March 3, 1942. E. GEERTZ 2,274,783

FIRE EXTINGUISHING APPARATUS

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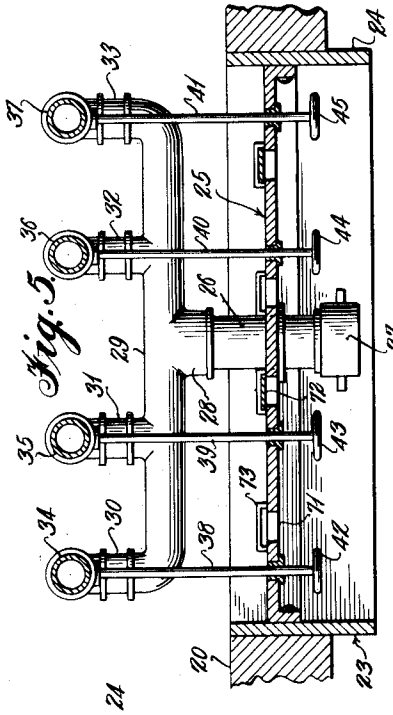


Fig. 5.

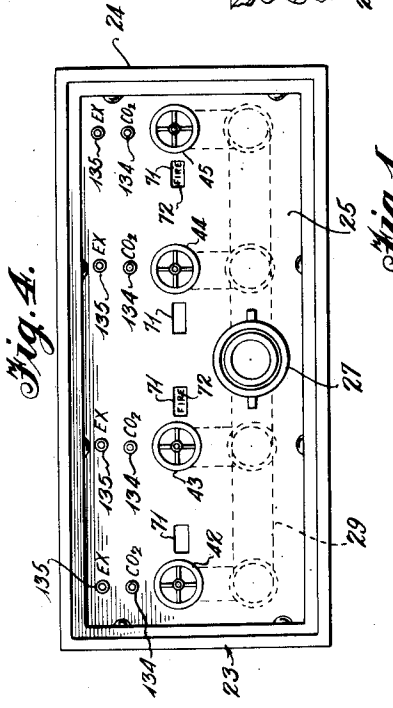


Fig. 4.

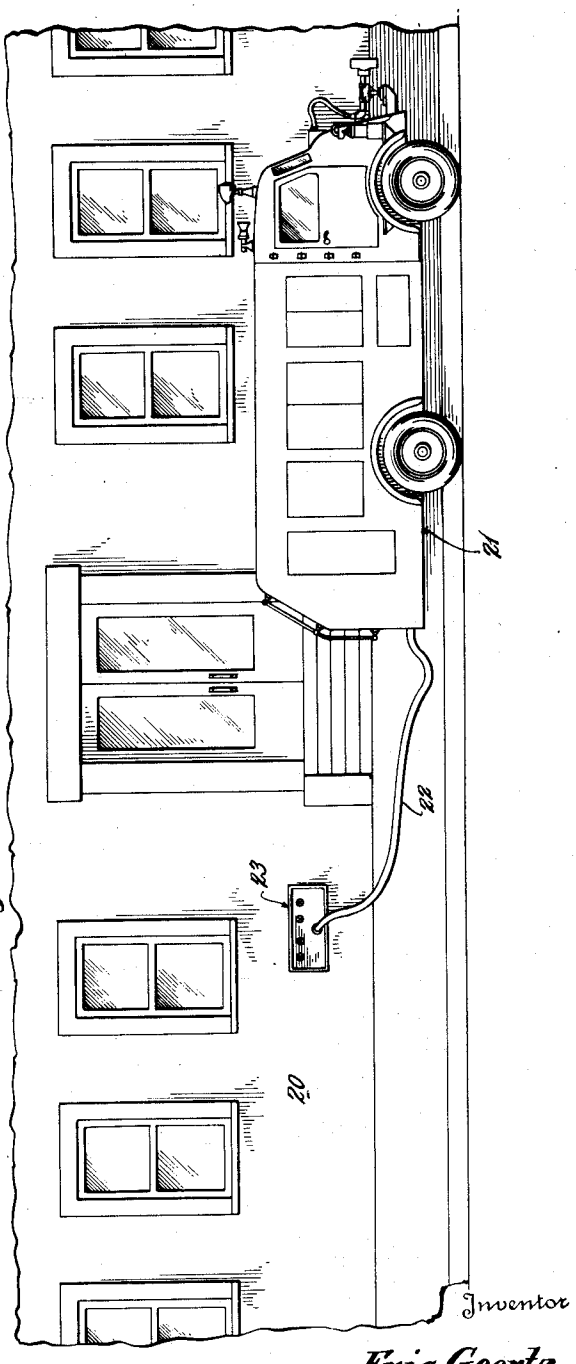


Fig. 1.

Inventor

Eric Geertz

By L. Donald Myers

Attorney

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FIRE EXTINGUISHING APPARATUS

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Fig. 2.

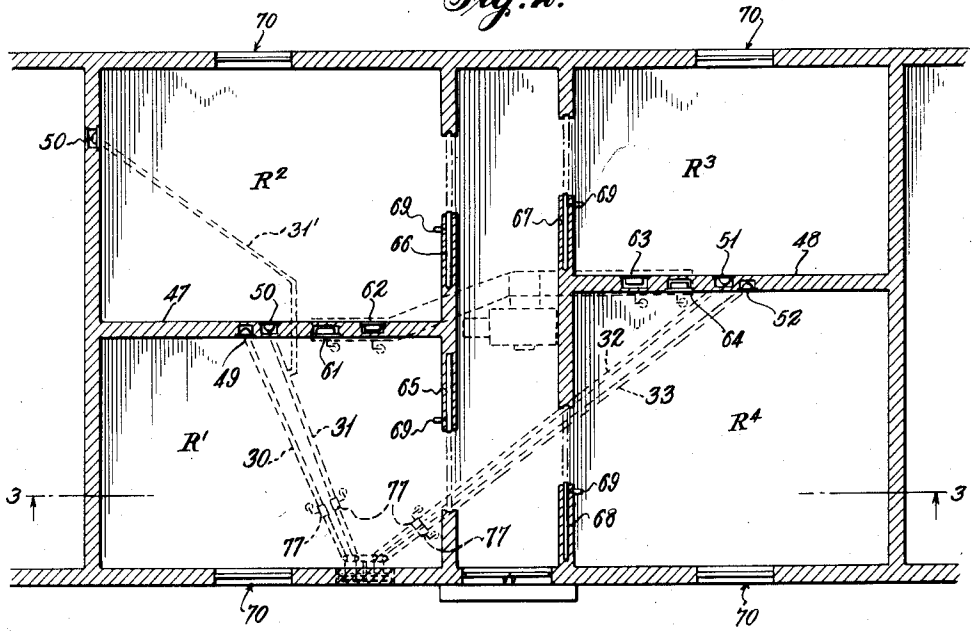
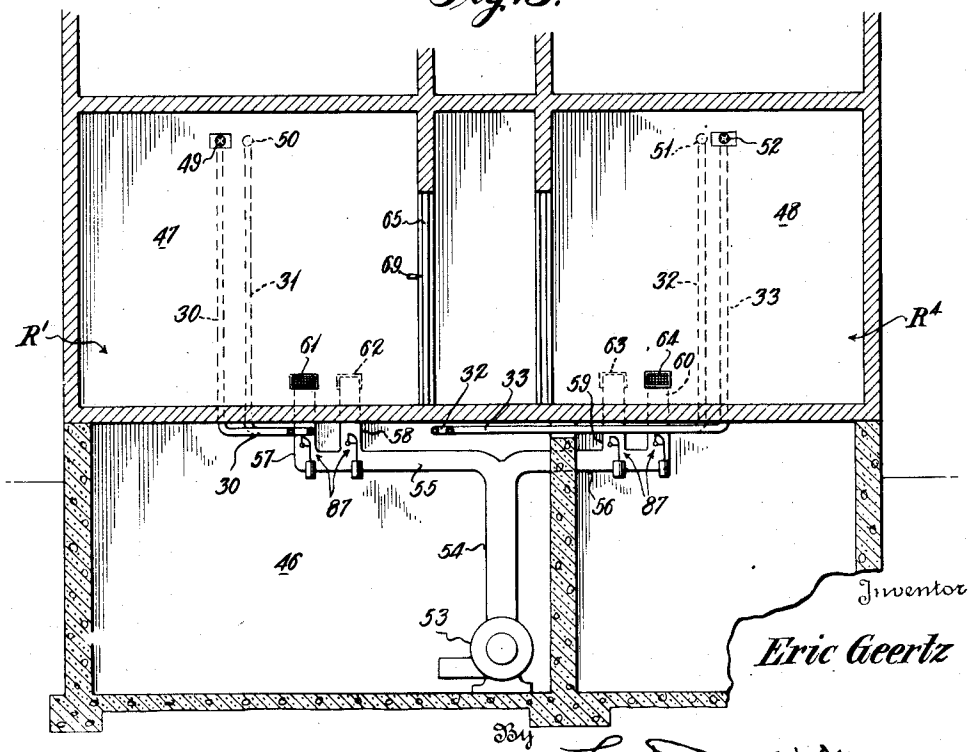


Fig. 3.



Inventor

Eric Geertz

By L. Donald Myers

Attorney

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Fig. 6.

