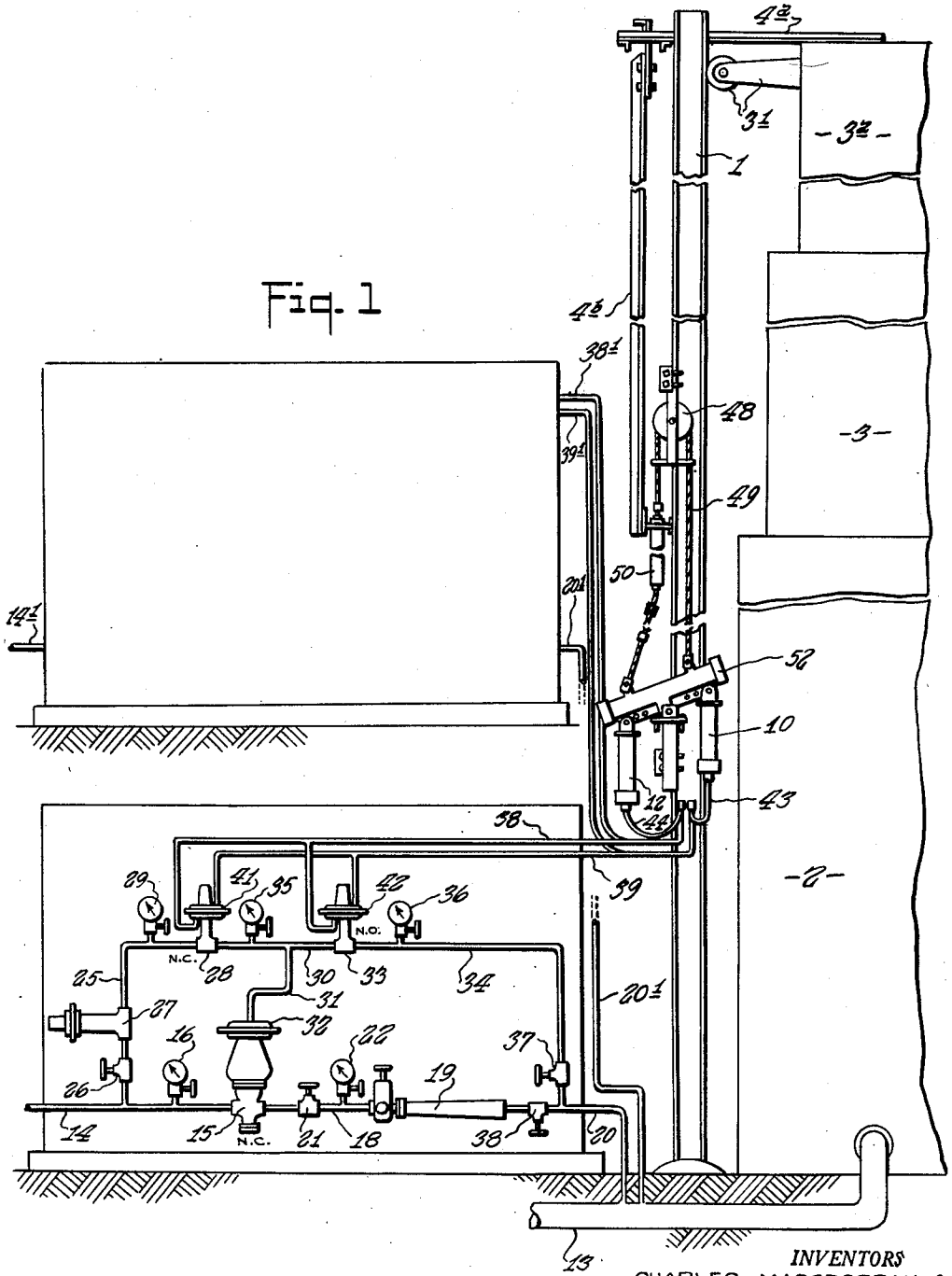
June 2, 1953 C. MacSPORRAN ET AL 2,640,768

AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

Filed June 25, 1948 5 Sheets-Sheet 1

Fig. 1




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AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

