

June 27, 1944.

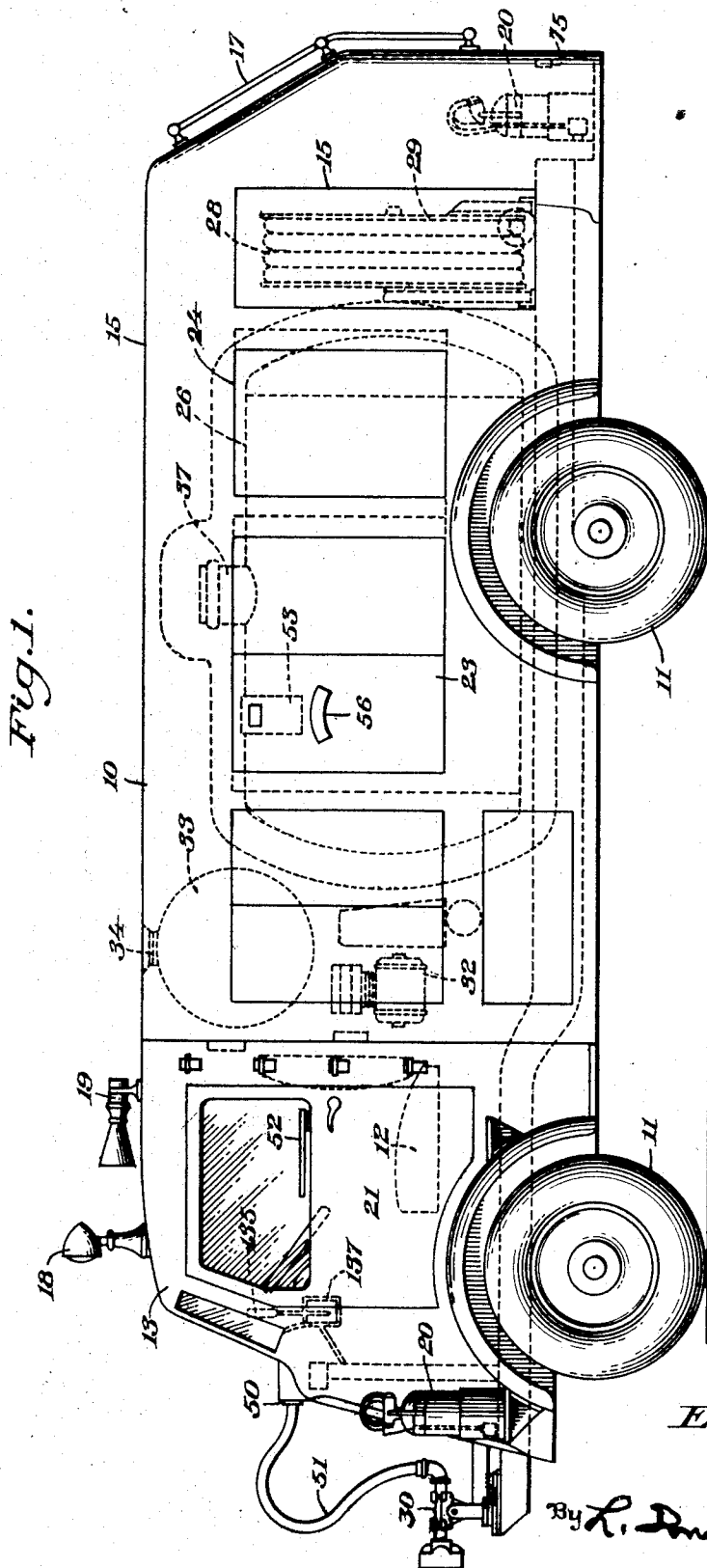
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2,352,379

MOBILE FIRE FIGHTING APPARATUS

Filed Aug. 14, 1941

11 Sheets-Sheet 1



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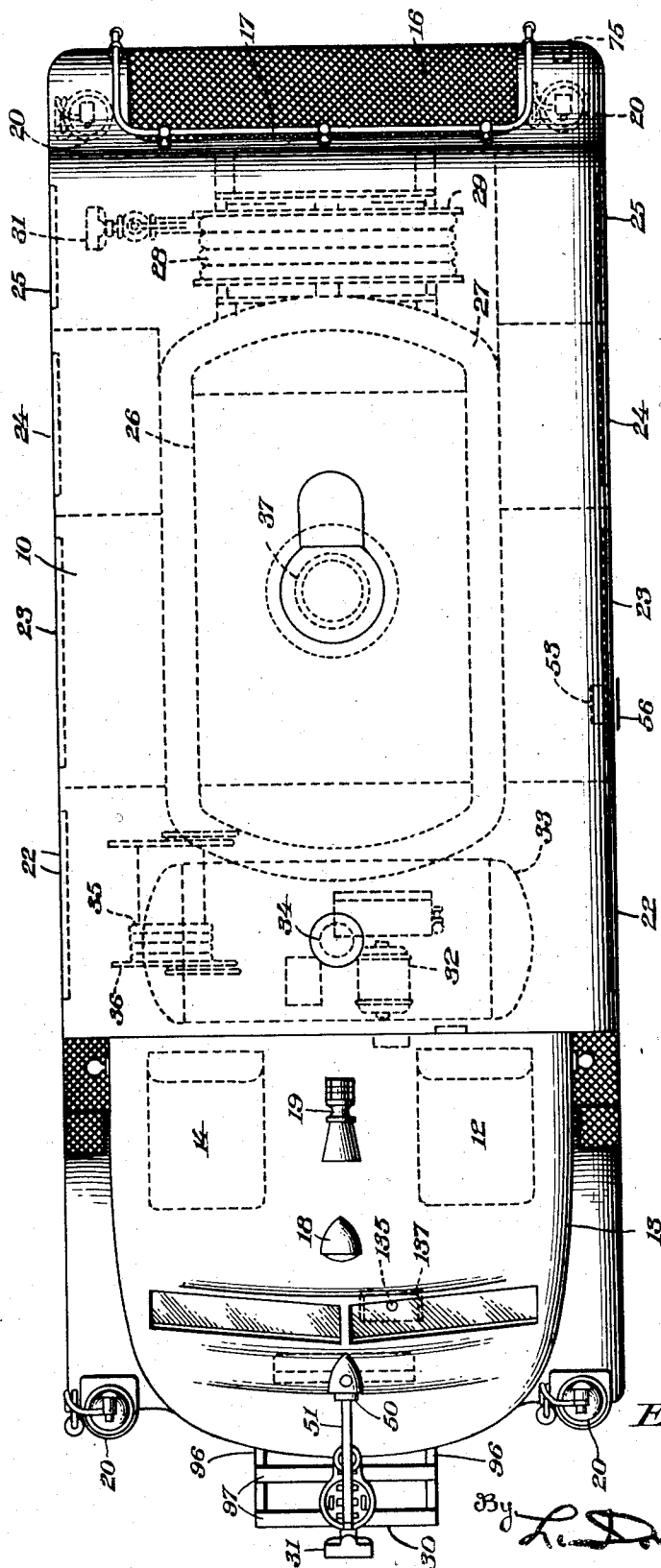
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MOBILE FIRE FIGHTING APPARATUS

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Fig. 2.



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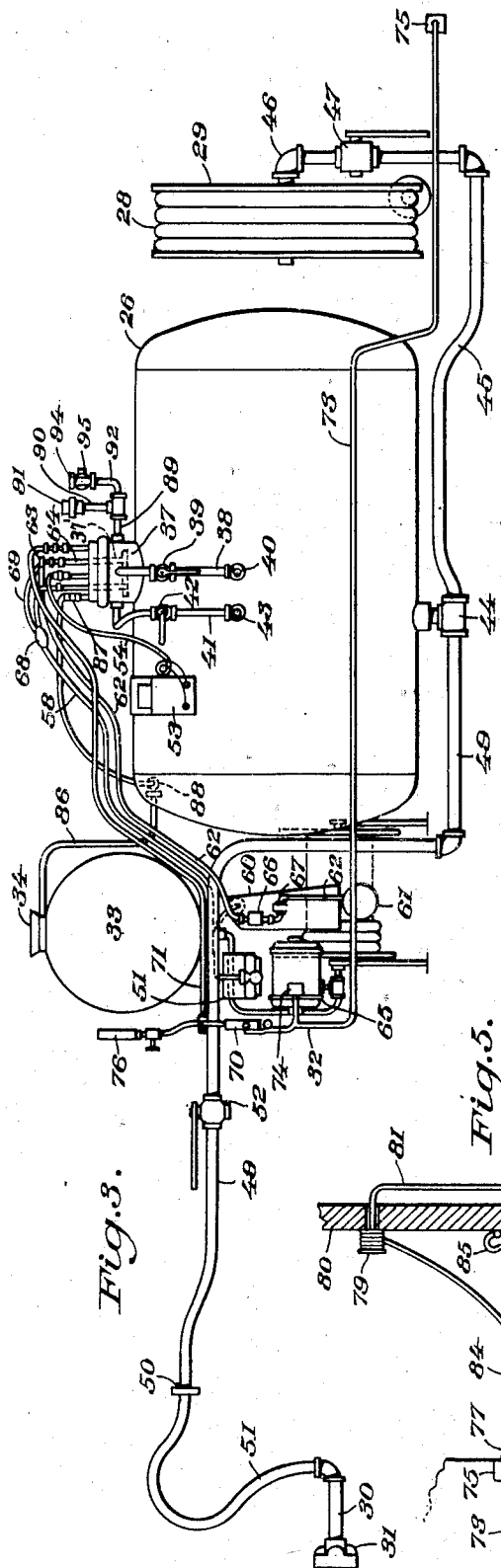
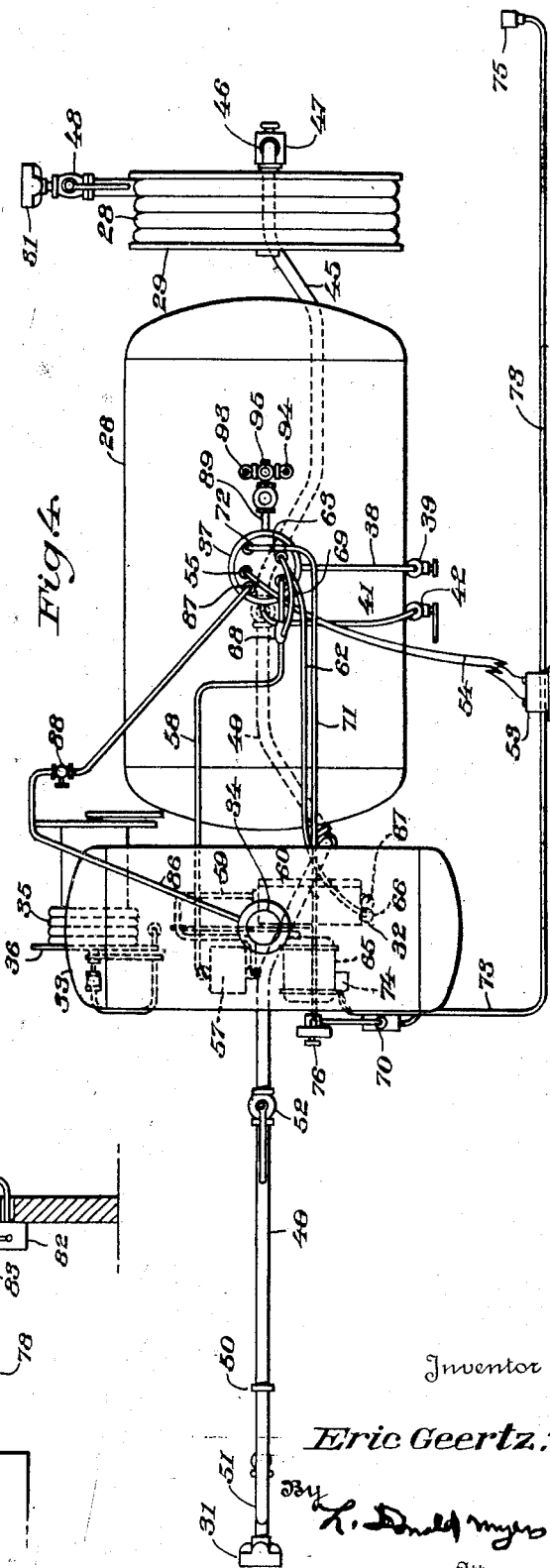
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MOBILE FIRE FIGHTING APPARATUS

