No. 868,218. PATENTED OCT. 15, 1907.

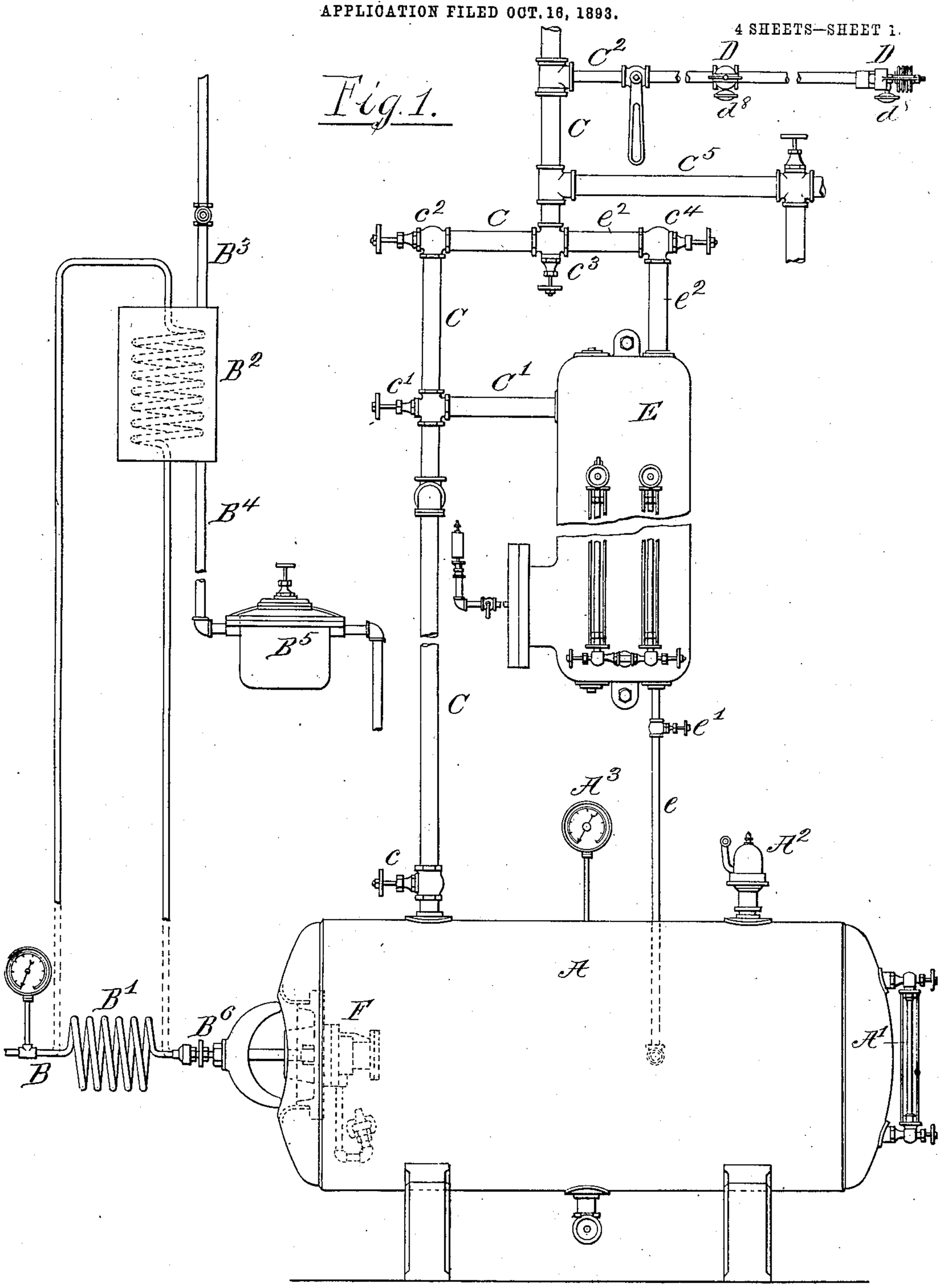
E. F. OSBORNE.

APPARATUS FOR THE USE OF CARBON DIOXID FOR THE EXTINGUISHMENT OF FIRES.

APPLICATION FILED OCT. 16, 1893.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 2.

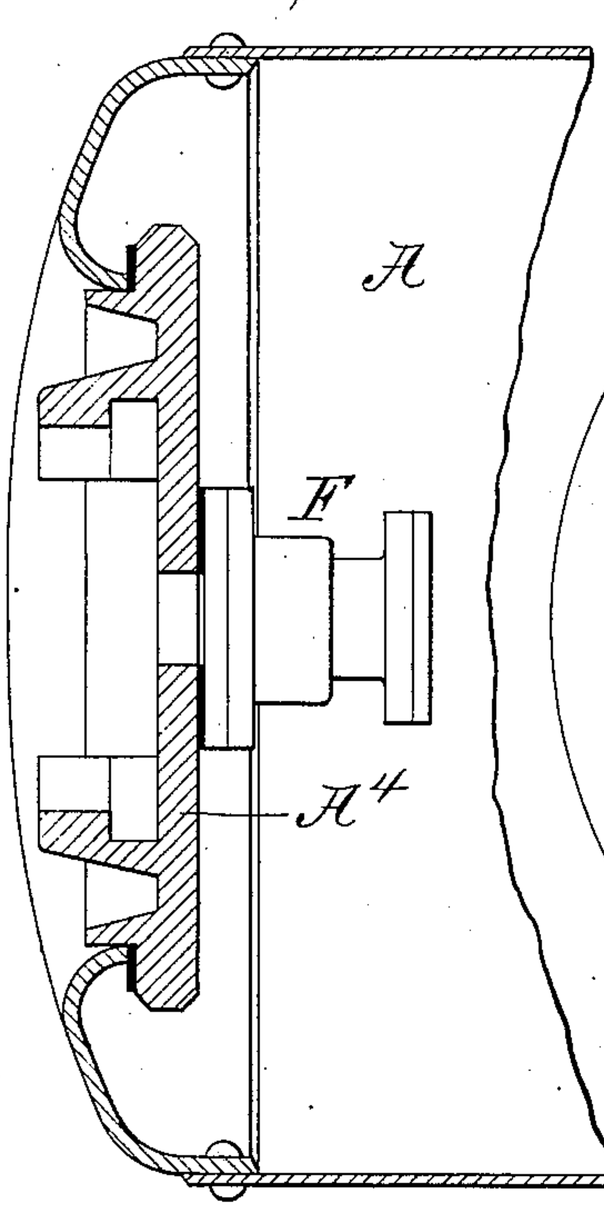


Fig. 3.