Filed June 25, 1948 5 Sheets-Sheet 2

Fig. 3

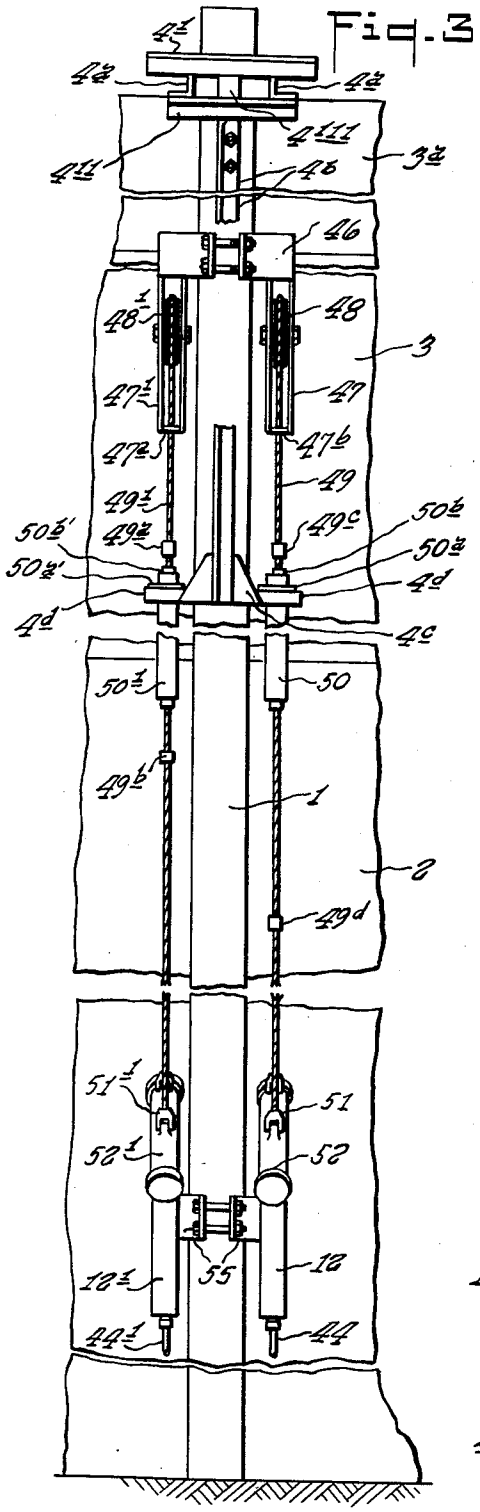
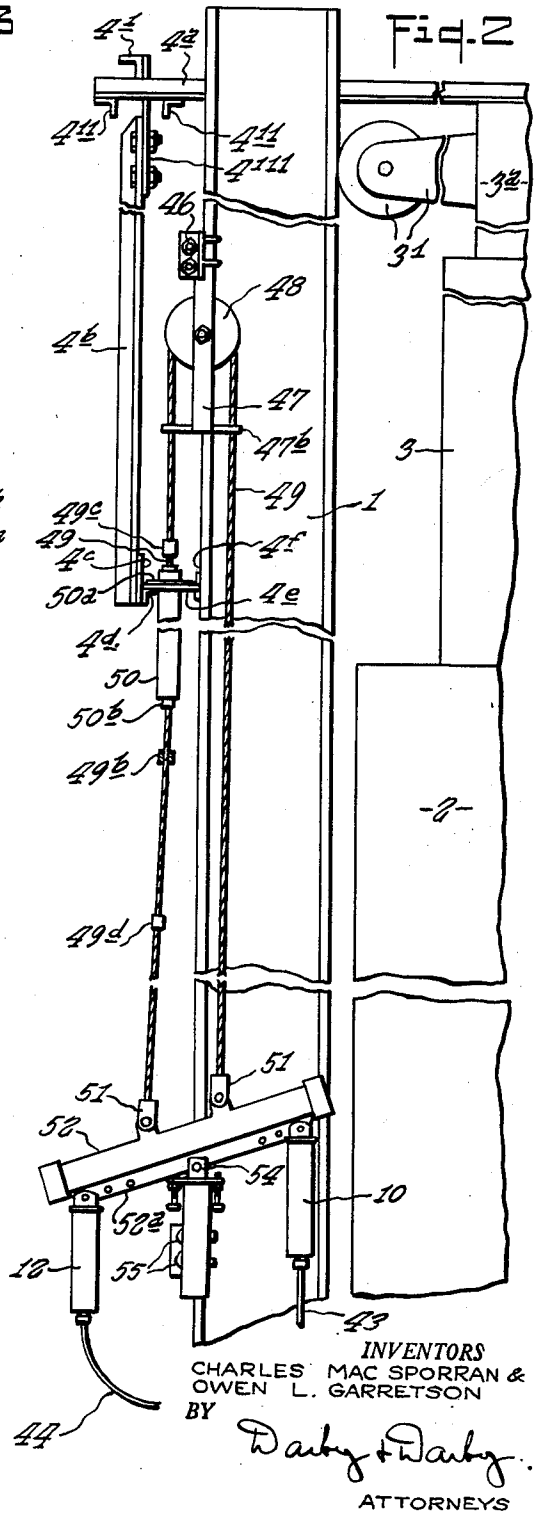



Fig. 2




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AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

Filed June 25, 1948 5 Sheets-Sheet 3

Fig. 4

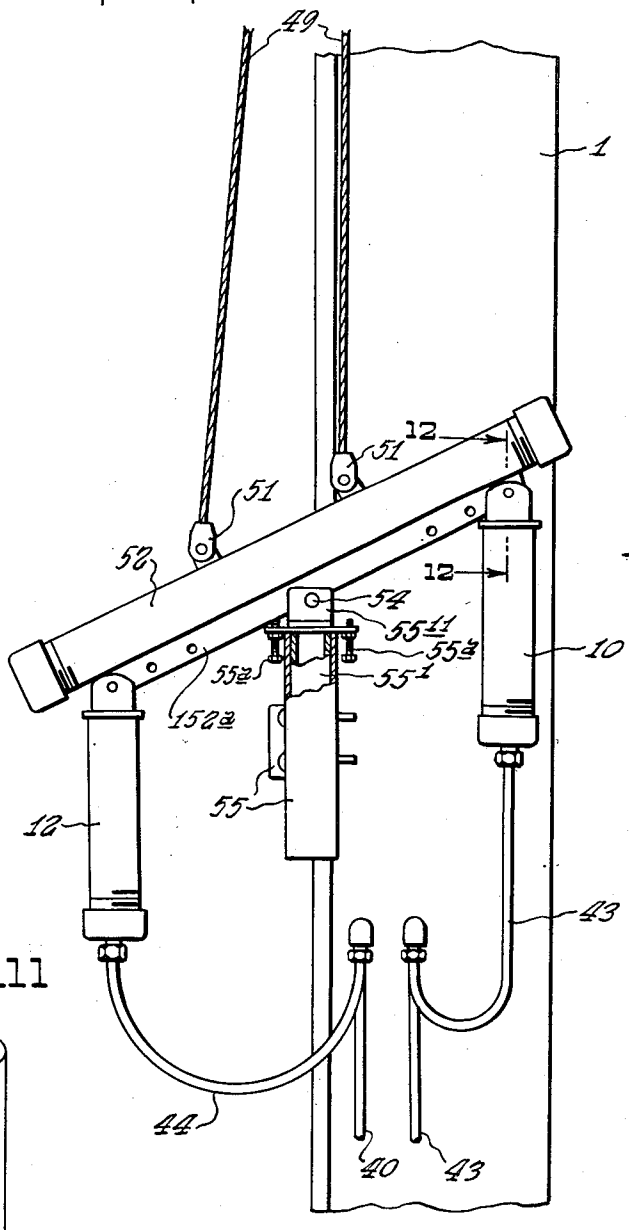



Fig. 12

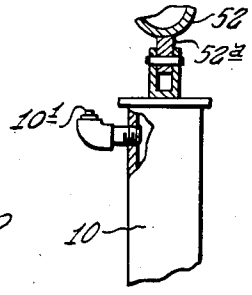
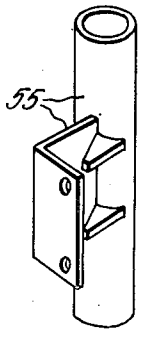



