USA Firefighting Air Corps

Presentation to the Wildfire Matters Review Committee
Colorado State Capitol
September 10, 2014

USA Firefighting Air Corps is currently developing an innovative airtanker and associated innovative aerial fire fighting methods, based on the conversion of the Fairchild A-10 Thunderbolt II. Using the processes of Edward Herlik, Colorado Springs, CO, the converted A-10 would provide states with a purpose-built airtanker for protecting the Wildland-Urban Interface.

Our objective is to provide an airtanker aircraft for the suppression of fires from the air which incorporates modern technology to correct problems associated with liquid release, liquid pattern control, aiming, navigation, response time, fire detection and location, limited use aircraft, inflight hazards, and performance limitations. We plan to meet this objective by converting military attack/fighter type aircraft, and their weapons delivery systems, to airtanker operations.

We propose a collaboration with states in which we would invest in the development of the airtanker while the states explore the acquisition of retired A-10 aircraft from the Air Force and the development of long-term public-private partnership agreements that sustain the resulting fire aviation program.

The following is a summary of our development activities.

OBJECTIVES

Liquid Release

- **Provide an airtanker liquid discharge system which accelerates the dropped liquid to substantial velocity and ejects it rearward from the aircraft and essentially parallel to the flightpath.** The resulting velocity of the liquid subtracts directly from the velocity of the aircraft thereby greatly reducing the forces which disperse and vaporize the liquid. For example, if an airtanker using this new technology passes through the air at 140 mph while discharging its liquid in the direction opposite to its direction of flight (rearward) at 60 mph, the ejected liquid will only experience the forces of the liquid's resultant 80 mph velocity. This method reduces the liquid's velocity relative to the air to below its terminal velocity of about 120 mph and well below the aircraft's velocity. Rather than experiencing the full force of the 140 mph relative wind, liquid discharged by this apparatus will only experience the significantly lesser forces of its lower resultant velocity. The liquid then forms drops naturally without being vaporized by higher velocity relative wind which is above water's terminal velocity.

- **Affect the velocity change by accelerating the liquid through discharge pipes fitted with pumps or impellers.**

Liquid Pattern Control

- **Vary the dropped liquid's pattern and density on the ground by varying the number of discharge pipes used simultaneously, by varying the velocity of the liquid in each pipe, and by varying the duration of their liquid discharge.** That flexibility allows for variations in dropped liquid patterns and density.

- **Provide airtankers which may be safely flown in formation under conditions which may currently prohibit formation flight.** Such formations of airtankers allow further variations on liquid drop patterns which are beyond the capabilities of any single aircraft.

Aiming

- **Overcome visual aiming limitations by use of infra-red vision systems which allow the pilot to attack fires which would otherwise be obscured by darkness, smoke and/or haze.**
- **Incorporate military weapons delivery technology into airtankers.** This new fire suppression technology will incorporate computers calculating exact aiming cues or references based on all relevant forces affecting the liquid delivery and displaying the aiming reference on heads up displays.

Navigation

- **Overcome navigation problems by adding inertial navigation systems, and possibly satellite navigation systems, to other visual and radio navigation technology currently in use.** Either inertial or satellite navigation is available at any point on Earth and so is not affected by the gaps in radio navigation coverage. Such systems will also allow safe navigation in heavily obscured conditions when navigation information is presented on the heads up display and verified with the infra-red vision system.

Response Time

- **Reduce airtanker response time by increasing the speed of the aircraft.** The preferred embodiment of our innovative airtanker is a military attack/fighter type aircraft, here represented by the Fairchild A-10 Thunderbolt 11. The A-10's 360 mph cruising speed through the air is 100 mph faster than most airtankers now in use. Given a nominal 150 mile round trip to a tanker base for liquid refill, the speed difference gives the A-10 a response time advantage of 11 to 25 minutes per trip. Given the airspeeds common to today's airtankers plus 15 minutes to deliver the liquid on the fire and another 15 minutes to refill at the tanker air base, typical aerial firefighting resources allow one delivery every 66 to 80 minutes. The A-10 airtanker can perform the same functions in 55 minutes. Other

suitable attack/fighter aircraft, such as the Grumman A-6 Intruder, are faster still.

