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United States Patent [19]

Linkewich

[11] **3,754,601**

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[54] **FIRE BOMBING METHOD AND APPARATUS**

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[51] **Int. Cl.**..... **A62c 3/02**, A62c 27/30, B05b 17/02

[58] **Field of Search**..... 169/1 R, 1 A, 2 R, 169/2 A; 244/136; 239/171

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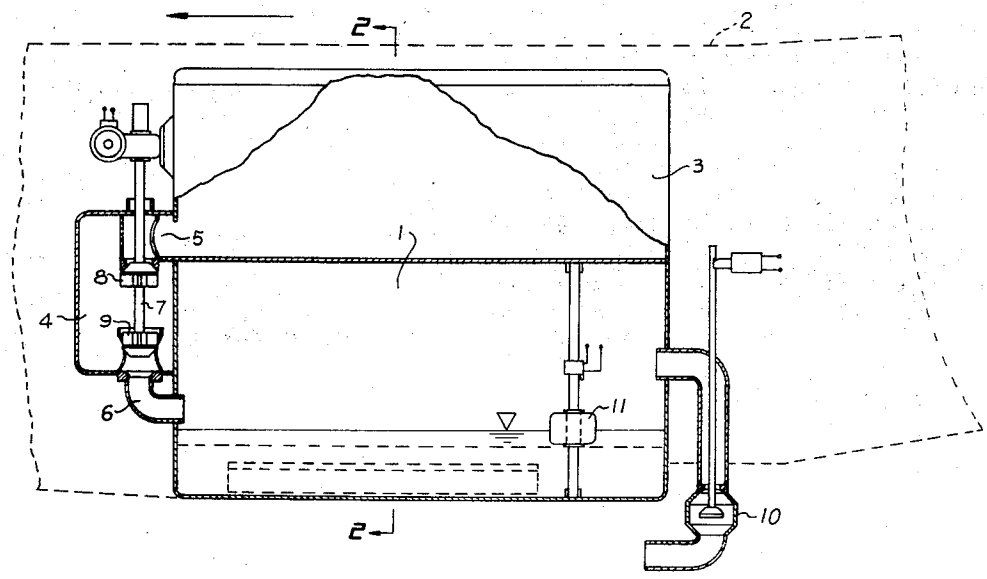
Primary Examiner—Robert S. Ward, Jr.
Attorney—Ernest Peter Johnson

[57] **ABSTRACT**

A fire bomber is fitted with a large container for storing long-term retardant. A measuring tank is connected between the container and the drop tank of the aircraft; a small measured charge of retardant can thus be introduced into the drop tank when required. In use, the bomber, almost fully loaded with retardant, is flown to a lake close to a fire to be controlled. A small amount of water is taken on and mixed with the charge of retardant in the drop tank to produce a minimum effective load of retardant slurry. The bomber flies to the fire and drops the slurry thereon. It then returns to the lake to mix a new batch of slurry. This procedure is repeated until the supply of retardant is exhausted. The technique is useful in that its use enables a relatively slow amphibious bomber such as a Canso PBY, to drop as much long-term retardant on a fire as relatively high-speed bombers, such as an A-26 or TBM, operating from an airport.