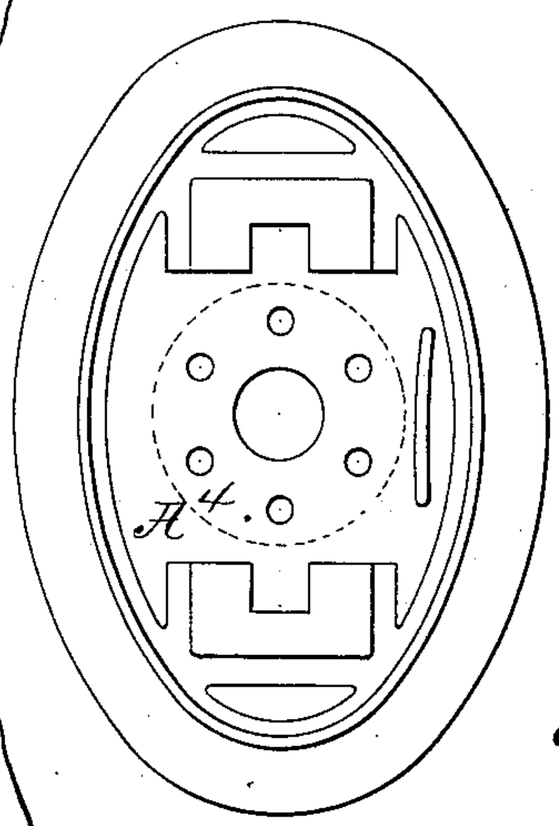


Fig. 8.

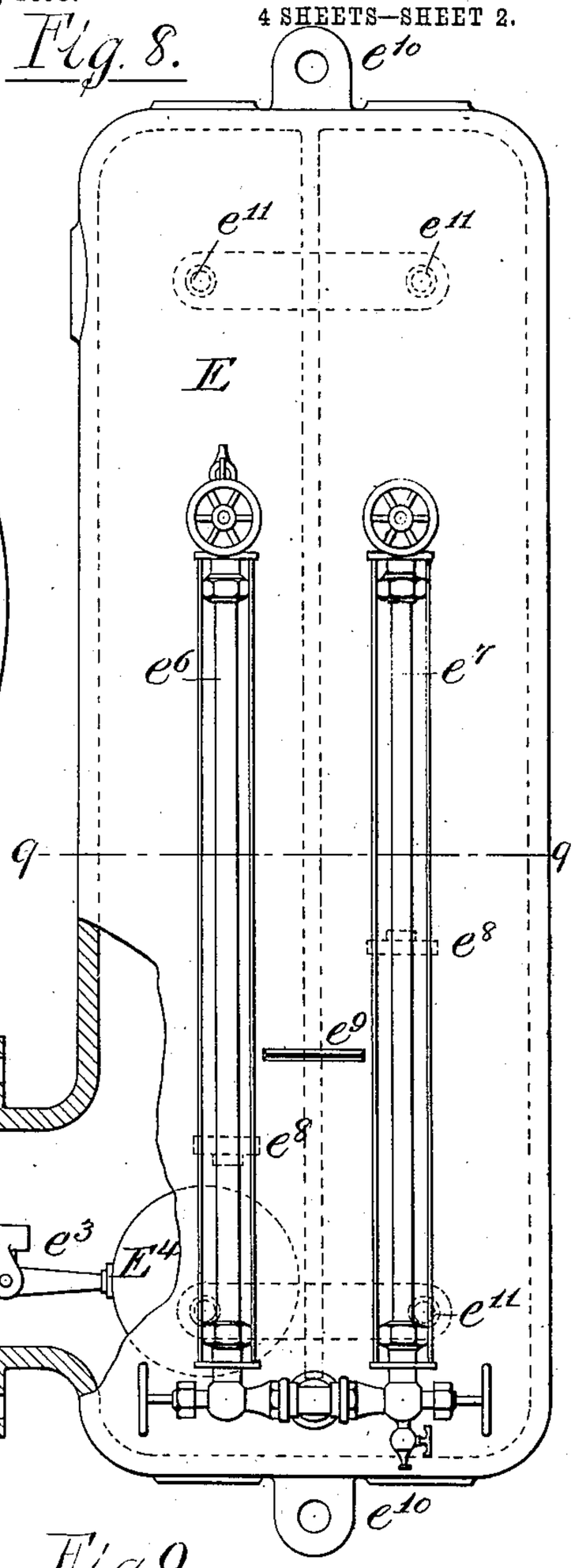


Fig. 10.

