor 5 via the second collection line 6, compressed to a storage pressure between 70 and approximately 200 bar and cooled down by means of a cooler 10 to the storage temperature of approximately 40 °C fed to the first collection line 3. Usually the first cavern 1 and the second cavern 2 are thereby loaded in parallel with the methane taken from the gas transport grid 7.

The invention now uses this basic structure.

In Figure 2 the process principle according to the present invention is illustrated by means of two different states of the caverns 1, 2.

In the state depicted in Figure 2a, both the first cavern 1 as well as the second cavern 2 are filled half-way with methane, wherein the filling pressure in each case is 135 bar. The pressure difference between the first cavern 1 and the second cavern 2 is zero, corresponding to an energy level of 0%.

At off-peak periods methane is now transferred by means of the compressor 4 (the same components are provided in all embodiments with the same reference signs) from the first cavern 1 into the second cavern 2, namely until the state shown in Figure 2b is reached and the first cavern 1 has a pressure level of 70 bar and the second cavern 2 has a pressure level of 200 bar. A pressure of 200 bar corresponds to the full state of the second cavern 2, a pressure of 70 bar corresponds approximately to the empty state of the first cavern 1. At this point it should be noted that the first cavern 1 is not emptied below 70 bar, since the pressure level of the gas transport grid 7 is approximately 70 bar.

The technically conditioned minimum pressure of the cavern 1 is approximately 30 to 60 bar.

The compression and the transfer of the methane from the first cavern 1 into the second cavern 2 occurs under expenditure of electrical energy from the power grid.

If the state reached in Figure 2b is achieved, the methane available in the second cavern 2 can be expanded from the pressure level of 200 bar back to the pressure level of 135, using the pressure gradient between the first cavern 1 and the second cavern 2. For this purpose, the methane is streamered from the second cavern 2 via a power machine in the form of a XX into the first cavern 1. The expansion turbine 11 in turn operates a generator 12, which generates electrical energy and feeds this into the power grid. This process occurs at peak-load periods, whereas the generation of the pressure difference and consequently the removal of electrical energy from the power grid, takes place at off-peak periods.

The method according to the present invention is explained below by means of the basic structure of the pressurized gas storage device according to the invention depicted in Figure 3.

The pressurized gas storage device according to the invention comprises at least one first storage cavern 1 and a second storage cavern 2, which in each case is connected both to a first collection line 3, as well as to a second collection line 6. The second collection line 6 is in turn connected to a gas transport grid 7. Between the second collection line 6 and the first collection line 3 several compressors 4 as well as at least one expansion turbine 11 are arranged opposite each other connected in parallel. The second collection line constitutes the low-pressure side with a pressure level of approximately 70 bar, whereas the first collection line constitutes the high-pressure side with a pressure level of up to 200 bar. As already mentioned above, in each case the first and the second caverns 1 and 2 are in each case connected to the second collection line 6 and to the first collection line 3. The corresponding line junctions in each case can be shut off with unspecified valves, so that different circuit arrangements can be realized.

Between the second collection line 6 on the low-pressure side and the first collection line on the high-pressure side a heat store 13 is arranged.

At least one compressor outflow 14 as well as at least one turbine feed 15 are thermally coupled with the heat store 13.

In the state of the pressurized gas storage device depicted in Figure 3 the first cavern 1 is provided with a minimum filling and the second cavern 2 with a maximum filling. The minimum filling corresponds to a pressure level of 70 bar at approximately 40 °C and the maximum filling to a pressure of 200 bar at approximately the same temperature.

Figure 4 illustrates the gas transfer between the gas storage volumes, that is, between the first cavern 1 and the second cavern 2 based on the same pressure level in the first cavern 1 and the second cavern 2. The same pressure level means in this case, that both caverns 1, 2 have the same filling level. Based on this state gas is now taken from the second cavern 2 and fed to a compressor 5 via the second collection line 6. There, the gas is compressed to a pressure up to 200 bar. With this pressure the first cavern 1 is loaded via the first collection line 3 until the gas pressure in the first cavern 1 corresponds approximately to 200 bar and the gas pressure in the second cavern 2 corresponds approximately to 70 bar. During the compression by means of the compressor heat accrues, which is given to the heat store 13 filled with water as a heat transfer medium. In addition, during the compression electrical energy is needed, which is taken from the power grid. This process occurs at off-peak periods, wherein the stored quantity of gas remains unchanged.

