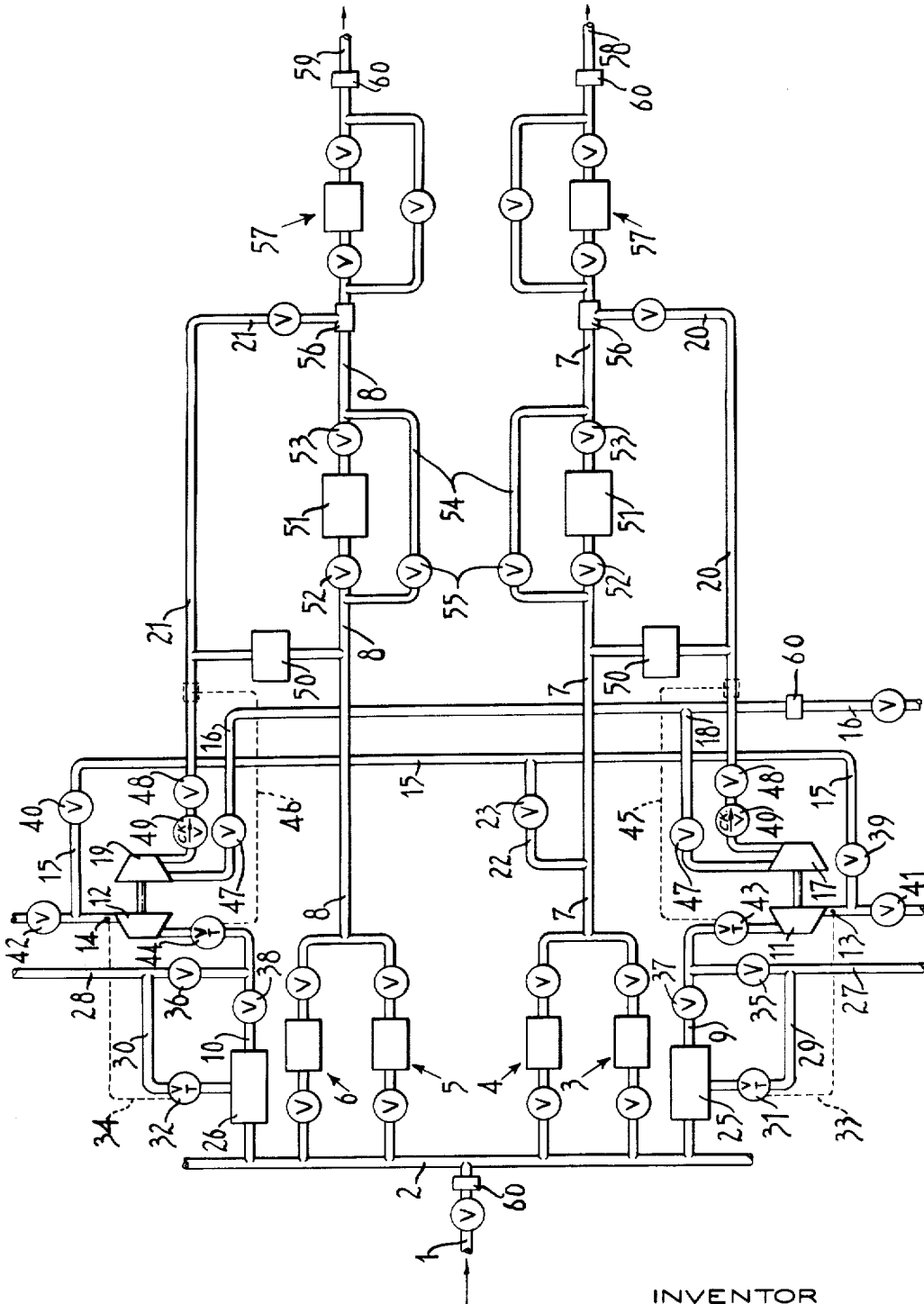


April 3, 1956

C. M. TENNEY, JR
GAS DISTRIBUTING SYSTEM

2,740,701

Filed June 5, 1953



INVENTOR
CHARLES M. TENNEY, JR
BY *Chapin & Neale*
ATTORNEYS

1

2,740,701

GAS DISTRIBUTING SYSTEM

Charles M. Tenney, Jr., Longmeadow, Mass.