5 Claims, 4 Drawing Figures



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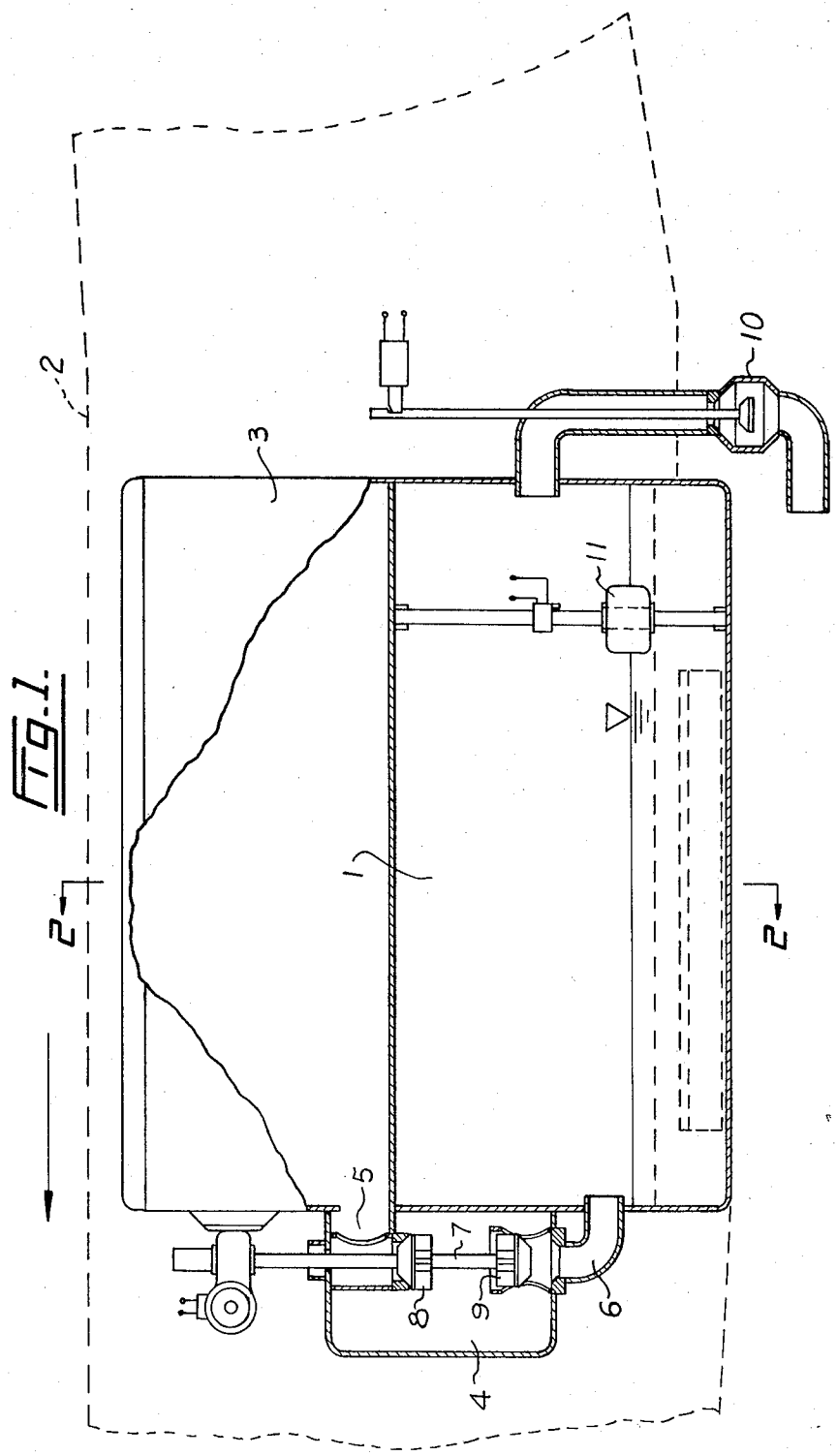
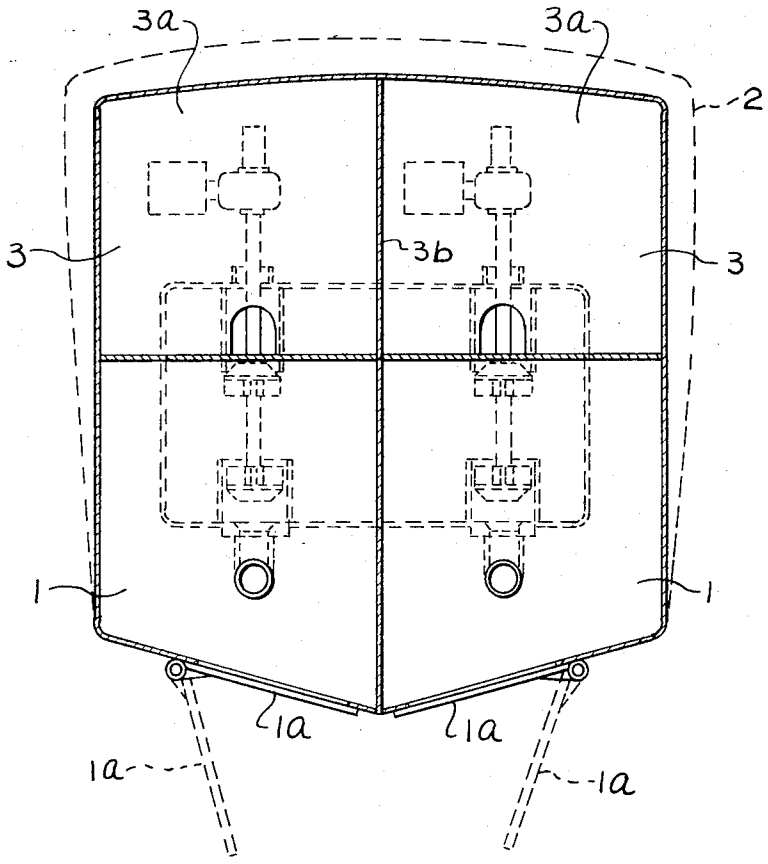