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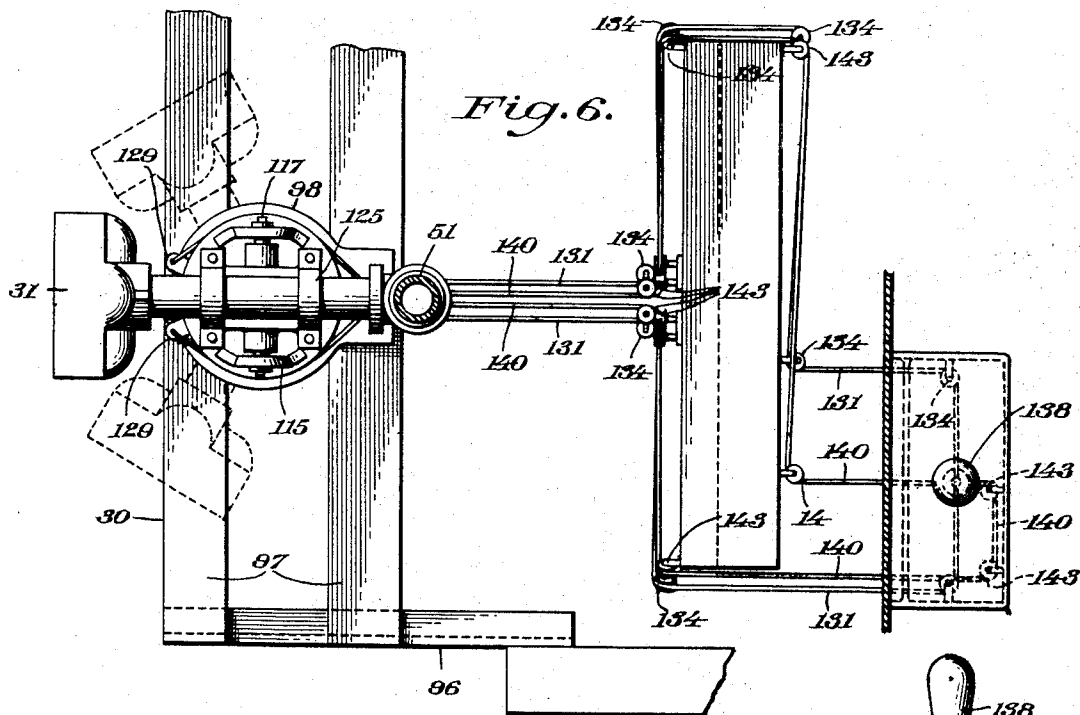
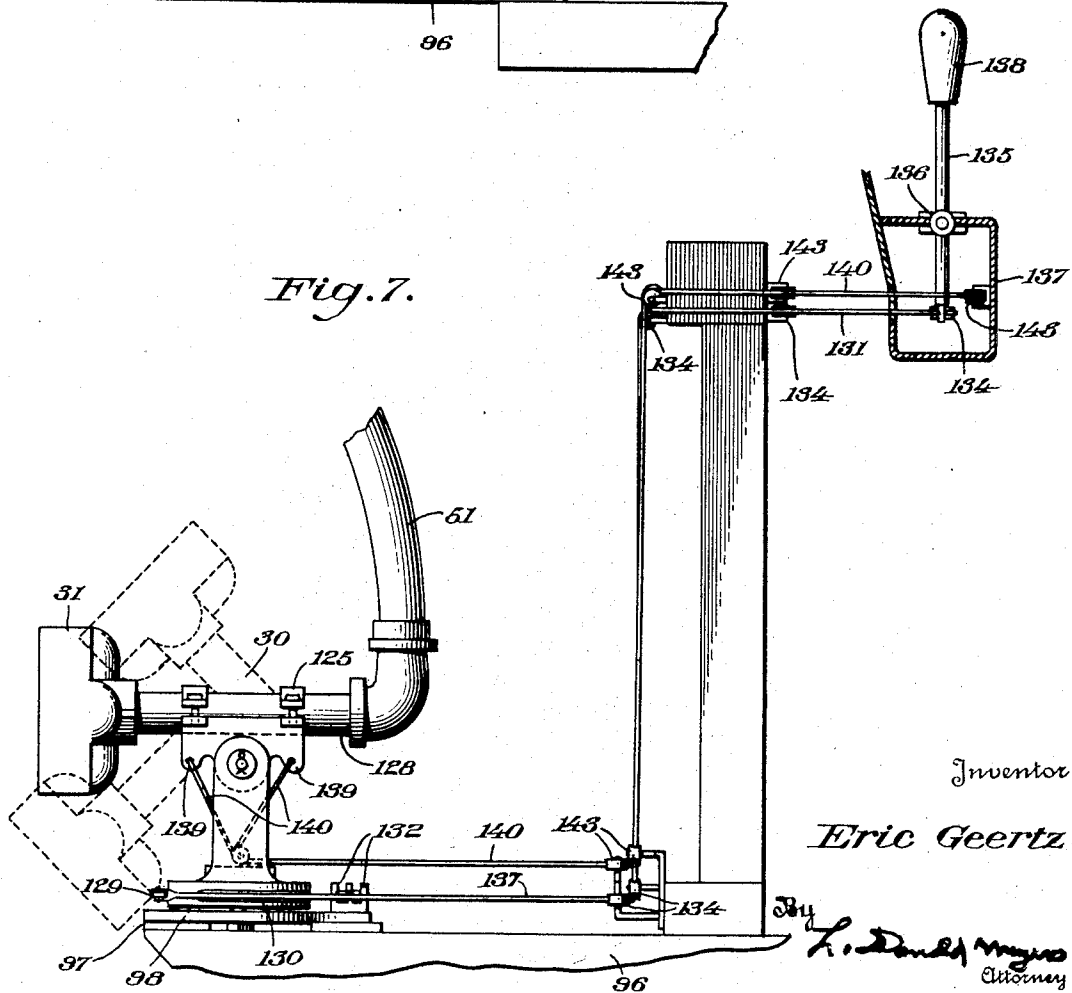


Fig. 7.



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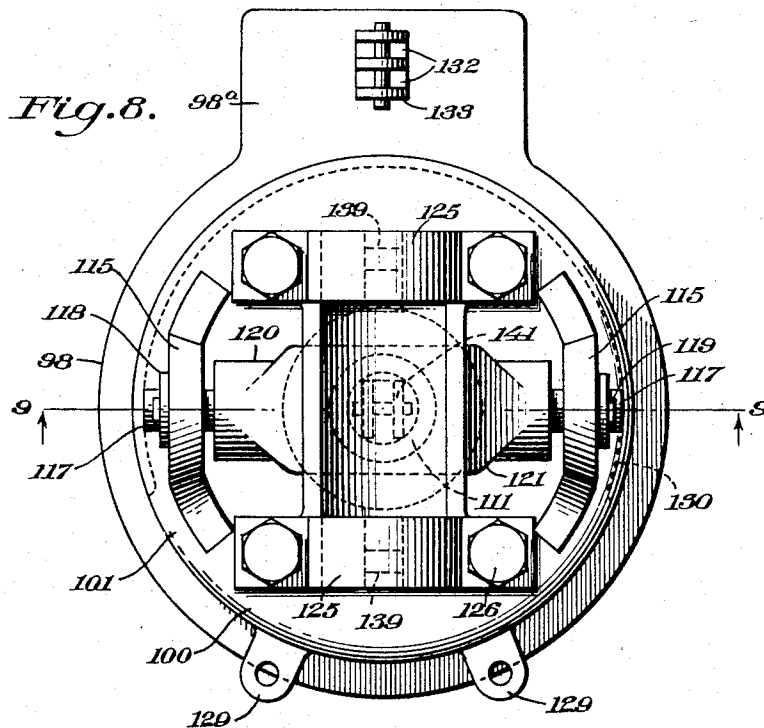
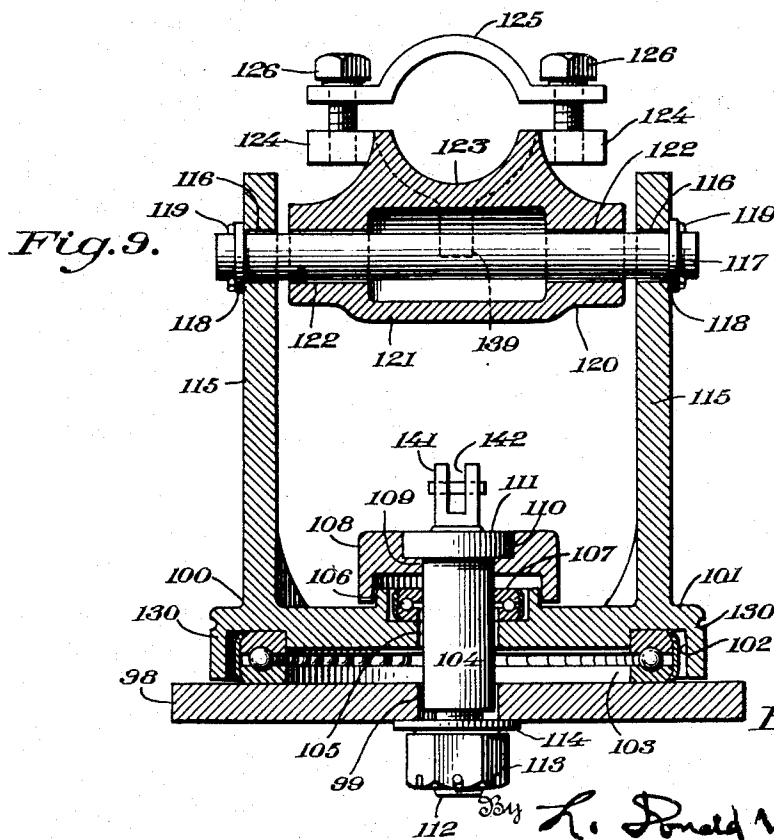
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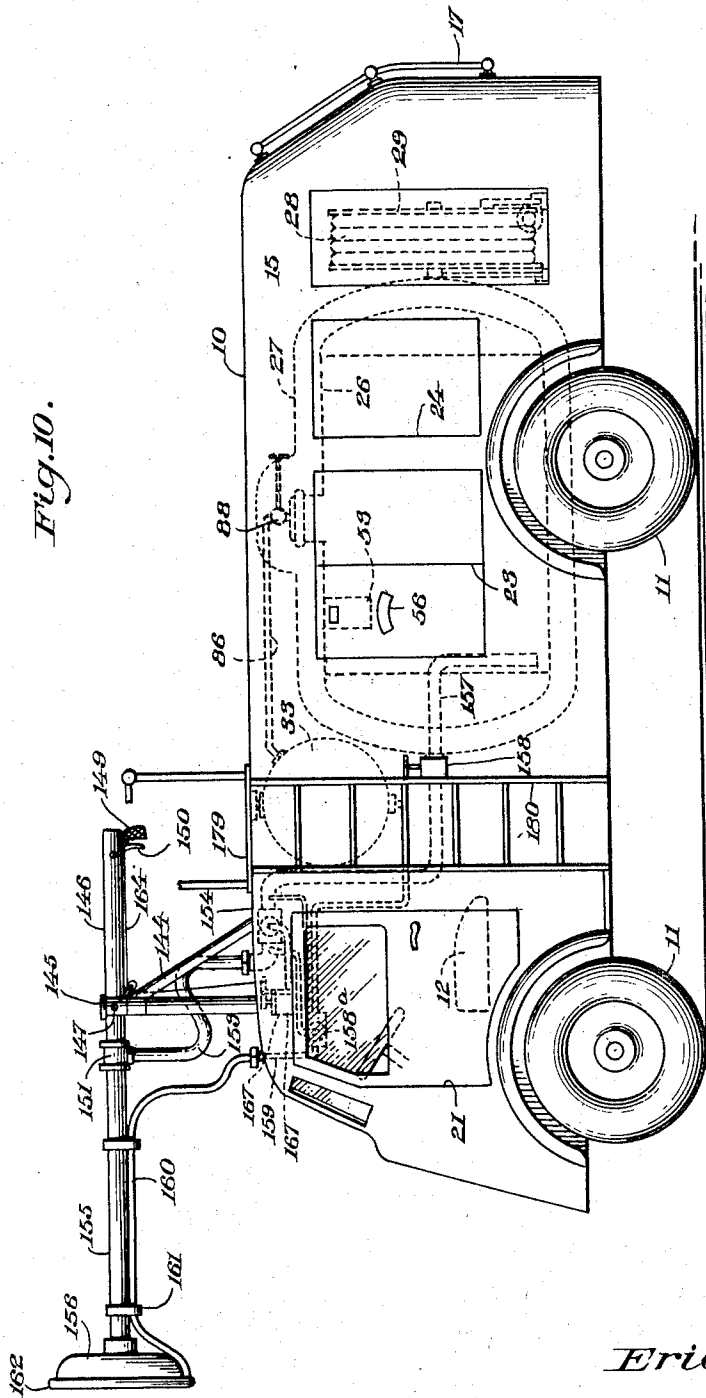
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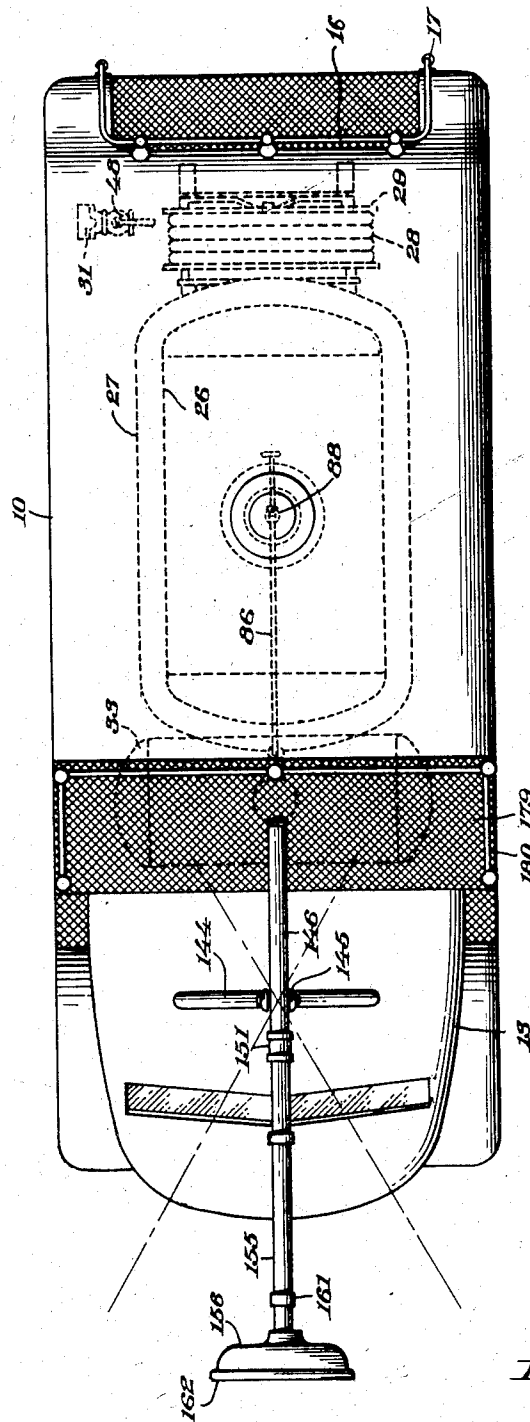
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MOBILE FIRE FIGHTING APPARATUS

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Fig. 11.