Fig. 11




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AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

Filed June 25, 1948 5 Sheets-Sheet 4

Fig. 5

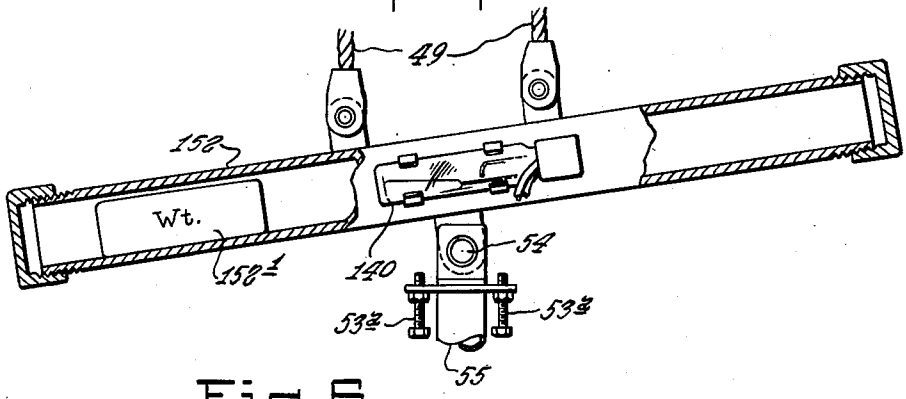



Fig. 6

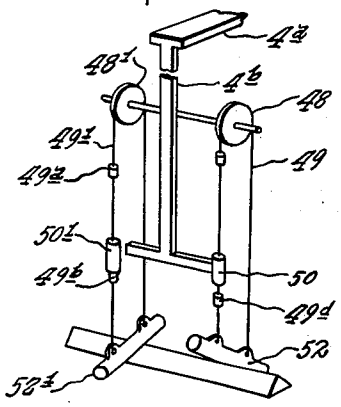



Fig. 7

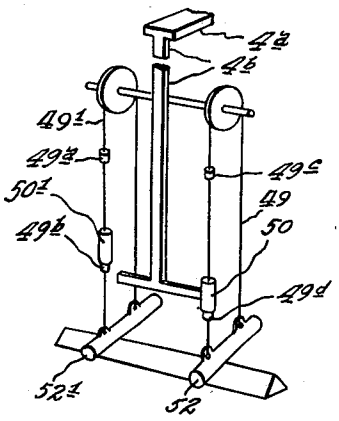



Fig. 8

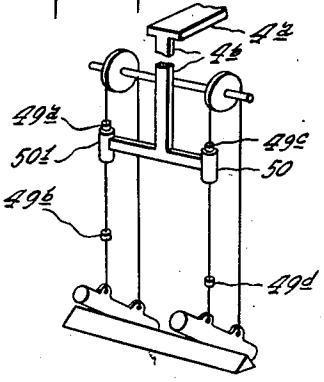
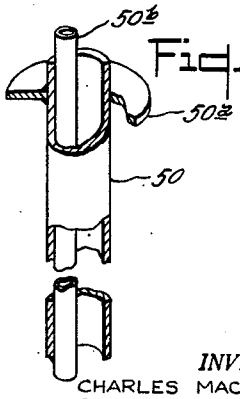