- **Reduce response time by providing an airtanker which can refill its liquid tanks inflight using well known refueling hardware and techniques.** These techniques involve the receiver flying in formation behind the tanker while liquid passes through a hose trailed by the tanker and which is connected to a probe extending from the receiver. The airtanker can fly from the tanker base to a fire, drop its original liquid load, refill from an orbiting aircraft and drop a second time in 15 minutes, refill inflight and drop a third time in another 15 minutes, and then return to the tanker base for fuel and liquid in a total of 85 minutes. In other words, our new airtanker can deliver approximately 4500 gallons of liquid and be reloaded for takeoff from base in approximately the time it currently takes a common heavy airtanker to deliver 2500 gallons of liquid and reload. In either scenario, the drastic reduction in response time is a significant improvement.

- **Further reduce response time by providing airtankers which can patrol over areas that are especially prone to burn while searching through darkness and haze in the infra-red spectrum.** Having detected an as yet extremely small fire, the innovative new airtankers can then suppress it with little additional effort. These new airtankers can deal with fires at the one-acre stage thereby obviating the need to confront 100- to 300-acre and expanding fires.

Fire Detection And Location

- **Fit the innovative new airtanker with an infra-red vision system.** The system detects a fire's infra-red radiation long before smoke is visible and is not hindered by darkness, smoke, haze or dust obscurations. Flight safety is maintained by displaying the infra-red information on a wide field of view heads up display. Such displays and aerial deliveries in obscured conditions, as well as at night, are standard in the military and can be applied to airtanker operations.

Limited Use Aircraft

- **Provide airtanker aircraft which are useful year round.** Given the infra-red systems and flexible liquid delivery systems, these innovative new airtankers are also useful for search and rescue (by scanning for infra-red as well as visual radiation); disaster damage assessment and recovery (by recording disaster scenes in both infra-red and visual light, and by acting as a communications relay); law enforcement (by infra-red scanning day or night); and natural resource protection such as dispersant spraying on oil spills and avalanche control.

Inflight Hazards

- **Counter the bird strike hazard with deflectors over the engine intakes.** Airtankers face inflight hazards that are intensified by the wild fire environment, specifically collisions with

large birds. Deflectors reduce engine damage caused by ingesting birds by deflecting all or most of those birds away from the engine intakes.

Performance Limitations

- **Reduce the safety threat inherent in operating without normal performance margins at takeoff with the choice of higher performance, military attack/fighter type aircraft such as the A-10.**

INNOVATIVE AIRTANKER METHODS

The new and unique capabilities of our innovative airtanker allow for improved fire fighting methods.

Computer Aided Delivery

- **Given the weapons aiming computers retained on the converted attack/fighter type airtanker, or fitted to other airframes, the new liquid delivery method of aiming with computer generated cues projected on a heads up display is enabled.** Weapons aiming computers are programmed with the freefall characteristics of the material to be dropped. They then measure the relevant parameters of the aircraft's performance and its environment to calculate the precise point on the ground where the material will impact. That calculated information is then projected on the aircraft's heads up display in the form of an aiming symbol. The pilot, looking through the heads up display at the terrain in front of him or her, then maneuvers the aircraft to line the aiming symbol up on the desired impact area and releases the liquid when the aiming symbol is superimposed on that desired impact area. The result is airtanker liquid delivery with great accuracy.

Restricted Visibility Delivery

- **Given the infra-red sensor system on this innovative new airtanker, flight and liquid delivery is now practical and safe under restricted visibility conditions such as darkness, smoke and haze which would otherwise prohibit airtanker operations.** If the infra-red sensor is gimbaled, the airtanker pilot can also scan the fire scene from high overhead before approaching for his or her delivery. Since said infra-red system is unaffected by darkness, smoke, haze, etc., singularly or in any combination, liquid deliveries made with the infra-red systems are safe and as accurate as deliveries made in clear daylight. Significant improvements arise from the ability to fight fires, and to navigate visually in the drop area, under darkness and/or totally obscured conditions.

Reduced Response Time

- **Given the capability to refill liquid tanks in flight, our innovative new airtanker allows the new fire fighting method of transferring liquid to airtankers in flight thereby reducing the number of round trips to an air base.** This method greatly increases the amount of liquid

that can be delivered in any given time period which correspondingly reduces the time and resources required to suppress a fire. Even if operated conventionally from airtanker bases, our new airtankers significantly reduce response times by virtue of their greater speed.