Fig. 1.

Fig. 2.



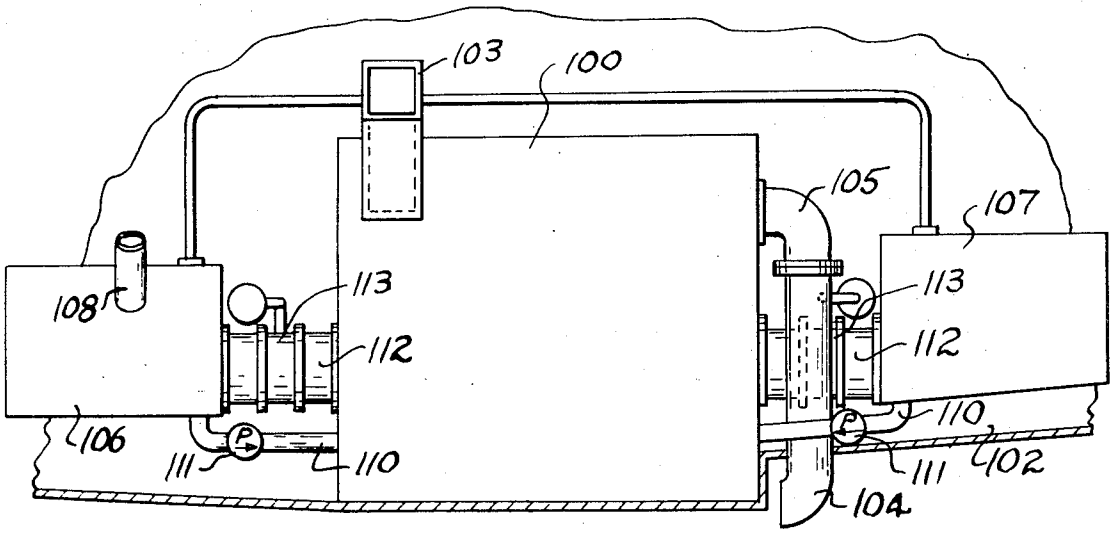

103
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FIG. 3.