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MOBILE FIRE FIGHTING APPARATUS

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Fig. 13.

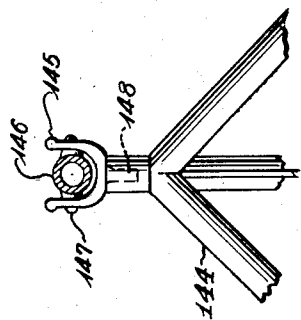


Fig. 12.

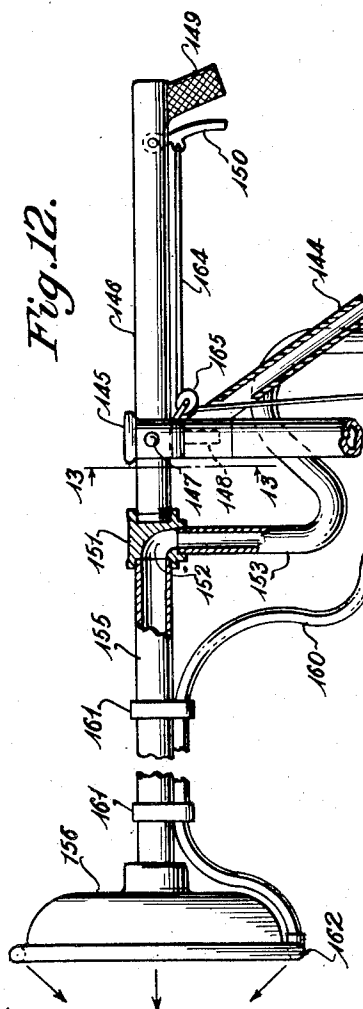
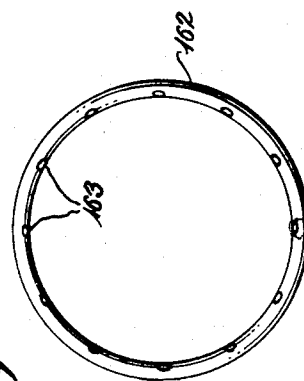
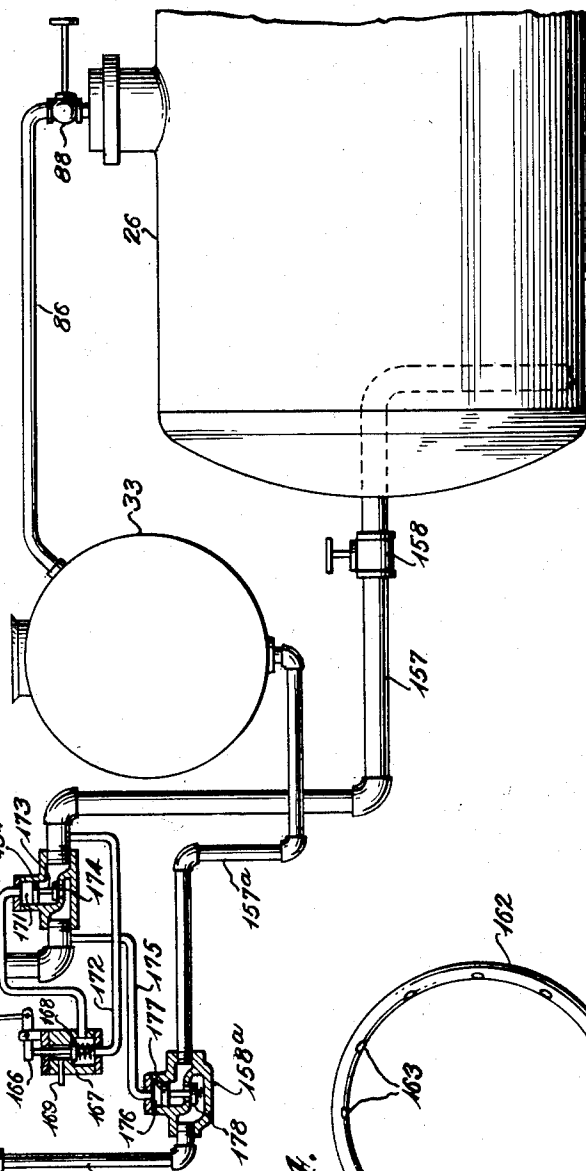


Fig. 14.



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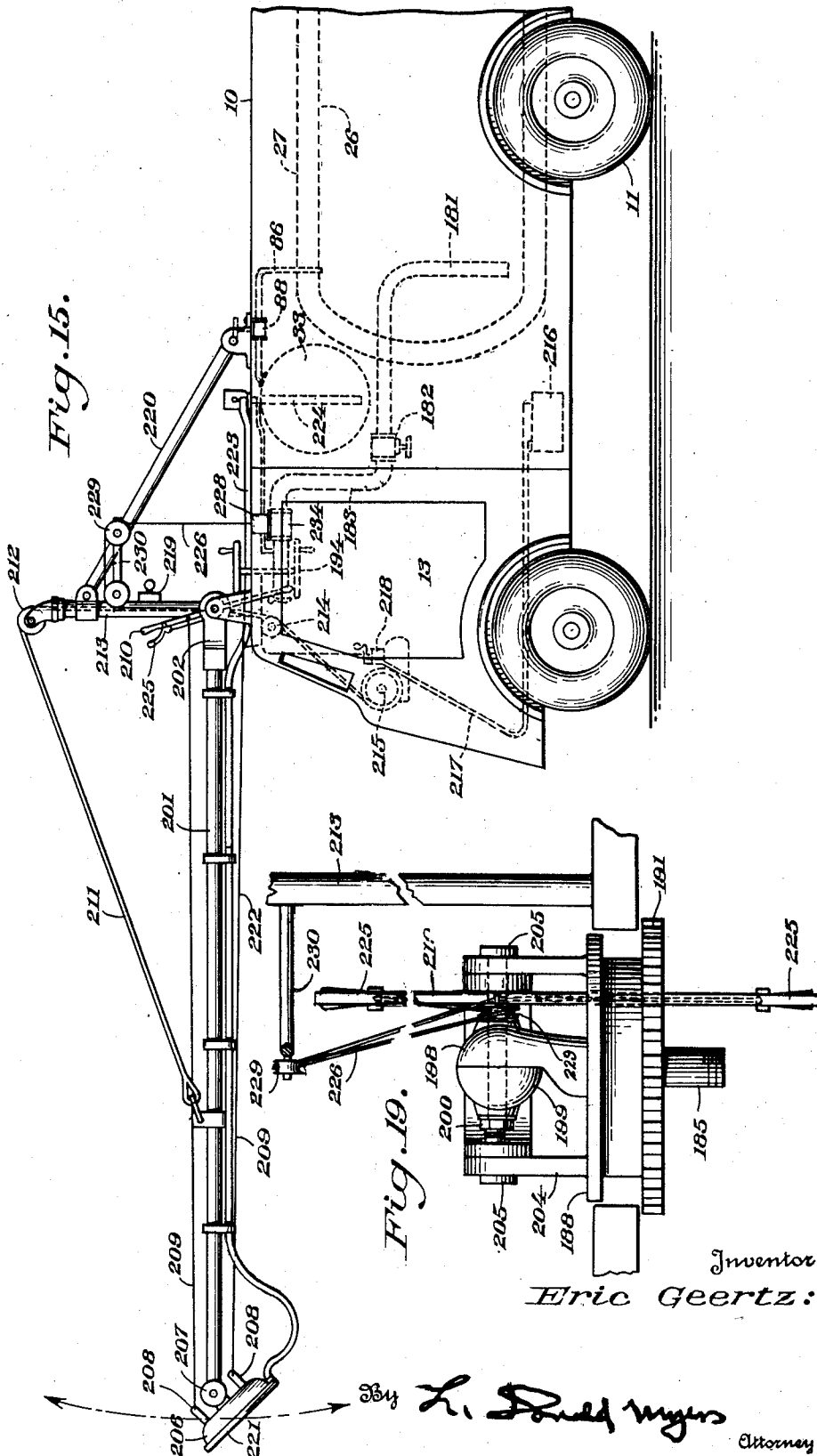
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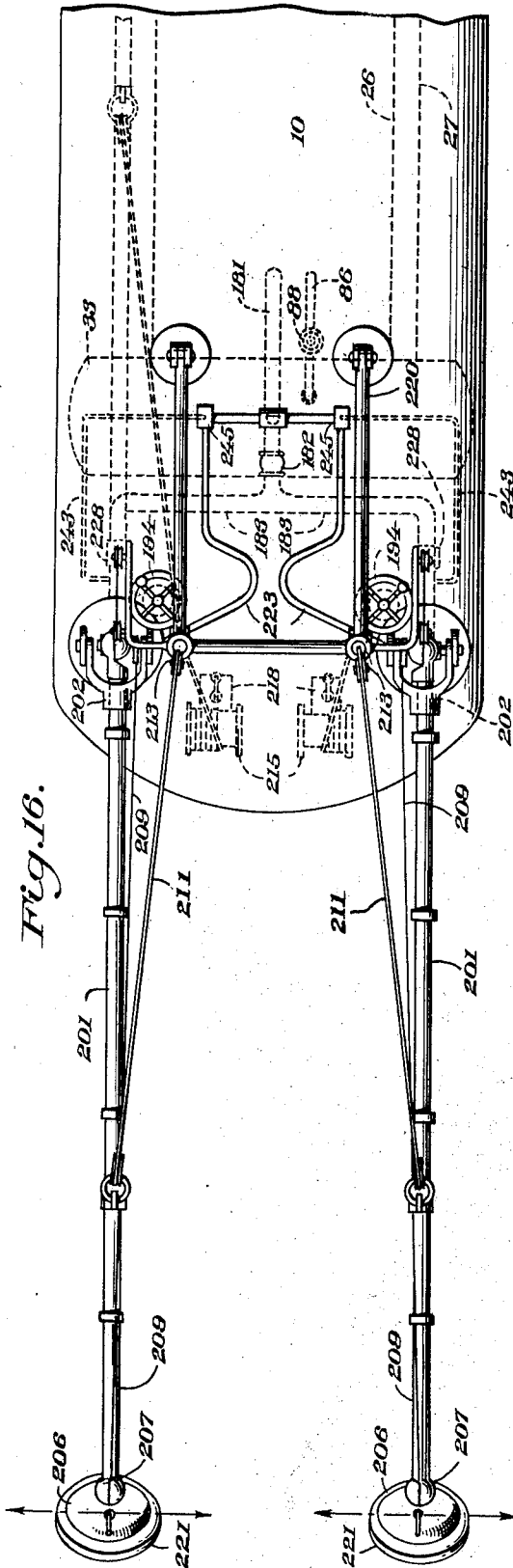
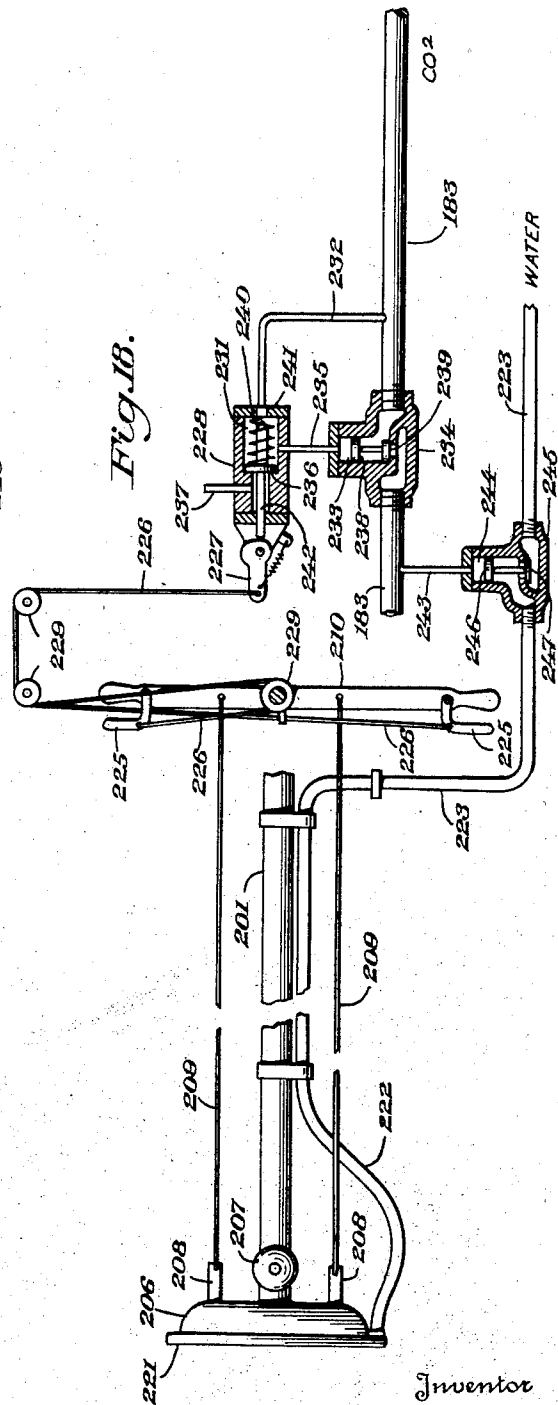
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11 Sheets-Sheet 10



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MOBILE FIRE FIGHTING APPARATUS

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Fig. 17.