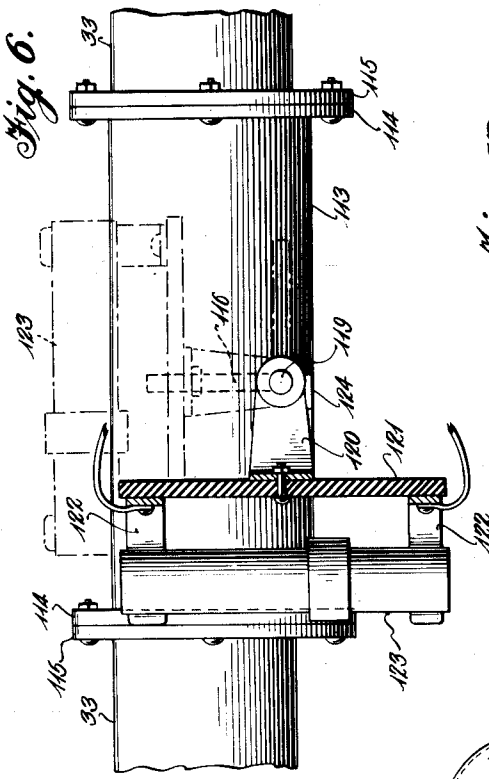


Fig. 13.

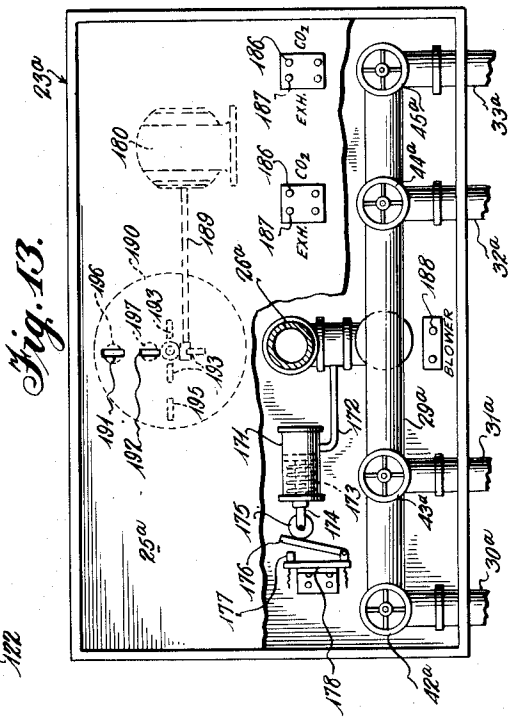


Fig. 9.

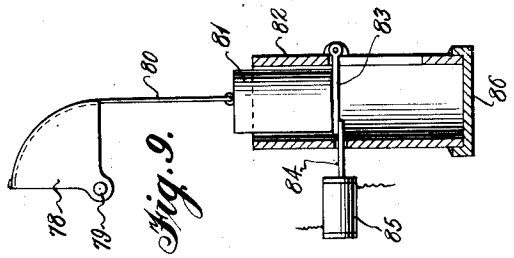


Fig. 7.

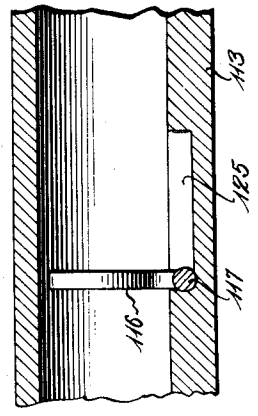
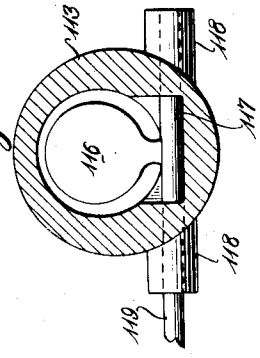


Fig. 8.



Inventor

Eric Geertz

By L. Donald Myers

Attorney

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FIRE EXTINGUISHING APPARATUS

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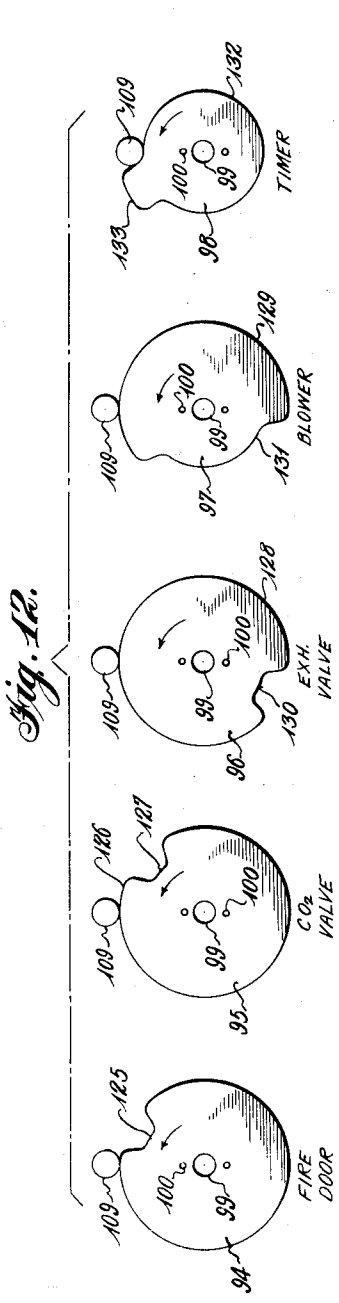


Fig. 12.

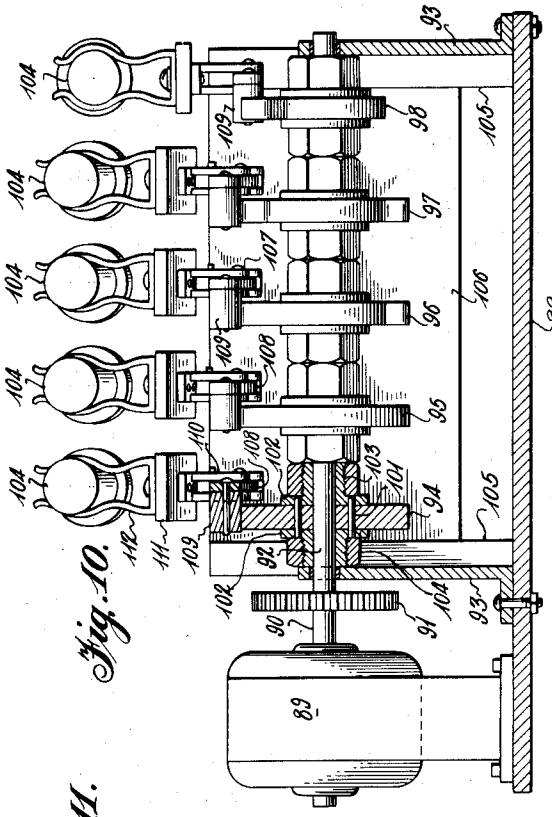


Fig. 10.

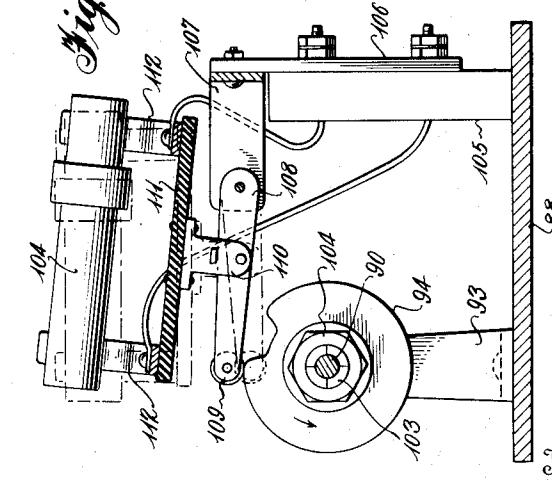


Fig. 11.

Inventor

Eric Geertz

By L. Donald Myers

Attorney

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Fig. 14.

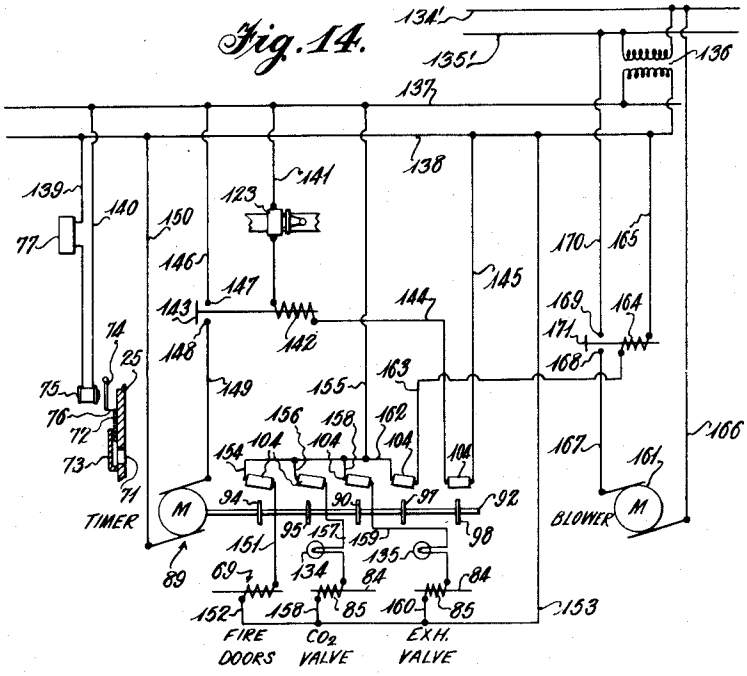
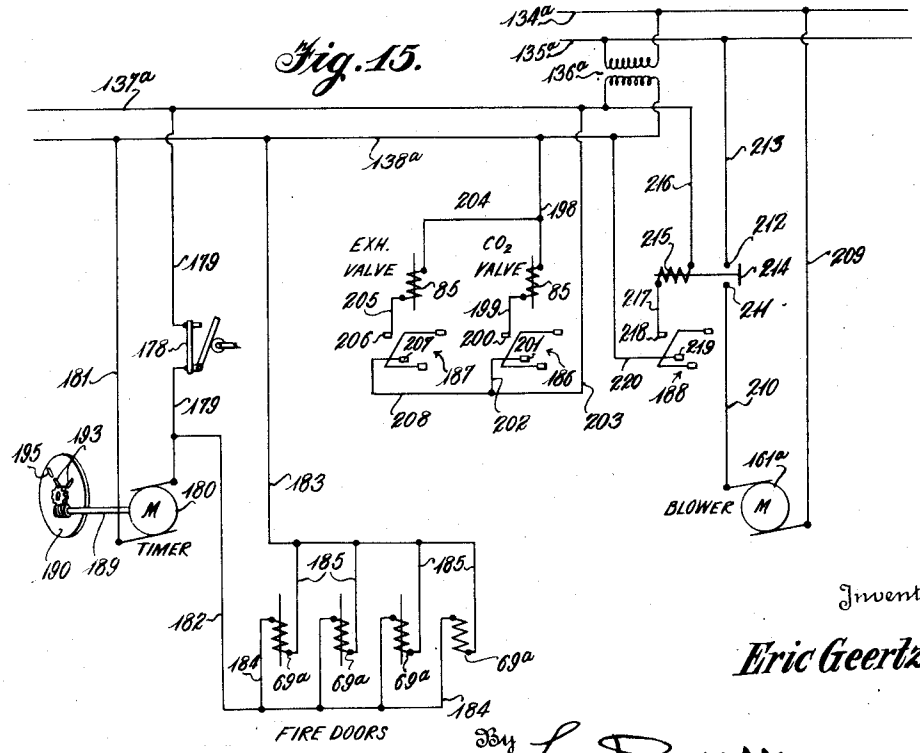


Fig. 15.