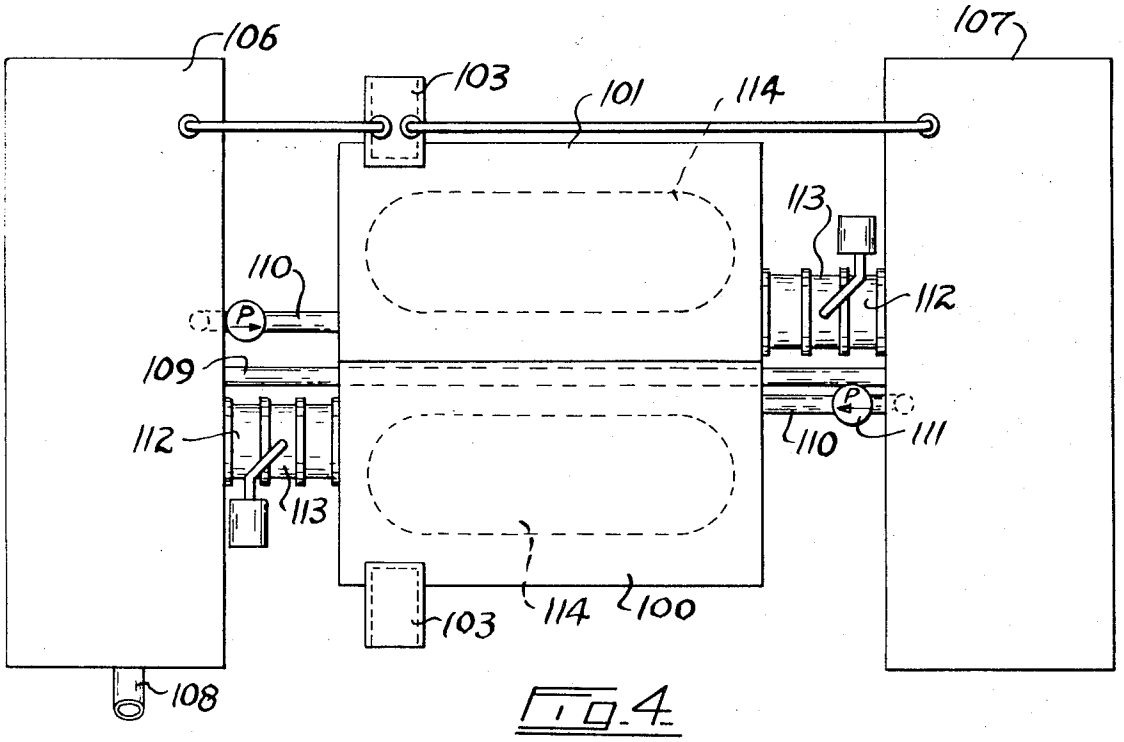
106
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FIG. 4.

FIRE BOMBING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to a method for delivering water and retardant to a fire, such as a forest fire. More particularly, it relates to a system for providing loads of retardant slurry on board an aircraft for repeated bombing of a fire. The invention also extends to the novel combination of known parts which provides the means for carrying out the method.

Any fire requires heat, fuel and oxygen in order to maintain itself. It is standard fire-fighting practice to remove one or more of these factors from the fire to extinguish it.

In recent years, aircraft have been used as the delivery means for supplying fire-extinguishing agents, such as water and retardants, to fires in remote areas. These aircraft are commonly termed "fire bombers."

When air spotters are used, it is usual to discover a fire within 10 to 15 minutes of the time at which it starts. The fire zone is usually about one-tenth to one-fourth acre in size at the time of discovery. It is necessary to contain the fire very quickly; otherwise it will grow too large for continued bombing to be effective. For example, in the dry, wooded areas of California, the fire bombers have about 20 minutes from the time of discovery within which to contain the fire; in the dense forests of Canada, this period is in the order of 120 minutes.

In its crudest form, fire-bombing involves dropping large quantities of water as quickly as possible on the fire. An amphibious aircraft, equipped with drop tanks and a snorkel water-loading device, is flown from an airport to a body of water close to the fire. There it takes on a capacity load of water, usually in the order of 8,000 pounds, and carries it to the fire where it is dropped to remove heat. The aircraft then returns to the lake for another load and repeats this procedure as required. Basic to this approach is the premise that there are usually lakes and rivers which are closer to the forest fire than is the airplane's base.

There are certain shortcomings with the system just described. When dropped from an aircraft, water disperses and forms a fine spray which is easily affected by the convection currents present above a fire. In many instances, the water never reaches the fire. In addition, water only removes one factor, i.e. heat, from the fire. Enormous quantities of it must be dropped over a very short time span in order to obtain a significant effect.