Fig. 9




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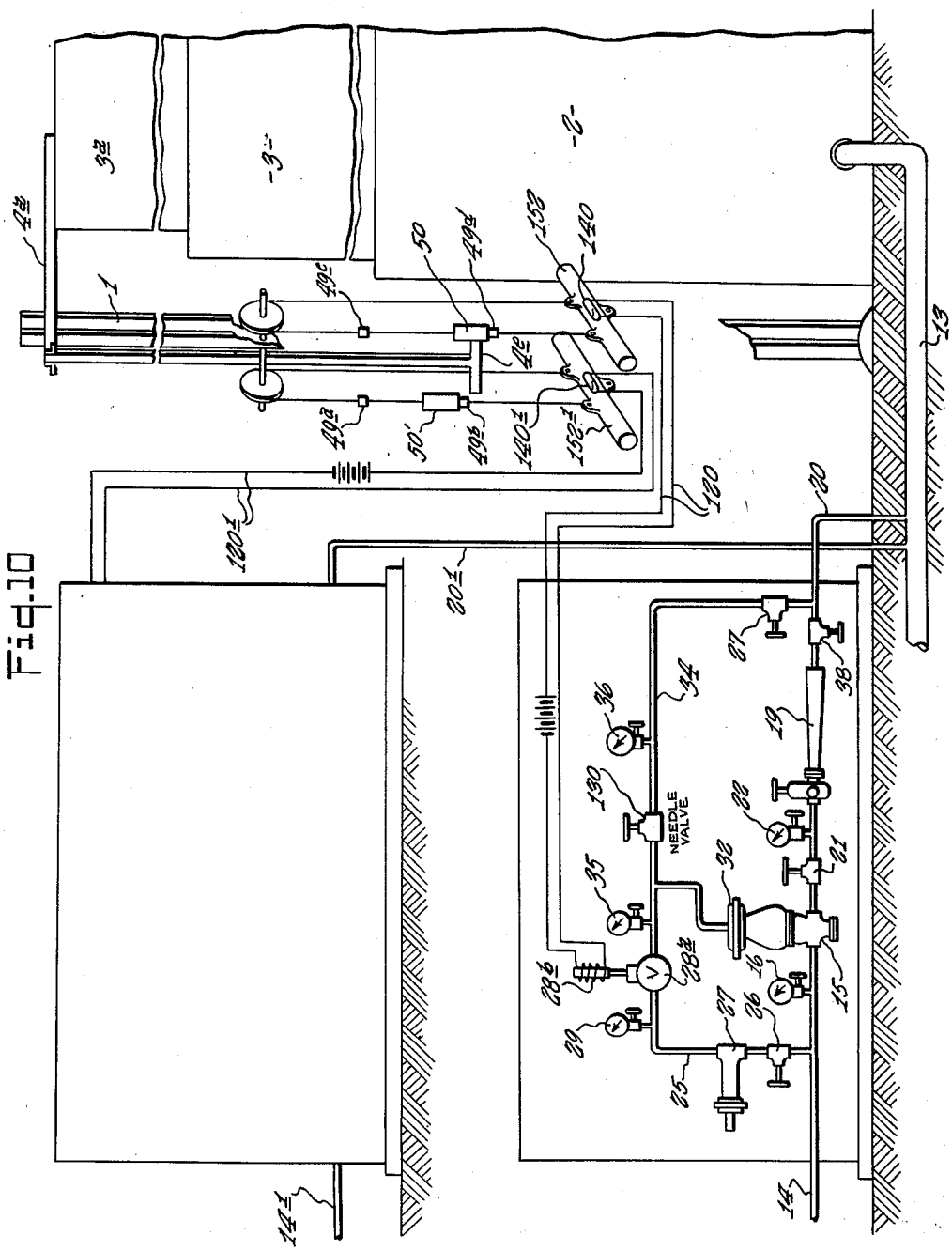
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AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

Filed June 25, 1948 5 Sheets-Sheet 5

Fig. 10




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Patented June 2, 1953 2,640,768

# UNITED STATES PATENT OFFICE

2,640,768

## AUTOMATIC ON AND OFF CONTROL SYSTEM FOR GAS PLANTS

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Application June 25, 1948, Serial No. 35,116

3 Claims. (Cl. 48—190)

1

This invention comprises automatic systems for supplementing the supply of gas to a gas holder.

Under present day economic conditions it has been found to be better practice to introduce gas from a supplementary or "stand-by" source into the gas supply system of a city to carry intermittent heavy loads rather than increase the gas manufacturing capacity of the system. The usual practice is to introduce a light hydrocarbon gas such as butane or propane directly into the gas holder of the system from a stand-by storage tank or tanks of sufficient capacity for the purpose. As the B. t. u. value of the supplementary gas used is considerably higher than that of manufactured gas, it is also the usual practice to dilute the butane or propane with air, preferably at the time of delivery into the gas holder. Admixture of air with the butane or propane is accomplished by the use of inspirators which serve to draw air into the system and admix it with the gas at the time of its delivery to the gas holder. This invention is concerned with such systems.

One of the objects of the invention is to provide an automatically operating on and off control system for supplying air diluted gas to the gas holder of a city gas system under the control of the movement of the gas holder.

A more specific object of this invention is to provide a hydraulic system for this purpose.

Another specific object of this invention is to provide an electric system for this purpose.

A still more specific object of the invention is to provide for the actuation of either type of system by the movement of the gas holder which results from the withdrawal of gas therefrom and the supply of gas thereto.

Still another object of the invention is to provide a system of either type by means of which two or more gas supply systems are caused to be successively placed in operation under loads so heavy that the actuation of one inspirator system is inadequate and the supply of supplementary gas by means of one or more additional inspirator systems is required.

Other and more detailed objects of the invention will be apparent from the within disclosure of the several embodiments thereof illustrated in the attached drawings.

In the accompanying drawings,

Figure 1 is a diagrammatic and schematic illustration of a hydraulically actuated control system in accordance with this invention for effecting the operation of two inspirators successively when conditions require;

2

Figure 2 is a side elevational view with parts broken away of the gas holder actuated control mechanism for this system;

Figure 3 is a front elevational view thereof;

Figure 4 is an enlarged side elevational fragmentary view of the hydraulic mechanism used in the system of Figure 1;

Figure 5 is a side elevational view with some parts in cross-section of an electric switch actuating mechanism for the system of Figure 10;

Figures 6, 7 and 8 are diagrammatic illustrations of the various control positions of the actuating mechanism for the system of Figure 1;

Figure 9 is a detailed perspective view with some parts broken away of the cable weight actuator for the system of Figure 1;

Figure 10 is a schematic and diagrammatic illustration of an electric system in accordance with this invention adapted to the successive control of two inspirators;

Figure 11 is a detailed perspective view of the starting member for the cable actuated support for the hydraulic cylinders of the system of Figure 1; and

Figure 12 is a detailed elevational cross-sectional view of the mounting for one of the hydraulic cylinders of the system of Figure 1.

