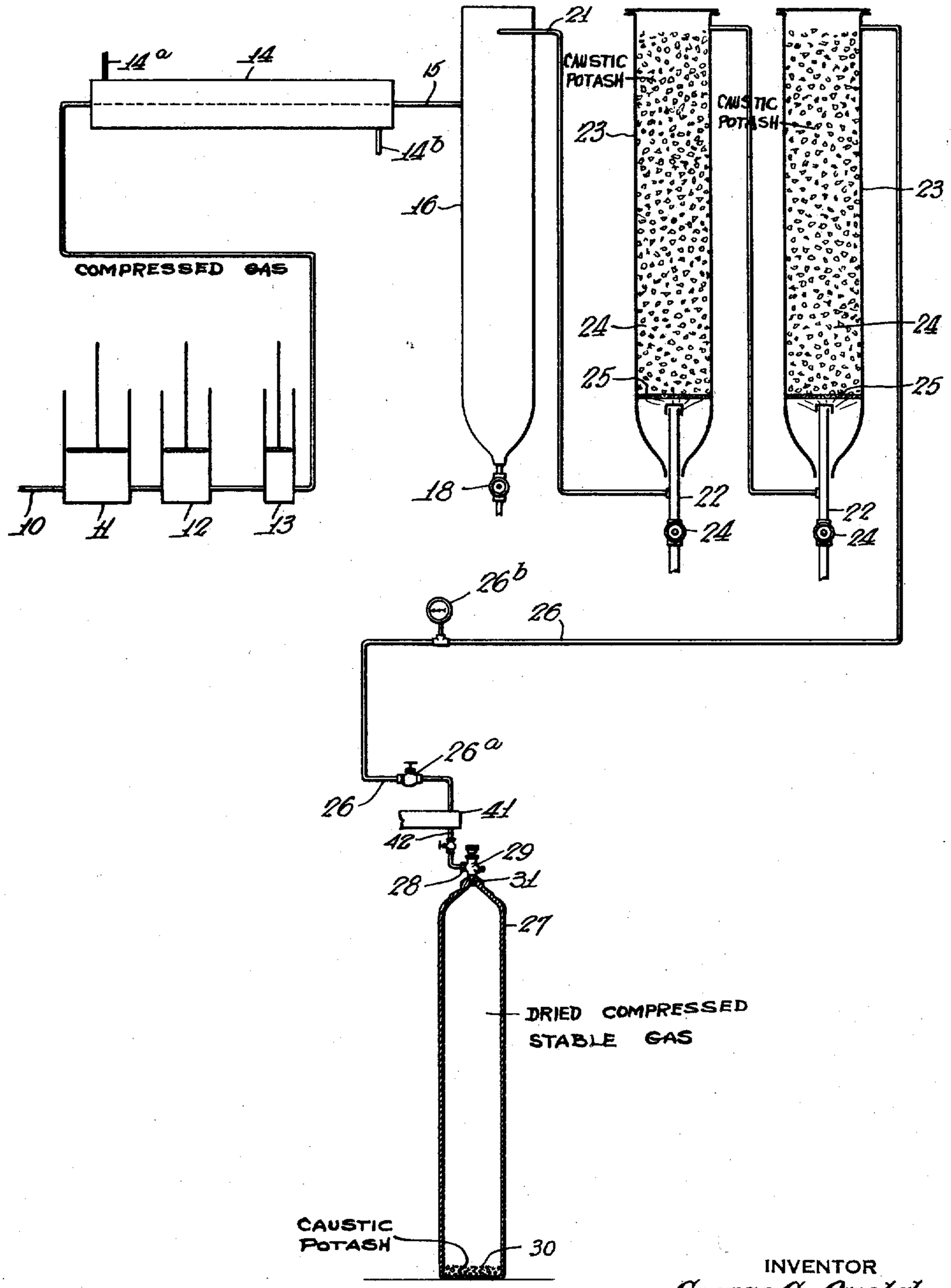
May 9, 1933. G. C. QUELCH 1,907,579

GAS PACKAGE

Filed Nov. 10, 1928



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BY
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Patented May 9, 1933 1,907,579

UNITED STATES PATENT OFFICE

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GAS PACKAGE

Application filed November 10, 1928. Serial No. 318,413.

My present invention relates to making natural gas suitable for use with oxygen in a blow torch to preheat and cut metal and at the same time suitable for storage in tanks at very high pressure yet capable of use with standard reducing valves and regulating equipment. It must be free from water or paraffin vapors when stored in the pressure container and should be suitable when compressed to 2,000 pounds per square inch for storage purposes. Its B. t. u. content should be as high as is practicable for free gas and its flame temperature high enough to effect efficient preheating of metal.

Natural gas as it comes from the mains, if compressed to 2,000 pounds per square inch would fail to meet these requirements because of the considerable amount of water gas and paraffin vapor which it carries and which would cause freezing and gumming at the valves when the gas is expanded through standard regulating apparatus.

By my present invention, I provide a means for and a method of treating natural gas which will not only free it from the undesirable paraffin and water vapors but which will permit the retention of all unobjectionable homologues in order that losses in the B. t. u. content of the gas may be avoided.