The system is improved by mixing short term retardant with the water to be dropped. A short term retardant improves the dropping characteristics of the water and retards its rate of evaporation. The retardant is stored on the aircraft, usually in an amount of about 200 – 300 pounds, and is mixed with the water being taken aboard to provide a viscous mixture containing about 1 pound of retardant per 100 gallons of water.

In recent years, short term retardants have been largely replaced by long term retardants, such as ammonium sulphate mixed with clay and a sticking agent. The long term retardants are mixed with relatively small amounts of water to form a thick slurry which has good dropping characteristics. When dropped on a fire, the slurry coats the trees to remove fuel, reacts to form ammonia and carbon dioxide gases which dilute the oxygen present, and evaporates slowly to remove heat. This three-pronged attack is much more effective than

the previously described systems. The slurry, containing about 1 gallon of liquid retardant concentrate per 4 gallons of water, is prepared at an airport using suitable mixing apparatus. High-speed, land-based bombers shuttle between the fire and the airport carrying full capacity loads of slurry on each trip.

The main disadvantage with the long term retardant system is that the aircraft which are used are expensive to purchase and operate.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a method which enables an aircraft to make repeated bombing runs within the critical initial period and drop a large amount (on a cumulative basis) of long term retardant on a fire without returning to the airport after each run.

It is another object to provide a method which can be used by relatively slow, amphibious aircraft, to deliver a large quantity of long term retardant to a fire within the critical initial period.

It is another object to provide modifications to such aircraft to permit their use in the practice of this novel method.

In accordance with the invention, an aircraft, fitted with one or more conventional drop tanks and water-loading means such as a snorkel, is modified by the provision on board of a long term retardant concentrate storage tank, and means for delivering a predetermined charge of concentrate from the storage tank to the drop tank. In operation, the aircraft leaves its base almost fully loaded with concentrate. Enough load carrying capacity is left unused to permit of the taking on board of enough water to form a small but effective drop load of slurry. On flying to a body of water close to the fire, this water is taken on and mixed in the drop tank with a suitable quantity of concentrate. If liquid concentrate is used, the turbulence of the incoming water is sufficient to provide adequate mixing within the drop tank. Now fully loaded, the aircraft flies to the fire and drops the relatively small load of slurry contained in the drop tank. It then returns to the body of water, another charge of concentrate is admitted to the drop tank, water is taken on and mixed with the concentrate, and the aircraft returns to the fire for a second drop. This procedure is repeated until the supply of concentrate is exhausted or the fire is extinguished. The aircraft then returns to base for reloading.

The prior art teaches flying a high-speed aircraft, fully loaded with slurry, to the fire, dropping the entire load, and returning to base for another load so as to repeat the process. In contradistinction, I propose utilizing most of the aircraft's load capacity to carry long-term retardant concentrate to a source of water near the fire. There I mix relatively small quantities of slurry on board the aircraft and then drop the small but effective loads on the fire zone. The mixing and dropping operations are repeated until the supply of concentrate is exhausted. By using this procedure, I find that a slow, amphibious aircraft, such as a Canso PBY can drop sufficient long term retardant slurry within the critical initial period to remain competitive with high-speed, land-based aircraft.

Broadly stated, the method of the invention comprises: flying an aircraft to a body of water which is relatively close to the fire; said aircraft carrying a load of retardant concentrate aboard, said load having a weight which comprises the major portion of the load-

carrying capacity of the aircraft; loading water on the aircraft; mixing the water with a charge of retardant concentrate to form a drop load of retardant slurry, said drop load having a weight which is substantially less than the load-carrying capacity of the aircraft; and flying to the fire and dropping the retardant slurry thereon.