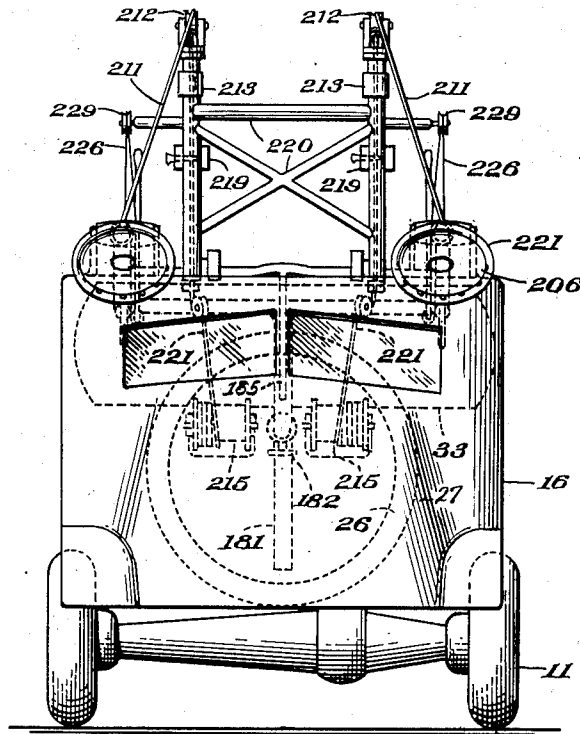


Fig. 20.

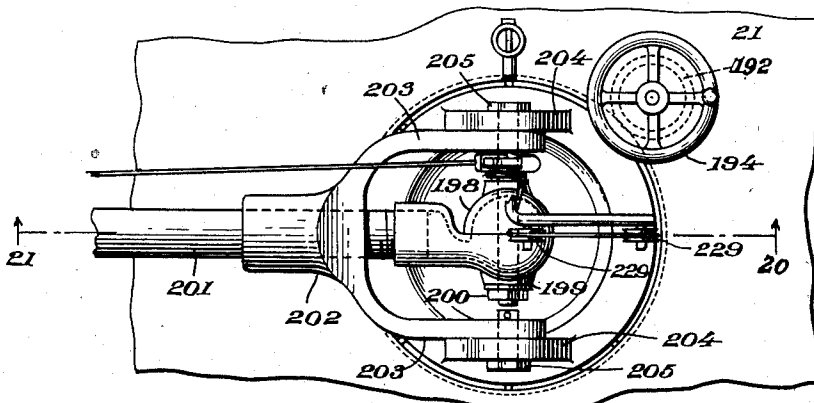
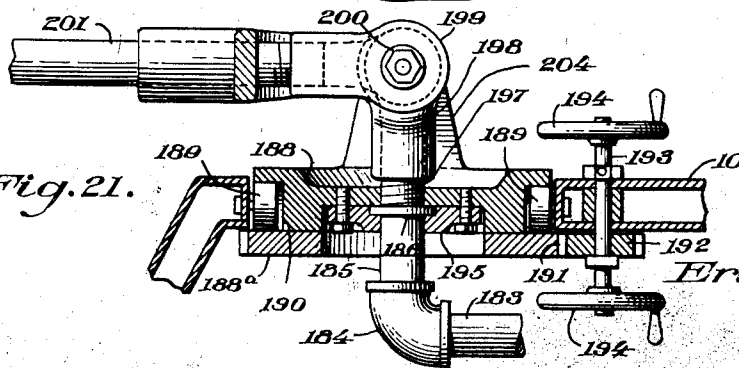


Fig. 21.



UNITED STATES PATENT OFFICE

2,352,379

MOBILE FIRE FIGHTING APPARATUS

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Application August 14, 1941, Serial No. 406,890

31 Claims. (Cl. 169—24)

This invention relates to new and useful improvements in mobile fire fighting apparatus.

This application is a continuation-in-part of my application Serial No. 263,301, filed March 21, 1939, for Mobile fire fighting apparatus, which in turn is a continuation-in-part of the application which has matured into Patent No. 2,202,343, issued May 28, 1940.

The primary object of this invention is to provide self propelled trucks which are so equipped as to adapt the same for use as self-contained, combined liquid carbon dioxide and water fire extinguishing apparatus. Due to the flexibility of the apparatus, they are especially adapted for use as fire and crash trucks at aviation flying fields and as fire trucks for storage yards of coal, lumber, grain, highly inflammable fluids, etc., and for manufacturing plants, freight yards, trash dumps, rural communities, and the like.

A further highly important object of the invention is to provide mobile fire fighting units which may be employed for transporting to the immediate vicinity of a fire a substantial volume of liquid carbon dioxide which has been maintained at a desired low temperature and corresponding vapor pressure awaiting use.

Another object of the invention is to provide mobile fire fighting units which, with the exception of being supplied with electricity from an external source while standing idle at their accustomed places of storage, are self-contained to the point of being able to discharge onto a fire, located either in the immediate vicinity of or at a considerable distance from said place of storage, a large quantity of liquid carbon dioxide confined at a temperature and its corresponding vapor pressure which may be any desired number of degrees below that of the surrounding atmosphere, so as to provide a type of discharge which will include a high percentage of snow, and/or a considerable quantity of water to be expelled by the vapor pressure of the carbon dioxide.

A still further object of this invention is to provide self propelled fire fighting units which are equipped to permit one operator to drive the unit to the scene of the fire and to direct a stream of carbon dioxide gas and snow onto and around the fire through a dirigible discharge nozzle without having to leave the position of the driver's seat.

Still another object of the invention is to provide mobile fire fighting units, which include equipment adapted to be supplied with electricity from a fixed source located at the accustomed places of storage for the units, with quick, self

breaking electric connections which will enable the units to be driven away from said places of storage without requiring previous attention or in any way damaging the connecting mechanism.

Another object of the invention is to provide mobile fire fighting units with one or more nozzles which are adapted for being manipulated from the driver's seat of the unit for varying the direction of discharge from the nozzles in both vertical and horizontal directions without necessitating moving the unit.

It is a still further object of the invention to provide mobile fire fighting units which are capable of carrying to the immediate vicinity of a fire a large quantity of low temperature and pressure liquid carbon dioxide and a considerable quantity of water to be expelled by the vapor pressure of the carbon dioxide and, by means of one or more suitable combination discharge devices and controls, effect simultaneous discharge of the same as mixtures of carbon dioxide snow and vapors and water particles with the result that the effectiveness of the low temperature carbon dioxide to extinguish certain types of fires will be improved, the amount of carbon dioxide required to effect extinguishment will be reduced, and the carrying and penetrating character of the low temperature carbon dioxide will be increased to a considerable extent beyond any values which can be obtained when the carbon dioxide constitutes the sole extinguishing medium discharged.

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 side elevational view of the mobile fire fighting unit embodying this invention,

Figure 2 is a top plan view of the unit illustrated in Fig. 1,

Figure 3 is a side elevational view of the fire extinguisher medium handling equipment for the unit disclosed in Figs. 1 and 2 with the remaining parts of the unit removed to better illustrate the fire extinguisher system,

Figure 4 is a top plan view of the mechanism disclosed in Fig. 3,

Figure 5 is a detail elevational view of electrical connecting mechanism employed for supplying certain elements of the unit with electricity and being designed to permit the unit to be driven away from the fixed source of supply without preliminary attention,

Figure 6 is an enlarged, detail plan view of a dirigible discharge nozzle, shown in Figs. 1 and 2 as being mounted on the front end of the fire fighting unit, with the manual control mechanism for the nozzle,

Figure 7 is a side elevational view of the mechanism disclosed in Fig. 6,

Figure 8 is a detail top plan view of the universal joint type of mounting mechanism for the dirigible nozzle of Figs. 6 and 7,

Figure 9 is a vertical sectional view taken on line 9—9 of Fig. 8,

Figure 10 is a side elevational view of a mobile fire fighting unit of the general type disclosed in detail in Figs. 1 to 4 inclusive but with a modified form of dirigible discharge apparatus mounted on the top of the vehicle body and manipulated and controlled by an operator located on a platform extending across the top of the vehicle body,

Figure 11 is a top plan view of the embodiment of the invention disclosed in Fig. 10,

Figure 12 is a diagrammatic view of the control mechanism of the discharge apparatus illustrated in Figs. 10 and 11,

Figure 13 is a detail vertical sectional view taken on line 13—13 of Fig. 12,

Figure 14 is a detail elevational view of a water discharge ring which forms an operative part of the discharge nozzle shown in Figs. 10 to 12 inclusive,

Figure 15 is a partial side elevational view of a mobile fire fighting unit of the general character illustrated in detail in Figs. 1 to 4 inclusive and illustrates a still further modified form of dirigible discharge mechanism which is mounted on the top of the vehicle body and which may be controlled from either the driver's cab or a location on the top of the body,

Figure 16 is a top plan view of the unit shown in Fig. 15,

Figure 17 is a partly front elevational view and partly diagrammatical view of the unit shown in Figs. 15 and 16 and is intended to more specifically illustrate the discharge mechanism,

Figure 18 is a diagrammatic view of the control mechanism for either one of the boom type of discharge devices disclosed in detail in Figs. 15 to 17 inclusive,

Figure 19 is a detail, elevational view of the swivel mounting employed for supporting one of the discharge booms illustrated in Figs. 15 to 17 inclusive,

Figure 20 is a detail top plan view of the swivel mechanism shown in Fig. 19, and

Figure 21 is a detail vertical sectional view taken on lines 21—21 of Fig. 20.

In the drawings, wherein for the purpose of illustration is shown one preferred embodiment of this invention, and particularly referring to Figs. 1 and 2, the reference character 10 designates in its entirety the body of a self propelled truck which is supported by the ground engaging wheels 11. While this unit is illustrated as being of a design best adapted for traveling over highways, and the like, it is to be understood that the unit may be provided with suitable rail engaging wheels so that it may be propelled along tracks and be a part of railway equipment. A suitable gasoline engine, or the like, not shown, is provided for the unit and is controlled by the driver occupying the seat 12 of the driver's compartment 13. An additional seat 14 may be provided in the compartment or cab 13 for a second fireman. The remainder of the body 10 takes the form of a suitable shell or sheathing 15 which

encloses the major portion of the fire fighting equipment. The rear end of the body 10 is provided with a step or platform 16 for additional firemen and a suitable hand rail 17 is carried by the body 10 for the convenience of the occupants of the step or platform 16.

As additional miscellaneous equipment, the unit is provided with a searchlight 18, a fire siren 19, a plurality of hand fire extinguisher units 20, doors 21 for the driver's cab 13, and doors 22, 23, 24, and 25 mounted in opposite sides of the shell or sheathing 15 to permit access to be had to the equipment housed by said shell.

Located within the shell 15 is a tank 26 which is adapted for receiving liquid carbon dioxide. This tank should be capable of storing two tons of carbon dioxide and should possess sufficient strength to confine the carbon dioxide at low pressures; for example, 500 pounds or 700 pounds per square inch, in view of certain devices which are included as a part of the equipment of the unit. This liquid carbon dioxide storage tank is completely enclosed in a heavy covering of insulating material 27 to prevent to the greatest extent possible the absorption of heat by the carbon dioxide stored within the tank. This storage tank and insulation covering assembly is arranged to extend longitudinally of the body 10 so as to be centered with respect to the width of the body and with its center of gravity located slightly in advance of the axle for the rear ground engaging wheels.

Liquid carbon dioxide is adapted to be dispensed from the storage tank 26 through the hose line 28 which is carried by a suitable reel 29 mounted within the shell 15 of the body in the space provided between the rear end of the tank 26 and the rear step or platform 16. The liquid carbon dioxide also may be discharged through the dirigible nozzle mechanism designated in its entirety by the reference character 30 and located at the front end of the body 10. The hose line 28 and the dirigible nozzle mechanism 30 are each provided with a suitable discharge head or nozzle tip 31. These discharge heads or nozzle tips may be of any desired form just so they are capable of creating sufficient back pressure in the lines leading to the heads from the storage tank to prevent the pressure of the liquid carbon dioxide from dropping to the value where the carbon dioxide will solidify, approximately 75 pounds per square inch; to bring about a sufficient drop in pressure within the discharge heads or nozzle tips to convert the carbon dioxide to a mixture of gas and snow, and to actually expel or project the mixture into the atmosphere at a desired velocity. Discharge heads or nozzle tips suitable for accomplishing these desired results are disclosed in my Patent No. 2,238,693, issued April 15, 1941, and in the patent of Harry Ensminger, No. 2,289,352, issued July 14, 1942.