Figure 5 illustrates the gas transfer between the first cavern 1 and the second cavern 2 under reduction of the pressure level in the first cavern 1 in favor of the pressure in the second cavern 2, wherein the pressure difference between the first and the second cavern 2 is used to generate electricity. For this purpose, the pressure in the first cavern 1 of 200 bar is compensated by the transfer of the gas via the first collection line 3 and the expansion turbine 11 with the second cavern 2, until the pressure level is approximately 135 bar. The methane is expanded in the expansion turbine 11 under operation of the generator 12 and fed to the second cavern 2 via the second collection line 6. The gas leaving from the first cavern 1 is thereby preheated in the turbine feed 15 with the heat stored in the heat store 13. The heat entering during the feeding-in is thereby withdrawn again from the heat store 13. Electrical energy is generated via the generator 12 in this process and fed into the power grid. This process preferably takes place at peak-load periods.

Figure 6 illustrates the state of the pressurized gas storage device, in which for stocking reasons both the first cavern 1 as well as the second cavern 2 are filled. In such a state a generation of electricity from the pressure difference between both caverns 1 and 2 can occur in relation to further caverns or using the gas transport grid 7 as a gas storage volume. The arrows depicted in the figure illustrate the discharge of methane from the first and second caverns 1, 2 in parallel via the expansion turbine 11 into the gas

transport grid 7 as well as the feeding of methane via the second collection line 6 by means of the compressor 5 into both caverns 1, 2 in parallel. In the first case a preheating of the gas fed to the expansion turbine 11 occurs via the heat store 13 under removal of heat, in the latter case the heat store 13 is loaded in the heat exchanger with the compressed methane.

In the variant of the method illustrated in Figure 7 the second cavern 2 is loaded from the gas transport grid 7, wherein the figure illustrates the gas feeding-in with the aid of the compressor 4. The first cavern 1 is not filled and remains at the pressure level of approximately 70 bar. Between the second cavern 2 and the first cavern 1 the pressure difference is thus enlarged. The compressor 4 takes more electrical energy for the feeding-in of the same quantity to both caverns 1, 2 at the compensated pressure level than in the case of parallel filling. Such a variant of the method can make sense in the case of an overlapping of the seasonal gas feeding-in with storage of electrical energy in the form of potential energy.

Finally, Figure 8 illustrates a variant of the method according to the invention, in which a gas discharge from both caverns 1, 2 under reduction of the pressure in both caverns 1, 2 takes place simultaneously under prevention of a pressure difference between the caverns, namely via the expansion turbine 11 under preheating of the gas during simultaneous removal of heat from the heat store 13. In this case, at a high price of electricity both gas is discharged as well as electricity is fed into the power grid. The expansion turbine 11 delivers more electrical energy for the discharge of the same quantity of gas than in the case of asymmetrical emptying of both caverns with a pressure difference. This variant of the method constitutes the overlapping of the seasonal gas discharge and the discharge of electrical energy depicted in Figure 5.

List of reference signs

- | | |
|----|----------------------------------|
| 1 | first cavern |
| 2 | second cavern |
| 3 | first collection line |
| 4 | compressor with electrical drive |
| 5 | gas pressure regulator device |
| 6 | second collection line |
| 7 | gas transport grid |
| 8 | heating device |
| 9 | regulator valve |
| 10 | cooler |
| 11 | expansion turbine |
| 12 | generator |
| 13 | heat store |
| 14 | compressor outflow |
| 15 | turbine feed |