A complete hydraulically actuated system in accordance with this invention employing two inspirators is illustrated in Figure 1. The gas holder, which is sometimes called a gasometer, as illustrated, consists of a surrounding supporting and guiding framework 1, a fixed container bottom section 2, and a pair of vertically movable top sections 3 and $3^a$. It is well understood, of course, that the upper sections 3 and $3^a$ are arranged for vertical telescoping movement with respect to each other and the bottom section 2, and are adapted for downward movement as the gas stored within the holder is withdrawn and upward movement as it is replenished. These elements are only diagrammatically illustrated as details of the gasometer form no part of this invention. In the system of Figure 1 the top holder section $3^a$ is provided with radially extending arms $4^a$ attached at the top thereof and connected at their outer ends by the cross-bracing angle irons 4' and 4''. A vertical member 4''', attached to the cross-brace 4' has the vertical supporting bar $4^b$ bolted thereto as shown. Secured to the lower end of bar $4^b$ by means of a reinforcing gusset plate $4^c$ is a cross arm $4^d$ to which is attached a plate $4^e$ having a guide $4^f$ for sliding engagement with the framework 1 (see Figs. 2 and 3).

Attached to the framework 1 by means of a

clamp 46 are a pair of yokes 47 and 47' in which are rotatably supported the sheaves 48 and 48'. Near the lower end of the framework 1 are clamped the bracketed tubular housings 55 (see Fig. 11) providing pivotal supports for tubular members 52 and 52'. Rotatably and vertically slidably mounted in the tubular housings 55 are the tubes 55' (see Fig. 4) on the upper end of which are pivotally mounted at 54 the tubular supporting members 52 and 52'. The upper ends of the tubular housings are each provided with a pair of adjustable set screws 55a for limiting pivotal rotation of the members 52 and 52' on the pivotal supports 54. The provision of the tubes 55' within the tubular casings 55 permits vertical sliding movement thereof so that in the event of the tipping of the gas holder under high wind pressures to the right (Fig. 2) these assemblies can move upwardly, thus insuring against the breakage of the cables which are attached to the members 52 and 52'. It will be understood by reference to Figure 3, that one of these assemblies is attached to each side of the column 1 by bolts which engage the brackets of each housing 55. Cables 49 and 49' are looped over the sheaves 48 and 48' and their respective ends are pivotally attached to the members 52 and 52' respectively by means of the shackles 51 and 51'.

Tubular members 52 have the same construction in this form of the system as they do in the electrical system, and as clearly illustrated in Figure 5. They each consist of a short length of pipe closed at the ends by means of pipe caps and have therein a weight, as in the case of the weight 152', which may slide from one end of the tubular housing to the other as it tilts back and forth. If desired the cylinder thus formed may contain a light viscous fluid such as a mineral oil and the relative size of the weight 152' with respect to the internal bore of the tube may be such that the rate of movement of the weight in the tube can be predetermined. The reason for this construction may as well be described at this point. These systems are of the on and off type, and it will be understood that as the tubular housing 152 tilts say from the angle shown in Figure 5 by clockwise rotation so as to tip in the opposite direction the weight 152' will move to the other end of the tube providing what is called herein an on and off type of action. In other words, when the tubular housing tips a little beyond center in either direction it is carried all the way in that direction by the shifting of the weight to the lower end thereof.

One course of each of the cables 49 and 49' passes through the tubular weights 50 and 50' respectively. These weights are constructed as illustrated in Figure 9, and each includes a smaller tube 50b, secured therein, through which the cable actually passes. Near the upper end of each tubular weight 50 is a flange 50a which may rest on the plate 4e (see Fig. 2) through which the tubular weights extend so as to lie in apertures therein. These weights are free to move up and down in the plate 4e but their downward movement is limited by the flanges 50a (Fig. 9). The same course of each of the cables has attached thereto adjustable collars. In the case of cable 49 these collars are shown at 49c and 49d, and in the case of cable 49' they are shown at 49a and 49b. These collars may be attached to the respective cables at various points therealong, for a function later described.

Pivotally suspended from the longitudinal rib 52a by means of which the tubular members 52 and 52' are pivotally supported are a pair of hydraulic cylinders 10 and 12. The rib 52a is provided with a series of holes equally spaced on opposite sides of the pivot point 54 so that the hydraulic cylinders 10 and 12 can be attached thereto at different radial points. The cylinders 10 and 12 are provided with flexible hose connections 43 and 44 respectively. Each of these cylinders is adapted to contain a liquid of suitable characteristics, as for example a mineral oil. As illustrated in Figure 12, in the case of cylinder 10, both cylinders 10 and 12 are provided with a vent 10' so that trapped air may move into and out of the cylinder as the fluid flows thereinto and therefrom in a manner to be described.

To insure clarity, it will be noted that the system illustrated in these figures comprises two exactly duplicated sets of mechanism because it is intended to illustrate in the complete system how the sequential operation of two inspirators may be effected. It will be understood, of course, that when only one inspirator is employed that only one of these actuator systems will be necessary. The complete system for one inspirator is shown in Figure 1, it being understood, as suggested above, that the apparatus within the rectangle will be duplicated for the actuator directly in back of that which appears in Figure 1 and which is shown on the left in Figure 3.

The propane or butane gas is supplied from suitable storage tanks, not shown, through the lines 14 and 14' at a pressure, for example, of 30 to 40 pounds per square inch. Pipe 14 connects directly to the inlet side of the normally closed valve 15 and is provided with a pressure gauge 16. The outlet side of valve 15 is connected by pipe 18 which includes a control valve 21 and a pressure gauge 22 to the intake side of the inspirator 19. The discharge connection of the inspirator is connected by a line 20 to the gas main 13 which connects the gas holder with the gas distributing system. Supplementary gas supply line 14 is provided with a branch 25 containing a control valve 26, a pressure regulator or reducing valve 27, and serves to connect line 14 with the intake side of the normally closed valve 28. The output side of this valve is connected to the input side of the normally open valve 33. The pipes 25 and 30 are provided with the pressure gauges 29 and 35, as shown. Pipe 30 is provided with a branch 31 which connects to a pressure fluid operated motor 32 and for actuating the valve 15. This motor may conveniently be of the diaphragm type. The output side of valve 33 is connected by means of a line 34 to the line 20 and includes the pressure gauge 36 and the control valve 37. Valves 28 and 33 are actuated by means of pressure fluid operated motors 41 and 42 which also may conveniently be of the diaphragm type. The housings for these motors are provided with connections to opposite sides of the diaphragms and hydraulic cylinder 10 is connected by means of the flexible hose 43 to the pipe 39 having branches which connect to the motors 41 and 42 on the top sides of the diaphragms thereof. Similarly the hydraulic cylinder 12 is connected by means of the flexible hose 44 to the pipe 38, which also has branches connecting to the hoses of motors 41 and 42 on the lower sides of the diaphragms thereof. The hydraulic cylinders corresponding to the cylinders 10 and 12, one of which, namely cylinder 12' appears in Figure 3, are similarly connected by flexible hoses to the lines 39' and

