Oct. 3, 1961 J. E. WETZEL ET AL 3,002,708

AIRCRAFT TOW REEL SYSTEM

Filed Sept. 28, 1959 3 Sheets-Sheet 1

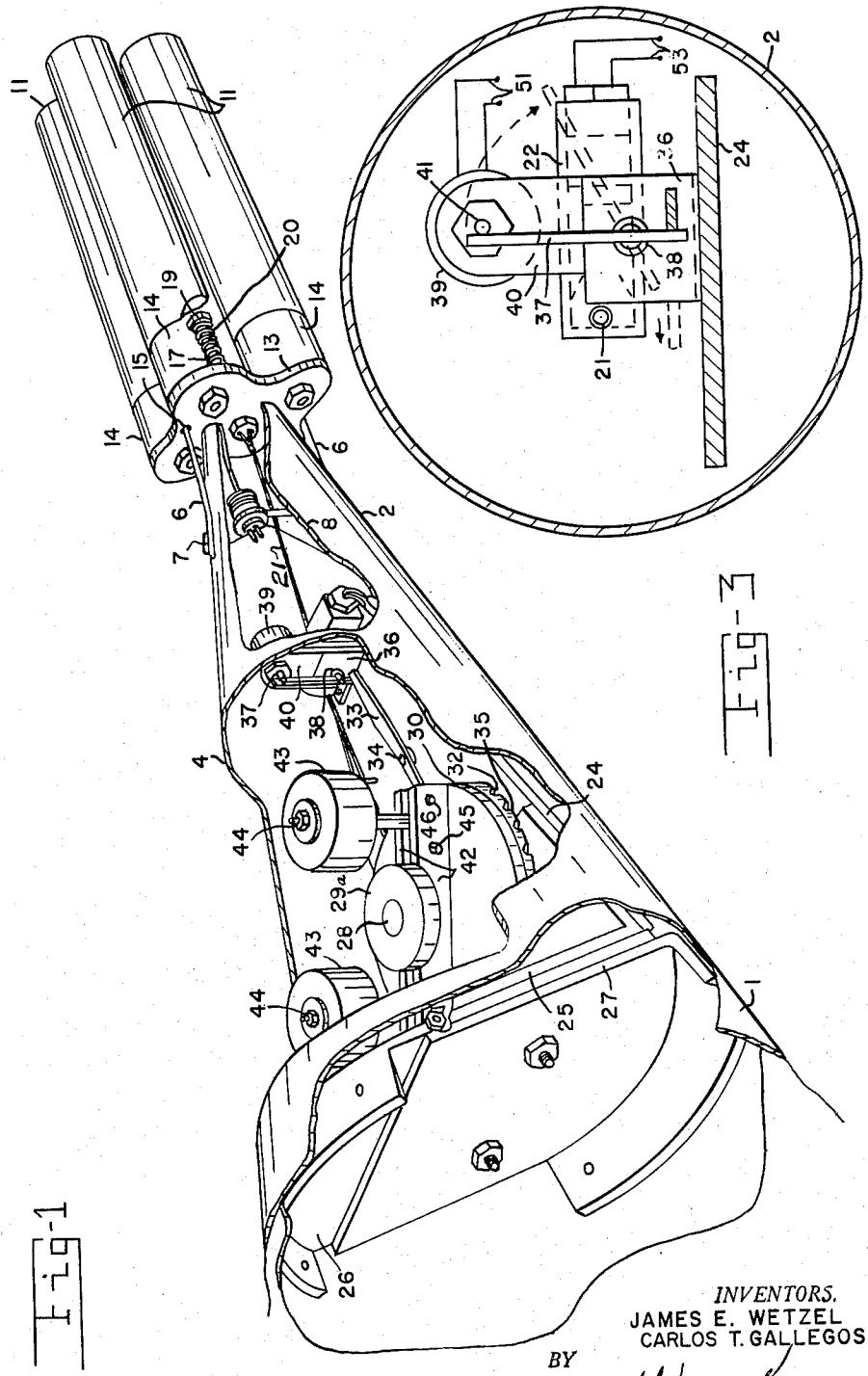


Fig-1

Fig-2

INVENTORS.
JAMES E. WETZEL
CARLOS T. GALLEGOS

BY

Wade Coontz
Charles R. Wagner
ATTORNEYS

Oct. 3, 1961 J. E. WETZEL ET AL 3,002,708