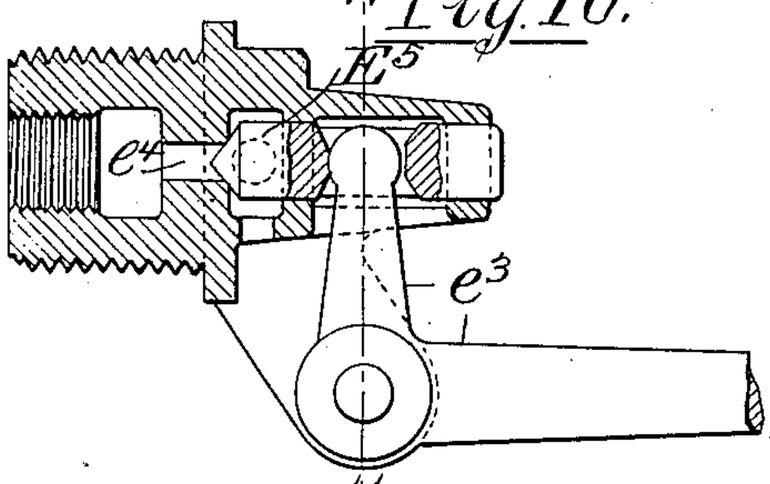


Fig. 11.

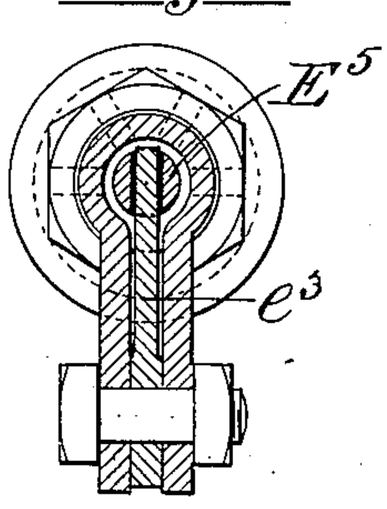
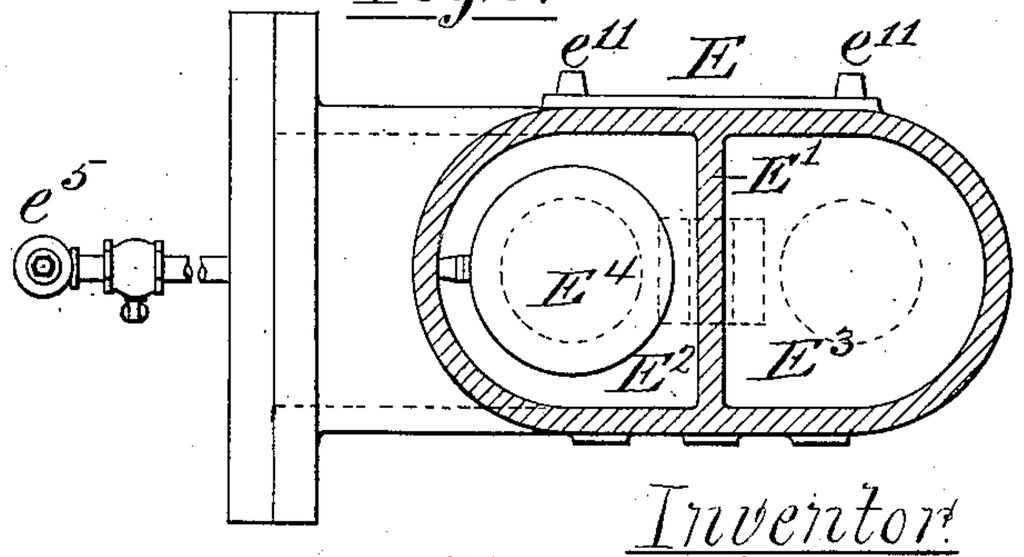


Fig. 9.



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4 SHEETS—SHEET 3.

Fig. 5.