38' to the control apparatus in the upper rectangle of Figure 1, which is exactly the same as that delineated within the lower rectangle. The supplementary gas is supplied from the upper system by means of line 20' to the gas main 13 as diagrammatically illustrated.

Before describing the operation of this system it is first to be noted that valve 15 is normally kept closed by means of spring loading and is arranged to open by movement of the valve disc downwardly from its seat when pressure is applied to the motor 32. Valve 28 is similarly constructed. On the other hand, valve 33 being normally open is loaded with a spring to hold the valve off its seat, which valve will move onto its seat when pressure fluid is supplied to the top side of the diaphragm of motor 42. It will be noted that in the position of the parts shown in Figure 1, which corresponds to the diagrammatic view of Figure 7, both cylinders 10 and the corresponding cylinder 10', not shown, are in their upper position so that the fluid pressure in the line 39 is greater than the fluid pressure in line 38. The result is that normally closed valve 28 is open and normally open valve 33 is closed. As valve 28 is opened pressure fluid comprising supplementary gas supplied through the branch 25 is supplied to the motor 32 through the branch 31 at some suitably lower pressure than the pressure in line 14 by reason of the action of pressure regulator 27. The supply of pressure fluid to the top side of the diaphragm of motor 32 causes valve 15 to open so that supplementary gas is supplied through line 14, valve 15, and line 18 to the inspirator 19. The movement of the gas through this inspirator draws air thereinto for admixture with the gas, which mixture is delivered by line 20 to the main 13, valve 38 of course being open, as well as valve 21.

As the corresponding control equipment in back of that appearing in Figure 1, that is the equipment at the left of Figure 3, is also in the same position as that shown in Figure 1, the system diagrammatically illustrated by the upper rectangle of Figure 1 is similarly in operation so that additional supplementary gas is supplied from the tanks through line 14' to line 20' and thence to the gas main 13. An inspirator for this second system admixes air with the supplementary gas so that the mixture of gas and air being supplied to line 13 through the connections 20 and 20' is substantially the same.

Figure 7 diagrammatically illustrates the positions of the cylinders 52 and 52' and the weights 50 and 50' with relation to the collars on the respective cables 49 and 49' so that simultaneous operation of both inspirator systems is thus effected.

Assuming that the supply of supplementary gas together with the normal supply of manufactured gas to the gas holder is at a rate greater than gas being withdrawn from the gas holder, it is apparent that the movable sections 3 and $3^a$ will gradually rise. The upward movement of these sections will carry with them the weight controlling structure $4^a$, $4^b$ and $4^c$, so that when these parts have moved to the position shown in Figure 3 both weights 50 and 50' will be resting on the bar $4^b$ and their upper ends will be approaching the collars $49^a$ and $49^c$ on the cables 49' and 49 respectively. When the gas holder moves into full position the upper ends of the weights 50' and 50 will engage the collars $49^a$ and $49^c$ to tip the control cylinders 52' and 52 from the position shown in Figures 2 and 3 to



the position shown in Figure 8, cutting off both inspirator systems simultaneously. The hydraulic cylinders 12' and 12 will be above the level of the hydraulic cylinders 10' and 10. As a result the pressure in lines 38' and 38 will be higher than the pressure in lines 39' and 39. It follows that the valve 28 for the lower system (Fig. 1) and the corresponding valve of the upper system (not shown) will be closed, and valve 33 and the corresponding valve of the upper system (not shown) will be open. The opening of valve 33 and the similar valve of the upper system will exhaust fluid pressure from motor 32 and the corresponding motor of the upper system (not shown) through branch 31 to line 30, through valve 33, pipe 34 and open valve 37 to line 20 and correspondingly through similar elements of the upper system through line 20'. Thus the small quantity of supplementary gas used as the pressure fluid for actuating the motor 32 and the corresponding motor of the upper system (not shown) will exhaust into line 13 through the lines 20 and 20' respectively rather than into the atmosphere, thereby eliminating all possible fire or explosion hazard.

To simplify the description, since the parts of the upper system of Figure 1 (not shown) are exactly like those of the lower system, the following description of the lower system will be taken as also representing the description of the upper system. The exhausting of motor 32 will permit valve 15 to close cutting off the supply of supplementary gas through the line 20 to the manifold 13, and of course, through the line 20'.

When the withdrawal of gas from the gas holder through the line 13 exceeds the rate at which it is normally being supplied from the gas manufacturing plant, the movable sections of the holder will begin to descend, of course carrying all of the parts suspended therefrom by the structure $4^a$ and $4^b$. Referring to Figure 8, it will be seen that since the collar $49^b$ is at a higher level than the collar $49^d$, should the gasholder sections continue to fall ultimately the weight 50' will engage the collar $49^b$ and tip the control cylinder 52' to the position shown in Figure 6, control cylinder 52 remaining in the position shown. As a result the pressure in line 39' will be higher than the pressure in 38', so that the upper inspirator system of Figure 1 will be put into operation.