NYOMÁS ALATT LEVŐ GÁZTÁROLÓ BERENDEZÉS
SZABADALMI IGÉNYPONTOK



1. Nyomás alatt levő gáz tároló berendezés, amely tartalmaz legalább két gáztárolási mennyiség tartályt, amelyek egy gázszállító hálózatra (7) vannak rácsatlakoztatva, ahol a gáztárolási mennyiség tartályok legalább egy első gyűjtővezetéken (3) keresztül egymással összeköttetésben vannak, és legalább egy második gyűjtővezetéken (6) keresztül a gázszállító hálózatra (7) rá vannak csatlakoztatva, továbbá a gáz tároló berendezés tartalmaz legalább egy kompresszort (4), amely a második gyűjtővezeték (6) és az első gyűjtővezeték (3) között van elrendezve, valamint tartalmaz legalább egy erőgépet és legalább egy generátort (12), ahol legalább az erőgép a második gyűjtővezeték (6) és az első gyűjtővezeték (3) között van elrendezve, ahol a kompresszor (4) és az erőgép a második gyűjtővezeték (6) és az első gyűjtővezeték (3) között párhuzamosan szembe vannak kapcsolva, és ahol a kompresszor (4) és az erőgép úgy vannak összekapcsolva, hogy a gáz a tartályok között, gáznyomás esés kihasználása alatt, a generátor (12) működésénél, vagy a kompresszor (4) működése alatti nyomásesés létrehozása mellett áthajtható.
2. Az 1. igénypont szerinti nyomás alatt levő gáz tároló berendezés, **azzal jellemezve, hogy** erőgépként egy hidraulikus gép, vagy egy **eltérő gép** van kiválasztva, expanziós turbinákat, dugattyús gépeket, csavarhajítású gépeket tartalmazó csoportból.
3. Az 1. vagy 2. igénypont szerinti nyomás alatt levő gáztároló berendezés, **azzal jellemezve, hogy** a gázmennyiség tárolók mind a második gyűjtővezetékre (6), mind az első gyűjtővezetékre mindig rá vannak kapcsolva.
4. Az 1.-3. igénypontok egyike szerinti nyomás alatt levő gáztároló berendezés, **azzal jellemezve, hogy** a gázmennyiség tárolók mindig földalatti tárolóként vannak kiképezve.
5. Az 1.-4. igénypontok egyike szerinti nyomás alatt levő gáz tároló berendezés, **azzal jellemezve, hogy** a kompresszor (4) és az erőgép mindig magasnyomású oldalon van legalább egy hőtárolóra (13) rácsatlakoztatva.
6. Az 5. igénypont egyike szerinti nyomás alatt levő gáz tároló berendezés, **azzal jellemezve, hogy** a hőtároló (13) hőszállító médiumként vízzel van kiképezve.
7. Eljárás nyomás alatt levő gáz tároló üzemeltetéséhez, legalább két, az 1.-6. igénypontok szerinti gáztárolási mennyiség tartállyal, ahol a gáztárolási mennyiség tartályokat gázszállító hálózatra (7) kötjük rá, és az eljárás a következő lépéseket tartalmazza:
 - nyomógázt tárolunk egy gázszállító hálózatról legalább egy gáztárolási mennyiség tartályban, egy évszakot illető gázszükséglet függvényében, és/vagy
 - nyomógázt vezetünk ki legalább egy gáztárolási mennyiség tartályból a gázszállító hálózatba, egy évszakot illető gázszükséglet függvényében, és/vagy
 - nyomógázt hajtunk át legalább egy első gáztárolási mennyiség tartályból legalább egy második gáztárolási mennyiség tartályba, kihasználva a gáztárolási mennyiségek közötti nyomásesést, legalább egy erőgép és

legalább egy generátor alkalmazása mellett, egy napszakot illető áramigény csökkenésének függvényében, és/vagy

– nyomógázt hajtunk át legalább egy első gáztárolási mennyiség tartályból legalább egy második gáztárolási mennyiség tartályba, nyomásesés képzése mellett, és legalább egy kompresszor alkalmazása mellett, napszak szerinti csökkenő áramigény függvényében, ahol a gáztárolási mennyiség tartályba történő betárolás mellett, vagy a gáztárolási mennyiség tartályból történő kivezetés során mindig képződik nyomáscsökkenés, és ahol a gáztárolási mennyiséget tárolásnál, vagy kivezetésnél sorosan ürítjük ki, vagy tároljuk be.

8. A 7. igénypont szerinti eljárás, **azzal jellemezve, hogy a gáz mennyiséget 10 bar, előnyösen 30 bar-50 bar minimális töltőnyomással, és 300 bar, előnyösen 200 bar-20 bar maximális töltőnyomással működtetjük.**
9. A 7. vagy 8. igénypontok egyike szerinti eljárás, **azzal jellemezve, hogy nyomógázként metán alkalmazását választjuk.**
10. A 7.-8. igénypontok egyike szerinti eljárás, **azzal jellemezve, hogy az eljárást földalatti tároló elrendezés alkalmazásával hajljuk végre.**
11. A 7.-10. igénypontok egyike szerinti eljárás, **azzal jellemezve, hogy a nyomógázt sűrítés után lehűtjük, feszültségmentesítés előtt felmelegítjük.**
12. A 11. igénypont szerinti eljárás, **azzal jellemezve, hogy a hűlést és a melegítést vízzel, mint hőhordozó közeggel üzemelő hőtárolóval hajljuk végre.**