Broadly stated, the apparatus in accordance with the invention comprises, in combination: an aircraft, having a load-carrying capacity, equipped with a drop tank and means connected to the drop tank for loading thereinto a pre-determined quantity of water from an exterior source; container means carried by the aircraft, said means being adapted to retain retardant concentrate in an amount such that the weight of the concentrate comprises the major portion of the load-carrying capacity of the aircraft; and means connecting the container means and drop tank for measuring and delivering a pre-determined quantity of concentrate from the container means to the drop tank when required.

DESCRIPTION OF THE DRAWINGS

In the drawing:

FIG. 1 is a schematic, sectional side view of an embodiment of the invention mounted in an aircraft which is fancifully indicated by shadow lines;

FIG. 2 is a front sectional view of the apparatus shown in FIG. 1, taken along section A—A, showing the measuring means and drop doors in shadow lines;

FIG. 3 is a partly broken away side view of another embodiment of the invention;

FIG. 4 is a top view of the invention illustrated in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention is illustrated in FIG. 1 in conjunction with the conventional dual drop tank 1 of an amphibious aircraft 2 (shown in shadow lines). Each drop tank 1 includes a door 1*a* of conventional design for dumping the drop tank contents. A retardant storage tank 3, divided into two compartments 3*a* by baffle 3*b*, is mounted over the drop tank 1. A measuring tank 4 is connected to the drop tanks 1 and storage tank 3. The tank 4 is sized to accomodate a small charge of concentrate, e.g. 40 Imperial gallons. The inlets 5 lead from each storage compartment 3*a* to the measuring tank 4. An outlet 6 leads from the measuring tank 4 back into each of the drop tanks 1. A valve stem 7, carrying inlet and outlet valves 8, 9 extends into the measuring tank 4 and controls one set of inlets 5 and outlets 6.

In the position shown, the inlet valve 8 is seated in inlet 5 and outlet valve 9 is unseated; concentrate from the storage tank 3 can thus fill the measuring tank 4. In a second operating position, the flow from the storage tank 3 is closed off by valve 8 seating in inlet 5 while valve 9 is unseated to permit the concentrate charge to drain into a drop tank 1. When the concentrate charge is in place, water is added through the conventional snorkel 10; the float 11 controls the amount of water taken on.

The operation of the invention is now exemplified with reference to a Canso PBY aircraft adapted to carry a load of 8880 pounds and equipped with dual drop and measuring tanks and a storage tank as follows:

TABLE I

Tank	Capacity Imp. Gallons
each drop tank	200
each measuring tank	40
storage tank	360

The aircraft is loaded with 520 gallons (7280 pounds) of long term ammonium sulphate liquid retardant concentrate as follows: 360 gallons in the storage tank; 40 gallons in each measuring tank and each drop tank. The aircraft is flown to a body of water close to the fire and 160 gallons of water are picked up and mixed with the concentrate in one drop tank to provide 200 gallons of slurry. The total load is now 8880 pounds, which is the full capacity of the aircraft. The aircraft is then flown to the fire and the slurry is dropped. This procedure is repeated for a total of five drops, at which time sufficient weight has been disposed of to begin loading each of the two drop tanks with 40 gallons of concentrate and 160 gallons of water. This loading is repeated for four drops, at which time the concentrate supply has been depleted.

A Canso PBY aircraft equipped in this manner carrying fuel sufficient to last 3 hours and 30 minutes can deliver about 29,120 pounds of slurry within a 50 mile radius of its base in approximately 2 ½ hours.

In Table II hereinbelow, the theoretical long term retardant delivery performance of the Canso PBY aircraft is compared with that of two high-speed aircraft commonly used for fire-bombing:

TABLE II.—COMPARISON OF AIR TANKER DELIVERY CAPABILITIES [1]

Aircraft	Air-speed	Number of Returns to airport	Total lbs. dropped	Total time, min.	Number of min. per 1,000 lbs. of dropped slurry	Time advantage percent
50 Mile Radius						
Canso [1]	130	1	29,120	156	5.36	
A-26	250	3	26,880	172	6.40	19
TBM	170	5	28,000	280	10.00	87
100 Mile Radius						
Canso [1]	130	1	26,800	190	7.07	
A-26	250	3	26,880	244	9.08	28
TBM	170	5	28,000	450	16.07	127

[1] Based on a situation where a body of water is available to the Canso 10 miles from the fire.