Access to the reel 29 with its hose line 28 may be had through the opposite side doors 25 of the body shell or housing 15. It will be appreciated that the discharge head 31 and the hose line 28 may be pulled out through either side opening closed by the doors 25.

A mechanical refrigerating unit, designated in its entirety by the reference character 32, is arranged in the space between the front end of the carbon dioxide storage tank 26 and the driver's compartment 13. This refrigerator unit, as will be fully explained at a later point, is employed for automatically maintaining the temperature of the liquid carbon dioxide stored within the

tank 26 at any desired value below that of normal room or atmospheric temperature. The advantages of employing liquid carbon dioxide, maintained at a sub-atmospheric temperature and its corresponding vapor pressure, as a fire extinguishing medium, are fully disclosed in my Patent No. 2,143,311, issued January 10, 1939. Briefly stated, the use of liquid carbon dioxide maintained at a sub-atmospheric temperature and pressure produces a much higher percentage of yield of snow when discharged to the atmosphere than is possible with carbon dioxide stored at the higher temperature of the surrounding air and the storage tank may be filled to a much higher percentage of its total capacity than is permissible where the carbon dioxide in storage is subjected to and is maintained at the temperature of the surrounding air. It is preferred that the refrigerating apparatus 32 maintain the temperature of the carbon dioxide stored within the tank 26 either at or below 32° F. Probably the most generally satisfactory temperature is 0° F. The vapor pressure of the stored carbon dioxide at this temperature will be approximately 290 lbs. gauge pressure.

Located above the refrigerating apparatus 32, in the space between the driver's cab 13 and the front end of the carbon dioxide storage tank 26 is a second storage tank 33 which is intended to hold approximately 100 gallons of water. This storage tank may be filled through the manhole 34, located in the top of the body 10. The water in this tank 33 is intended to be discharged through the hose line 35 carried by the reel 36 which is located within the shell or housing 15 at one end of and below the tank 33. Access to this hose line 35 may be had through the door 22 located at its side of the body 10. The displacement of the water from the tank 33 by means of the vapor pressure of the carbon dioxide stored in the tank 26 will be explained in detail at a later point.

Figs. 3 and 4 disclose in detail the mechanism of the unit employed for maintaining and expelling the liquid carbon dioxide and the water. These various devices will be described in detail in connection with these two figures.

It is preferred that the tank 26 be charged with liquid carbon dioxide at the temperature and pressure at which the carbon dioxide is to be maintained while in storage. The liquid carbon dioxide, therefore, is charged into the tank through the dome 37 of the tank by means of the pipe line 38. This pipe line is provided with a control valve 39 and terminates in a suitable coupling end 40 at the side of the tank. To permit the liquid carbon dioxide to be pumped into the storage tank 26 from the source of supply of the liquid, the vapor pressure in the tank 26 and the tank which contains the source of supply should be equalized. This equalizing of the vapor pressure in the two tanks is accomplished by means of the pipe line 41 which extends into the dome 37 and is provided with a control valve 42. The end of this pipe line terminates in a suitable coupling 43 located alongside of the supply line coupling 40.

The discharge of the low temperature and pressure liquid carbon dioxide from the tank 26 to the hose line 28 is by means of the T coupling 44, connected to the bottom of the tank 26, and the pipe line 45 which leads to the center of the hose reel 29, as at 46. A control valve 47 is provided in the pipe line 45. To enable the firemen using the hose line 28 to have final control of

the discharge of the extinguishing medium, a control valve 48 is provided in the hose line 28 adjacent the discharge head or nozzle tip 31. Discharge of the liquid carbon dioxide through the dirigible nozzle assembly 30, located at the front end of the unit, is through the T coupling 44 and the pipe line 49 to the coupling 50. From the coupling 50 down to the dirigible assembly 30, the liquid carbon dioxide is fed through a section of flexible hose or tubing 51. A control valve 52 is located in the pipe line 49. The portion of the pipe line 49 which includes the control valve 52 extends through the driver's cab or compartment 13 so that the control valve 52 will be conveniently located with respect to the occupants of either one of the seats 12 and 14, see Figs. 1 and 2.

For the purpose of determining at a glance, from the exterior of the shell or housing 15, the level of the liquid carbon dioxide within the tank 26, an electric liquid level gauge 53 is mounted on one of the doors 23 of the shell or housing 15. Wires 54 connect the gauge 53 with suitable mechanism located within the tank, not shown, and these wires 54 extend through a suitable outlet pipe 55 connected to the dome 37. Of course, this outlet pipe 55 must be constructed to permit the wires 54 to extend outwardly thereof without leakage of pressure from within the tank 26. The reference character 56 diagrammatically designates a suitable mechanical liquid level gauge which may be employed if desired to supplement the electric gauge 53. No attempt has been made to illustrate mechanism for either of these gauges. As will be explained at a later point, this fire fighting unit is supplied with electricity from a fixed source while the unit is at its accustomed place of storage. The electric liquid level gauge, therefore, will be entirely satisfactory during periods when the unit is not actually being used to extinguish a fire. While on a "run," the unit is not supplied with electricity from an external source and a mechanical liquid level gauge is needed during actual periods of use of the unit. Of course, the liquid level gauge 53 may be designed to operate from the storage battery which forms a part of the ignition system of the unit if such an arrangement is found to be desirable. Under such operating conditions, a mechanical liquid level gauge would only be needed as a supplement for the electric liquid level gauge in case of mechanical failure of said latter gauge.

For the purpose of maintaining the liquid carbon dioxide within the storage tank 26 at a desired sub-atmospheric temperature, and its corresponding vapor pressure, a suitable evaporator coil 37' is arranged within the dome 37 of the tank 26. This evaporator coil operates to condense the carbon dioxide vapors which contact the same. The condensate runs back by gravity to the body of liquid within the tank. The evaporator coil is connected at one of its ends to one side of the compressor 57 by means of the compressor line 58. The other side of the compressor 57 is connected by a pipe line 59 to a radiator type of air cooled condenser 60. The remaining side of the condenser 60 is connected to a refrigerant receiver or storage tank 61. A pipe line 62 extends from the receiver or storage tank 61 to the expansion valve 63 located above the dome 37 and connected by a pipe 64 with the second end of the evaporator coil located within the dome 37. This series of elements, bearing reference characters 57 to 64, inclusive,

constitutes the circuit for the refrigerating apparatus. The compressor 57 is suitably driven by an electric motor 65.

The expansion valve line 62 has coupled therein a pressure filter 66 and a sight glass 67, which are best illustrated in Fig. 3. A thermobulb 68 is located in the compressor line 58 and is connected by suitable tubing 69 to the expansion valve 63. This bulb and tube provide a pneumatic control for varying the extent to which the expansion valve 63 is opened and responds to temperature changes in compressor line 58.

This refrigerating apparatus is intended to be automatically controlled so as to maintain the temperature of the liquid carbon dioxide within the storage tank 26 at a desired value. To obtain this automatic control, a mercury switch 70 is connected by a gas pressure pipe line 71 to a connection 72 which extends out of the top of the tank dome 37. This mercury switch is electrically connected in the circuit wires 73 for the electric motor 65. These circuit wires 73 extend to a terminal box 74, mounted on the side of the motor 65 and to a connector device 75 shown in Figs. 1 and 2 as being mounted at the rear end of the shell or housing 15 for the body of the unit.

A suitable pressure gauge 76 is connected in the gas pressure line 71, extending from the tank dome 37 to the mercoid switch 70. With this arrangement, the refrigerator mechanism will be automatically controlled by the vapor pressure of the liquid carbon dioxide stored within the tank 27. When this vapor pressure rises above the desired value at which the mercoid switch 70 is set to operate, the circuit for the refrigerator motor 65 will be closed and the compressor 57 will be operated. When the temperature of the carbon dioxide within the storage tank 26 drops to a point where the corresponding vapor pressure will again actuate the mercoid switch 70, the circuit for the refrigerator motor 65 will be broken and the compressor will be stopped.

It is desired to have the electric motor 65 of the refrigerating mechanism connected to a suitable source of supply of electricity while the fire fighting unit is located at its customary place of storage so that the temperature of the liquid carbon dioxide within the storage tank 26 will be maintained at the desired low value. It, also, is highly desirable to be able to quickly drive away the fire fighting unit without being called upon to first manually break the connection between the supply lines 73 of the refrigerator motor and the fixed source of supply of electricity. Fig. 5 diagrammatically illustrates means for automatically breaking this electrical connection without in any way damaging the equipment.

The connector box 75, which forms a part of the fire fighter unit, is adapted to make connection with a push plug 77 which is carried by a wire cable or cord 78. This electric cord or cable extends to a rewind reel 79 mounted on a suitable wall 80 of the storage space for the unit. Electric cables run from the reel 79 in a suitable conduit 81 to a switch box 82, also mounted on the wall. This switch box includes a control arm 83 which is illustrated in Fig. 5 in the position assumed by the same when the switch within the box 82 is closed. A pull cable or cord 84 is connected at one end to the push plug 77 and at its other end to the switch operating arm 83. A safety cord or cable 85 is anchored at one end

to the wall 80 and is connected at its remaining end to the switch operating arm 83.

When the fire fighting unit is driven away from the wall 80, the pull cord 84 will operate to move the switch operating arm 83 into a position to open the switch within the box 82. The safety cable or cord 85 will limit the outward swinging movement of the switch operating arm 83. The pull cord or cable 84 and the safety cord or cable 85 will then function to pull out the push plug 77 from the connector box 75. This mechanism, therefore, operates to permit the fire fighting unit to be driven away from its accustomed place of storage without requiring any preliminary consideration or manipulation of the electrical connecting mechanism.

As has been stated heretofore, the water stored within the tank 33 may be expelled by employing the pressure of the carbon dioxide within the storage tank 26. To accomplish this desired result, the top of the water storage tank 33 is connected by means of a vapor pressure pipe line 86 to the connection 87 extending from the dome 37 of the carbon dioxide storage tank 26. A hand control valve 88 is positioned in this line 86.

If the fire to be extinguished by the unit is of such a character as to be best treated with water, the valve 88 may be opened for creating any desired pressure within the water storage tank 33. The water from this tank, of course, is to be directed to the fire by means of the hose line 35 mounted on the reel 36. The withdrawal of gas from the vapor space of the carbon dioxide storage tank 26 will have no detrimental effect upon the liquid carbon dioxide stored therein. As a matter of fact, withdrawal of vapor from the storage tank 26 will operate to lower the temperature of the liquid stored therein.

The operator in charge of the fire fighting unit should possess sufficient experience or knowledge to be able to ascertain whether the particular fire being dealt with can be best extinguished by means of carbon dioxide or water. If carbon dioxide is to be employed, it may be discharged either through the dirigible assembly 30 at the front of the unit, or it may be discharged through the hose line 28 coming from the rear end of the unit. Of course, both of these discharge devices may be simultaneously employed if found to be necessary. If water will make a better extinguishing medium than carbon dioxide, the fire fighting unit is driven to the vicinity of the fire and the hand valve 88 is manipulated to build up a desired discharging pressure within the water storage tank 33. The hose line 35 is then employed for directing the water from the tank 33 on to the fire.

If the liquid carbon dioxide is employed in an endeavor to extinguish the fire and the supply of liquid carbon dioxide becomes exhausted before the fire is completely extinguished, the vapor or gas remaining in the carbon dioxide tank 26 may be employed for building up pressure within the water storage tank 33 so that the water can be used in an endeavor to finally extinguish the fire.

Should the fire fighting unit be compelled to remain away from its accustomed place of storage, with the source of supply of electricity, for an unusual length of time, or should the source of supply of electricity at the storage space for the unit fail for any reason, a dangerous pressure condition might arise within the storage tank 26. To fully protect the system from such a possibility, a pipe line 89 extends from the side

of the dome 37 and connects with a branch pipe 90 which has mounted on its extremity a mounting 91 for a frangible disc, not shown. This disc will rupture or blow out upon the attainment of any predetermined pressure within the tank 26.

If, for any reason, electricity cannot be obtained for operating the electric motor 65 of the refrigerating unit for a limited length of time, the desired low temperature and pressure of the liquid carbon dioxide within the storage tank 26 may be obtained by bleeding gas or vapor from the dome 37 of the tank 26 through a branch pipe 92, extending from the pipe line 89, and a pop valve 93. For supplementing the operation of the pop valve 93, a safety valve 94 is also connected to the branch line 92. A three-way plug valve 95 controls communication between the branch line 92 and the pop and safety valve 93 and 94, respectively.

Referring particularly to Figs. 6 to 9, inclusive, there is disclosed the dirigible discharge assembly for the liquid carbon dioxide with its control mechanism. Projecting from the front end of the body 10 of the fire fighting unit is a frame which includes the two longitudinally extending bars 96 and the parallel, transversely extending bars 97 which are connected at their opposite ends to the longitudinal bars 96. A base plate 98 is suitably mounted on the transversely extending bars 97. This base plate 98 includes a main body portion which is of substantially circular formation, see Figs. 6 and 8, with a rearwardly extending flange portion 98a carried thereby. Fig. 9 discloses a central aperture 99 formed in the main, circular body portion of this base plate. A turntable, designated in its entirety by the reference character 100, is rotatably mounted on the circular portion of the base plate 98 and, preferably, is centered with respect thereto. This turntable 100 includes a circular base portion 101 which is recessed in its under surface to provide an annular channel 102. Received within this channel and cooperating with the top surface of the base plate is a ball bearing assembly 103 which functions to rotatably support the turntable 100 on the base plate 98.