Application June 5, 1953, Serial No. 359,925

4 Claims. (Cl. 48—190)

This invention relates to a system for utilizing the high pressures of a natural gas pipe line feeding into a local distribution system which is operated at lower distributing line pressures and for supplementing from time to time during periods of heavy demands on the local system the intake of natural gas with manufactured substitute gas or gas stored at lower holder station pressures. The invention also relates to an economical use of auxiliary gas manufacturing facilities normally utilized only for supplying locally available gas for a particular distribution system in the event of a failure of the natural gas supply.

An object of the invention is to provide the means for an economical usage of the pressures in a natural gas supply line to furnish power for feeding a supplementary supply of manufactured gas into a local distribution system at pressures suitable for the local system. More specifically the invention is designed to provide a more economical method to introduce gas manufactured for local use at extremely low pressures into the local lines at the required higher pressures for said local distributing lines and in instances where the natural gas supply line is fed into the system at initial pressures appreciably greater than said required local distributing line pressure.

As is well known in the trade natural gas is marketed by natural gas pipe line transmission companies according to a prescribed rate structure in the calculation of which a dominant factor is the largest amount of gas or the peak load received by the local distributing company in any one daily period during the year. Accordingly a local distributing system may maintain an auxiliary supply of manufactured or storage gas, not only for maintaining service to users in the event of a serious failure of the natural gas supply, but also to feed manufactured gas into its lines to mix with the natural gas whenever it appears during periods of heavy demand that a daily amount of natural gas taken in will be excessively high. This is known as peak shaving and operates by the introduction of a locally produced supply during periods of excessive demands to level off the intake of natural gas and thus more equitably average out the rate factor determined by the largest daily amount received.

When gas is manufactured locally or held in reserve at holder stations the pressures are of course, relatively low and must be raised for transmission through the local distribution lines to the point of use. Compressors suitably driven by an outside source are commonly used to compress the gas to the required pressures. An object of this invention is to utilize the power from the high pressure natural gas intake lines and, in lieu of simply reducing the pressures at the intake by exhausting the same, to drive one or more compressors to raise the pressure of the local supply lines and to collect the exhaust natural gas of the drivers, proportion, and mix it with all or part of the locally produced gas and distribute the mixture into the local lines. It will be realized that the amount of local gas to be compressed will be determined by the power available through the expansion of the local system's lowest pressure natural gas requirements. Thus in particular systems where the expansion of natural gas through turbo-compressor units will not supply a sufficient concentration of local gas at the required pressures for the needs of the system, additional or auxiliary power may need to be added either by steam, electric, diesel or gas combustion engines.

2

The above and other objects and advantages of the invention will be apparent from the following description thereof in connection with the accompanying drawing showing a diagrammatic representation of a distributing system in which natural gas is utilized and wherein the system supplies its gas at several pressures each being higher than holder or other local source pressure.

Referring to the drawing a valved natural gas intake line 1 is shown at the left feeding into an inlet header 2 where the incoming natural gas for the system is delivered at a relatively high pressure as, for example, 90 p. s. i. g. Attached to the header 2 are a pair of inlet lines having suitable flow-controlled pressure regulators with inlet and outlet valves as indicated at 3 and 4 and a pair of lines having pressure regulators as at 5 and 6. The regulators at 3 and 4 may be adapted to reduce the natural gas to one pressure, for example, 10 p. s. i. g., required for local distribution through a pipe 7; and the regulators at 5 and 6 may be adapted to reduce the natural gas to a second pressure required for distribution in the system through pipe 8 as for example 40 p. s. i. g. The balance of the system's natural gas requirements may be fed from header 2 to power a pair of natural gas driven turbo-compressor units through pipes 9 and 10. The turbine drivers of the compressor units are indicated at 11 and 12. The exhaust lines 13 and 14 for drivers 11 and 12 are connected by an exhaust gas header 15. The turbines may be suitably adapted to operate either by natural gas under pressure or by steam pressure. The compressors may be of any suitable type such as a rotary positive-pressure compressor. An inlet substitute gas line 16 from a holder source or from a source of locally manufactured gas is connected to the inlet side of the compressor 17 powered by driver 11 by a branch line 18, and is connected directly to the compressor 19 of the driver 12. The inlet source line of the locally substituted gas is supplied at a pressure lower than that required for distribution in the system and may be, for example, at a pressure of ½ p. s. i. g.