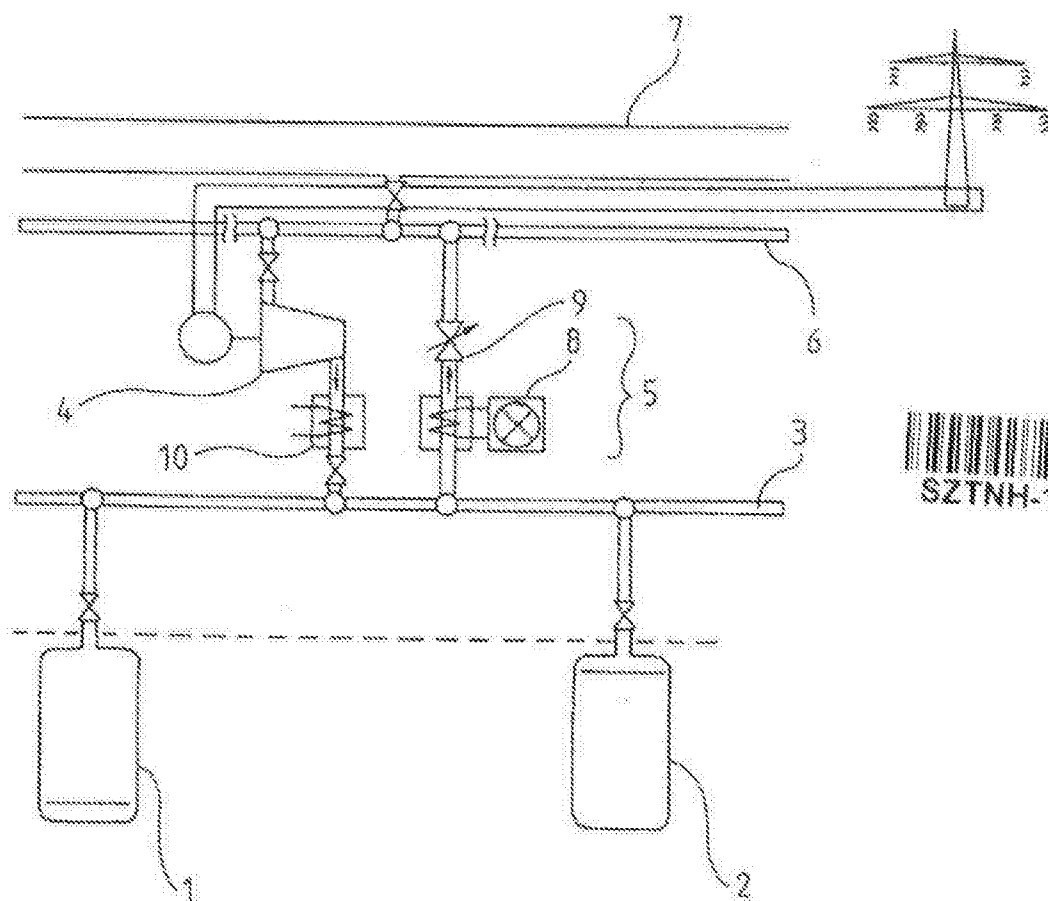


Fig. 1

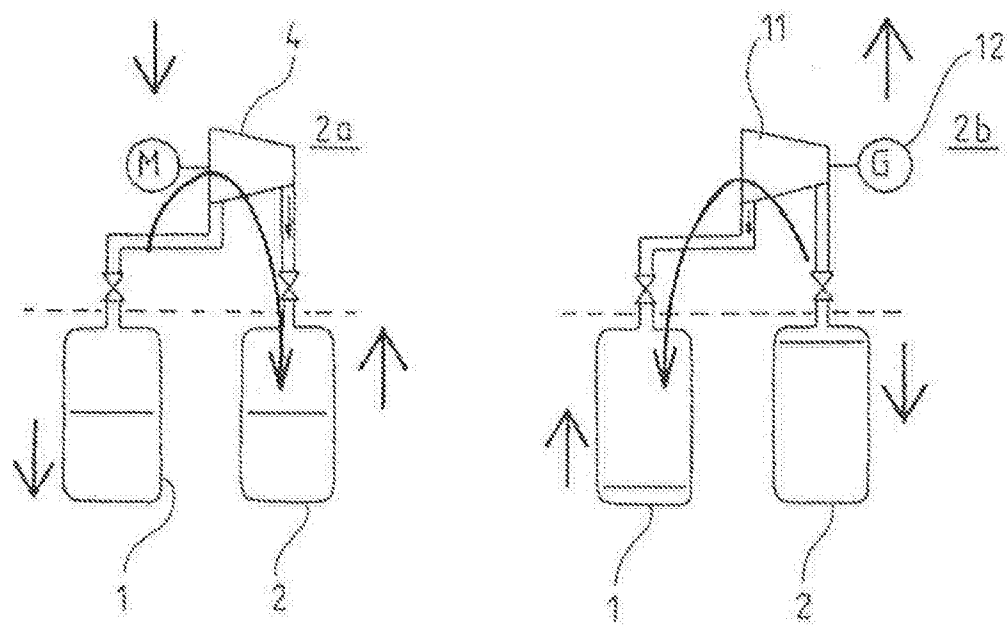