Inventor

Eric Geertz

By *L. Donald Myers*

Attorney

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2,274,783

UNITED STATES PATENT OFFICE

2,274,783

FIRE EXTINGUISHING APPARATUS

Eric Geertz, Glen Ellyn, Ill., assignor to Cardox Corporation, Chicago, Ill., a corporation of Illinois

Application December 2, 1939, Serial No. 307,317

26 Claims. (Cl. 169—11)

This invention relates to new and useful improvements in apparatus for extinguishing fires.

In my Patent No. 2,143,311, issued on January 10, 1939, there is disclosed and claimed a method of extinguishing fires by means of carbon dioxide which is maintained in readiness for instant use at a controlled subatmospheric temperature and its corresponding vapor pressure. The patent discloses examples of apparatus which may be employed in carrying out the claimed methods. The illustrated example of a suitable source of supply of the low temperature and pressure liquid carbon dioxide consists of an insulated storage container which is permanently installed in a building to be protected from damage by fire. Such a fixed storage installation is entirely satisfactory under such circumstances as where the user's properties are not widely scattered and can be conveniently protected from a central source of supply. It, also, is an exceedingly practical installation where a large quantity of liquid carbon dioxide is required for each hazard or building.

There are other circumstances and conditions under which a fixed storage installation is not the most practical and economical way of supplying the fire extinguishing medium of the aforesaid patented method. For example, a company may own and operate quite a number of buildings scattered over a tract of land which covers considerable area and which is so located as to be entirely beyond the limits of any territory covered by city fire departments. These several buildings may present one fire hazard per building, or some or all of the buildings may each present two or more fire hazards. Complete extinguishment of a fire involving any one of these various independent hazards or of fires involving all of the hazards in any one of the buildings may require the use of a comparatively small amount of liquid carbon dioxide as compared to the total requirements for all the buildings. For example, from one to eight tons of liquid carbon dioxide might afford proper protection for any one building in the group. However, to provide a fixed storage installation in each one of the several buildings, which will be adequate to take care of the fire hazard or hazards involving that building might necessitate employing for the entire area storage containers having a total capacity of one or more hundred tons. Under such a set of conditions, the company can provide adequate protection for all of its buildings if it maintains the liquid carbon dioxide required for any one of the buildings, for example, up to eight tons, stored in a single transportable tank unit which can be moved readily to the particular building in which a fire is burning and completely extinguish the fire in that building by discharging the amount of liquid carbon dioxide for the particular hazard or hazards involved. The liquid carbon dioxide stored in the tank unit may be very easily maintained at the desired low temperature and pressure while the unit is idle in its garage.

Let us, also, assume that the fire department of a municipality has in the area it is responsible for quite a large number of buildings which present fire hazards that can be most effectively protected by the use of carbon dioxide. Further, that there is an additional large number of buildings the owners or users of which fully appreciate the superior qualities of low temperature and pressure liquid carbon dioxide as a fire extinguishing medium and are desirous of having their properties protected from fire by its use. Of course, a fire ordinance could be passed to compel the owners of the first mentioned properties to provide carbon dioxide fire protection systems which involve individual fixed storage supplies and similar systems could be installed on the properties of those who particularly desire the same. However, the fire department of a municipality is maintained principally by the taxes collected from the property owners, and it should be considered as a part of the responsibilities of such a department to provide the best fire protection possible at the lowest cost to everybody concerned.

All of the properties mentioned above can be fully protected most economically by providing the fire department with a suitable number of transportable tank units in which low temperature and pressure liquid carbon dioxide is stored in readiness for instant use upon reaching the scene of a fire.

A fire of any magnitude raging in an enclosed space, such as a room of a building, can be very quickly and most effectively extinguished by totally flooding the enclosed space with low temperature, low pressure carbon dioxide. To extinguish a fire by total flooding, it is necessary to discharge into the space a sufficient amount of carbon dioxide to provide at least a concentration of 30%. It is desirable, however, to create a concentration of 65% to be certain of complete extinguishment, regardless of the type of combustible that may be in the room. This concentration should be created as rapidly as possible and must be maintained for a necessary length of time to effect complete extinguishment and to cool all involved heat absorbing objects below the temperature at which the combustible materials in the space will rekindle. It has been established by actual tests that low temperature, low pressure liquid carbon dioxide can be discharged from large capacity storage containers through pipes measuring at least four inches in diameter. A rate of discharge of approximately 100 pounds per second has been ob-

tained through pipes of this size without encountering any difficulties, such as excessive pressure drops which will result in freeze ups. Of course, slower rates of discharge may be employed where adequate by merely providing smaller supply lines, by valving the lines to reduce the rate of flow, by reducing the total area of discharge to the atmosphere through the discharge nozzle or nozzles, etc.

As an illustrative example, a room or other enclosed space, of 44,000 cubic foot capacity can be flooded in three minutes to provide a 44% of carbon dioxide concentration through a 1½ inch feed line having a single nozzle providing a total area of discharge to the atmosphere of approximately 0.8 square inch. If the space is reasonably well sealed, i. e., window and other sizeable openings being closed off, the initial concentration will be maintained for approximately ten minutes and will drop to a concentration of 20% in approximately 30 minutes. Of course, if all sizeable openings are not reasonably well sealed, the above values will not apply, and it will be necessary to increase the rate of discharge into the space an amount which will be adequate to create and maintain the desired concentration in spite of the loss of carbon dioxide through the uncovered openings.

Of course, it is possible to effect total flooding of a room or an enclosed space with low temperature and pressure carbon dioxide, stored in a transportable tank unit, by employing one or more flexible hose lines which are laid from the tank unit to the scene of the fire. This procedure becomes rather difficult and is very time consuming if the room to be flooded can only be reached from the front street or a back alley by traversing long hallways, flights of stairs, and numerous corners. It has been determined, however, that for the greatest possible efficiency, a fire protection system employing one or more large capacity transportable carbon dioxide tank units to provide fire protection for a large number of buildings presenting one or more fire hazards per building, the following equipment should be provided. Each building should have installed therein a piping system which will include pipe lines extending from a convenient location accessible from the exterior of the building to each one of the several rooms to be provided with fire protection. Completely automatic, semi-automatic, or purely manual control means should be provided which will make it possible for the exact amount of carbon dioxide to be delivered to the particular room or rooms involved. Such control means should operate to eliminate any possibility of wasting the extinguishing medium in putting out a fire in any particular room and thereby enable maximum protection to be obtained with a limited amount of liquid carbon dioxide. With such equipment, a transportable tank unit can be driven to the building and quickly connected to the piping system. The control means then may be properly manipulated and the fire quickly extinguished. If the control system is sufficiently automatic in its operation, the extinguishment may be accomplished without necessitating firemen entering the building. This is a very desirable feature where the building contains explosive materials or houses high potential electric equipment.

The invention has for its primary object the provision of apparatus for providing liquid carbon dioxide fire protection for a large number of buildings or independent fire hazards with a minimum amount of equipment and quantity of stored extinguishing medium.

A further important object of the invention is the provision of apparatus which is particularly adapted for providing liquid carbon dioxide fire protection for a plurality of hazards in each one of a number of distantly located buildings by means of a transportable source of supply of the extinguishing medium.