Preventive Airtanker Patrol

- **Our innovative airtanker has the capability to patrol over threatened areas while scanning the infra-red spectrum, through darkness and obscuration, for small fires.** When such a new fire is detected, the pilot can suppress it immediately with the other innovative new systems. This new method is an improvement over other scenarios in which airtankers must be led to fires by specialized lead planes. In addition, most airtankers or lead planes in current operation do not operate at night.

Formation Flight

- **Our innovative new airtankers with properly trained pilots are able to attack fires while flying in formation.** The new airtankers, flying in formation, can spread out, overlap or sequence liquid drop patterns in ways that are not now utilized. Formation drops also facilitate a higher concentration of aircraft in the same airspace thereby reducing the time required to suppress a fire and increasing safety (by reducing the number of independent entities in the air near a fire). Formation flight is practical either visually or with the aid of the infra-red systems.

Although our innovative airtanker and the associated methods have been described with reference to the A-10 aircraft, different airframes may be used, and changes and modifications to these specifications may be made without departing from the spirit and scope of our innovations or the associated methods. These systems may also be fitted to current airtankers and other non-attack/fighter type airframes to realize many of the same benefits.

CONVERSION SPECIFICATIONS

Developing our innovative new airtanker begins by selecting a suitable and available airframe for conversion or developing a purpose built model. For this description, the Fairchild A-10 Thunderbolt II will be used as the example airframe for conversion. The technologies described here can easily be designed into other converted or purpose built airtankers.

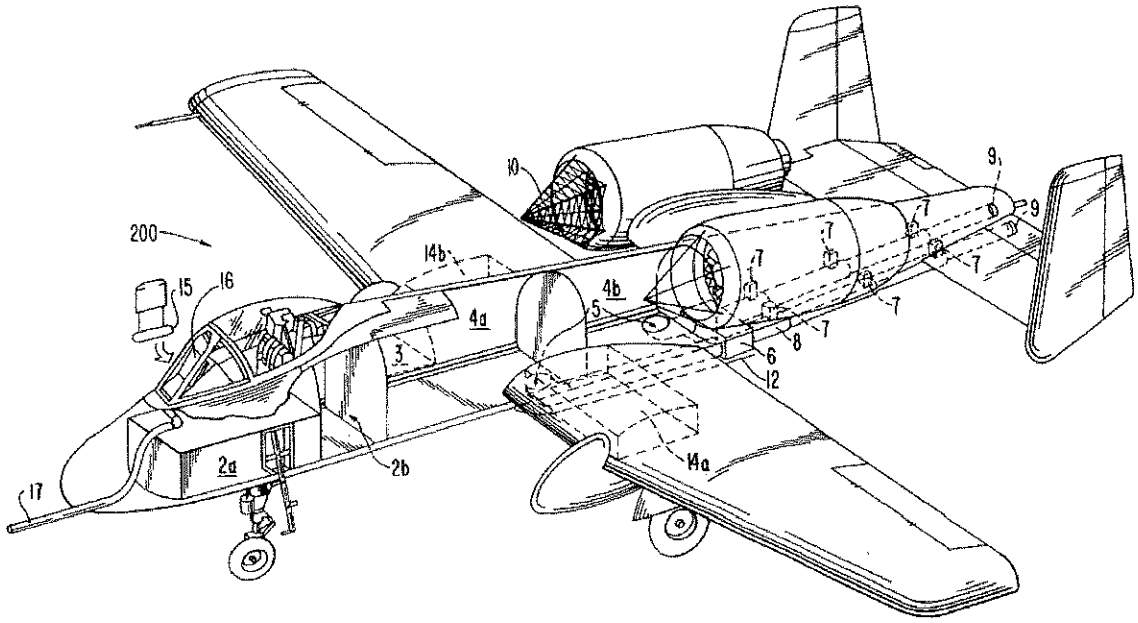

Fig. 1 - Perspective of the converted Fairchild A-10 Thunderbolt II, showing the locations of the major sub-systems