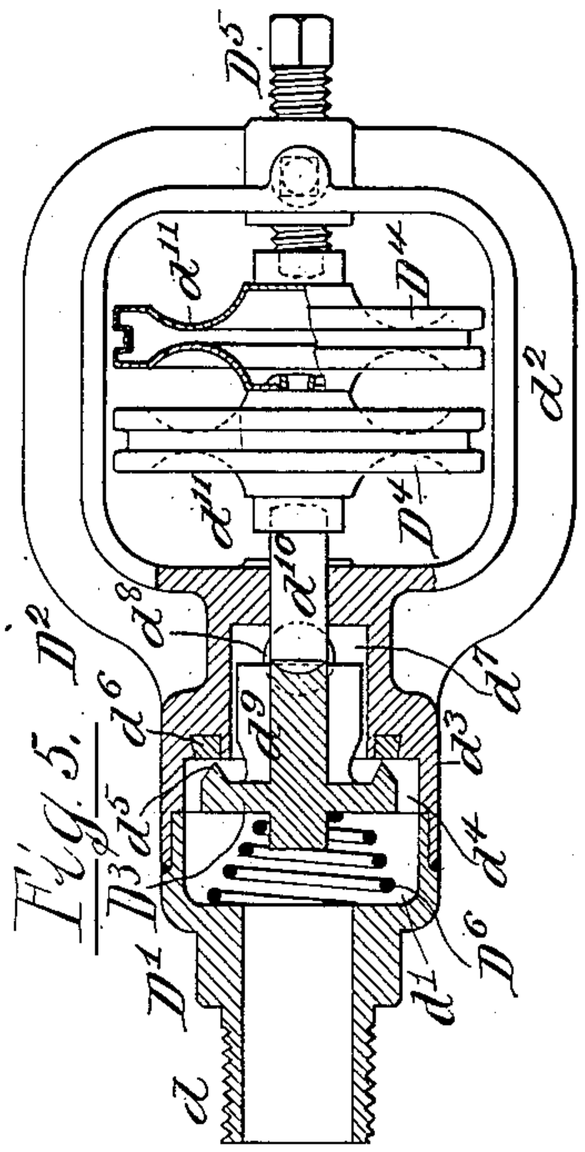

Fig. 6

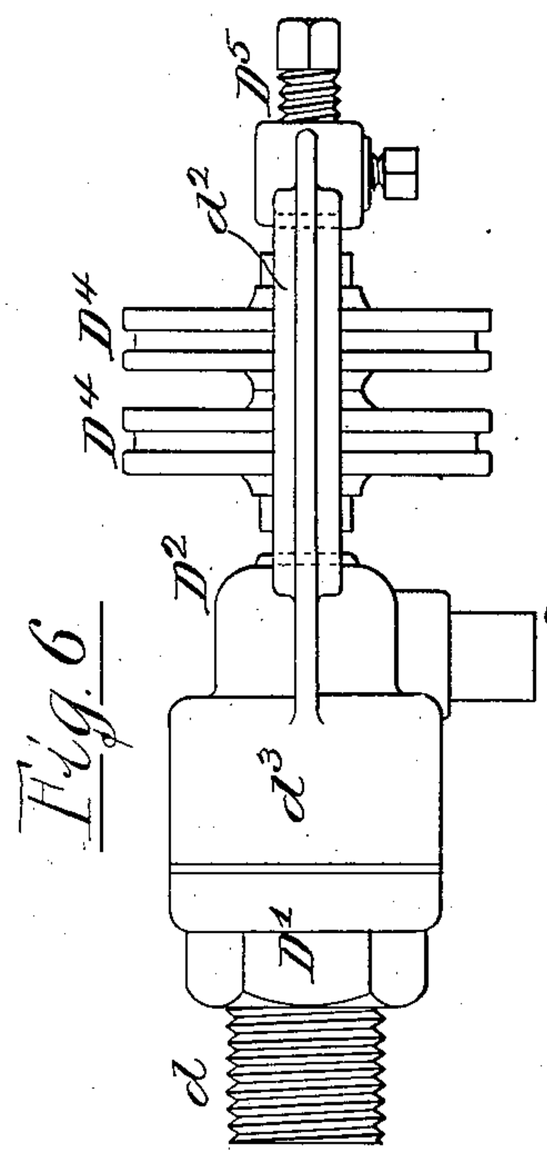

Fig. 7.

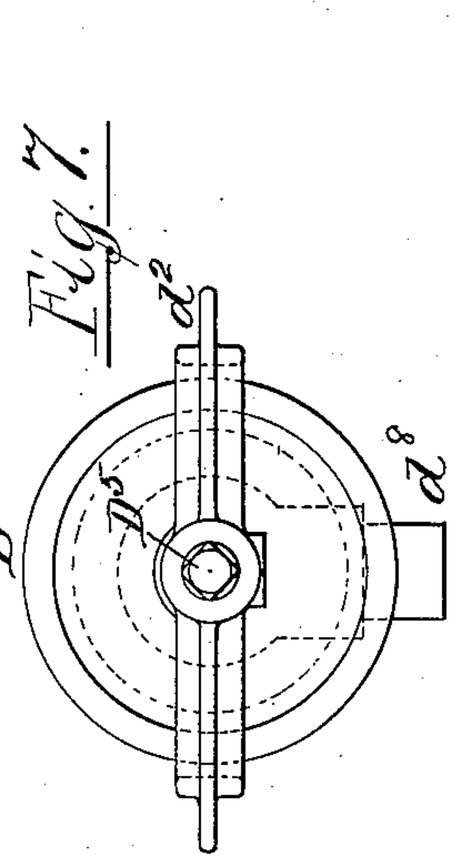

Fig. 4.

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4 SHEETS—SHEET 4.

Fig 12

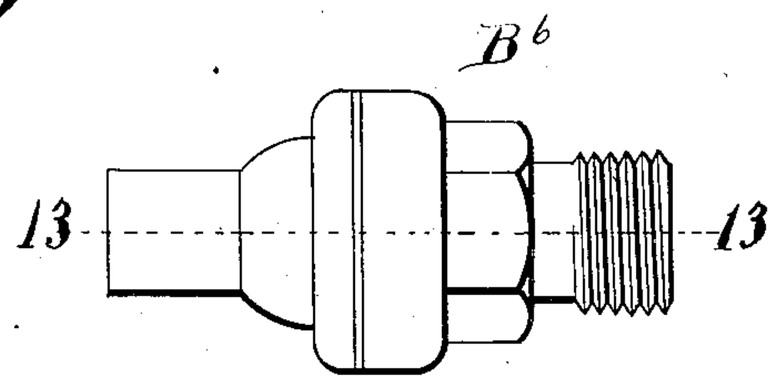
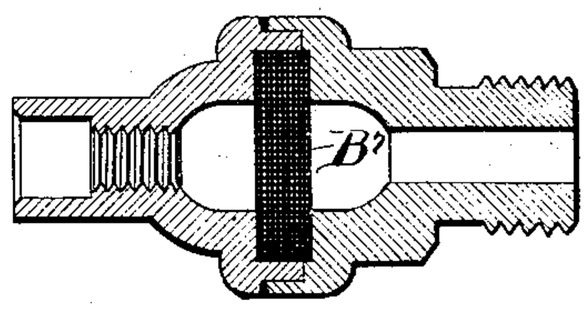


Fig 13



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE USE OF CARBON DIOXID FOR THE EXTINGUISHMENT OF FIRES.

No. 868,218. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed October 16, 1893. Serial No. 488,255.

To all whom it may concern:

Be it known that I, EUGENE F. OSBORNE, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for the Use of Carbon Dioxid for Extinguishing Fires; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention has for its object to provide a new and improved apparatus for the use of carbon dioxid as means for extinguishing fires in buildings and rooms of buildings.

The apparatus in its entirety and completeness embraces an abundant source of carbon dioxid supply under high pressure wherein the dioxid will preferably be in liquid form; a gas space and distributing system under relatively low pressure into which the dioxid is automatically admitted during discharge therefrom; means for preventing stoppage by freezing of the passages at and near the point of expansion or entry to the gas space; discharging devices controlled by the temperature of the atmosphere surrounding them, such discharging devices being adapted to both open and close under predetermined variations in temperature; a suitable leakage detector, and an alarm indicating the existence of a leak or fire. The apparatus is, however, not necessarily limited to the employment of automatic discharging devices since it may include a pipe or pipes adapted to be opened by hand so that, for example, by means of a hose attached to such a pipe, the gas may be delivered into a room not provided with automatic discharging devices or into a neighboring building to which the apparatus proper does not extend.