The outlet lines of the compressed local gas are at 20 and 21 and assuming in the example being given that the requirements of the system are for distribution as through lines 7 and 8 of gas at pressures of 10 p. s. i. g. and 40 p. s. i. g., respectively, as above mentioned, the locally supplied gas is to be raised from the inlet pressure of ½ p. s. i. g. in lines 18 and 16 to an outlet pressure in lines 20 and 21 of 10 p. s. i. g. and 40 p. s. i. g. The natural gas and substitute gas in lines 7 and 20 at 10 p. s. i. g. are mixed by suitable means as will be described. The natural and substitute gas in lines 8 and 21 at 40 p. s. i. g. may be similarly mixed for passing into the local distributing system.

The natural gas admitted at 90 p. s. i. g. to the turbine drivers 11 and 12 is exhausted into the common discharge header 15 and header 15 is connected with the natural gas line 7 by a pipe 22 having an exhaust valve 23. The pressure of the exhaust natural gas in header 15 and connector 22 is maintained at 10 p. s. i. g. by reason of the 10 p. s. i. g. pressure maintained in line 7 by the flow controlled pressure regulators 3 and 4. Thus the exhaust natural gas is fed back into the system at the required pressure for the local distribution line 7.

Heat exchangers 25 and 26 for pipes 9 and 10 are provided for raising the temperature of the natural gas passing to the turbines 11 and 12 from header 2. The source of heat for the exchangers may be live steam from steam headers 27 and 28 through connector pipes 29 and 30. Control valves 31 and 32 govern the amount of steam required to heat the incoming high pressure natural gas to a temperature sufficient to pass through the turbines and into the exhaust lines 13 and 14 at a constant

3

exhaust temperature, for example at 60° F., regardless of the quantity of natural gas passing through the turbine. The amount of steam required to keep the exhaust natural gas temperature constant may be regulated through a conventional control line for each exchanger as indicated at 33 and 34.

The steam headers 27 and 28 also feed into the lines 9 and 10 and are for operating the turbines 11 and 12 in the event of a total natural gas failure or in the event a higher concentration of locally manufactured gas is required than can be produced by the existing energy balance. For normal operation live steam inlet valves 35 and 36 are closed for driving the turbines by the high pressure natural gas in lines 9 and 10. For driving the turbines by steam, inlet valves 37 and 38 are closed against the natural gas inlet supply and outlet valves 39 and 40 are also closed in the natural gas exhaust header 15. The steam inlet valves 35 and 36 are opened on the live steam inlet side and steam exhaust valves 41 and 42, normally closed, are opened to exhaust the steam from the turbines. Thus the turbines may be driven by live steam during periods of emergency when the natural gas supply has failed for any reason.

Throttle valves 43 and 44 at the inlet sides of turbines 11 and 12 are for maintaining the required pressure of 10 p. s. i. g. and 40 p. s. i. g. in the compressor outlet lines 20 and 21 being regulated by conventional control lines 45 and 46 sensitive to the pressures in lines 20 and 21 as indicated. The compressors are provided with the suitable inlet and outlet valves indicated at 47 and 48 respectively for both units, a suitable check valve 49 also being placed on the discharge side in each instance.

From the above it will be seen that the incoming natural gas at the high pressure at which it is received is thus utilized to drive a pair of turbo-compressor units for raising the pressure of locally manufactured or stored gas to the requirements of the local distributing system. The example of the local system as shown requires different pressures in two distributing lines. It may, of course, be adapted for a system requiring but one distributing line at a given pressure lower than the natural gas inlet pressure and may also be adapted to operate in a system where multiple pressures are required.

In the example of the drawing the lines 7 and 20 of natural and locally produced gas at 10 p. s. i. g. and lines 8 and 21 at 40 p. s. i. g. are mixed in any conventionally arranged manner, the system shown having conventional ratio control devices at 50 connected between lines 7 and 20 and 8 and 21. In lines 7 and 8 conventional orifice meters 51 are provided with inlet and outlet valves 52 and 53 and by-pass lines 54 with by-pass valves 55. These units meter the total requirements of the system's natural gas requirements coming through lines 7 and 8.