The details of setting this system into operation so that supplementary gas is supplied from line 14' through the associated inspirator and line 20' into the main 13 and thence to the gasholder will be apparent from the following description of the details of setting the second inspirator system into operation which occurs if the movable sections of the gasholder continue to descend, notwithstanding the supply of supplementary gas by means of the upper inspirator system. In other words, if gas is being withdrawn from the gasholder faster than it is supplied from the manufacturing plant as supplemented by the upper inspirator system, the movable sections will continue to fall until the weight 50 engages the collar $49^d$, whereupon the control cylinder 52 will be tipped to the position shown in Figure 7. As a result hydraulic cylinder 10 will be higher than cylinder 12 and the pressure in line 39 will be higher than the pressure in line 38, putting the lower inspirator system of Figure 1 in operation. This results because normally closed valve 28 will open and normally open valve 33 will close, from which

it follows that gas under pressure will be supplied from line 14 through hand valve 26, pressure reducing valve 27, line 25, valve 28, line 30 and branch 31 to motor 32 of valve 15, which being normally closed upon energization opens. The opening of valve 15 will supply supplementary gas from line 14 through valve 15, manual valve 21 and line 18 to the inspirator 19. The supplementary gas in passing through the inspirator 19 will pick up and admix therewith air which is discharged through valve 33 and line 20 into the main 13 and thence into the gasholder.

Assuming that the system is properly designed so that the total supply of supplementary gas through the two inspirator systems to the gasholder is adequate in conjunction with the gas being supplied from the manufacturing plant to overcome the maximum drain on the gasholder it is apparent that the gasholder sections will now begin to rise and will carry with it the parts supported by the members $4^a$ and $4^b$, so that ultimately the system will return to the position shown in Figure 3, and then finally move to the position shown in Figure 8, at which time both inspirator systems are shut off simultaneously.

It seems hardly necessary to note that the additional movement of the bracket $4^b$ and connected parts from the position shown in Figure 6 to the position shown in Figure 7 is possible because the weight 50' will rest on the collar $49^b$ as the bracket $4^b$ descends to the position shown in Figure 7 to tip the control cylinder 52 into the position shown in Figure 7. This has been diagrammatically illustrated by the disconnection of the cross-bar $4^e$ from the weight 50' (see Fig. 7).

It will, of course, be understood that in installations where more than one inspirator will not be required that the same system may be employed, but it can be simplified by the elimination of the second inspirator and associated equipment and controls therefor. Likewise, where it is anticipated that more than two inspirator systems are required it will be possible to duplicate the apparatus to provide three or four additional supplementary gas inspirator systems, a condition however, which is not likely to occur because by proper design no more than two inspirator systems will be necessary to provide the required supplementary gas capacity.

The electrical system is generally similar to the hydraulic system just described with some modification, as illustrated in Figures 5 and 10. In the electrical system the pivotally mounted cylinders 152 and 152' corresponding to the cylinders 52 and 52' are provided, but in this case there is mounted on these cylinders the mercury switches 140 and 140'. A double inspirator system is shown in Figure 10, and is modified sufficiently to adapt it to electrical operation. In this case the pressure fluid operated valve 28 in each inspirator system is substituted by a valve $28^a$ which is electro-magnetically operated by means of an electric motor such as for example the solenoid motor $28^b$. Valve $28^a$ is normally closed as is valve 15. In this system there is no need for a valve corresponding to the valve 33 of the hydraulic system. In place thereof there is provided a needle valve 130 for controlling the rate of pressure fluid exhaust from the motor 32, which as before operates the valve 15. The terminals of the solenoid motor $28^b$ are connected by the wires 120 to the mercury switch 140 and include a current source as illustrated. Similarly, the mercury switch 140' is connected to the solenoid motor of the upper inspirator system diagrammatically illustrated by a rectangle in Figure 10, and indicating an exact duplicate of the apparatus within the lower rectangle of that figure. The pivoted cylinders 152 and 152' are operated in exactly the same way as in the previous system by means of the weights which move with the movable sections of the gasometer, and the collars on the cables which operate therewith.

It will be assumed that the system as shown in Figure 10 is in the condition where the movable sections of the gas holder are all the way down and both inspirators are operating. In other words, the cylinders 152 and 152' have been moved to the position shown in Figure 10 by the weights as indicated so that both circuits 120 and 120' are energized. Thus both solenoid motors $28^b$ will be energized and both valves $28^a$ will be open. As a result pressure fluid from the gas lines 14 and 14' is supplied to the motors 32 so that the valves 15 are open. Thus air and supplementary gas in mixture are introduced into the gas distributing system 13 and the gasometer through both of the lines 20 and 20' to supplement the normal supply of manufactured gas to the system. If the rate of supply exceeds the rate of outgo the movable sections will start upwardly until weight 50' is picked up by the bar $4^e$, so that it moves the weight 50. When the gasholder is full the weights 50' and 50 will engage the collars $49^a$ and $49^c$ tipping both cylinders 152' and 152 from the position shown in Figure 10 to a position corresponding to the position of the cylinders 52' and 52, as illustrated in Figure 8. Thus the mercury switches 140' and 140 will break the circuits 120' and 120 to the solenoid valves of both inspirator systems. The effect of this will be described in detail in connection with the lower inspirator system, it being understood that the upper inspirator system is exactly the same and works in the same way. Thus the opening of circuit 120 will de-energize the solenoid $28^b$ so that valve $28^a$ will be closed by its spring, it being a normally closed valve biased by a spring to closed position. The closing of valve $28^a$ will cut off the supply of gas from the line 14 to the motor 32 of valve 15, and the motor 32 will then exhaust through the needle valve 130, line 34 and valve 27 into line 20, and from there into line 13. Valve 15 is also of the normally closed type, and as soon as its motor 32 is de-energized and exhausted it will close, cutting off the supply of supplementary gas from line 14 to inspirator 19.