The novel features of the improvements in said apparatus will be more fully set forth in the following description of the accompanying drawings which illustrate a practical construction embodying my said invention.

In these drawings, Figure 1 is a side elevation of the apparatus. Fig. 2 is a horizontal central section of the receiving end of the water tank shown in the lower portion of Fig. 1. Fig. 3 is a front view of the manhead closing an opening in the end of said tank and seen in section in Fig. 2. Fig. 4 is an enlarged section of the automatic reducing valve connected with the inlet pipe of said tank and situated within the same where it is immersed in water. Fig. 5 is a partial plan and horizontal section of an automatic gas-discharging valve controlled by the temperature of the surrounding atmosphere at the point where it is situated. Fig. 6 is a side elevation of said discharge valve. Fig. 7 is an end view of said discharging valve. Fig. 8 is a side elevation, enlarged, of the leak detector shown in Fig. 1. Fig. 9 is a horizontal section in the line 9—9 of Fig. 8. Fig. 10 is an enlarged section of the outlet valve leading from the chamber of the leak detector to the whistle shown in Fig. 8 and operated by a float. Fig. 11 is a transverse section in the line 11—11 of Fig. 10. Fig. 12 is a side elevation. Fig. 13 is an axial section of a coupling containing a strainer.

First naming the principal elements in the apparatus shown in said drawings, A represents a tank nearly but not entirely filled with water or other suitable liquid; B an inlet pipe; C an outlet pipe; D D automatic gas dischargers located near the ceiling of a room or rooms in which fire is to be extinguished; E a leak detector, and F an automatic pressure reducing valve situated within the tank A below the surface of the water for the control of induction of carbon dioxid from the pipe B to the interior of said tank A.

The tank A is desirably provided with the water glass A^1, safety valve A^2, and pressure indicator A^3. It is also connected with the lower part of the chamber E of the leak detector by the pipe *e* leading from the tank A below the water level therein and provided with the valve e^1 whereby a desired amount of water may be forced from the tank A upward into the chamber E by the pressure in said tank.

The pipe B connects with an abundant source of carbon dioxid supply which may either be a suitable tank on the premises containing the apparatus or a street or other distribution system, such tank or system containing the dioxid preferably in liquid form and under a high pressure of say 700 pounds to 1200 pounds per square inch.

B^1 represents a coil or its equivalent in the pipe B, which is externally exposed to the atmosphere, to steam or to other medium for imparting heat to said pipe and its contents, B^2, representing the coil as being inclosed within a chamber supplied with steam from a pipe B^3 and discharging the condensed water through a pipe B^4 into a trap B^5. In large apparatus likely to be called on for lengthy operation in extinguishing a fire, the alternative form of device for supplying heat of vaporization, shown at B^2, will be preferably employed.

In the pipe B is placed a coupling B^6 containing a strainer B^7, as indicated in the sectional Fig. 13, this strainer being of brass wire gauze and employed for the purpose of preventing dirt from entering the valve within the tank A and next to be described.

The automatic pressure reducing valve, indicated in dotted lines at F in Fig. 1 and in full lines in Fig. 2, is shown in vertical section and enlarged in Fig. 4. In

said Fig. 4 A^4 represents a man-head to the inside of which the case of the valve F is secured, said case having a shank F^1 which projects through a corresponding opening in the man-head. Into this shank F^1 is secured the end of the inlet pipe B continuous with the opening in which is a passage *f* having the inner terminal enlargement f^1 bounded by the annular valve seat f^2. F^2 is the valve chamber proper of the valve F, communicating with the passage f^1 and having the discharge passage f^3. F^3 is the valve for closing the passage *f*, said valve consisting of a head fitted to bear, as indicated, upon the annular seat f^2 by means of a suitable packing f^4, preferably of soft metal. F^4 is the stem of the valve F^3, which stem passes through annular, conical packing rings f^5 of leather or other suitable material arranged as shown, and bears at its outer end against a diaphragm F^5 through the medium of a suitably wide head f^6. The outer surface of the diaphragm is exposed to the pressure of the fluid within the tank A through openings f^7 in the cap F^6 which holds the circular margin of the diaphragm F^5 in place, and, by its central portion, affords a back-stop for the valve. A space f^8 is provided beneath the outwardly and inwardly movable diaphragm head f^6, which space communicates through a passage f^9 with the atmosphere external to the tank A. The annular packing rings f^5 are supported in conical form by the correspondingly shaped seats f^{10} f^{11} and are confined in place by means of the gland f^{12}.

With the outlet passage f^3 of the valve chamber F^2 is desirably connected a nozzle F^7 which is directed into the orifice of a second nozzle F^8, the inner end of the latter being flared and open to the contents of the tank A. This nozzle F^8 is preferably directed towards the part of the case of the valve F which incloses the valve chamber F^2, as indicated in Fig. 4 and in dotted lines in Fig. 1. The object of this nozzle device is to cause a current of water, when induced by the discharge of gas from the chamber F^2 to flow against and past the shell of the valve F and to thereby prevent freezing up and closure of the said valve and its inlet and outlet passages by reason of the expansion of the dioxid, it being understood that such expansion is to take place only during the short period of time in which a fire is being extinguished, and that the body of water within the tank A is of sufficient extent to prevent freezing during such limited period of time, without being itself cooled to the freezing point. In case of continued operation of the apparatus, the liability to extreme cooling of the tank water and to freezing of the passages will be lessened by use of the heating device shown at B^2.