Fig.2

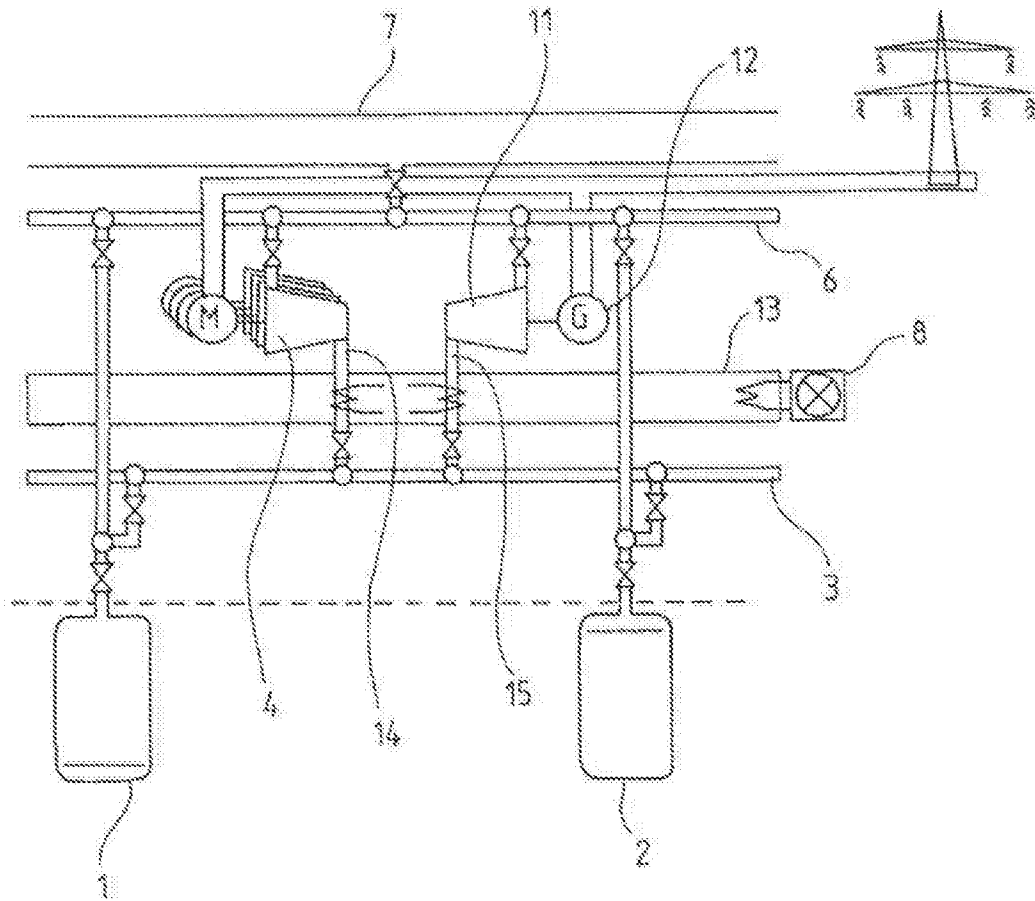


Fig. 3