The A-10 (**200**) is first demilitarized by removing the gun, those weapons pylons which are not needed for external fuel tanks, and the militarily sensitive hardware. The two fuselage fuel tanks and their associated plumbing are also removed, but the inflight refueling hardware is retained. Other extraneous hardware and fittings are removed to reduce the aircraft's weight as much as is practical. The two wing fuel tanks **14a, 14b** may also be removed and replaced with the highest capacity conventional fuel cells that will fit in the given space and which are then connected to the remaining plumbing. One or two new fuel cells **2a, 2b** are fitted in the nose approximately in the space vacated by the gun and plumbed so that fuel feeds out of the forward most tank last in order to keep weight in the aircraft's nose as long as possible. The new fuel tanks are plumbed so that fuel from the single point refueling receptacle passes through the left wing, nose, and right wing tanks enroute to the external fuel tanks in order to eliminate fuel stagnation in the nose tanks. Existing external fuel tank plumbing is connected to the new fuel tanks. Appropriate connections are made to the engines and the auxiliary power unit.

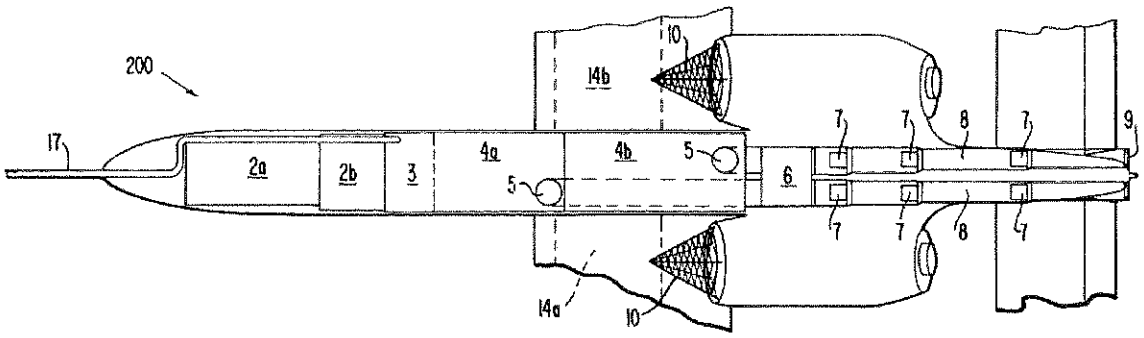

Fig. 2 - Top view of the fuselage section of the converted Fairchild A-10, showing major sub-systems

The fuselage space between the cockpit and the nose fuel tanks forward, and the auxiliary power unit and the internal structure of the tail aft, is filled with one or more baffled liquid tanks **4** designed to make maximum use of the available volume. A refilling fitting is mounted on the aircraft's right side (opposite the single point refueling receptacle on the left side) to allow all tanks to be filled from the standard airtanker retardant refill fitting.

If the aircraft is to be refillable in flight, a refilling probe **17** is mounted in the nose and plumbed to the liquid tanks **4**. A storage tank **3** is fitted within the liquid tanks in such a manner as to hold concentrated retardant when its valves are closed and to be available for liquid storage when its valves are open. A system selectable by the pilot will flush the retardant storage tank so as to mix the concentrated retardant with water coming into the aircraft during in flight refilling. It is also possible to refill with pre-mixed retardant in the same manner.

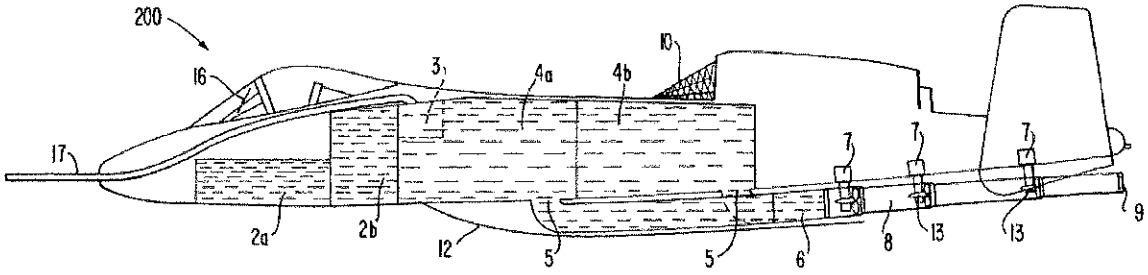

Fig. 3 - Left side view of the converted Fairchild A-10

High capacity plumbing is fitted to the aft-most low point of each tank and passed through the bottom of the fuselage taking care to not interfere with the use of external fuel tanks. If more than one of those tank drains **5** is required, they all then feed aft into a common manifold **6**. One or more large diameter pipes 8 extend either from a single tank drain or the common manifold aft to near the trailing edge of the horizontal stabilizer. The discharge pipes may be stepped down in size to increase discharge velocity. The tank drain(s), the manifold if used and at least the joints with the discharge pipes are covered with