The nozzle mechanism F^7 F^8 of the valve discharge passage f^3 being submerged, the gas rises through the superjacent body of water in the tank A and in to the space above its surface and thence passes outward through the discharge pipe C, whenever an outlet is made therefor by the opening of any one or more of the automatic gas discharging valves D D. Inasmuch, however, as leakage may occur and as carbon dioxid is itself odorless and therefore gives no indication of its presence, while, if present in excessive quantity in an apartment it is dangerous to life, I propose to impart thereto an artificial odor in order that it may indicate its presence to the sense of smell and thus afford a safeguard against harmful results. For this purpose I preferably place an odorizer in the tank A, and such odorizer may be of any selected material. I have advantageously used peppermint for this purpose.

Next describing the automatic gas discharging device D, attention is directed to Figs. 5, 6 and 7 which show the same enlarged and in various views. D^1 is a nipple fitted with a screw thread *d* by which it connects with the gas distributing pipe or branch C^2 and provided with a recess d^1 in its outer end. D^2 is a casting comprising a yoke d^2 and a cylindrical portion d^3 having a recess d^4 in its end and fitted to slip loosely over the recessed end of the nipple D^1 to which it is secured by solder adapted to yield at a temperature of say, 250° Fahrenheit. In the chamber formed by such connection of recessed parts D^1 and D^2 is arranged a valve D^3 provided with an annular edge d^5 which bears against a soft metal seat d^6 in the member D^2, as shown in Fig. 5. Encompassed by the seat d^6 is a recess d^7 from which proceeds an outlet passage or short pipe d^8 leading to the exterior of the valve case and directed downwardly. The valve D^3 has a winged hub d^9 entering the recess d^7 and serving to guide the valve. Abutting against the hub d^9 is a sliding pin d^{10} which projects through the wall of the valve case and into the space within the yoke d^2 where it is exposed to inward pressure for the purpose of unseating the valve, the means of such pressure being any suitable device adapted to cause the necessary pressure when subjected to a temperature calling for the discharge of gas. The means shown and preferably employed for giving such pressure consists of one or more disk-shaped bulbs or chambers D^4 having thin and flexible walls d^{11} one of which bears centrally against the pin d^{10} and the other of which is centrally supported by a set screw D^5 passing through the outer part of the yoke. The chambers D^4 are filled with sulfuric ether or any other suitable liquid adapted, when confined, to produce a wide variation of pressure under relatively small variation in temperature, and are sealed. The disk form given to the chambers D^4 manifestly favors their expansion in the direction of their axes, and such expansion, under the temperature produced at the ceiling of a room containing an unconfined fire, such as calls for extinguishment, will thrust the valve d^3 from its seat and permit gas to escape from the discharge opening d^8. Upon the falling of the temperature in the room after the fire has been extinguished the contents of the chambers D^4 become cool again and contract, allowins the outwardly closing valve D^3 to reseat under the pressure of the gas behind it, or under the operation of a spring D^6 which may, if desired, be employed.

Under ordinary circumstances it is not intended that the valve case shall part at the soldered joint uniting the two members of the said valve case, but, when a fire is long continued or extremely hot, said joint may yield and the gas may then enter the room more rapidly through the larger passage of the nipple D^1.

The leak detector E consists of a relatively high chamber having a vertical partition E^1 extending from its closed top to near its closed bottom and dividing said chamber into two compartments E^2 E^3. Into the upper end of the former leads the pipe C^1 which branches from the pipe C and from the upper end of the latter leads the pipe e^2 which leads back to the pipe C. Near the lower end of the compartment E^2 is arranged a

float E^4 which, through the medium of a lever e^3, operates a valve E^5 that closes a passage e^4 leading from said compartment E^2 to a whistle e^5, which whistle may be situated at any desired place more or less remote from the chamber E, as, for example, at the office of the premises containing the apparatus or at a fire station distant from said premises. Both compartments E^2 and E^3 are preferably provided with water glasses e^6 e^7 and to each is desirably applied a slide e^8 which may be moved by hand to any selected point where it will remain. If the valves c^1 c^3 and c^4 be opened and the valve c^2 be closed, the only passage leading from the tank A to the distribution gas pipe C^2 will be through the compartments E^2 and E^3 of the chamber E. Within these compartments should stand a body of water, the normal depth of which in each is indicated by the appropriate gage glass, and the adjustable slides e^8. A leakage beyond the chamber will result in the depression of the water column in the compartment E^2 and its elevation in the compartment E^3 and the presence and extent of such leakage will be shown by the gages which will be from time to time inspected. The falling of the water column to near the bottom of the compartment E^2 (as the result of either continued leakage or of a fire) will additionally cause the float E^4 to fall and open the valve E^5 when the whistle e^5 will be sounded. Any appreciable leakage detected should be promptly remedied in order that the material need not be wasted and that no harmful result may follow its escape, and the odor which the escaping odorized gas will emit will enable the point of escape to be located after the indicator shall have shown a leakage to exist, if not before. But supposing a fire to have started in some room containing a discharger D while the detector E is in connection, the escape of gas from such discharger will at once transfer the water from the compartment E^2 to the compartment E^3 to the extent of bringing the water level in the former to the bottom of the partition E^1 whereupon the gas passing beneath said partition will rise through the water column in the compartment E^3 and pass on to the distributing pipe C^2 which supplies the acting discharger or dischargers D. The water column subject to the pressure of gas in the delivery pipes constitutes in effect a pressure indicator or gage adapted to show at all times the presence or absence of pressure in the delivery pipes and also the degree of pressure therein in case of leakage.

The gage glasses e^6 and e^7 are shown as having a common central connection at their lower ends with the chamber E and separate connections at their upper ends with the several compartments E^2 and E^3 of said chamber. Their connections are also shown to be provided with suitable valves and petcocks for the purpose of restoring equilibrium in the compartments E^2 and E^3 of the chamber E or of allowing the glasses to be disused or replaced. The proper water line of the chamber E is indicated by a mark or prominence e^9 upon the exterior of the chamber, or by other suitable means. The chamber E may be supported by fastening it to a wall or post and, to suit it for attachment to either, it is shown as being cast with lugs e^{10} and studs e^{11}.