The outlet end of each local gas outlet line 20 and 21 is connected to natural gas lines 7 and 8 by a mixing T as at 56. Beyond the T the mixed natural and local gases pass through the district regulators 57 in the usual fashion and out into the distribution system through lines 58 and 59.

For checking the richness of the mixed gases gravity recorders 60 may be located in the inlet line 1 of the natural gas, in the inlet line 16 of the substitute gas and in the mixed gas system lines 58 and 59. The specific gravities may thus be compared for determining any necessary adjustments in the system.

The system shown may be adapted for the introduction of natural gas alone directly into the system when no locally substituted gas is required; for the introduction of prescribed quantities of local gas as may be desired for shaving the natural gas intake load during periods when an abnormal daily peak load may be anticipated; and for auxiliary operation to distribute local gas entirely when the natural gas supply is interrupted for any reason.

What is claimed is:

1. In combination with a natural gas pipe line inlet

4

header through which natural gas is received by a local distributing system at a higher pressure than the pressures required for said distributing system and a substitute gas inlet line in which a local reserve supply of gas is carried at a pressure lower than said required distributing pressure, means for utilizing the higher pressure of the natural gas line to raise the pressure of said local supply to said required local distributing pressures and distribution into the system mixed with said natural gas, said means including a turbo-compressor unit with the natural gas inlet header connected to the inlet side of the driver thereof and the said inlet of the local supply line being connected to the compressor inlet, an exhaust line at the outlet side of said driver element and a natural gas feeder line communicating therewith and with said inlet header with flow controlled pressure reducing means to maintain the pressure in said feeder line and exhaust line at a required local distributing pressure, a discharging line at the outlet of the compressor for delivery of said local gas supply at the required distributing pressure, and said compressor discharge and feeder lines being united with gas mixer means therebetween for controlling the ratio of mixed natural and local gases for passage into said local distributing system.

2. The combination of claim 1 in which said natural gas inlet line is provided with heating means to raise the temperature of said incoming natural gas and heat input regulating means to supply said heating means having a control sensitive to the temperature of said natural gases at the exhaust side of said driver element to control said heater means.

3. The combination of claim 2 in which said inlet line to the driver element is provided with a throttle valve having a control sensitive to the pressures in said compressor discharge line for regulating the rate of natural gas passing to said driver.

4. In combination with a natural gas pipe line inlet through which natural gas is received by a local distributing system at a higher pressure than the pressures required for said distributing system, a substitute gas inlet line in which a local reserve supply of gas is carried at a pressure lower than said required distributing pressures and means for utilizing the higher pressure of the natural gas line to raise the pressure of said local supply to said required local distributing pressures and distribution into the system mixed with said natural gas, said means comprising a pair of turbo-compressor units with a natural gas inlet header connected to the inlet sides of the drivers thereof, said inlet of the local supply line being connected to the compressor inlets, a natural gas feeder line connected to said natural gas inlet header and having flow-controlled pressure reducing means adapted to admit natural gas thereto at one pressure and a second natural gas feeder line similarly connected to said natural gas inlet header and having flow-controlled pressure reducing means adapted to admit natural gas thereto at a lower pressure, a natural gas exhaust header connected to the outlet sides of said unit driver elements having an outlet joined to said second feeder line, the discharge line of one of said compressors being connected to said first feeder line for delivery of locally supplied gas at said first feeder line pressure with ratio control means therebetween for governing the mixture of gases at said connection, the discharge line of the other compressor having a controlled mixer connection with said second feeder line for mixing the local and natural gases at the lower pressure beyond the connection of said second feeder with said exhaust header.

References Cited in the file of this patent

UNITED STATES PATENTS

1,873,045	Saathoff	Aug. 23, 1932
2,392,783	Stevens	Jan. 8, 1946
2,631,931	Shaeffer et al.	Mar. 17, 1953
2,640,768	MacSporran	June 2, 1953
2,676,876	Mosely	Apr. 27, 1954