The turntable 100 is maintained in place by means of the shaft 104 which passes through the aperture 99 formed in the base plate 98 and through an aperture 105 formed in the base 101 of the turntable. Concentric with the aperture 105 is a bearing recess or pocket 106 which opens upwardly of the turntable base 101. Positioned within this bearing recess or pocket 106 is a ball bearing assembly 107. The upper race member of this ball bearing assembly snugly fits the periphery of the shaft 104 and rotates with this shaft. The lower race remains stationary with respect to the turntable base 101. A bearing cap 108 overlies and closes the top of the bearing recess 106. This bearing cap has a central aperture 109 for the passage of the shaft 104 and an enlarged recess 110 for receiving the head 111 of the shaft. The lower end of the shaft 104 is reduced and externally screw threaded, as at 112. Threaded on this reduced portion is a nut 113. A washer 114 is interposed between the nut 113 and the lower face of the base plate 98. This nut 113 with the washer 114 ties the shaft 104 to the base plate 98 and retains the turntable assembly in proper position.

Projecting upwardly from the base portion 101 of the turntable are the two bracket arms 115 which are arranged in spaced parallelism. The

upper ends of these arms are provided with bearing apertures 116 to receive the spindle 117. A washer 118 is mounted on each projecting end of the spindle 117 and a cotter pin 119 is associated with each washer 118 and the adjacent end of the spindle 117. These washers 118 and cotter pins 119 retain the spindle 117 in proper position relative to the bracket arms 115.

A pipe saddle 120 is journaled on the spindle 117. This pipe saddle includes a main body portion 121 which has the bearing openings 122 at its opposite ends for rotatably receiving or fitting the spindle 117. Projecting upwardly and laterally in opposite directions from the central portion of the main body 121 is a semi-circular pipe seat 123. The opposite end portions of this seat are provided with laterally projecting ears 124. The several figures clearly indicate that there are four of these ears 124. Each transverse pair of ears 124 has secured thereto a pipe clamp 125 by means of the screws 126 which are threaded into the apertures of the ears 124.

Figs. 6 and 7 disclose the rigid pipe stem 128 as being mounted in the seat 123 of the saddle 120 and as being retained in this seat by straps 125. This stem 128 for the discharge head or nozzle tip 31, therefore, is securely fastened to the pipe saddle 120.

It is desirable to be able to adjust the discharge head 31 and its rigid stem 128 both horizontally and vertically, or by means of a universal joint type of support. The right angularly arranged shaft 104 and spindle 117 with the turntable 100 and the pipe saddle 120 form this type of mounting for the discharge head 31 and its pipe stem 128. For the most efficient operation of this dirigible discharge assembly, it is desirable that the discharge head and its stem be manipulated from the driver's seat 12 in the cab or compartment 13. The mechanism for accomplishing this result is clearly illustrated in Figs. 6 and 7.

The base 101 of the turntable 100 has projecting forwardly from its front side two ears 129. The periphery of the turntable base 101 is provided with semi-circular, cord receiving grooves 130. Cords or cables 131 are attached at their forward ends to the ears 129 and extend around the turntable base 101 within the grooves 130. These cables 131 are brought around to the rearwardly projecting flange 98a of the base plate 98 and cross each other through the two guideways 132 of the double clevis 133 which is mounted on the said flange 98a, see particularly Figs. 7 and 8. The cables 131 then pass around sheaves 134 which guide them up to the level of the bottom end of a control lever 135 which is universally mounted at 136 in the bracket 137. The opposite extremities of these cords or cables 131 are attached to the lower end of the control lever 135. By rocking this lever, through the medium of its handle 138, laterally in opposite directions, the turntable 100 with its supported discharge head 31 will be moved horizontally about the axis of the perpendicular shaft 104.

Depending from the opposite end portions of the pipe seat 123 are apertured ears 139. These apertured ears, as will be seen in Fig. 7, are located on opposite sides of the spindle 117. Cables 140 are connected to these apertured ears 139 and extend downwardly to pass through the single clevis 141 which, as is clearly illustrated in Figs. 8 and 9, is mounted on the enlarged head 111 of the shaft 104. From the guide portion 142 of this clevis 141, the cables 140 pass around the guiding sheaves 143 up to the lower end portion

of the control stick 135 and approach this control stick from opposite sides; i. e., from the front and rear sides of the stick. These cords 140 are connected to the lower end portion of the stick 135 and movement of this stick forwardly or rearwardly will bring about rocking movement of the discharge head 131 and its pipe stem 128 about the axis of the spindle 117 for vertically changing the discharge from the head 31.

From this disclosure of the control mechanism for the discharge head 31 and the previous description of the control valve 52 for the pipe line which leads from the bottom of the liquid carbon dioxide storage tank 26 to the discharge head 31, it will be appreciated that one operator may drive this fire fighting unit up to the location of a fire and, without leaving the driver's cab 13, start and control the direction of discharge of a stream of carbon dioxide gas and snow on to the fire. As one portion of the fire is quickly extinguished by this discharge of carbon dioxide, the operator may quickly and easily change the location of the fire fighting unit for directing the extinguishing stream on to other portions of the fire. This combined control of the fire fighting unit and its dirigible discharge assembly particularly adapts the unit for fighting a fire which is burning over a considerable area.

The remaining figures of the drawings, identified by the numbers 10 to 24 inclusive, disclose three mobile fire fighting units which are modifications of the unit disclosed in detail in Figs. 1 to 9 inclusive. To avoid unduly multiplying the drawings, the modified units of Figs. 10 to 24 inclusive have been prepared so that they only illustrate the modified structures. It is to be understood, however, that these additional units are provided with the same equipment for maintaining a suitable source of supply of liquid carbon dioxide at a desired, controlled sub-atmospheric temperature and its corresponding vapor pressure; a source of supply of water which is to be expelled by carbon dioxide vapor pressure obtained from the storage unit for this latter medium, and a suitable hose line for effecting discharge of the water when this extinguishing medium is to be used by itself. Figs. 10 and 11 disclose a hose line for effecting discharge of the carbon dioxide by itself for the unit shown in Figs. 10 to 14 inclusive. Figs. 22 and 23 also disclose this type of discharge for the carbon dioxide. The rear end of the unit illustrated in Figs. 15 to 21 inclusive has been omitted but it is to be understood that a hose line for the carbon dioxide is to be provided for this modification.

The three embodiments of the invention illustrated in the figures still to be described differ from the embodiment of the invention illustrated in Figs. 1 to 9 inclusive by employing modified forms of discharge mechanism and by providing for the discharge of an extinguishing medium which consists of a mixture of carbon dioxide vapors and snow with a suitable quantity of water particles entrained therein. The method of extinguishing fires resulting from combining carbon dioxide snow and vapors with water particles is fully disclosed and claimed in my Patent Numbered 2,248,270, issued July 8, 1941. Additionally, these three remaining modifications differ from the embodiment of the invention illustrated in Figs. 1 to 9 inclusive by employing control mechanism for effecting this combined discharge of carbon dioxide and water.

The reference characters employed in Figs. 1 to 9 inclusive for identifying certain structural

elements of the vehicle body per se, etc., will be employed in Figs. 10 to 24 inclusive to identify the same elements where they are illustrated in the latter figures. New reference characters will only be applied to the elements which actually constitute the modifications.

Referring now specifically to the disclosure of Figs. 10 to 14 inclusive, the reference character 144 designates in its entirety a rigid tripod which is suitably secured to the roof of the driver's cab 13. An oar-lock type of swivel mounting 145 is suitably attached to the upper end of this tripod. The arms of this oar-lock or fork 145 have positioned between the same the barrel 146. A pivot pin 147 is employed for attaching the barrel to the swivel member 145. It will be appreciated, therefore, that the barrel 146 may partake of universal movement relative to the tripod 144. The movement about a horizontal axis is provided by the pivot pin 147 while the movement about a vertical axis is provided by the mounting pin 148 which connects the swivel mount 145 to the tripod.

The rear or inner end of the barrel 146 has suitably attached thereto or formed thereon a pistol grip 149 with which is associated a trigger lever 150.

The outer or front end of the barrel 146 has suitably attached thereto a special elbow coupling 151 provided with an angular bore 152 which communicates at one end with a pipe 153 that leads to a differential pressure operated valve casing 154. The remaining end of the elbow coupling bore 152 communicates with a pipe 155 which has suitably mounted on its outer end the discharge nozzle 156. This discharge nozzle is of a suitable design to effect a dense discharge of carbon dioxide snow and vapors when low temperature liquid carbon dioxide is delivered thereto through the pipe 155, etc. The differential pressure valve casing 154 has a second branch connected to a pipe line 157 which extends into the carbon dioxide storage tank 26 to terminate near the bottom thereof. A suitable manual control valve 158 is provided in this pipe line 157 and functions to either completely shut off the flow of liquid carbon dioxide through the pipe line or to regulate the rate of flow.

The water supply tank 33 is connected to the vapor space of the carbon dioxide supply tank 26 by means of the pipe line 86 which is controlled by the manual valve 88. From the bottom of the water tank 33 extends a pipe line 157a which is connected at its outer end to one branch of the fluid pressure operated valve casing 158a. The remaining branch of this casing has a pipe section 159 connected thereto. A flexible hose 160 is connected to the outer end of the pipe section 159. This hose is secured to the pipe 155 by suitable straps 161 and extends to and is connected with a ring 162 which surrounds and is suitably secured to the periphery of the carbon dioxide discharge nozzle 156.

Fig. 14 discloses this water discharge ring 162 in detail. Radially inwardly directed ports 163 are formed in the water ring 162. When carbon dioxide is discharged through the nozzle 156 and water is discharged in the form of a plurality of jets through the ports 163 of the ring 162, the water jets or streams will be thoroughly broken up by the carbon dioxide discharge so that all of the water particles will be entrained in the cloud of carbon dioxide snow and vapors. A complete explanation of the advantages and mode of operation of this type of combined dis-

charge is fully set forth in my aforementioned Patent No. 2,248,270 and reference may be had thereto for a more thorough understanding.

In effecting control over the simultaneous discharge of carbon dioxide and water, it is desirable for the operator to be able to control both of these fluids by means of a single element. The trigger lever 150 is employed for this purpose. This lever has connected thereto a cable 164 which passes around the sheave 165 and extends to the operating lever 166 of a pilot valve 167. This lever is employed for unseating a spring loaded valve 168. When this valve is unseated, the chamber of the pilot valve casing is placed in communication with the vent 169.

A pipe line 170 connects the chamber of the pilot valve casing 167 to the cylinder 171 formed in the top of the differential pressure valve casing 154. A second pipe line 172 connects the chamber of the pilot valve casing 167 to the carbon dioxide pipe line 157 in advance of the inlet for the differential pressure valve casing 154.

When the valve 168 of the pilot valve structure 167 is seated, the pipe lines 170 and 172 deliver carbon dioxide to the cylinder 171 of the differential pressure casing 154. This carbon dioxide applies pressure to the top surface of the piston operated valve 173 which is located in the differential pressure casing 154. In other words, this piston of the valve 173 normally has carbon dioxide pressure applied to both of its faces. Carbon dioxide pressure, additionally, is applied to the back of the valve head 174. As long as this pressure condition exists, the valve head 174 will remain against its seat and carbon dioxide will be prevented from flowing to the pipe line 153, the pipe 155 and the discharge nozzle 156. However, when the trigger lever 150 is moved toward the grip 149, the pilot valve operating lever 166 is actuated to unseat the valve 168. When this valve is unseated, the chamber of the pilot valve casing 167 is vented to the atmosphere and the carbon dioxide pressure is removed from the cylinder 171 of the differential pressure valve casing 154. The carbon dioxide pressure applied to the inner face of the piston for the valve member 173 then operates to unseat the valve head 174 and carbon dioxide will then flow through the pipe lines 157, 153, and 155 to the discharge nozzle 156.

As carbon dioxide is admitted to the pipe line 153, it flows through the short pipe section 175 to the cylinder 176 formed in the top of the fluid pressure operated valve casing 158a. This carbon dioxide pressure acts on the piston 177 and results in unseating the valve 178 which is normally retained against its seat by a suitable spring that underlies the same. Water then will be permitted to flow from the supply tank 33 through the pipe lines 157a, 159 and 160 to the water discharge ring 162.

It now will be appreciated that the person designated to manipulate the combined carbon dioxide and water discharge mechanism by means of the pistol grip 149, attached to the universally movable barrel 146, may start and stop the flow of carbon dioxide and water by manipulating the trigger lever 150. Manipulation of this lever results in seating and unseating pilot valve 168. When the pilot valve is unseated, the carbon dioxide and water will flow to their respective discharge devices. When the pilot valve is seated, the flow of both carbon dioxide and water will be stopped.

Figs. 10 and 11 clearly show the various control valves for the carbon dioxide and water as being located inside of the body 10 of the vehicle. The trigger lever 150 and its cord 164 are the only portions of the control mechanism which are located outside of the vehicle body.

A suitable platform 179 extends across the top of the vehicle body and is reached by a suitable ladder 180. The person designated to operate the discharge mechanism stands on this platform and manipulates the discharge mechanism when this mobile fire fighting unit is being employed for extinguishing a fire.