The apparatus used is extremely simple and the method may be a substantially continuous one which takes the natural gas direct from the mains, compresses it and charges it at the desired pressure directly into the pressure containers with most of the undesirable water and paraffin vapors removed.

An important feature of the invention and one which greatly simplifies the apparatus and speeds up the method is the use of drying agents in the compressed gas containers so that the final drying occurs in the containers after the gas has been packaged ready for shipment.

Practically all of the natural gas distributed in the Pittsburgh district has been treated at relatively low pressures for the recovery of certain readily condensible fractions. The gas analysis after such treatment varies somewhat at different plants but may be said to contain the following elements at close to the general proportions listed:

Methane	84.7 to 87.4
Ethane	6.8 to 9.4
Propane	1.55 to 3.0
Butane	1.81 to 1.3
Pentane	trace
Nitrogen	1.6 to 3.2
Oxygen	trace to .1

The water vapor content is around 2%, the flame temperature around 4200° F. and the B. t. u. per cubic foot in the neighborhood of 1125 to 1150.

If a gas having the above approximate analysis is compressed to 2,000 pounds per square inch and then expanded through the ordinary reducing valve, there will be trouble at the valve. The water vapor will freeze and the paraffin vapor will liquefy at the valve and the valve opening would be quickly completely blocked or rendered totally inefficient for effecting a continuous and regulable supply of gas. The compressed gas mixture would be unstable.

Part of the water vapor and part of the condensible paraffin vapors can be removed by compression and subsequent cooling the natural gas from the mains, this removal being assisted by the affinity of certain of the oil vapors for the lubricating oil used in the compressors. The condensed vapors may be trapped and drawn off with the water vapors compressed out of the gas. Such a method, however, even when supplemented by the passage of the gas through chemical drying means is not sufficiently effective when carried out at commercially practicable pressures, say above 1500 pounds per square inch to give a product which is usable when subsequently stored at 2,000 pounds.

In accordance with the present invention, therefore, I supplement the compressing, cooling and chemical drying method of gas treatment by a final chemical drying which occurs in the compressed gas container. Preferably this final drying is accomplished by the provision of a small quantity of caus-

tic potash in the gas container, such potash being preferably of walnut size so that it may be readily introduced through the ordinary ¾ inch valve opening in the container. I find that after the gas has been partially dried by the successive steps of compression, cooling and chemically drying and then introduced into a tank containing the caustic potash at the pressure of 2,000 pounds per square inch, final drying will occur in 24 hours producing a stable gas which is sufficiently dry to be expanded through a nozzle and which has the calorific qualities necessary to produce the intense heat required for a cutting flame.

A peculiarity of the final drying medium, to-wit, the caustic potash used in the pressure tanks, is the fact that a single small charge of such material, say about two pounds of it, will last for years. Even though the tank which contains it be repeatedly charged with gas, the potash retains its drying efficiency over unexpectedly long periods of time.

From the foregoing general discussion of the invention, it will be seen that one feature of my invention concerns a gas package consisting of a gas at high pressure packaged in a pressure tank in the presence of a drying agent.

The invention from another aspect is concerned with a method and apparatus for treating natural gas to produce a suitable gas for storage at high pressures and which gas when mixed with oxygen will produce an efficient cutting flame.

The invention may be more fully understood from the following description in connection with the accompanying drawing which is a diagrammatic view showing the apparatus which carries out the process by taking natural gas from the mains and charging it in a highly compressed and partially dried condition into a final gas package.

In this drawing I have used the reference numeral 10 to designate a conduit adapted to deliver natural gas from the main to a triple stage compressor 11, 12 and 13 which compresses the gas to say about 1500 pounds per square inch, certain of the water vapors in the gas being liquefied and certain of the oil vapors being entrapped by the lubricating oils of the compressors. The highly compressed gas from the last compressor 13 containing a certain amount of condensate is then passed through a cooler 14 in which further condensation occurs. Water inlets and outlets for the cooler are shown at 14*a*, 14*b*. From the cooler the gas and its entrained condensate pass through a pipe 15 into a pinging bottle 16, the lower end of which is equipped with a valve 18 through which condensate may be drained off.

Gas passes off from the top of the pinger through a pipe 21, which pipe delivers it into a stand-pipe 22. The upper end of the pipe 22 discharges into the first of a pair of similar drying bottles or towers 23 adapted to contain a chemical drying agent, while the lower end of the pipe 22 is equipped with a second drain valve 24 through which further condensate may be removed. The chemical drying agent used in the bottle 23 is preferably caustic potash 24, this potash being approximately nut-size and being supported in conventional manner upon a screen 25 within the bottle. The bottle 23 may be surrounded by refrigerating coils or other cooling jackets if desired. From the top of the drying bottle gas passes to the second similar bottle, thence through a pipe line 26 to a header 41 from which the tanks 27 are filled. A header outlet pipe 42 is coupled directly to the inlet valve boss 28 of the container. A valve 26*a* is located in the line 26. When the process is started valve 26*a* is closed until the compressor builds up a pressure of 1500 pounds in the system as shown by gauge 26*b*. The valve is then opened wide enough to permit the compressor to force gas into the cylinder 27 at its rated capacity until the pressure therein reaches 2,000 pounds. At this time by closing the valve on one cylinder and opening the valve of the next one, gas is directed into the second cylinder.