In case of a fire having been brought to the attention of operatives by sound of the whistle, the valve c^2 should be opened in order to give freer passage of gas from the tank A to the distributing pipe or pipes C^2, as the detector obviously imposes some obstructions to such free flow.

C^5 represents a valved pipe which may lead beneath the ground or floor or overhead to the street or other open space or to any other point where it may be provided with a hose which may be thrust through a broken window of a neighboring building or otherwise used to deliver gas at a point where dischargers D are not provided. Or said pipe C^5 may lead to other buildings or premises to supply distributing pipes equipped with dischargers.

In the operation of the apparatus described, as the result of a fire, the heating of the bulbs or chambers D^4 of the discharge device D causes expansion of their contents and the opening of the discharge valve D^3 in a manner set forth. The gas contained in the gas pipe C^2 thereupon finds escape through the downwardly directed opening or pipe d^8 and by reason of its greater specific gravity than the air of the room and by reason of the downward direction given it, the emitted gas quickly descends to the lower part of the room. At this point there exists an air current induced by and directed towards the fire and, mingling with this current, the gas moves along the floor to the fire where it rises with the air into the flame or into contact with the burning object, with the effect of extinguishing the fire upon principles well understood. When the fire has been quelled the temperature of the room at the discharger will fall and the discharger valve will promptly close.

The escape of gas from the gas distributing system for the extinguishment of a fire is of course accompanied by a reduction of pressure in the tank A, and this results in the automatic opening of the valve F and the resupply of gas to the tank from the inlet pipe B. Such resupply of gas to the tank will continue so long as the discharge continues and will cease when the discharge ceases, the time occupied in putting out a fire ordinarily being very brief. While the inflow of gas to the tank A continues, there obviously is present a strong tendency of the valve passages to freeze, owing to the wide difference in pressure on opposite sides of said valve. This is counteracted by the water current induced within the tank by the nozzle devices F^7 F^8, such current serving to bring fresh portions of the tank water into contact with the shell of the valve F through which heat is taken from the water to supply heat of evaporization to the carbon dioxid. The size of the tank A should therefore be such as to contain a sufficient body of water at the temperature of the atmosphere to serve this purpose during the possible continuance of a fire. The current will obviously be more effective if directed immediately upon the inclosure of the expansion chamber of the valve, as indicated, for which reason the construction shown is preferred. If the fire be exceptionally obstinate and longcontinued and the body of water in the tank A be likely to prove insufficient in quantity to furnish heat for an unusually lengthy operation of the apparatus, heat may be applied to the coil B^2 or B^2 for the purpose of gasifying the liquid before its entrance to the valve F and of thus lessening the amount of heat taken from the tank water. Obviously the water tank A may be so large as in no case to require the application of heat to the coil.

The operation of the leak detector has already been sufficiently stated in the foregoing description of its construction and the same is true of the gas discharger D.

By reliance upon the air current at the bottom of a room to convey the gaseous carbon dioxid to a fire to be extinguished, a less number of dischargers may be employed for a room of given dimensions than would otherwise be necessary, and ordinarily in large rooms such dischargers will be placed say about twenty feet apart.

The apparatus described is obviously adapted to work with certainty and uniformity and at the same time with the utmost practical economy. To the latter end the construction of the discharger, by which it is adapted to automatically close as well as open, largely contributes, since, by this construction, the escape of gas is automatically arrested as soon as a demand for it in extinguishing a fire ceases.

The method set forth may, manifestly be put into practice by other forms of apparatus than that shown in the drawings, and the apparatus illustrated may be varied in many ways without departure from the principles of the invention embodied therein. For example, other means than a liquid in a tank A, or a coil B^1 or B^2 may obviously be employed to heat the valve F or the gas on its way from the source of supply to the gas containing spaces or passages from which it is taken by the discharger or dischargers D; or a different construction of leak detector or of gas discharger may be employed, or the ordorization of the gas may be otherwise affected.

I claim as my invention:

1. In an apparatus for the extinguishment of fire by the use of carbon dioxid, the combination with a source of carbon dioxid supply under high pressure, of a tank or vessel containing liquid of greater specific gravity than the dioxid and containing a gas space above the surface of said liquid, a pipe leading from the gas space of said tank, an automatic discharger applied to said tank and provided with means whereby the same will be opened to give discharge to the gas, such means being adapted to open the discharger at a predetermined temperature of the surrounding atmosphere, and an automatic pressure reducing valve controlling the admission of carbon dioxid which is submerged in the liquid.

2. In combination with a source of carbon dioxid supply under high pressure, a tank connected with such source of supply by means of an automatic pressure reducing valve and containing a liquid in which said valve is submerged and also containing a gas space above the surface of said liquid and a delivery pipe leading from the gas space of the tank, said liquid within the tank containing an admixture of odorizing material whereby the gas is odorized in its passage through the liquid in the tank.

3. In apparatus for the automatic use of carbon dioxid for the extinguishment of fires, the combination with a source of carbon dioxid supply under high pressure, of an automatic pressure reducing valve in the passage leading from such source of supply and controlled by the pressure of the gas discharged from said valve, means for applying heat to the shell of said valve, embracing a liquid supply, which is caused to circulate in contact with the valve a pipe or passage communicating with the outlet of said valve and a discharger applied to said pipe or passage, said discharge being provided with means for automatically opening the same adapted to so open the discharger at a predetermined temperature of the surrounding atmosphere.

4. In apparatus for the extinguishment of fires by the use of carbon dioxid, the combination, with a source of carbon dioxid supply under high pressure, of a tank or vessel containing liquid of greater specific gravity than the dioxid and containing a gas space above the surface of said liquid, a pipe leading from the gas space of said tank, an automatic discharger applied to said pipe and provided with means whereby the same will be opened to give discharge to the gas, such means being adapted to open the discharger at a predetermined temperature of the surrounding atmosphere, and an automatic pressure reducing valve controlling the admission of carbon dioxid to the tank, which is submerged in the liquid within said tank and has its discharge opening arranged below the surface of said liquid.