Coming now to the disclosure of Figs. 15 to 21 inclusive, we have a mobile fire fighting unit which is provided with two booms which may be raised and lowered as well as swung horizontally. The extent to which each boom may be raised and lowered is approximately 90°. The extent to which each boom may be swung horizontally is approximately 180°.

By referring first to Figs. 15 and 16, it will be seen that a pipe line 181 extends from the bottom portion of the carbon dioxide storage tank 126 to a manual control valve 182 which is located outside of the tank and its insulation. Just beyond this valve 182, the pipe line is formed into two branches 183 which extend to the respective booms.

In Figs. 19 to 21 inclusive there is shown the mounting mechanism for one of the booms. It will be understood that each boom is mounted in the same manner. Fig. 21 discloses a branch line 183 as being connected to an elbow 184 which in turn has connected thereto a short vertical pipe section 185. This pipe section 185 has a flange 186 formed on its upper end.

A turntable 188 is mounted in an opening formed in the roof portion of the vehicle body 10; that is, in the roof of the driver's cab 13 of the vehicle body. This turntable is supported for angular movement by a suitable number of rollers 189 which are arranged in a groove or trackway 190. The turntable 188 is formed in two parts so that the top and bottom flanges of the groove or trackway 190 may be separated to admit the rollers 189. The detachable bottom portion 188a of the turntable is provided on its periphery with gear teeth 191 which are engaged by the teeth of the pinion 192. This pinion is suitably keyed to an operating shaft 193 which extends through the cab roof and has operating wheels 194 attached to its upper and lower ends. It will be appreciated that the turntable 188 may be rotated either from within the driver's cab 13 or from the roof of the vehicle by means of these respective hand wheels 194.

The top flange 186 of the carbon dioxide pipe section 185 is clamped to the upper member of the turntable 188 by means of a ring 195. This ring acts as a swivel mounting for the pipe flange 186. Suitable packing, not shown, will be interposed between the pipe flange and the body of the turntable 188.

A pipe nipple 197 is threaded into a hole formed in the upper part of the turntable 188 and registers with the carbon dioxide pipe section 185 so that a flow path for carbon dioxide will be formed by these two pipe sections 185 and 197. The pipe section 197 is suitably connected to one member 198 of a half-together swivel joint or coupling which additionally includes the member 199. These two members are held together by a bolt and nut assembly 200. No attempt has been made to disclose packing between these

two half coupling members 198 and 199 but it is to be understood that suitable packing is to be used.

The half coupling member 199 has connected to its outlet branch a pipe 201 which functions as the arm of a boom and as the conduit for the carbon dioxide to be discharged from the outer end of the boom.

To support this boom arm 201 for vertical swinging movement, a fork 202 is connected to the boom arm 201. The branches 203 of this fork are pivotally connected to the upstanding ears or arms 204 by means of pivot pins 205. These upstanding ears or arms are carried by the turntable 188 so as to move angularly with the latter. It will be appreciated, therefore, that when the turntable is rotated by means of either one of the wheels 194, the associated boom arm 201 will rotate with the turntable.

By referring specifically to Figs. 15 to 18 inclusive, it will be seen that each boom arm 201 has mounted on its outer end a carbon dioxide discharge nozzle 206. This nozzle is connected to the end of the boom arm by means of another half-together swivel coupling 207 which allows the discharge nozzle to pivot about a horizontal axis at right angles to the boom arm.

To effect and control this pivotal movement of each carbon dioxide discharge nozzle relative to its boom arm, the nozzle has formed thereon rearwardly extending fingers 208 which are connected to control cables 209. These control cables extend longitudinally of their respective boom arm 201 and are connected at their inner ends to the opposite arms of a double lever 210. This connection of the inner ends of the control cables 209 to the opposite arms of the double lever 210 is best illustrated in Fig. 18. Figs. 19 and 20 clearly illustrate this double lever 210 as being pivotally supported by one of the pivot pins 205 which connects an arm 203 of the yoke 202 with its respective supporting ear 204. This type of support for the double ended lever 210 causes its axis of pivotal movement to correspond with the axis of pivotal movement of the associated boom arm 201. If desired, the bolt 200 for connecting the two half coupling members 198 and 199 may also be employed as the mount for the double ended lever 210 and as the pivot pin for connecting the fork arm 203 and the mounting ear 204 on the level side. In any event, the lever 210 should be capable of being moved relative to the associated boom 201 so as to tilt the carbon dioxide discharge nozzle 206 relative to its boom while the double ended lever 210 should swing with its boom when the latter is raised or lowered.

Each boom 210 is raised and lowered by means of a cable 211 which is attached at its outer end to the boom at a point intermediate the ends of the latter. This cable 211 extends to and passes around a sheave 212 which is mounted for swiveling movement on the upper end of a standard 213 that extends vertically from the roof of the driver's cab. The cable 211 extends through the bore of this standard to the interior of the driver's cab where it passes over a guiding sheave 214 and is wound around the spool 215 of an electric motor driven winch. This winch may be reversibly driven so that its spool or drum 215 will either wind up or unwind the cable 211. The electric motor for each winch is supplied with electricity from the battery 216 of the vehicle by means of wires 217. A reversing switch 218 is mounted in the driver's cab so

that the driver, or an attendant, located in the cab may control the operation of the winches for both of the booms. To enable a person located on the top of the vehicle to also control the raising and lowering of the booms, a second motor reversing switch 219 is provided for each winch and is mounted on the respective standards 213. Figs. 16 and 17 disclose the two standards 213 and the bracing bars 220 which interconnect the standards.

The two carbon dioxide discharge nozzles are provided with water discharge rings 221 of the character disclosed in detail in Fig. 14. These rings are supplied with water through the interconnected hose line 222 and pipe line 223. The two pipe lines 223 for the two water rings are joined together above the water tank 33 and receive their supply through the dip-tube 224.

It is desirable to be able to control the discharge of the carbon dioxide and water either from a position within the driver's cab 13 or a position on the roof of the cab. For that reason, both arms or branches of the double ended lever 210 have discharge control levers 225 mounted thereon. Separate cables 226 extend from these control levers 225 to the operating cams 227 of the pilot valves 228 which are provided for the respective booms. Suitable guiding sheaves 229 are provided for the cables 226. Certain of these sheaves 229 are supported by bracket arms 230 which are supported by the standards 213.

Coming now to the control valves for the discharge of carbon dioxide and water from the outer end of each boom arm 201, it is believed that Fig. 18 provides the clearest illustration. The pilot valve unit 228 is provided with a chamber 231 which is normally in communication with the carbon dioxide supply pipe 183 through the medium of the tube 232. This chamber 231, also, is in communication with the cylinder 233 of the differential pressure valve casing 234 through the medium of the tube 235. A spring loaded valve 236 is provided in the pilot valve chamber 231 and is controlled by the cam lever 227. A vent 237 is provided for the pilot valve casing 228 and communication between the chamber 231 and the vent 237 is controlled by means of the valve 236.

With the valve 236 in the position illustrated in Fig. 18, carbon dioxide is delivered from the supply line 183 to the cylinder 233 where the pressure of the same is applied against the upper face of the piston 238. This piston operates to control the seating and unseating of the valve 239. Carbon dioxide pressure additionally is applied to the upper or inner face of the valve 239 and to the opposed or inner face of the piston 238 through communication of the supply line 183 with the inlet of the differential pressure valve casing 234. The outer end of the stem for the valve 236 is pointed at 240 to cooperate with the tapered seat 241 formed at the pilot valve end of the tube 232. This pointed valve stem end functions as a needle valve for controlling the flow of carbon dioxide through the tube 232 into the chamber 231.

When the cable 226 for a particular pilot valve is actuated to pivot its cam lever 227, the push rod 242 operated by this cam lever will function to unseat the valve 236 and to seat the needle valve 240. The delivery of carbon dioxide to the chamber of the pilot valve through the tube 232 is stopped and the carbon dioxide in

this chamber, the tube 235 and the cylinder 233 are vented to the atmosphere through the outlet 237. When the cylinder 233 is vented, the carbon dioxide pressure applied to the inner face of the piston 238 will function to unseat the valve 239 and allow carbon dioxide to flow through the differential pressure valve casing 234 and on through the remainder of the pipe line 183 to the boom associated with this control mechanism.

When carbon dioxide is admitted to the pipe line 183 beyond the differential pressure valve casing 234, it will flow through the tube 243 to the cylinder 244 of a fluid pressure operated valve casing 245 which is connected in the water flow pipe 223. The carbon dioxide pressure in the cylinder 244 is applied against the piston 246 and results in unseating the valve 247. When this latter valve is unseated, water will flow from the storage tank 33 to the discharge ring 221 of the associated carbon dioxide discharge nozzle 206.

There now has been explained mechanism for swinging the respective booms from a position in front of the vehicle body 10 to a position where the boom will overlie the roof of the body. Of course, either boom may be stopped in any intermediate position. There, also, has been disclosed mechanism for raising and lowering each boom and for tilting the combined carbon dioxide and water discharge mechanism relative to the outer end of the associated boom. This ability to manipulate the booms and their discharge devices will permit the extinguishing medium to be discharged in any desired direction with respect to the mobile fire fighting unit equipped in the manner illustrated in Figs. 15 to 21 inclusive. Whenever desired, the discharge of carbon dioxide and water from the end of either boom may be accomplished by manipulating either of the control levers 225 for that particular boom. It further will be appreciated that manipulation of both booms and control of the discharge of the extinguishing medium may be accomplished either from a position within the driver's cab 13 or from a position on top of the vehicle body.

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. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated pressure liquid carbon dioxide storage tank within the housing, a mechanical refrigerating device within the housing and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide, means operating in response to an increase in pressure in the tank for causing the refrigerating device to operate to maintain the liquid in the tank at a desired constant low temperature and pressure, a dirigible discharge device connected to the tank for discharging carbon dioxide and mounted on the front portion of the body above the plane of the body chassis and forward of the driver's cab so that discharging carbon dioxide to the front, the side or upwardly of the body will not be interfered with by any portion of the body, and means operable from within the driver's cab for adjusting the position of and

for controlling the flow of carbon dioxide to the discharge device.

2. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric capacity mounted on said body, a mechanical refrigerating device mounted on said body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide in the tank, means operating in response to an increase in pressure in the tank for causing the refrigerating device to operate to maintain the liquid in the tank at a desired constant low temperature and pressure, a comparatively small water storage tank mounted on said body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in said latter tank for expelling the water, and separate pipe lines for effecting discharge of the water and liquid carbon dioxide from their respective tanks either simultaneously or independently, the relative volumetric capacities of the carbon dioxide and water storage tanks being such that the desired vapor pressure for completely expelling the water may be obtained from the carbon dioxide tank either prior to, during or after discharge of all of the liquid carbon dioxide.

3. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated liquid carbon dioxide storage tank within the housing, mechanical refrigerating means within the housing and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, an adjustable discharge device connected to the tank for discharging carbon dioxide and mounted on the front portion of the body above the plane of the body chassis so that discharging carbon dioxide to the front or the side of the body and above the plane of the body chassis will not be interfered with by any portion of the body, and means operable from the body of the unit for adjusting the position of and for controlling the flow of carbon dioxide to the discharge device.

4. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated liquid carbon dioxide storage tank within the housing, mechanical refrigerating means within the housing and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a discharge device connected to the tank for discharging carbon dioxide and adjustably mounted on the front portion of the body so as to be arranged above the plane of the body chassis and so as to discharge carbon dioxide to the front or the side of the body above the plane of the body chassis without interference from any portion of the body, and means operable from the body of the unit for adjusting the position of and for controlling the flow of carbon dioxide to the discharge device.

5. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated liquid carbon dioxide storage tank within the housing, mechanical refrigerating means within the housing and operatively connected to said tank for lowering the temperature

and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a discharge device connected to the tank for discharging carbon dioxide and mounted on the body, said discharge device being mounted on the front portion of the body and being adjustable for discharging to the front of the body or for discharging laterally to opposite sides of the body, and means operable from the body of the unit for adjusting the position of the discharge device mounted on the front portion of the body and for controlling the flow of carbon dioxide to the discharge device.

6. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated liquid carbon dioxide storage tank within the housing, mechanical refrigerating means within the housing and operatively connected to the tank for lowering the temperature and pressure of the liquid carbon dioxide and to maintain the same at a desired constant low temperature and pressure, a carbon dioxide discharge pipe connected to the tank, a discharge nozzle attached to the outer end of said pipe, means for mounting the pipe on the top of the wheeled body for universal movement, and means operable from a position on the wheeled body for effecting adjustment of the discharge device and for controlling the flow of carbon dioxide through the pipe to the nozzle.

7. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, an insulated liquid carbon dioxide storage tank within the housing, mechanical refrigerating means within the housing and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a carbon dioxide discharge pipe connected to the tank, a discharge nozzle adjustably attached to the outer end of said pipe, means for mounting the pipe on the top of the wheeled body for universal movement, and means operable from a position on the cab of the wheeled body for effecting adjustment of the discharge pipe, for effecting adjustment of the discharge nozzle relative to the outer end of the pipe, and for controlling the flow of carbon dioxide through the pipe to the nozzle.

8. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, a source of supply of liquid carbon dioxide carried by the body within the housing, a carbon dioxide discharge pipe connected to the source of supply, a discharge nozzle attached to the outer end of said pipe, means for mounting the pipe on the roof of the driver's cab for universal movement, and means operable from a position on top of the wheeled body for effecting adjustment of the discharge pipe and for controlling the flow of carbon dioxide through the pipe to the nozzle.