While the invention has been described with reference to a measuring tank system whose capacity is fixed, other equivalent means could be used to feed batches of concentrate to the drop tank in fixed or ever increasing amounts as the weight of the concentrate on board is lightened by dropping. For example, such an alternative System is shown in FIGS. 3 and 4.

The system comprises of two 400 gallon water drop

tanks **100,101.** The drop tanks are mounted side by side in the hull **102** at the centre of gravity. An overflow line **103** connects the drop tanks with the outside for dumping any overflow. This line **103** can also be used for loading water during land-based operations. A snorkel **104** is provided in conventional manner for loading the drop tanks through line **105.** Two 260 gallon retardant tanks **106, 107** are located fore and aft of the drop tanks. A port **108** connects the front retardant tank with the outside for filling. To eliminate unbalance during pumping or loading of the retardant, a pipe **109** interconnects the retardant tanks. While not shown, each of the drop and retardant tanks will normally be equipped with liquid level indicating probes adapted to provide a reading within the cockpit. Each retardant tank is connected with one of the drop tanks by a line **110** and positive displacement-type pump **111.** The pump functions to transfer retardant into the drop tank and is normally equipped with a volume meter (not shown) adapted to provide a reading in the cockpit. The pump will usually be operable from the cockpit via an electric or hydraulic circuit (not shown). Each retardant tank is also connected with a drop tank by a dump line **112** controlled by a normally closed valve **113.** In the event that the load is to be jettisoned, the retardant and water can be dumped through the dump doors **114.**

The main advantage of this alternative system is that the pilot can control the volume of retardant which is admitted to the drop tank by means of the displacement pump.

What is claimed is:

1. In combination:

an aircraft, having a load-carrying capacity and equipped with a drop tank, and means connected to the drop tank for loading thereinto a predetermined quantity of water from an exterior source;

container means carried by the aircraft, said means being adapted to retain retardant concentrate in an amount such that the weight of the concentrate comprises the major portion of the load - carrying capacity of the aircraft; and

means connecting the container means and drop tank for delivering a pre-determined quantity of concentrate from the container means to the drop tank when required.

2. In combination:

an aircraft equipped with a drop tank and means connected to the drop tank for loading thereinto a predetermined quantity of water from an exterior source;

a retardant concentrate storage tank carried within the aircraft above the drop tank;

a measuring tank having inlet means connecting it with the storage tank and outlet means connecting it with the drop tank; and

valve means, associated with the measuring tank, adapted to control the batch flow of retardant concentrate into and out of the said tank from the storage tank to the drop tank.

3. In combination:

an aircraft equipped with drop tank means and means connected to the drop tank means for loading thereinto a pre-determined quantity of water from an exterior source;

second tank means, for holding a supply of retardant concentrate, mounted within the aircraft;

pump and line means connecting the retardant and drop tank means for transferring retardant concentrate therebetween;

the liquid-carrying capacity of the second tank means being substantially greater than that of the drop tank means.

4. A method for delivering water and retardant to a fire which comprises:

flying an aircraft to a body of water which is relatively close to the fire, said aircraft carrying a supply of long term retardant concentrate aboard, said retardant concentrate having a total weight which makes up the major portion of the load capacity of the aircraft;

loading water on the aircraft;

mixing the water with a charge of retardant concentrate to form a drop load of slurry, said drop load having a weight which is substantially less than the load capacity of the aircraft; and

flying to the fire and dropping the retardant slurry thereon.

5. The method as set forth in claim **4** including the additional steps comprising:

flying the aircraft back to the body of water after the first drop;

loading water on the aircraft;

mixing the water with a charge of retardant concentrate to form a drop load of slurry, said drop load having a weight which is substantially less than the load capacity of the aircraft;

flying to the fire and dropping the retardant slurry thereon; and

repeating this procedure until at least a substantial proportion of the retardant supply has been dropped.

* * * * *