More specific objects of the invention are the provision of piping systems for buildings which will enable liquid carbon dioxide to be selectively delivered to any one or more of several rooms to accomplish fire extinguishment by complete flooding of the same, and to provide control systems which make it possible for a fireman to effect extinguishment of fires in one or more enclosed spaces of a building by completely flooding the spaces with carbon dioxide and then rapidly conditioning the spaces for inspection to determine the extent of damage and to make certain that no glowing or smoldering embers remain which might cause rekindling of the fire, without requiring the fireman to enter the building prior to the extinguishment and conditioning.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a fragmentary front elevational view of a building equipped to be protected from fires by the methods and apparatus embodying this invention and with a liquid carbon dioxide transportable tank unit drawn up at the curb in front of the building and connected to the piping system in readiness to extinguish the fires burning in one or all of the protected spaces,

Figure 2 is a fragmentary, horizontal sectional view showing the interior of the building of Fig. 1 and the fire extinguishing system employed for providing protection for four enclosed spaces or rooms of the building,

Figure 3 is a vertical sectional view taken on line 3—3 of Fig. 2,

Figure 4 is a detail, front elevational view of the exterior hose coupling and control panel which is illustrated in Fig. 2 as being mounted in the front wall of the building,

Figure 5 is a detail, horizontal sectional view of the coupling and control panel disclosed in Fig. 4,

Figures 6, 7, and 8 are, respectively, a side elevational view and two vertical sectional views of a liquid carbon dioxide flow operated, electric circuit control device which is incorporated in each one of the pipe lines leading from the exterior control panel to each one of the rooms to be protected,

Figure 9 is a detail, vertical sectional view of a weight operated valve mechanism which is duplicated and employed for automatically operating certain valves arranged in the piping system illustrated in Figs. 2 and 3,

Figure 10 is a partly elevational and partly vertical sectional view of a motor driven timer mechanism which automatically operates to produce the desired sequential actuation of the various electrical instrumentalities incorporated in the system,

Figure 11 is a detailed vertical sectional view taken at right angles to the disclosure of Fig. 10,

Figure 12 is an exploded view of the several cam elements of the timer mechanism disclosed in Figs. 10 and 11,

Figure 13 is a front elevational view, partly broken away, of a modified form of exterior hose coupling and control panel which may be employed in place of the panel illustrated in Figs. 1, 4, and 5,

Figure 14 illustrates the wiring diagram for the system disclosed in Figs. 1 to 12, inclusive, and

Figure 15 illustrates the wiring diagram for the modified form of control system illustrated in Fig. 13.

In the drawings, wherein for the purpose of illustration are shown the preferred embodiments of this invention, and particularly referring to Fig. 1, the reference character 20 designates one of several buildings to be protected from fires by means of the transportable tank unit 21 which is drawn up at the curb in front of the building. It is to be understood that the system need not be designed for fire protection at the front of the building if any other exterior walls are situated with respect to alleys or other open spaces so that a hose line leading from the truck unit 21 may be readily laid thereto.

No detailed features of construction will be specifically described in connection with the transportable tank unit 21 other than to point out that this unit may be designed to conveniently hold and transport one or more tons of low temperature, low pressure liquid carbon dioxide which may be discharged through one or more hose lines 22. Transportation tank units of this character have been used and moved over the highways which are adapted to carry up to eight tons of liquid carbon dioxide. I do not desire to be limited to this particular maximum capacity as railway tank cars having twenty-four tons capacity have been successfully operated, and it is conceivable that larger road tank units can be provided. If more specific information regarding such a transportable tank unit is desired, reference may be made to my copending application Ser. No. 263,301, filed March 21, 1939, for Mobile fire fighting apparatus.

Referring now to Figs. 1 to 5, inclusive, it will be seen that the building 20 has mounted in its front wall the hose coupling and control panel 23 which is disclosed in detail in Figs. 4 and 5 as being of box-like formation. Although not specifically illustrated, it is believed to be desirable to provide a cover for this control panel which may be closed and locked to prevent tampering with the various instrumentalities which otherwise would be accessible to everyone passing the building. The operator of the transportable unit 21 may be provided with a master key which will fit the locks for the covers of all control panels falling within the territory to be protected by his particular tank unit.

The control panel includes the various wall portions 24 which have suitably secured thereto the panel board 25. Extending through this panel board is a pipe section 26 which has mounted on its outer end portion the coupling member 27 which is adapted for use in connecting the hose line 22 to the said pipe section. The inner end of this pipe 26 is connected to the branch or inlet 28 of the manifold pipe 29. Fig. 5 discloses this manifold as having connected thereto four branch lines 30, 31, 32, and 33. These branch lines have mounted therein suitable valves 34, 35, 36, and 37, respectively, which have valve stems 38, 39, 40, and 41 extending therefrom through the panel board 25. An operating handle is provided for each one of these valve stems and the four handles are designated by the reference characters 42, 43, 44, and 45, respectively.

In Figs. 2 and 3, the various branch lines 30 to 33, inclusive, are illustrated as extending through the basement 46 of the building and through partition walls 47 and 48 which are arranged between the four rooms R1, R2, R3, and R4. The branch line 30 is clearly illustrated in Figs. 2 and 3 as being connected at its upper end to a discharge nozzle 49 which opens into the room R1. The branch line 31 is illustrated in Figs. 2 and 3 as being connected at its upper end to a discharge nozzle 50 which opens into the room R2. To illustrate the possibility of more rapidly flooding a large room, an extension line 31' leads from branch line 31 to a second discharge nozzle 50 for room R2. The branch line 32 has connected to its upper end a discharge nozzle 51 which opens into the room R3. A discharge nozzle 52 is connected to the upper end of the branch line 33 and communicates with the room R4. It will be noted that these various discharge nozzles 49 to 52, inclusive, are located in the walls or partitions 47 and 48 adjacent the ceilings of the several rooms. In completely flooding an enclosed space with the carbon dioxide vapors and snow which will be discharged from the nozzle communicating with the room, it has been found to be very desirable to effect this discharge adjacent the ceiling of the room as the vapors and snow are heavier than air and will gradually settle toward the floor.

The nozzles 49 to 52, inclusive, should be of proper design to cause the low temperature and low pressure liquid carbon dioxide to be converted to vapor and snow as a result of being permitted to suddenly expand in the atmosphere. An appropriate nozzle design is disclosed in the application filed by Harry Ensminger on December 22, 1938, Serial Number 247,268.

As has been pointed out above, the best way in which to extinguish a fire in an enclosed space is to flood the space with carbon dioxide for the purpose of obtaining a desired, predetermined concentration. This concentration of carbon dioxide will remain for an appreciable length of time if the space is properly closed or sealed. It is desirable to maintain a certain concentration for a sufficient length of time to bring about complete extinguishment of the fire and complete cooling of all involved objects to a temperature below that at which the combustible materials will rekindle. Such an extinguishing and cooling concentration renders the enclosed space unfit for occupancy by human beings. To expedite the fire fighting operation, therefore, it becomes desirable to mechanically exhaust the carbon dioxide vapors from the room or rooms in which complete flooding has taken place. As the vapors tend to settle toward the floor line, it is desirable to connect exhausting means with the protected spaces at points close to the floor.

In Figs. 2 and 3, an exhaust blower 53 is illustrated as being located in the basement 46 and as having connected to its inlet a main conduit 54 which communicates with manifold branch conduits 55 and 56. Manifold conduit 55 communicates with the branches 57 and 58. Manifold branch conduit 56 is communicates with branch lines 59 and 60. An exhaust register 61

is arranged over the upper end of the branch line 57 and this branch line operates to exhaust the carbon dioxide vapors from the room designated by the reference character R1. Branch line 58 has its upper end covered by a register or grill 62. This branch line is arranged to exhaust room R2. Branch line 59 has a grill plate 63 over its upper end and this branch line is arranged to exhaust room R3. Branch line 60 is arranged to exhaust room R4 and is provided at its upper end with a grill plate 64.

To quickly and easily build up the desired concentration in any room, or other enclosure, to be totally flooded, it is highly desirable to close all openings, such as doors and windows. The rooms disclosed in Figs. 2 and 3 are illustrated as being provided with fire doors, or the like, 65, 66, 67, and 68 for the doorways leading into the rooms R1 to R4, respectively. No detail features of construction of these doors are illustrated, but it is to be understood that they should take the form of gravity closed doors that are retained in their open positions until it becomes necessary to extinguish a fire in the rooms with which they are associated. These doors are retained in their open positions by solenoid controlled latch mechanisms 69. The circuits for these latch mechanisms will be described at a later point. It is to be understood that similar automatic control mechanism may be associated with the various windows 70 of the several rooms if desired.

When the fireman approaches the control panel 23 of the building 20, in response to a fire alarm, it is highly desirable that he be able to quickly determine just which room or rooms should be flooded for the purpose of extinguishing fires. To accomplish this desired result, the control panel board 25 is provided with an annunciator opening 71 for each one of the valve handles 42 to 45, inclusive. Operatively associated with each one of these openings 71 is an annunciator drop 72 which has printed thereon the word "Fire." In Fig. 4, the annunciator drops 72 for the control handles 43 and 45 are in position in front of the openings 71 and indicate to the fireman that these two valve handles should be manipulated to feed the low temperature, low pressure liquid carbon dioxide to the two rooms under the control of the valves manipulated by these two handles. Fig. 14 discloses diagrammatically one of these annunciator drops 72 arranged in its normal position in which it is out of register with the annunciator opening 71. The annunciator drop 72 is guided in its downward movement by the holder 73 which lies in back of the panel board 25. The armature 74 for the magnet 75 is provided with a latch pin 76 which enters an aperture in the annunciator drop 72 and retains this drop in its normal position until the magnet is actuated. The magnet circuit is closed by the heat detecting and responsive device 77 which is diagrammatically illustrated in Fig. 14.

As it requires a predetermined amount of carbon dioxide to totally flood a room of a given size, it is desirable to be able to shut off the feeding of carbon dioxide to a room after the desired concentration has been obtained. Of course, it is possible to figure out just how many seconds it will require to totally flood a given room when the liquid carbon dioxide is discharged through a supply pipe of a given diameter, if the liquid carbon dioxide is coming from a source of supply maintained at a predetermined temperature. It is impossible to predetermine the rate of flow of liquid carbon dioxide if the pressure of the source of supply is not known or is allowed to fluctuate in response to changes in temperature of the surrounding atmosphere. That is one of the reasons why the source of supply maintained in the transport tank unit 21 is kept at a predetermined temperature and its corresponding vapor pressure.