It is believed that the description of the manner in which the inspirator system, first the upper inspirator system of Figure 10 and then the lower inspirator system of Figure 10 are succesively put into operation when the gasometer sections 4 under conditions where the withdrawal of gas from the gasholder through the main exceeds the supply of gas to the gasholder from the manufacturing plant, will be apparent. Briefly, the tipping of cylinder 152' which occurs first will close the circuit 120' at mercury switch 140', setting the upper supplementary gas system into operation to supply supplementary gas from line 14' to line 20'. Should the gasholder sections continue to fall cylinder 152 will be tipped to cause mercury switch 140 to close circuit 120 and put the lower inspirator system into opera-

tion by opening valve 28 so that gas is supplied from the supplementary line 14 to line 20.

It will be understood that in all forms of the system herein disclosed the pressure fluid for operating the motors 32 may be compressed air supplied from auxiliary equipment in which case the exhaust lines 30 may open to the atmosphere as there would be no hazard in discharging the engines 32 to atmosphere. It is also to be noted that the needle valves 130 could be substituted by orifices of the proper capacity to permit operation of the motors 32 as required to get the desired results of this invention.

It is also to be understood that it is contemplated as being within the scope of this invention to operate the valves 15 of the system of Figure 10 directly by means of electric motors like the solenoid motors 28b, which would be arranged to cooperate with the stems of the valves 15. While this simple change would greatly simplify the system, it is not as desirable as the system shown because a considerably more powerful motor would be needed to operate the valves 15.

It is also contemplated to be within this invention to use either the hydraulic or electric systems for operating mechanisms equivalent to the inspirators for supplying the supplementary gas. Thus, for example, the hydraulic or electrical control systems may be used to actuate devices such as blowers or compressors for delivering the supplementary gas from the storage holders to the gasometer and connected mains. Thus there are obviously a number of changes within the skill of those familiar with the art which would be substituted in the light of the disclosure herein, but which would be the equivalent of the systems disclosed, and therefore considered to be within the scope of this disclosure.

It will be understood that the various control valves 21, 26, 37 and 38 are merely provided for the purpose of isolating the inspirator system for repair and maintenance purposes, and for complete shut-down under some conditions.

As will also be understood by those skilled in the art the supplementary gas would normally be collected in the storage tanks at a pressure normally above 30 to 40 pounds, the pressure at which it is supplied to the line 14, which of course, contemplates the provision of a suitable pressure reducing valve or regulator in the line 14, but not shown as it is not essential to operativeness.

It is within the scope of this invention employing either of the systems here disclosed, to supply all of the gas to the gasholder through the inspirator systems, in which case the gas supplied from the source, as for example a gas manufacturing plant, would be delivered to the lines 14 and 14' and under the control of the inspirator systems ultimately into the main 13 and thence to the gasholder or directly into the gasholder. For this reason it is not intended that the use of the words "supplementary gas" in the claims is to be intended to limit the invention to supplying gas to the gasholders from an auxiliary source to supplement the supply of gas to the gasholders from a gas manufacturing plant. It is intended that all of the claims in this case cover systems where all gas supplied from the gasholder goes through one or more inspirator systems as well as cases where gas is supplied through one or more inspirator systems to supplement the supply of gas from a main source such as a gas manufacturing plant.

In view of the foregoing we do not desire to be limited to the particular embodiments herein disclosed, but rather as required by the scope of the claims granted us.

What is claimed is:

1. In a gas supply system, the combination comprising a variable volume gas holder normally supplied from a primary gas source, said gas holder including a top section movable vertically with changes in the volume of gas contained therein, a first conduit connecting a supplementary gas supply to said holder, a first control valve in said first conduit, a second conduit connecting a supplementary gas supply to said holder, a second control valve in said second conduit, a first pulley mounted adjacent said gas holder, a cable carried by said pulley, a pivoted member carried by said cable and adapted to assume a first position upon movement of said cable in one direction and a second position upon movement of said cable in the opposite direction, a second pulley mounted adjacent said gas holder, a cable carried by said second pulley, a pivoted member carried by said second cable and adapted to assume a first position upon movement of said cable in one direction and a second position upon movement of said cable in the opposite direction, means carried by the movable section of said gas holder adapted to cause movement of said first cable in one direction upon downward movement of said gas holder to a predetermined point and adapted to cause movement of said second cable in the same direction upon further downward movement of said gas holder, said last means also adapted to cause simultaneous movement of said cables in the opposite direction upon movement of said movable section to the full position of said gas holder, and valve actuating means responsive to the positions of said pivoted members whereby said control valves are opened upon movement of said pivoted members to said first positions and closed upon movement of said pivoted members to said second position.

2. In a gas supply system, the combination comprising a variable volume gas holder normally supplied from a primary generating source, said gas holder including a top section movable vertically with changes in the volume of gas stored therein, conduit means connected to said holder for supplying supplementary gas thereto and hydraulically operated control valves actuated by said movable section for rendering said supplementary gas supply means operative in successive stages to supply supplementary gas at two different rates to said gas holder under conditions of heavy gas demand on said gas holder, said valves being also actuated by said movable section to render said supplementary supply means inoperative when the volume of gas in said gas holder is restored to a predetermined level.

3. In a gas storage and supply system, the combination comprising a gas holder having a movable section responsive by vertical displacement to the volume of gas contained therein, said gas holder being connected to a gas distribution system and also being normally supplied with gas from a principal gas generating source, a supplementary source of gas, conduit means connecting said supplementary source to said gas holder, said conduit means including therein fluid operated control valves, cable suspended weights

carried by said gas holder linking said control valves to the movable section of said gas holder, a hydraulic pressure actuated system responsive in successive stages to displacement of said weights to actuate said control valves to open them successively upon downward movement of said movable section to pass a supply of gas from said supplementary source to said gas holder, and upon upward movement to interrupt the supply of gas thereto when a predetermined volume has been restored to said holder.

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