an easily removed hiring **12** for streamlining. The inside of each pipe is polished, and possibly supplied with a non-stick coating, to reduce friction as much as practical. Each said discharge pipe is fitted internally with one or more high capacity impellers **13** which, in turn, are driven by motors **7** mounted within the aft fuselage and connected through shafts (transmissions) extending downward through the fuselage and pipe walls. The motors may be hydraulically driven by the aircraft's existing hydraulic systems (both engines and the auxiliary power unit) though other suitable power sources may be used. The discharge pipes 8 may be angled some few degrees from the aircraft centerline to compensate for the angle of attack at operating airspeeds and other aerodynamic factors. The aft ends of the pipes are supplied with variable nozzles or quick release fittings **9** that allow various fixed nozzles to be installed.

The aircraft is also fitted with an infra-red vision system **15**. That sensor may or may not be gimbaled. If it is gimbaled, then the aircraft will also be fitted with a video monitor in the cockpit. In any case, the infra-red view will be displayable, at the pilot's discretion, on a wide field of view heads up display **16** which replaces the heads up display originally fitted to the A-10. All standard heads up display presentations are retained.

The innovative new airtanker is then stripped of paint, etc. The skin is smoothed and then finished in a high visibility paint scheme with materials chosen to reduce drag as much as is practical.

Since bird strikes are a serious threat, the engine intakes are fitted with a system designed to deflect large birds away from the engines. That deflector **10** may be six or eight solid supports spaced equally around the rim of the intake which join several feet in front of the intake and approximately on the engine's centerline axis. A continuous, extremely high strength fiber or filament is wound through the supports so as to form a mesh. The intent is for the mesh to transfer impact forces as widely as possible across the supports thereby deflecting a substantial portion of the bird away from the engine intake. The aircraft may also be fitted with ram air driven horns or whistles which alert or irritate the most commonly encountered birds when the aircraft is flown at liquid drop airspeeds. The aircraft may also be fitted with high intensity strobe lights oriented forward and intended to frighten or startle birds.

The described airtanker will be used to fight fires in this way: The airtanker will either fly to a known fire or locate the fire independently. On approach to the fire scene, the pilot will scan the area in infra-red to locate the fires and hazards while coordinating with the controlling person or agency. Having been assigned a drop point and liquid pattern, the pilot will then select the combination of discharge tubes and impellers required to meet the assignment while maneuvering to begin the drop run. Viewing the scene in infra-red displayed on the heads up display, the pilot will approach the fire and superimpose the aiming cue on the assigned drop area. When that aiming cue reaches the near end of the drop area, the pilot will begin releasing retardant. When the aiming cue reaches the far side of the drop area, the pilot will cease releasing retardant. He or she will then repeat the drops until the liquid tanks are empty and then refill those tanks from an orbiting aircraft or at the tanker base.

About USA Firefighting Air Corps

USA Firefighting Air Corps (USAFAC) is a Denver, Colorado company in formation. Our business model draws on the multidisciplinary process which led to the successful establishment, funding, and launch of the Colorado Firefighting Air Corps, an initiative begun in 2012 to address the gap between what aerial firefighting resources Colorado needs and what the state can expect to receive in a timely manner from the Federal government.

The mission of USAFAC is to help grow the newly-redefined United States and international aerial firefighting market by assisting local, tribal, state, regional, and national entities in developing and maintaining their own firefighting air corps; provide fire aviation and related firefighting products and services, as well as the necessary research, promotion, coalition-building, recommendations, consensus-building, financing, acquisition facilitation, and implementation tracking related to the purchase and use of fire aviation and related firefighting products and services; and develop and promote research and development of intellectual property, economic development opportunities, public-private partnerships, and other financial offerings in connection with these fire aviation activities.

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