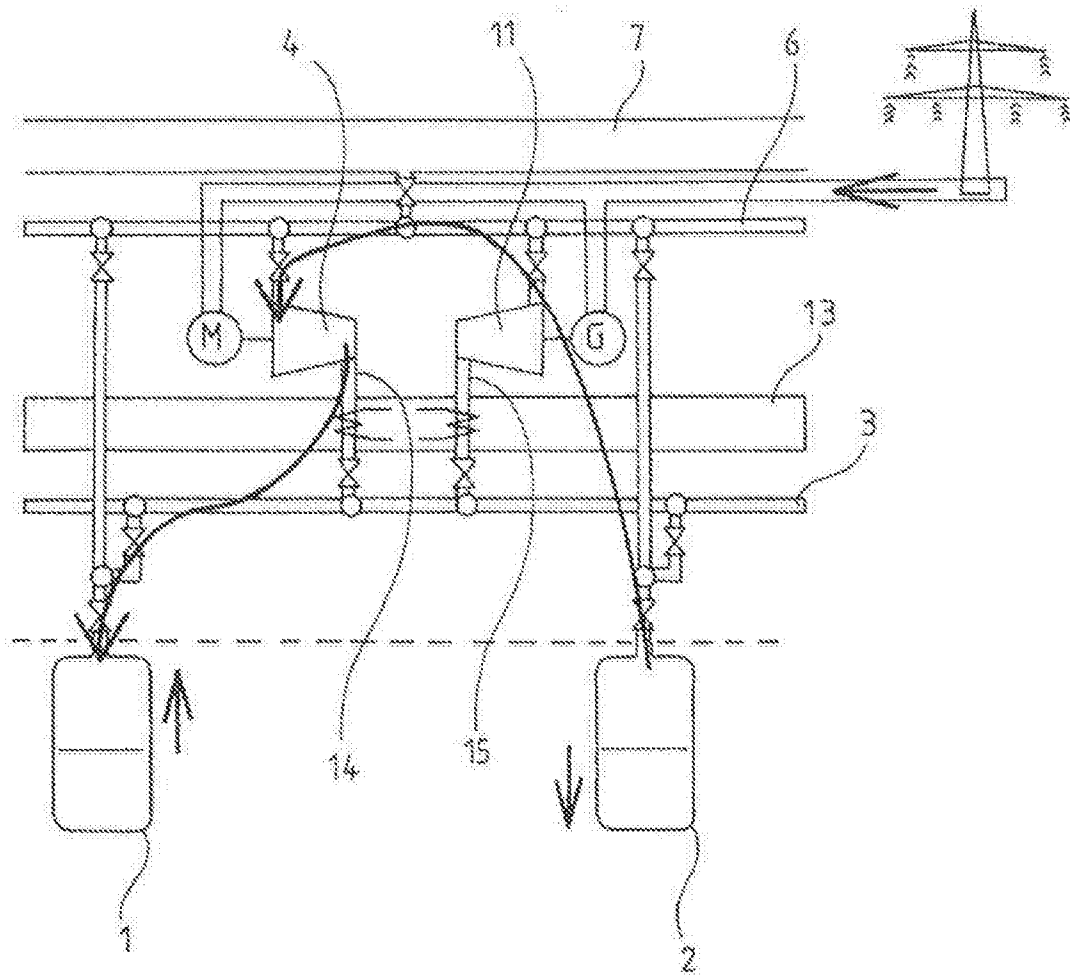


Fig. 4

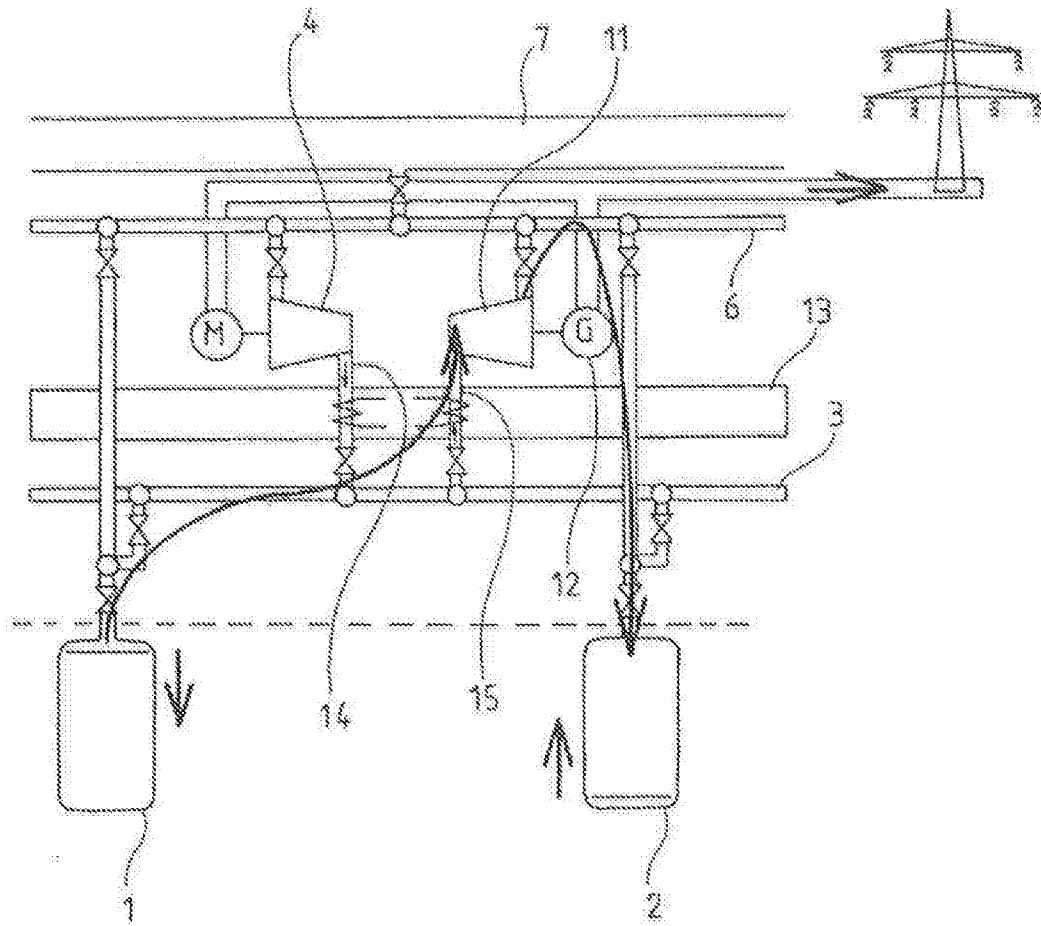