To make certain that the feeding of liquid carbon dioxide to each one of the rooms R1 to R4 is shut off when the right amount of carbon dioxide has been discharged, each one of the carbon dioxide branch lines 30 to 33, inclusive, is provided with a shut off valve 77. These shut off valves are to be automatically closed by means of the weight mechanism illustrated in detail in Fig. 9. This mechanism includes a sector shaped arm or lever 78 which is suitably keyed to the valve shaft 79. A cable 80 is trained over the arm or lever 78 and is connected at its lower end to the weight 81. The weight is guided by a tubular holder 82 and is retained in its elevated position by means of a hinged bar 83. This bar is held in its weight supporting position by the armature 84 of an electric solenoid 85. When this solenoid is energized, the armature 84 is retracted and releases the bar 83. The weight drops until it strikes the bottom wall 86 of the tubular holder 82 and in this position the weight has functioned to rotate the valve carried by the stem 79 through 90 degrees, which may be from an open to a closed position as would be the case with the carbon dioxide shut off valve 77.

After a room has been totally flooded and the desired carbon dioxide concentration has been maintained for a length of time sufficient to completely extinguish the fire in the room and to cool all objects and surfaces below the ignition temperature of the combustible materials within the room, it becomes desirable to exhaust the carbon dioxide vapors from the room which has been flooded so that the firemen may safely enter the room to determine the extent of damage and to ascertain whether any glowing or smoldering embers remain which might cause rekindling of the fire.

To accomplish this desired result, the electric motor of the exhaust fan 53 should be started automatically and the appropriate branch line 57 to 60 placed in communication with its manifold pipe 55 or 56 and the main conduit 54 leading to the fan. The rooms not involved, however, should be kept isolated from the exhaust fan. Each one of the branch conduits 57 to 60, inclusive, is provided with a normally closed valve which is diagrammatically illustrated in Fig. 3. Thes various valves are opened when needed by the electrically controlled weight operating mechanism of Fig. 9. To identify these various exhaust valves in Fig. 3, the reference character 87 will be applied thereto.

To bring about the desired sequential operation of the carbon dioxide shut off valves, the closing of the fire doors, the energizing of the exhaust fan motor circuit, and the opening of the appropriate exhaust valves, a suitable, automatic timer mechanism is required. As the various rooms R1 to R4 are illustrated in Fig. 2 as being of different sizes, different amounts of carbon dioxide must be fed to the same to provide just the desired amount of concentration so that no carbon dioxide will be wasted. It is necessary, therefore, to provide a separate timer for each one of the four rooms. These timers will all be of the same general construction, and one

of the same is illustrated in detail in Figs. 10 to 12, inclusive.

The timer of these figures consists of an appropriate supporting base 88 which has mounted thereon a small electric motor 89 having an armature shaft 90 which is connected by speed reducing gearing 91 to a timer shaft 92. Although the gearing 91 may provide any degree of reduction desired, for the particular example to be considered, the reduction gearing 91 should be appropriate to drive the timer shaft 92 one complete revolution every twenty minutes. This timer shaft is suitably supported above the base 88 by means of brackets 93.

Fig. 12 discloses in detail the contours of five cams which are identified by the reference characters 94 to 98, inclusive. Legends appear under each one of these cam discs which designate the devices or instrumentalities to be controlled by the same.

Fig. 10 discloses these various cam discs 94 to 98, inclusive, mounted on the timer shaft 92. The mechanism employed for securing these cam discs to the timer shaft is illustrated in connection with the sectional disclosure of cam disc 94. This securing means will be described as follows:

The various cam discs are each provided with a central aperture 99 which fits the timer shaft 92. Diametrically arranged small apertures 100 also are provided in the several discs for receiving the pins 101 which are carried by the flanges 102 of the split sleeves 103 which are arranged on opposite sides of the cam disc. Clamping nuts 104 are threaded on the split sleeves 103 and function to compress or contract the sleeves into tight gripping engagement with the timer shaft 92. This mechanism will securely fasten the various timer discs to the timer shaft 92 so that the discs will rotate with the shaft.

Fig. 10 discloses a mercury switch element 104 for each one of the cam discs 94 to 98, inclusive. Fig. 11 discloses in detail the mounting for each one of these mercury switch elements.

Upstanding bracket arms 105 are connected to the supporting base 88 and carry a panel 106 formed of suitable insulating material. A bracket arm 107 is provided for each mercury switch element and is secured to the upper edge portion of the insulating panel 106. Each bracket arm 107 has pivoted thereto a lever arm 108 which has journaled at its outer end a roller 109 adapted to ride on the periphery of the particular cam disc employed for operating the mercury switch being considered.

Fig. 11 illustrates the cam disc 94 and its associated mercury switch 104. A mounting bracket 110 is suitably secured to the lever arm 108 and supports an insulating plate 111 which carries the mounting clips 112 for the mercury switch element 104. It will be appreciated that the weight of the elements 108, 110, 111, 112, and 104 will retain the roller 109 in contact with the periphery of its respective cam disc. When the rollers 109 are in engagement with the high parts of their cam discs, the mercury switch elements 104 are arranged or supported in open circuit positions. When the rollers 109, see the roller for disc 98 at the right of Fig. 12, are in engagement with the low portions of their cam discs, the mercury switch elements 104 are in their circuit closing positions. In Fig. 10 the four mercury switch elements 104, starting from the left and proceeding toward the right, are in their open circuit position while the remaining or fifth mercury switch element 104 is in its circuit closing position. In Fig. 12 the rollers 109 are arranged in the positions they normally assume during the idle periods of this timer mechanism or with the circuits open for the "fire door," the "CO_2 valve," the "exhaust valve," and the "blower." The mercury switch element 104 actuated by the timer cam disc 98 normally is in its circuit closing position.

The desired sequential operation of the various automatically controlled instrumentalities should not start until the firemen arrive on the scene and carbon dioxide is actually being delivered to the room to be flooded. Figs. 6 to 8, inclusive, disclose means employed for closing the circuit of the timer motor 89 as a result of starting the feeding of carbon dioxide through the desired branch line 30 to 33, inclusive. As this circuit controlling mechanism is duplicated for each of these carbon dioxide branch lines, a description of this mechanism in connection with line 33 will be sufficient for all of the lines.

Inserted at a suitable point in the branch line 33 is a tubular member 113 which has flanges 114 at its opposite ends that are suitably bolted, or otherwise secured to flanges 115 carried by sections of the line 33. It is to be understood that a tight, pressure joint should be provided between these two flanges to prevent loss of carbon dioxide when it is being discharged through the line 33. Figs. 7 and 8 disclose a blade 116 arranged in the bore of the tubular element 113. This blade is carried by a shaft 117 which is journaled in bearings 118. Suitable packing should be provided for the shaft 117 to prevent leakage of the carbon dioxide between the shaft and its supporting bearings 118. The projecting end portion 119 of the shaft 117 has mounted thereon a bracket 120 which carries an insulating plate 121 on which are mounted the clips 122 that support the mercury switch element 123. The element 123 is illustrated in Fig. 6 in its open circuit position. A stop 124 is carried by the tubular element 113 and functions to support the mercury switch element 123 in this open circuit position. When in this position, the blade 116 is arranged as disclosed in Figs. 7 and 8 in full lines and in Fig. 6 in dotted lines. A recess 125 is provided in the wall of the tubular element 113 to receive the blade 116 when it is moved through 90 degrees by the flow of liquid carbon dioxide through the element. When the blade 116 is moved into the recess 125, the mercury switch element 123 is moved into the dotted line position of Fig. 6 and closes the circuit to the timer motor 89. It will be explained in connection with the wiring diagram of Fig. 14 that the mercury switch element 123 and the mercury switch element 104 which is actuated by the cam disc 98 control the circuit for the timer motor 89. Normally the circuit is closed by the mercury switch element 104 and is opened by the mercury switch element 123. At the start of the feeding of carbon dioxide the circuit for the timer motor 89 is completely closed by the movement of the switch element 123 into its dotted line position of Fig. 6. After the timer motor has operated for a predetermined length of time, its circuit is broken by actuation of the mercury switch element 104 controlled by the cam disc 98.

Referring again to Fig. 12, it will be noted that the roller 109 for the fire door cam disc 94 will be allowed to drop into the low portion 125 promptly after the timer motor has started and the disc 94

rotates in the direction of the arrow applied thereto. The roller 109 of this disc 94 will remain in the low portion 125 for a sufficient interval of time of close the circuit for the solenoid 69 of the fire door latch mechanism which is controlled by the mercury switch element 104 operated by the cam disc 94. It is only necessary to retain the fire door solenoid 69 energized a sufficient length of time to unlatch the fire door. The door then moves by gravity into its closed position. As the roller 109 moves out of the low portion 125 of the cam disc 94 the circuit to the solenoid 69 is broken.

It will be considered that sufficient carbon dioxide will be fed through the branch line 33 into the room R4 in one minute, or 60 seconds to completely flood this room and bring the carbon dioxide concentration up to the value desired to extinguish the fire. The high part 126 of the cam disc 95 represents the movement of this disc, in the direction of its arrow, during the first 60 seconds of operation of the timer shaft 92. The roller 109 for the cam disc 95 then will drop into the low portion 127 of its disc. This movement of the roller 109 will cause the mercury switch element 104, which is actuated by the cam disc 95, to be moved into its circuit closing position. The circuit then will be closed for the solenoid 85 which controls the weight 81 that operates the carbon dioxide shut off valve 77 in the line 33. The feeding of carbon dioxide to room R4 then stops although the valve for this line which is manually controlled by the wheel 45 is still left open. As it only requires a momentary energization of the solenoid 85 to trip the weight 81, the roller 109 for the cam disc 95 again moves to the high part of the disc and remains on this high part until the timer motor again comes to rest.