5. The combination with a gas-supply fire extinguishing apparatus, of the discharger described having a valve which is operated to open and close by means affected by changes in temperature and also having a soldered connection around the main inlet passage adapted to remain intact in air of a temperature which affects the opening of the valve, and to separate at a higher temperature.

6. In combination with a source of carbon dioxid supply under high pressure, a tank connected with such source of supply by means of an automatic pressure reducing valve and containing a liquid in which said valve is submerged, and also containing a gas space above the surface of said liquid, means for withdrawing the gas from said tank and a pipe leading from the discharge of said valve and having its outlet directed toward the valve case beneath the surface of the liquid, whereby a current of such liquid is directed into contact with the said valve case during the period in which the valve is opened.

7. In combination with the liquid tank and the valve F, therein, of means for circulating the liquid around said valve comprising a pipe leading from the valve chamber and provided with the gas nozzle F^7 and the projector nozzle F^8, the latter being open at both ends to the liquid in which the valve and said nozzle is submerged.

8. In an automatic apparatus for the use of carbon-dioxid for the extinguishment of fires, the combination with a source of carbon-dioxid supply under high pressure, a relatively large space or chamber connected with said source of supply through an automatic pressure reducing valve, a pipe or passage leading from said space or chamber to an automatic, normally closed, discharging device, an indicator connected with said pipe or passage constructed to visually indicate the leakage of small quantities of gas from the system and an audible signaling device connected with said passage, so constructed and coöperating with the visual indicator as to indicate leakage of gas from said passage only upon substantial leakage of gas from said passage.

9. In apparatus for the automatic extinguishment of fires by the use of carbon dioxid, a leak detector consisting of a chamber having a depending partition dividing said chamber into two compartments connected with each other at their lower ends, which compartments are partially filled with a liquid and are severally connected at their upper ends with inlet and outlet pipes, the inlet compartment being provided with an outlet leading to a signaling device and controlled by a float.

10. In apparatus for automatically extinguishing fires by the use of carbon dioxid, a leak detector consisting of a chamber containing a depending partition which divides the chamber into two compartments said compartments being connected at their lower ends and severally connected with inlet and outlet pipes, and each of said compartments being provided with a water glass adapted to indicate the level of a liquid therein.

11. In apparatus of the general character described, the combination with the tank A, the leak detector E containing two compartments which communicate with each other at their lower ends, said compartments being provided with water glasses and severally connected with an inlet and outlet pipe, and a valved pipe *e* leading from the liquid space of the tank A to the liquid space of the detector chamber E.

12. In apparatus essentially as described, the combination, with the tank A and gas delivery pipes C and C^3 of a detector E having its several compartments in communication with the pipe C and the valve c^2 arranged in the pipe C between the connections of the detector with said pipe C.

13. In apparatus for the extinguishment of fires by the

use of carbon dioxid, the combination, with a source of carbon dioxid supply under high pressure, a tank and a pressure reducing valve submerged in said tank and discharging into a liquid in order that the latter may gove its heat to the dioxid in the act of expansion, of an auxiliary heating device for heating the duct which delivers to said valve.

14. The combination with a source supplying a liquefiable gas under pressure, a gas space, connections between said gas space and the source of supply embracing an expansion valve, a normally closed discharge device, a passage connecting said discharge device and gas space and including a chamber containing a shiftable body of liquid, and a device associated with said chamber constructed to indicate the displacement of said liquid upon the escape of gas from the system beyond said device.

15. In an apparatus for the extinguishment of fires by the use of carbon dioxid, a source of carbon-dioxid under suitable pressure, a space connected with said source through an automatic pressure regulating valve, and normally under a considerably lower pressure than said source, and provided with discharge outlets, whereby, when said discharge outlets, or either of them, are open, said carbon-dioxid under the full pressure of said source passes through said space and from said outlet or outlets, and heating means preventing the freezing of the expanding gas at said valve.

16. In an apparatus for the extinguishment of fires by the use of carbon-dioxid, a source of carbon-dioxid under suitable pressure, a space connected with said source through an automatic pressure regulating valve, and normally under a considerably lower pressure than said source, and provided with discharge outlets, whereby, when said discharge outlets, or either of them, are open, said carbon-dioxid under the full pressure of said source passes through said space and from said outlet or outlets, and heating means at said valve within said space.

17. The combination with a source supplying a liquefiable gas under pressure, a gas space, connections between said gas space and source of supply embracing an expansion valve, a normally closed discharge device, a passage connecting said discharge device and gas space and including a chamber containing a shiftable body of liquid, an audible alarm device connected with said chamber, and a float mechanism located in said chamber and constructed to actuate said alarm device upon the leakage of gas from the system beyond said device.

18. In an apparatus for the extinguishment of fire by the use of carbon dioxid the combination with a source of carbon dioxid under suitable pressure, of a discharging device, a passage leading from said source to the discharging device; an automatic pressure regulating valve in said passage constructed to maintain a pressure on that part of the passage between the valve and the discharging device, when the latter is closed, less than the pressure of said source of supply and to permit the gas, under the pressure of said source, to escape through said passage when the discharging device is open and a body of relatively warm liquid enveloping said passage at the valve to prevent clogging of said passage by freezing of the expanding gas at the valve.

19. The combination with a source of carbon dioxid under suitable pressure, of a tank containing a body of liquid and containing a gas space above said liquid which communicates with a discharge passage, and a passage leading from said source to said tank and discharging carbon dioxid into the tank below the level of the liquid therein.

In testimony, that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

EUGENE F. OSBORNE.

Witnesses:

DENNIS O'DAY,

D. D. AVERY.