Fig. 5

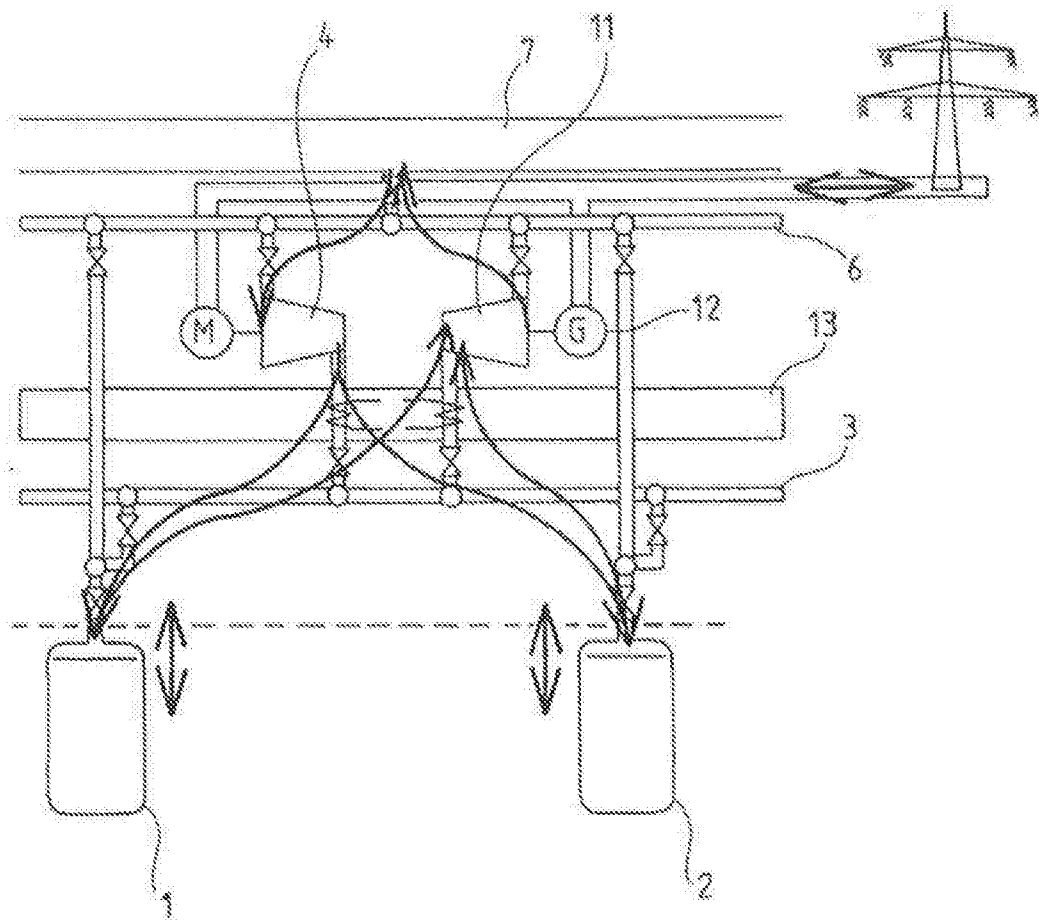


Fig. 6