In the illustrative example being given, it will be understood that maintaining the desired concentration in the room R4 for nine minutes after the feeding of carbon dioxide has stopped will be sufficient to effect complete extinguishment of the fire in this room. Therefore, ten minutes after the carbon dioxide is turned on it becomes desirable to open the exhaust valve 87 for room R4 and to close the circuit for the blower or exhaust fan 53. High portions 128 and 129 of cam discs 96 and 97 are intended to represent an elapsed period of ten minutes. After this time interval has elapsed, the rollers 109 for the cam discs 96 and 97, respectively, drop into the lower portions 130 and 131 of these two cams. The third and fourth mercury switch elements 104 then are moved into their circuit closing positions. The mercury switch element operated by the cam disc 96 closes the circuit to the solenoid 85 which controls the weight that operates the valve 87 in the exhaust branch conduit 60. Momentary energization of this exhaust valve solenoid 85 accomplishes the desired result and the circuit to this solenoid is again broken by the movement of the roller 109 back onto the high portion of the cam 96. It is necessary, however, to keep the blower operating approximately eight minutes to effect complete exhaustion of the carbon dioxide gas from the room R4. The lower portion 131 of cam disc 97, therefore, represents the elapse of eight minutes. The circuit to the blower or exhaust fan 53 is then broken by movement of the roller 109 back onto the high portion of cam disc 67.

During these eight minutes of operation, the roller 109 for the cam disc 98 has been traveling over the low portion 132 of this disc. After eight minutes, this roller is moved up onto the high portion 133 of this cam disc 98 with the result that the mercury switch element 104, at the right of Fig. 10, is moved into its circuit breaking position and the timer motor 89 is stopped. The timer mechanism remains in this condition until it is reset for further use.

It will be appreciated that a fireman now may enter room R4 to determine the extent of damage done by the fire and to ascertain whether the fire is completely extinguished. If any small localized fires or beds of glowing embers are found as a result of this inspection, final extinguishment can be accomplished by means of a portable hand extinguisher. If the fire has not been sufficiently extinguished to enable portable hand extinguishers to complete the work, it is possible to again feed carbon dioxide into the room by manually opening the valve 77 arranged in the branch line 33.

The above described operation has resulted in the extinguishment of the fire in the room R4. The control panel board 25 in Fig. 4 indicates that a fire, also, is burning in room R2. It was described above that the feeding of carbon dioxide to room R4 for 60 seconds provided the desired degree of concentration and the discharge was automatically stopped by actuation of the valve 77 in the branch line 33. The actuation of this carbon dioxide shut off valve 77 is indicated to the fireman by the actuation of the signal light 134 shown in Figs. 4 and 14. After the flow of carbon dioxide is stopped through the branch line 33, the fireman may open the valve in the branch line 31 by manipulating the valve control handle 43. The signal lights 134, therefore, prevent the fireman from unintentionally feeding carbon dioxide to two or more rooms at any one time, as this double feeding of carbon dioxide would destroy the accuracy of the timing mechanism.

The fireman also is advised when the exhaust valve for any room is opened and the exhaust motor is started by energization of the signal light 135 provided for each exhaust line. These signal lights 135 are illustrated in Figs. 4 and 14.

The wiring diagram disclosed in Fig. 14 is for the system illustrated in Figs. 1 to 12, inclusive. This wiring diagram now will be described.

The reference characters 134' and 135' designate the two main supply lines which may carry either 110 or 220 volts. This voltage will be stepped down by the transformer 136 to approximately 24 volts for the control circuit which includes the supply lines 137 and 138.

The first circuit to be closed is the one for the annunciator magnet 75 of the room or rooms in which the fire is burning. The branch wires 139 and 140 are connected to the control circuit supply wires 138 and 137, respectively, and lead to the magnet winding 75. The heat responsive, circuit closing device 77 is connected in series with the winding for the magnet 75 and is specifically in the branch line 139.

The next circuit to be energized is the control circuit for the timer motor 89. This control circuit includes the branch line 141 in which the mercury switch element 123 is interposed. This branch line 141 extends to and is connected with the winding for the solenoid 142 which operates the movable contact 143. The second side of the winding 142 is connected by a branch wire 144 with the mercury switch element 104 which is controlled by the cam disc 98. The control circuit for the switch solenoid coil 142 is completed by the branch line 145 which connects with the

control circuit supply line 138. The specific actuating circuit for the timer motor 89 includes a line 146 which is connected to the supply line 137 at one end and to the contact 147 at its other end. A second line extends from the second contact 148 to one brush of the timer motor 89. This second wire bears the reference character 149. The second brush of the timer motor is connected by the branch line 150 to the control circuit wire 138. When the solenoid coil 142 is energized, as a result of actuation of the mercury switch element 123, the switch formed by the elements 143, 147, and 148 is closed and the timer motor 89 started.

The next control circuit to be energized involves the solenoid 69 which controls the latch for the fire door of the room involved. This circuit includes the mercury switch element 104 which is controlled by the cam disc 94. One lead of this mercury switch element is connected to one terminal of the solenoid winding 69 and bears the reference character 151. The second terminal of this solenoid winding is connected by a branch line 152 with a common line 153 which extends to and is connected with the control circuit supply line 138. The remaining terminal of the mercury switch element 104 is connected by a branch wire 154 to a common line 155 which extends to and is connected with the control circuit supply line 137. Manipulation of the mercury switch element 104 connected in the circuit of the fire door solenoid 69 will make and break this circuit.

The next circuit to be closed controls the solenoid for the carbon dioxide shut off valve 77 in the line leading to the room involved. This control circuit includes the mercury switch element which is actuated by the cam disc 95. One side of this mercury switch element is connected by the wire 156 to the common line 155. The remaining branch line 157 for this circuit extends to and is connected with one terminal of the weight controlling solenoid 85. This branch line 157 has the signal light 134 in circuit therewith. The remaining side of the valve controlling solenoid 85 is connected by the wire 158 to the common wire 153.

The next circuit to be energized controls the solenoid 85 for the exhaust valve 87. This circuit includes the mercury switch element 104 which is controlled by the cam disc 96. A branch line 158 connects one side of this mercury switch element 104 to the common line 155. The branch line 159 connects the other side of the mercury switch element to one terminal of the solenoid 85 which controls the weight that actuates the exhaust valve. This wire 159 has the signal light 135 in its circuit. A branch line 160 connects the other terminal of this valve operating solenoid 85 to the common line 153.

The next circuit to be energized is the control circuit for the electric motor 161 which operates the blower or exhaust fan 53. This control circuit includes the mercury switch element 104 that is actuated by the cam disc 97. One side of this mercury switch element is connected by the branch line 162 with the common wire 55. The other side of the mercury switch element is connected by a wire 163 which leads to one terminal of the switch controlling solenoid coil 164. The remaining terminal of this winding 164 is connected by a wire 165 to the control circuit supply line 138. The blower or exhaust fan motor 161 is to be operated by the current of the main supply lines 134' and 135' and includes a wire 166 which extends to the main supply line 134'. A second wire 167 extends to the contact 168 of the switch controlling the blower motor circuit. A second contact 169 is connected by the line 170 with the main supply line 135'. When the cam disc 97 operates to move the mercury switch element 104 controlled by the same to close the circuit for the switch operating solenoid winding 164, the movable contact 171 is actuated or shifted to bridge between the stationary contacts 168 and 169 and the blower circuit is closed. The cam disc 97, after the lapse of a predetermined time interval, will actuate the mercury switch element 104 for breaking the circuit to the switch controlling winding 164 and the blower or exhaust fan motor 161 will be stopped.

Figs. 13 and 15 disclose a modified form of control system which is not automatic in its operation to the same extent as the system illustrated and described in connection with Figs. 1 to 12, inclusive, and 14. It is to be understood, however, that the control mechanism of Figs. 13 and 15 is applicable to the building structure disclosed in Figs. 1, 2, and 3.

This modified form of control includes a control panel 23a which is to be mounted in the exterior wall of a building, as disclosed in Figs. 1, 2, and 5. Branch lines 30a, 31a, 32a, and 33a are intended to lead to the rooms R1 to R4, respectively. These branch lines are connected to a manifold 29a and the connections are controlled by the valve operating wheels 42a, 43a, 44a, and 45a. A main pipe 26a is connected to the manifold 29a and is intended to have the hose line 22 of the transportation tank unit 21 connected thereto in the manner illustrated and described in connection with Figs. 1 and 5.

The supply pipe 26a has connected thereto a cylinder 174 by means of the tube 172. When liquid carbon dioxide is flowing through the pipe 26a, the manifold 29a, and one of the branch lines 30a to 33a, the carbon dioxide will build up a pressure in the cylinder 171 which will actuate the piston 172 to move the same against the pressure of the spring 173. The piston 172 has a piston rod 174 connected thereto and extending outside of the cylinder 171. A roller 175 is carried by the piston rod 174. When the carbon dioxide pressure moves the piston 172 longitudinally of the cylinder 171, the roller 175 will be moved to shift the switch blade 176 into engagement with the contact 177 of the switch 178.

By referring to Fig. 15, it will be seen that this switch 178 is connected in a line 179 which leads from the control circuit supply line 137a. This branch line 179 also leads to one brush of the timer motor 180. This motor is illustrated in dotted lines in Fig. 13. The other brush of this motor 180 is connected by a branch line 181 to the control circuit supply line 138a.

This pressure operated switch 178 also controls the circuit to solenoids 69a which operate the latching mechanisms for all of the fire doors 65 to 69, inclusive, see Fig. 2. The circuits for these fire door controlling solenoids include the branch lines 182 and 183 which, respectively, are connected to the branch line 179 of the switch 178 and the control circuit supply line 138a. Lead wires 184 and 185 connect the opposite terminals of the solenoid coils 69a to the lines 182 and 183.

Push button switches 186 and 187 are employed, respectively, for making and breaking the circuits to the carbon dioxide shut off valves 77 and the exhaust control valves 87. In other

words, these valves 77 and 87 are manually controlled by the push button switches 186 and 187. The circuit to the blower motor is manually controlled by the push button switch 188. It is to be understood that switches 186 and 187 are duplicated for each one of the rooms R1 to R4 while a single switch 188 is employed for controlling the circuit to the blower or exhaust fan motor 161a, see Fig. 15. Furthermore, the pressure of the carbon dioxide flowing through one of the branch lines 30a to 33a automatically functions to start the timing motor 180 and to close all of the fire doors.