9. A fire fighting unit comprising a self-propelled wheeled body including an enclosing housing and a driver's cab in advance of the housing, a pair of booms mounted at their inner ends on the top of the wheeled body for universal movement, means associated with each boom for raising and lowering the same and for swinging it horizontally, a discharge nozzle pivotally connected to the outer end of each boom, a source of supply of liquid carbon dioxide carried by the

wheeled body, means for conducting carbon dioxide from the source of supply to the discharge nozzles mounted on the outer ends of the booms, and dual control means operable from within the driver's cab or from the top of the vehicle body for controlling adjustments of the booms relative to the body, for controlling adjustments of the discharge nozzles relative to their respective booms, and for controlling discharge of carbon dioxide from said nozzles.

10. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric capacity mounted on said body, mechanical refrigerating means mounted on the body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a water storage tank mounted on the body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in the latter tank to expel the water, a discharge device mounted on the body and connected to the carbon dioxide and water storage tanks, said device being operable to discharge a mixture of carbon dioxide snow and vapors with water particles entrained therein, and means, including a single actuating member, for simultaneously controlling the flow of liquid carbon dioxide and water to the discharge device.

11. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric capacity mounted on said body, mechanical refrigerating means mounted on the body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a water storage tank mounted on the body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in the latter tank to expel the water, a discharge device mounted on the body and connected to the carbon dioxide and water storage tanks, said device being operable to discharge a mixture of carbon dioxide snow and vapors with water particles entrained therein, and means for controlling the flow of liquid carbon dioxide and water to the discharge device.

12. Fire fighting apparatus comprising an insulated pressure liquid carbon dioxide storage tank, a mechanical refrigerating device operatively connected to said tank for lowering the temperature and pressure of the liquid in the tank to maintain the same at a desired constant low temperature and pressure, a relatively small water storage tank located adjacent the liquid carbon dioxide storage tank, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in said latter tank for expelling the water, and separate pipe lines for effecting discharge of the water and liquid carbon dioxide from their respective tanks either simultaneously or independently, the relative volumetric capacities of the carbon dioxide and water storage tanks being such that the desired vapor pressure for completely expelling the water may be obtained from the carbon dioxide tank either prior to, during, or after discharge of all of the liquid carbon dioxide.

13. Fire fighting apparatus comprising an in-

insulated pressure liquid carbon dioxide storage tank of large volumetric capacity, mechanical refrigerating means operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a source of supply of water operatively associated with the liquid carbon dioxide storage tank, means for controllably connecting the vapor space of the liquid carbon dioxide storage tank with the source of supply of water to effect discharge of the water by vapor pressure from the storage tank, a discharge device connected to the carbon dioxide storage tank and the source of supply of water, said device being operable to discharge a mixture of carbon dioxide snow and vapors with water particles contained therein, and means, including a single actuating member, for simultaneously controlling the delivery of liquid carbon dioxide and water to the discharge device.

14. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric capacity mounted on said body, mechanical refrigerating means mounted on the body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a water storage tank mounted on the body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in the latter tank to expel the water, an adjustable discharge device connected to the carbon dioxide and water storage tanks for discharging a mixture of carbon dioxide snow and vapors with water particles entrained therein, said discharge device being mounted on the front portion of the wheeled body above the plane of the body chassis so that discharging the mixture of carbon dioxide and water to the front or the side of the body and above the plane of the body chassis will not be interfered with by any portion of the body, and means operable from the body of the unit for adjusting the position of and for controlling the flow of carbon dioxide and water to the discharge device.

15. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric capacity mounted on said body, mechanical refrigerating means mounted on the body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a water storage tank mounted on the body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in the latter tank to expel the water, a plurality of discharge devices connected to the carbon dioxide and water tanks for discharging a mixture of carbon dioxide snow and vapors with water particles entrained therein, said plurality of discharge devices being adjustably mounted on the front portion of the body and being adjustable to discharge the extinguishing medium either to the front or to the side of said body, and means operable from the body of the unit for adjusting the position of said discharge devices and for controlling the flow of carbon dioxide and water to the devices.

16. A fire fighting unit comprising a self-propelled wheeled body, an insulated pressure liquid carbon dioxide storage tank of large volumetric

capacity mounted on said body, mechanical refrigerating means mounted on the body and operatively connected to said tank for lowering the temperature and pressure of the liquid carbon dioxide to maintain the same at a desired constant low temperature and pressure, a water storage tank mounted on the body, means for controllably connecting the vapor space of the carbon dioxide storage tank with the water storage tank to build up pressure in the latter tank to expel the water, separate pipe lines for effecting discharge of the water and liquid carbon dioxide from their respective tanks, means for mounting the outer portions of said pipe lines for simultaneous universal movements relative to the wheeled body, a discharge device attached to the outer ends of said pipes and operative to effect a discharge of mixed carbon dioxide snow and vapors with water particles entrained therein, and means operable from the body of the unit for adjusting said outer end portions of the separate pipe lines and for controlling the flow of liquid carbon dioxide and water therethrough to the discharge device.

17. Fire fighting apparatus comprising a source of supply of liquid carbon dioxide maintained at a constant low temperature and pressure, a source of supply of water, a combined discharge device for effecting discharge of a mixture of carbon dioxide snow and vapors with water particles entrained therein, a pipe line leading from the source of supply of liquid carbon dioxide to the discharge device, a pipe line leading from the source of supply of water to the discharge device, a separate control valve located in each pipe line, and means for employing the pressure of the liquid carbon dioxide to effect opening of both of said control valves.

18. A fire fighting unit comprising a wheeled vehicle, a source of supply of liquid carbon dioxide mounted on the wheeled vehicle, a discharge device connected to the said source of supply to receive liquid carbon dioxide therefrom, said discharge device comprising a boom, means for mounting one end of the boom on the vehicle for pivotal movement about a vertical axis and a horizontal axis, and a discharge nozzle mounted on the free end of the boom; means carried by the vehicle for effecting movement of the boom about its pivotal axes, and means for controlling the flow of carbon dioxide to the discharge device.

19. A fire fighting unit comprising a wheeled vehicle, a source of supply of liquid carbon dioxide mounted on the wheeled vehicle, a discharge device connected to the said source of supply to receive liquid carbon dioxide therefrom, said discharge device comprising a boom, means for mounting one end of the boom on the vehicle for pivotal movement about a vertical axis and a horizontal axis, and a discharge nozzle mounted on the free end of the boom for pivotal movement relative to the boom about a transverse axis; means carried by the vehicle for effecting movement of the boom about its pivotal axes, means for effecting pivotal movement of the nozzle relative to the boom, and means for controlling the flow of carbon dioxide to the discharge device.

20. A fire fighting unit comprising a wheeled vehicle including a driver's cab, a source of supply of liquid carbon dioxide mounted on the vehicle, a discharge device connected to the said source of supply to receive liquid carbon dioxide therefrom, said discharge device comprising a boom, means for mounting one end of the boom on the top of said cab for universal pivotal movement, and a discharge nozzle mounted on the

free end of the boom; means operable from within the cab for effecting adjustments of the boom, and means operable from within the cab for controlling the flow of carbon dioxide to the discharge device.

21. A fire fighting unit comprising a wheeled vehicle including a driver's cab, a source of supply of liquid carbon dioxide mounted on the vehicle, a discharge device connected to the said source of supply to receive liquid carbon dioxide therefrom, said discharge device comprising a boom, means for mounting one end of the boom on the top of said cab for universal pivotal movement, and a discharge nozzle mounted on the free end of the boom for pivotal movement relative to the boom about a transverse axis; means operable from within the cab for effecting movement of the boom about its pivotal means, means operable from within the cab for effecting pivotal movement of the discharge nozzle relative to the boom, and means operable from within the cab for controlling the flow of carbon dioxide to the discharge device.

22. A fire fighting unit comprising a wheeled vehicle, a source of supply of liquid carbon dioxide mounted on the vehicle, a water storage tank mounted on the vehicle, means for effecting controlled application of carbon dioxide vapor from its source of supply to the water storage tank to build up pressure to expel the water, discharge means mounted on the vehicle and connected to the source of supply of carbon dioxide and the water storage tank, said discharge means being operable to discharge a mixture of carbon dioxide snow and vapors with water particles entrained therein, and means for controlling the flow of carbon dioxide and water to the discharge means.

23. A fire fighting unit comprising a wheeled vehicle, a source of supply of liquid carbon dioxide mounted on the vehicle, a water storage tank mounted on the vehicle, means for effecting controlled application of carbon dioxide vapor from the carbon dioxide source of supply to the water storage tank to build up pressure to expel the water, a discharge device connected to the source of supply of carbon dioxide and the water storage tank, said device being operable to discharge a mixture of carbon dioxide snow and vapors with water particles entrained therein, said discharge device comprising a boom, means for mounting one end of the boom on the wheeled vehicle for universal pivotal movement, and a discharge nozzle mounted on the free end of the boom; means for effecting desired adjustments of the boom, and means for controlling the flow of carbon dioxide and water to the discharge device.

24. A fire fighting unit comprising a self-propelled wheeled body, a source of supply of liquid carbon dioxide mounted on said body, a water storage tank mounted on the body, means for controllably connecting the source of supply of carbon dioxide with the water storage tank to controllably deliver carbon dioxide vapor to said tank to build up pressure to expel the water, an adjustable discharge device connected to the carbon dioxide source of supply and the water storage tank for discharging a mixture of carbon dioxide snow and vapors with the water particles entrained therein, said discharge device being mounted on the front portion of the wheeled body above the plane of the body chassis so that discharging the mixture of carbon dioxide and water to the front or the side of the body and above the plane of the body chassis will not be interfered with by any portion of the body, and means operable from the body of the unit for

adjusting the position of and for controlling the flow of carbon dioxide and water to the discharge device.

25. A fire fighting unit comprising a self-propelled wheeled body, a source of supply of liquid carbon dioxide mounted on said body, a water storage tank mounted on the body, means for controllably delivering carbon dioxide vapor from the carbon dioxide source of supply to the water storage tank to build up pressure in the latter to expel the water, separate pipe lines for effecting discharge of the water and liquid carbon dioxide, means for mounting the outer portions of said pipe lines for simultaneous universal movements relative to the wheeled body, a discharge device attached to the outer ends of said pipes and operative to effect a discharge of mixed carbon dioxide snow and vapors with water particles entrained therein, and means operable from the body of the unit for adjusting said outer end portions of the separate pipe lines and for controlling the flow of liquid carbon dioxide and water therethrough to the discharge device.

26. Fire fighting apparatus comprising a source of supply of liquid carbon dioxide, a source of supply of water, means for effecting controlled application of carbon dioxide vapor to the water to effect delivery of the water under a substantial pressure head, means for effecting discharge of carbon dioxide snow and vapors with water particles entrained therein, a pipe line leading from the source of supply of carbon dioxide to the discharge means, a pipe line leading from the source of supply of water to the discharge means, and a separate control valve located in each of said pipe lines.

27. A fire fighting unit comprising a self-propelled wheeled enclosed body, a source of supply of a fire extinguishing medium, adapted to be discharged at a high pressure, carried within the enclosed body, a fire extinguishing medium discharge pipe connected to the source of supply and extending through the top of the enclosed body, a discharge device attached to the outer end of said pipe, means for mounting the discharge device on the top of the enclosed body for universal movement, and means operable by personnel on the wheeled body for effecting adjustments of the discharge device and for controlling the flow of the extinguishing medium to the discharge device.

28. A fire fighting unit comprising a self-propelled wheeled enclosed body, a source of supply of a fire extinguishing medium, adapted to be discharged at a high pressure, carried within the enclosed body, a fire extinguishing medium discharge pipe connected to the source of supply and extending through the top of the enclosed body, a discharge device attached to the outer end of said pipe, means for mounting the discharge device on the top of the enclosed body for universal movement, means operable from a position on top of the wheeled body for effecting adjustment of the discharge device, and means for controlling the flow of the extinguishing medium to the discharge device.

29. A fire fighting unit comprising a self-propelled wheeled enclosed body, a source of supply of a fire extinguishing medium, adapted to be discharged at a high pressure, carried within the enclosed body, a pair of fire extinguishing medium discharge devices mounted on the top of the wheeled body for universal movement, piping extending from the source of supply of extinguishing medium to the discharge devices, and means

operable by personnel on the wheeled body for effecting independent adjustments of the pair of discharge devices and for controlling the flow of the extinguishing medium to the discharge devices.

30. A fire fighting unit comprising a self-propelled wheeled enclosed body, a source of supply of a fire extinguishing medium, adapted to be discharged at a high pressure, carried within the enclosed body, a pair of fire extinguishing medium discharge devices mounted on the top of the wheeled body for universal movement, piping extending from the source of supply of extinguishing medium to the discharge devices, and means operable from positions on top of the wheeled body for effecting independent adjustments of the

pair of discharge devices and for controlling the flow of the extinguishing medium to the discharge devices.

31. Fire fighting apparatus comprising a source of supply of liquid carbon dioxide, a source of supply of water, means for effecting delivery of the water from its source under a substantial pressure head, means for forming carbon dioxide and water into a composite discharge stream composed of carbon dioxide snow and vapor with water particles trained therein, piping leading from the source of supply of carbon dioxide and water to the discharge means, and valves located in the piping for controlling the flow of carbon dioxide and water to the discharge means.

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