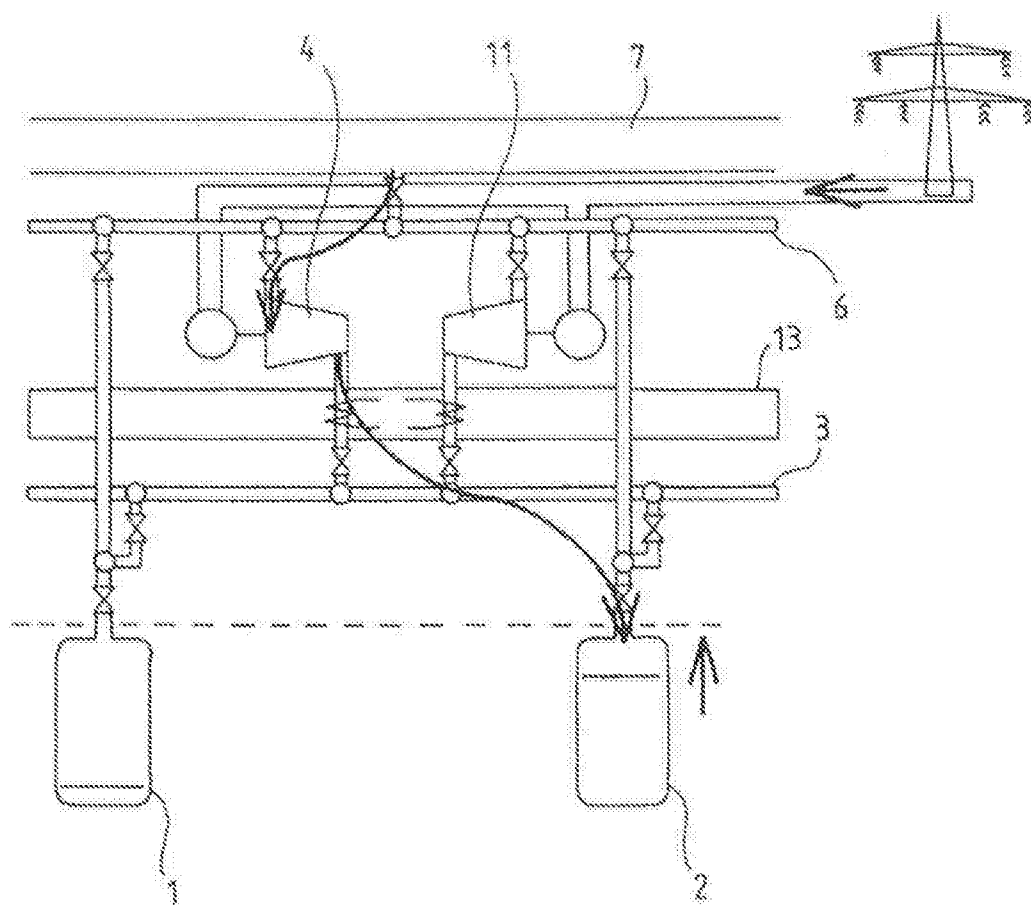


Fig. 7

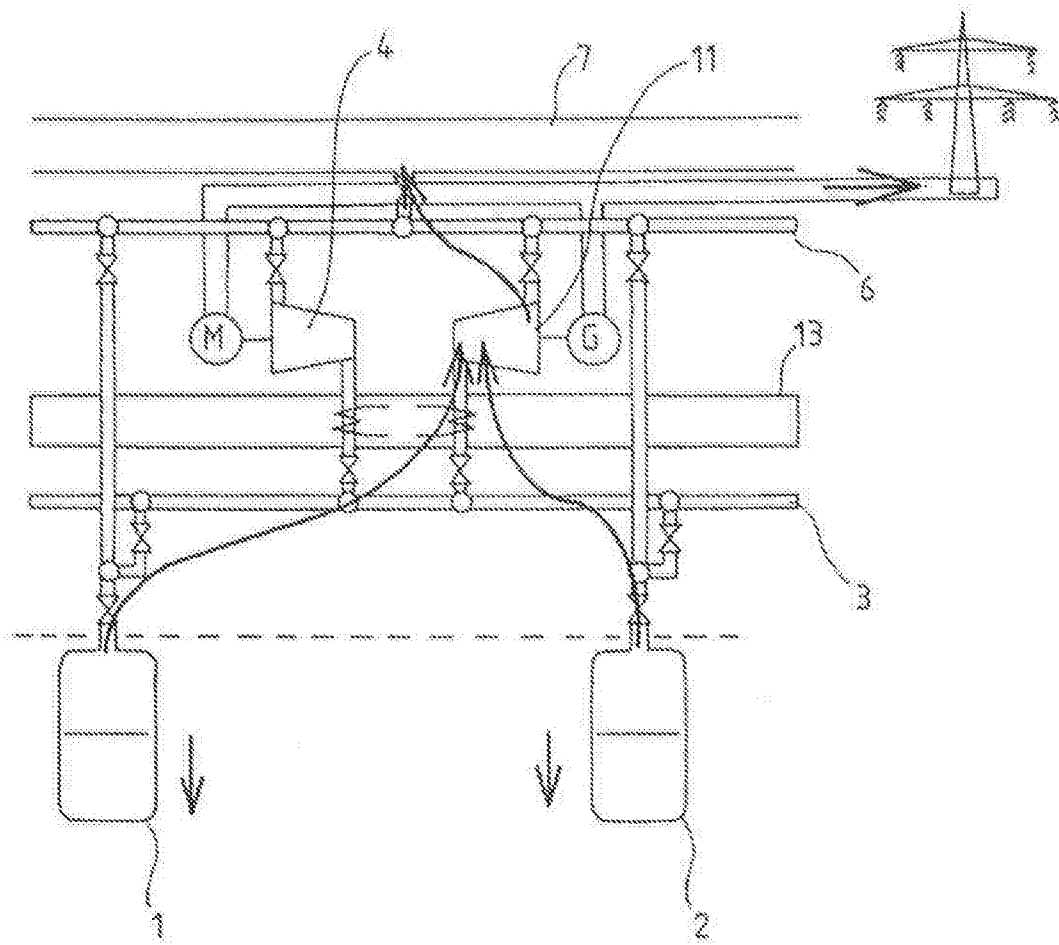


Fig. 8