The timing motor 180 is employed to operate mechanism which will indicate to the fireman the elapse of time so that he can manually control the feeding of carbon dioxide to the involved rooms and control the exhausting of the carbon dioxide vapors from said rooms. Although not shown, a plate may be provided on the panel board 25a of the control panel 23a which will bear the necessary instructions for the fireman to enable him to feed the right amount of carbon dioxide to each room, etc.

For denoting the lapse of time, the timer motor 180 has an armature shaft 189 which drives a disc 190 located in back of the panel board 25a. The panel board has windows 191 and 192 formed therein. The timer motor driven disc 190 is provided with four slots or openings 193 which are adapted to register with the window 192 in the panel board 25a. The timer motor driven disc 190 also is provided with a slot 195 which is adapted to register with the panel board window 191. Electric signal lights 196 and 197 are located in back of the disc 190 and in alignment with the windows 191 and 192. The timer motor 180 should be of such a construction as to rotate the disc 190 a single complete revolution in 60 seconds or one minute. It will be appreciated, therefore, that the passage of the slot 195 between the signal light 196 and the window 191 will occur once every minute. The slots 193, however, will pass between the signal light 197 and the window 192 every fifteen seconds. The fireman, by watching the signals through the windows 191 and 192 can determine the passage of time in minute and 15 second intervals and in this way can properly time the feeding of carbon dioxide and the exhausting of the carbon dioxide vapors. When the source of supply of liquid carbon dioxide under pressure is disconnected from the pipe 26a, the pressure within the cylinder 171 will drop and the switch 178 may be opened, either manually or by means of a spring device, not shown.

Fig. 15 will be further referred to in connection with the circuits for the push button switches 186, 187, and 188. The carbon dioxide shut off valve and the exhaust valve push button switches 186 and 187, respectively, have in their circuits solenoids 85, see Fig. 9. One terminal of the solenoid 85 in the circuit of the switch 186 is connected by the wire 198 to the control circuit supply line 138a. The other side of this solenoid is connected by the wire 199 to the terminal 200 of the switch 186. The remaining terminal 201 is connected by the wire 202 to a wire 203 which extends to and is connected with the control current supply line 157a. The solenoid 85 for the switch 187 is connected to the wire 198 by a branch wire 204. The second side of this solenoid coil 85 is connected by a wire 205 to the terminal 206 of the switch 187. The second terminal or contact 207 of this switch is connected by the wire 208 to the wire 203.

The control circuit supply lines 137a and 138a are supplied with a current of approximately 24 volts by means of the transformer 136a which receives its current from the main supply lines 134a and 135a.

The blower motor 161a is to be operated from the main supply lines 134a and 135a. A line 209 leads from one brush of this blower motor to the main supply line 134a. A second wire 210 leads from the second brush of the motor 161a to the terminal 211 of a switch which includes a second terminal 212 that is connected by the wire 213 to the main supply line 135a. A movable contact 214 is adapted to be moved into and out of circuit closing position with respect to the stationary contacts 211 and 212 by energization of the solenoid coil 215. One side of this coil is connected by the wire 216 to the control circuit supply line 137a. The second side of this solenoid coil 215 is connected by the wire 217 to the terminal 218 of the push button or switch 188. The second terminal 219 of this switch is connected by the wire 220 to the control circuit supply line 138a.

Although Figs. 13 and 15 do not disclose annunciator drops and their circuits for the various carbon dioxide feeding branch lines 30a to 33a and the rooms R1 to R4 to which these branch lines extend, it is to be understood that annunciators of the type illustrated in Figs. 4 and 14 may be provided if desired.

It is to be understood that the forms of this invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, I claim:

1. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, a normally closed manual valve in each line for starting the flow of carbon dioxide therethrough, a normally open power operated valve in each line for stopping the flow, timer means set in motion as a result of opening of the manual valve for causing the power operated valve to close after the lapse of a predetermined time interval, discharge means connected to each one of said pipe lines and arranged to discharge into the room to which the pipe line extends, and means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which the fire is burning to effect the complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge.

2. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, a manual valve in each line for starting the flow of carbon dioxide therethrough, a power operated valve in each line for stopping the flow after the lapse of a predetermined time interval, motor driven timer mechanism for measuring the lapse of time for said power operated valve,

discharge means connected to each one of said pipe lines and arranged to discharge into the room to which its pipe line extends, and means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which a fire is burning to effect complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge means.

3. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, a manual valve in each line for starting the flow of carbon dioxide therethrough, a power operated valve in each line for stopping the flow after the lapse of a predetermined time interval, motor driven timer mechanism for measuring the lapse of time for said power operated valve, a discharge nozzle connected to each one of said pipe lines and arranged to discharge into the room to which its pipe line extends, means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which a fire is burning to effect complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge nozzle, and means under the control of the timer mechanism for exhausting the carbon dioxide vapors from said room after extinguishment of the fire.

4. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, control valve means in each line for starting and stopping the flow of carbon dioxide therethrough, timer mechanism for causing the flow stopping operation of the control valve means to occur after a predetermined amount of carbon dioxide has passed through the line, a discharge nozzle connected to each one of said pipe lines and arranged to discharge into the room to which its pipe line leads, means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which a fire is burning to effect complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge nozzle, and means under the control of the timer mechanism for exhausting the carbon dioxide vapors from said room after extinguishment of the fire, said exhaust means including a blower, and conduits extending from the intake of the blower to the several rooms.

5. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, power driven timer means, control valve means in each line for starting and stopping the flow of carbon dioxide therethrough with the valve means being under the control of the timer means for its flow stopping operation, a discharge nozzle connected to each one of said pipe lines and arranged to discharge into the room to which its pipe line leads, means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which a fire is burning to effect complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge nozzle, and means under the control of the timer means for exhausting the carbon dioxide vapors from said room after extinguishment of the fire, said exhaust means including a blower, conduits extending from the intake of the blower to the several rooms, and valve means in each conduit for controlling the exhausting of carbon dioxide vapors therethrough.

6. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be provided with fire protection, of a piping system including pipe lines extending from a common point exterior of the building to each one of said rooms, control valve means in each line for starting and stopping the flow of carbon dioxide therethrough, a discharge nozzle connected to each one of said pipe lines and arranged to discharge into the room to which its pipe line leads, means for connecting a mobile source of supply of carbon dioxide to the pipe line leading to the room in which a fire is burning to effect complete flooding of the room with carbon dioxide vapors moved under their own pressure through the single pipe line and its discharge nozzle, means for exhausting the carbon dioxide vapors from said room after extinguishment of the fire, said exhaust means including a blower, conduits extending from the intake of the blower to the several rooms, valve means in each conduit for controlling the passage of carbon dioxide vapors therethrough, and timer mechanism for automatically controlling the operation of the conduit valve means and for starting and stopping the blower.

7. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a motor driven timer device, means actuated by carbon dioxide in the piping system for starting the timer device, and means for stopping the feeding of carbon dioxide to the room being flooded after the operation of the timer device for a predetermined length of time.

8. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a motor driven timer device, means actuated by carbon dioxide in the piping system for starting the timer device, a weight operated valve for stopping the feeding of carbon dioxide to the room

being flooded, and means actuated in response to operation of the timer device for releasing the weight to effect closing of the valve.

9. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a motor driven timer device, means actuated by carbon dioxide in the piping system for starting the timer device, a weight operated valve for stopping the feeding of carbon dioxide to the room being flooded, and electrical means controlled from the said panel for releasing the weight to effect closing of the valve after the timer device has operated for a predetermined length of time.

10. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of a fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a carbon dioxide vapor exhausting system including a motor driven blower, piping leading from each room to the intake of the blower, and a separate valve for each room to control the exhausting of the vapors by the blower; a motor driven timer device, means actuated by carbon dioxide in its piping system for starting the timer device, means for stopping the feeding of carbon dioxide to the room being flooded after the timer device has operated for a predetermined length of time, and means for operating the exhaust valve to the flooded room and starting the blower after the timer device has operated for a predetermined length of time beyond the stopping of the feeding of carbon dioxide.

11. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a carbon dioxide vapor exhausting system including a motor driven blower, piping leading from each room to the intake of the blower, and a separate valve for each room to control the exhausting of the vapors by the blower; a motor driven timer device, means actuated by carbon dioxide in its piping system for starting the timer device, a weight operated valve for stopping the feeding of carbon dioxide to the room being flooded, means actuated in response to operation of the timer device for releasing the weight to effect the closing of the valve, and means for opening the exhaust valve to the flooded room and for starting the blower after the timer device has operated for a predetermined length of time beyond the stopping of the feeding of carbon dioxide.

12. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a carbon dioxide vapor exhausting system including a motor driven blower, piping leading from each room to the intake of the blower, and a separate valve for each room to control the exhausting of the vapors by the blower, a motor driven timer device, means actuated by carbon dioxide in its piping system for starting the timer device, a weight operated valve for stopping the feeding of carbon dioxide into the room being flooded, electrical means controlled from the said panel for releasing the weight to effect closing of the valve after the timer device has operated for a predetermined length of time, and means for opening the exhaust valve to the flooded room and for starting the blower after the timer device has operated for a predetermined length of time beyond the stopping of the feeding of carbon dioxide.