Prior to the application of the valve fitting 29 to the container 27, a small amount of caustic potash 30 has been introduced into the bottom of the container through the valve opening 31. A couple of pounds of potash are ordinarily sufficient for the ordinary size tank. The potash is preferably of nut size so that it may be conveniently introduced through the usual ¾ inch valve opening 31.

Exactly what reactions occur in the various stages of the process have not been accurately determined. I do know, however, that the condensate which is tapped off through the valve 18 consists of condensed water vapors and condensed paraffin vapors mixed with a slight amount of the lubricating oil which has been carried along from the compressor. Apparently the most efficient condenser temperature is approximately 40° to 50° F.

I also have discovered that gas passed through an apparatus such as that described above at a pressure maintained at 1400 to 1500 pounds, or over, still contains an undesirable quantity of water vapor and paraffin vapor when it enters the storage container, these constituents being sufficiently high to cause freezing at the valve if the gas were to be immediately expanded from the normal tank pressure, in the usual way. Nevertheless, within 24 hours from the in-

troduction of the gas into the container, the supplemental drying effected by the potash 30 seems to have substantially removed or rendered harmless such undesirable vapors and the gas is well suited for expansion in the regulating apparatus, without danger of freezing or clogging. As noted above, a single small charge of the caustic potash drier in the tank not only takes care of the first charge of gas but also repeated recharges, remaining effective over a period of two years or more. This action seems to be phenomenal and I can offer no entirely satisfactory explanation of it.

I have found that even though the gas at 1500 pounds pressure or over is passed through a long series of drying towers containing caustic potash, drying is still incomplete, yet I am apparently able to obtain substantially complete drying by letting the gas stand for 24 hours at 2,000 pounds pressure in the presence of a small amount of caustic potash, whereas passing it through an indefinite series of drying towers containing the same material is insufficient to produce my remarkable results.

This might lead to various theories, as, for instance, that the drying action of the potash is dependent not so much on the surface which is exposed to the gas, but upon the time of exposure. It is obviously impracticable to reduce the rate of gas flow through the apparatus to such an extent that the gas would remain stagnantly in contact with the drying agent over a long period of time. Another possibility is that the potash acts as a mechanical, molecular or chemical storage reservoir, taking care of the freezing constituents while the tank is at full 2,000 pounds pressure and giving off some or all of them when the pressure has fallen to a point where freezing temperatures are no longer produced by the expansion.

By using some of the drying agent in the container, both of the difficulties are overcome either by complete drying or by the above suggested temporary storage of the freezing constituents.

I believe that the time factor and the pressure factor are both important in so far as the complete drying is concerned, but it is possible that if the gas direct from the final drying tower were simply stored in a large reservoir in the presence of caustic potash, similar effects might eventually result, but it would take a very long time at the low pressures which would be practical in a large reservoir. Such method would also be objectionable in that it would involve recompressing of the gas whereas the present process permits the gas from the mains to be compressed and forced right through the apparatus and into the final shipping containers.

I claim:—

1. As a new article of manufacture, a package including a transportable storage and service tank having an outlet valve fitting, a gas within the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and under relatively high compression and a relatively small amount of solid chemical gas drying agent in the tank.

2. As a new article of manufacture, a package including a transportable storage and service tank having an outlet valve fitting, a stable gas within the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and under a pressure of the order of 133 atmospheres and a relatively small amount of solid chemical gas drying agent in the tank.

3. As a new article of manufacture, a package including a transportable storage and service tank having an outlet valve fitting, natural gas having most of its moisture and paraffin content removed, said gas being charged into the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and under high pressure in the tank and a relatively small amount of solid chemical gas drying agent in the tank.

4. As a new article of manufacture, a package including a transportable storage and service tank having an outlet valve fitting, a stable gas within the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and under a pressure of approximately 2000 pounds per square inch and a relatively small amount of solid chemical gas drying agent in the tank, the gas-drying agent comprising lump material of sufficiently small size for introduction through the valve fitting opening.

5. As a new article of manufacture, a gas package including a transportable storage and service tank, a stable gas within the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and of a character which will produce a cutting flame when mixed with oxygen, the gas being at a pressure of approximately 2000 pounds per square inch and a relatively small quantity of caustic potash in the bottom of the said service tank.

6. As a new article of manufacture, a gas package including a tank, a stable gas within the tank divested of all but a relatively small percentage of condensible vapor such as paraffin, moisture and the like and of a character which will produce a cutting flame when mixed with oxygen, the gas being at a pressure of approximately 2000 pounds per square inch and a relatively small quan-

tity of caustic potash in the bottom of the tank, the potash being of approximately walnut size so that it may be conveniently introduced through the valve fitting opening of the tank prior to the application of the valve fitting.

Signed at Verona, in the county of Allegheny, and State of Pennsylvania this 7th day of November, A. D. 1928.

GEORGE C. QUELCH.