13. Carbon dioxide fire extinguishing apparatus of the type described, comprising the combination with a building having several rooms to be independently flooded with carbon dioxide vapors in the event of fire, of a piping system leading from a control panel in an exterior wall of the building to each one of said rooms, means at the control panel for connecting a mobile source of supply of liquid carbon dioxide to said piping system, a separate valve for each room to start the feeding of carbon dioxide thereto, a nozzle discharging a mixture of vapor and snow into each room from the piping system, a carbon dioxide vapor exhausting system including a motor driven blower, piping leading from each room to the intake of the blower, and a separate valve for each room to control the exhausting of the vapors by the blower; a motor driven timer device, means actuated by carbon dioxide in its piping system for starting the timer device, a weight operated valve for stopping the feeding of carbon dioxide to the room being flooded, means actuated in response to operation of the timer device for releasing the weight to effect closing of the valve, a weight for opening the exhaust valve to the flooded room, control means for starting and stopping the blower motor, and means actuated in response to operation of the timer device for releasing the weight for the exhaust valve to effect opening of said valve and for effecting operation of the control means for the blower motor.

14. Carbon dioxide fire extinguishing apparatus of the type described, comprising a building having an enclosed space to be flooded with carbon dioxide in the event of fire, a pipe line leading from the exterior of the building to the enclosed space, means located exteriorly of the

building for connecting a mobile source of supply of carbon dioxide to said pipe line, a valve in the pipe line for starting the feeding of carbon dioxide therethrough into the enclosed space, discharge means at the enclosure end of the pipe line for releasing the carbon dioxide into the space, and means set in motion at the time carbon dioxide starts flowing through the pipe line for permitting delivery of a sufficient quantity of carbon dioxide to the enclosed space to produce the desired fire extinguishing concentration and for then stopping said delivery.

15. Carbon dioxide fire extinguishing apparatus of the type described, comprising a building having two or more rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from the exterior of the building to each one of said rooms, means at the exterior extremity of the piping system for connecting a mobile source of supply of carbon dioxide to the system, valve means for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide discharge means for each room connected to the piping system, means for stopping the feeding of carbon dioxide to the desired room, and means set in motion at the time carbon dioxide starts flowing to the desired room for effecting actuation of the feed stopping means after sufficient carbon dioxide has been delivered to the room to build up the desired fire extinguishing concentration.

16. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having two or more rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from the exterior of the building to each one of the rooms, means at the exterior extremity of the piping system for connecting a mobile source of supply of carbon dioxide to the system, valve means for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide discharge means for each room connected to the piping system, means for stopping the feeding of carbon dioxide to the desired room, carbon dioxide vapor exhausting means including a blower, a piping system leading from the intake of the blower to each one of said rooms, and valve means for selectively connecting the blower to the portion of the vapor exhausting piping leading to the desired room; and means set in motion at the time carbon dioxide starts flowing to the desired room for effecting actuation of the feed stopping means after sufficient carbon dioxide has been delivered to the room to build up the desired fire extinguishing concentration and for effecting operation of the carbon dioxide vapor exhausting means to withdraw the vapors from the flooded room after they have been permitted to remain therein for a predetermined length of time after feeding of carbon dioxide has stopped.

17. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having a plurality of rooms to be flooded with carbon dioxide in the event of fire, a piping system extending from the exterior of the building to each one of said rooms, means at the exterior extremity of the piping system for connecting a mobile source of supply of carbon dioxide to the system, valve means for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide discharge means for each room connected to the piping system, means at the exterior extremity of the piping system for indicating the room or rooms in which fire is burning, means for stopping the feeding of carbon dioxide to the desired room, and means set in motion at the time carbon dioxide starts flowing to the desired room for effecting actuation of the feed stopping means after sufficient carbon dioxide has been delivered to the room to build up the desired fire extinguishing concentration.

18. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having two or more rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from the exterior of the building to each one of said rooms, means at the exterior extremity of the piping system for connecting a mobile source of supply of carbon dioxide to the system, valve means for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide discharge means for each room connected to the piping system, means at the exterior extremity of the piping system for indicating the room or rooms in which fire is burning, means for stopping the feeding of carbon dioxide to the desired room, means set in motion at the time carbon dioxide starts flowing to the desired room for effecting actuation of the feed stopping means after sufficient carbon dioxide has been delivered to the room to build up the desired fire extinguishing concentration, and means at the exterior extremity of the carbon dioxide piping system for indicating when and in connection with which room carbon dioxide is being fed.

19. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having a plurality of rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from the exterior of the building to each one of said rooms, means at the exterior extremity of the piping system for connecting a mobile source of supply of carbon dioxide to the system, valve means for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide discharge means for each room connected to the piping system, means for stopping the feeding of carbon dioxide to the desired room, carbon dioxide vapor exhausting means including a blower, a piping system leading from the intake of the blower to each one of said rooms, and valve means for selectively connecting the blower to the portion of the vapor exhausting piping leading to the desired room; means set in motion at the time carbon dioxide starts flowing to the desired room for effecting actuation of the feed stopping means after sufficient carbon dioxide has been delivered to the room to build up the desired fire extinguishing concentration and for effecting operation of the carbon dioxide vapor exhausting means to withdraw the vapors from the flooded room after they have been permitted to remain therein for a predetermined length of time after feeding of carbon dioxide has stopped, and means at the exterior extremity of the carbon dioxide piping system for indicating when and in connection with which room carbon dioxide is being fed and vapors are being exhausted.

20. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having a plurality of rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from a control point at the exterior of the building to each one of said rooms, means at said control point for connecting a mobile source of supply of carbon dioxide to said piping system, valve means operable from said control point for selectively starting the feeding of car-

bon dioxide to the desired room, means visible from the control point for measuring the lapse of time, means for starting the operation of said time measuring means when carbon dioxide starts flowing through the system, and means operable from the control point for stopping the feeding of carbon dioxide to the desired room after said time measuring means has indicated the lapse of a predetermined time interval.

21. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having a plurality of rooms to be flooded with carbon dioxide in the event of fire, a piping system leading from a control point at the exterior of the building to each one of said rooms, means at said control point for connecting a mobile source of supply of carbon dioxide to said piping system, valve means operable from said control point for selectively starting the feeding of carbon dioxide to the desired room, carbon dioxide vapor exhausting means selectively connectable to each one of said rooms, means visible from the control point for measuring the lapse of time, means starting the operation of said time measuring means when carbon dioxide starts flowing through the system, means operable from the control point for stopping the feeding of carbon dioxide to the desired room after said time measuring means has indicated the lapse of a predetermined time interval, and means operable from the control point for starting operation of the vapor exhausting means and for connecting the desired room thereto after said time measuring means has indicated the lapse of a predetermined time interval following the stopping of the feed of carbon dioxide to the room.

22. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having a plurality of rooms to be flooded with carbon dioxide in the event of fire, a carbon dioxide piping system connectable to a source of supply and leading to each one of said rooms, said system including at least one discharge device for each room delivering carbon dioxide at a level close to the ceiling of the room, a carbon dioxide vapor exhausting system including a blower and piping leading from the intake of the blower to each one of said rooms with the connections to said rooms being located adjacent their floor levels, manually actuated means for starting the feeding of carbon dioxide to any one of said rooms, means for stopping the feeding of carbon dioxide, means for starting the blower of the exhausting system, means for connecting the flooded room to the blower through the proper exhaust piping, and timer means set in motion when the feeding of carbon dioxide is started for controlling and timing the sequence of operation of the last three mentioned means.

23. Carbon dioxide fire extinguishing apparatus of the type described comprising a building having two or more rooms to be flooded with carbon dioxide in the event of fire, a carbon dioxide piping system connectible to a source of supply and leading to each one of said rooms, said system including at least one discharge device for each room delivering carbon dioxide at a point close to the ceiling level, a carbon dioxide vapor exhausting system including a blower and piping leading from the intake of the blower to each of said rooms with the connections to said rooms being located adjacent their floor levels, means for starting the feeding of carbon dioxide to any desired one of said rooms, automatic means set in motion as a result of starting said feed for effecting stopping of the feeding of carbon dioxide after the selected room has been properly flooded, and means for effecting operation of said exhausting system to withdraw the vapors from said room or rooms after they have been left in a flooded condition for a predetermined length of time.

24. A carbon dioxide fire extinguishing system, comprising the combination with a property having several hazards to be provided with fire protection, of a piping system extending from a supply point relative to said property to each one of said hazards and including a pipe line for each hazard, valve means for starting the flow of carbon dioxide through the piping system to any selected one of said hazards, power operated valve means in each line for stopping the flow of carbon dioxide to the selected hazard after a predetermined amount of carbon dioxide has been delivered thereto, power operated timer means operable to limit the length of time carbon dioxide is delivered to the particular hazard involved to provide the predetermined amount and for then causing operation of the power operated valve for the hazard to stop the flow of carbon dioxide, discharge means connected to each one of said pipe lines and arranged to properly deliver the carbon dioxide passing therethrough to the hazard served thereby, and means for connecting a source of supply of carbon dioxide to the piping system at said supply point.

25. A carbon dioxide fire extinguishing system, comprising the combination with a property having several hazards to be provided with fire protection, of a piping system extending from a fixed supply point relative to said property to each one of said hazards and including a pipe line for each hazard, means for connecting a source of supply of carbon dioxide to the piping system at said supply point, valve means for starting the flow of carbon dioxide through the piping system to any selected one of said hazards, discharge means connected to each one of said pipe lines and arranged to properly deliver the carbon dioxide passing therethrough to the hazard served thereby, and time controlled means set in motion as a result of starting the operation of the system for permitting delivery of a sufficient quantity of carbon dioxide to the hazard to effect extinguishment of the fire and for then stopping said delivery.

26. A carbon dioxide fire extinguishing system, comprising a hazard to be provided with fire protection, a pipe line leading from a source of supply of carbon dioxide to said hazard, discharge means connected to the pipe line and arranged to properly deliver the carbon dioxide passing therethrough to the hazard, a valve in the pipe line for starting the feeding of carbon dioxide therethrough, and time controlled means set in motion as a result of starting operation of the system for permitting delivery of a sufficient quantity of carbon dioxide to the hazard to effect extinguishment of the fire and for then stopping said delivery.

ERIC GEERTZ.