AIRCRAFT TOW REEL SYSTEM

Filed Sept. 28, 1959 3 Sheets-Sheet 2

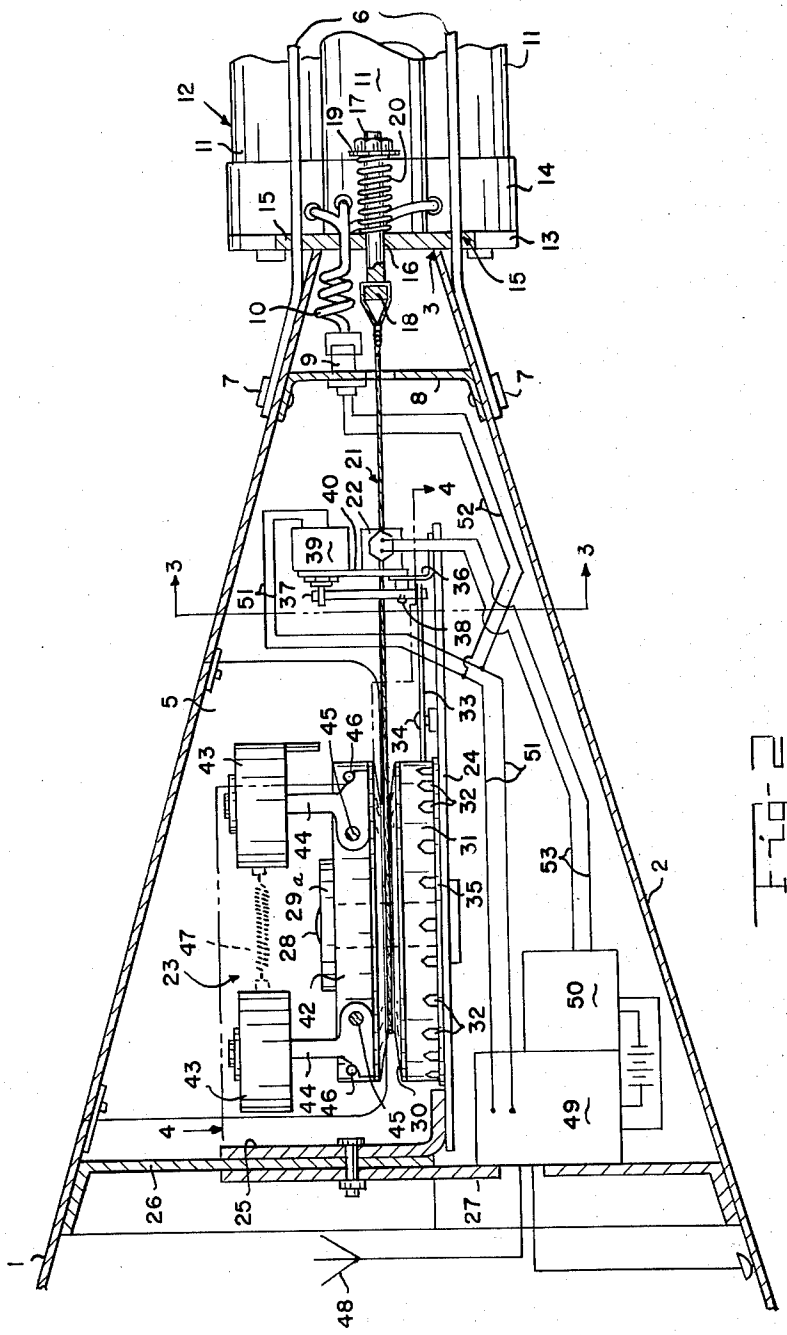


Fig. 2

INVENTORS.
JAMES E. WETZEL
CARLOS T. GALLEGOS

BY

ATTORNEYS

Oct. 3, 1961 J. E. WETZEL ET AL 3,002,708

AIRCRAFT TOW REEL SYSTEM

Filed Sept. 28, 1959 3 Sheets-Sheet 3

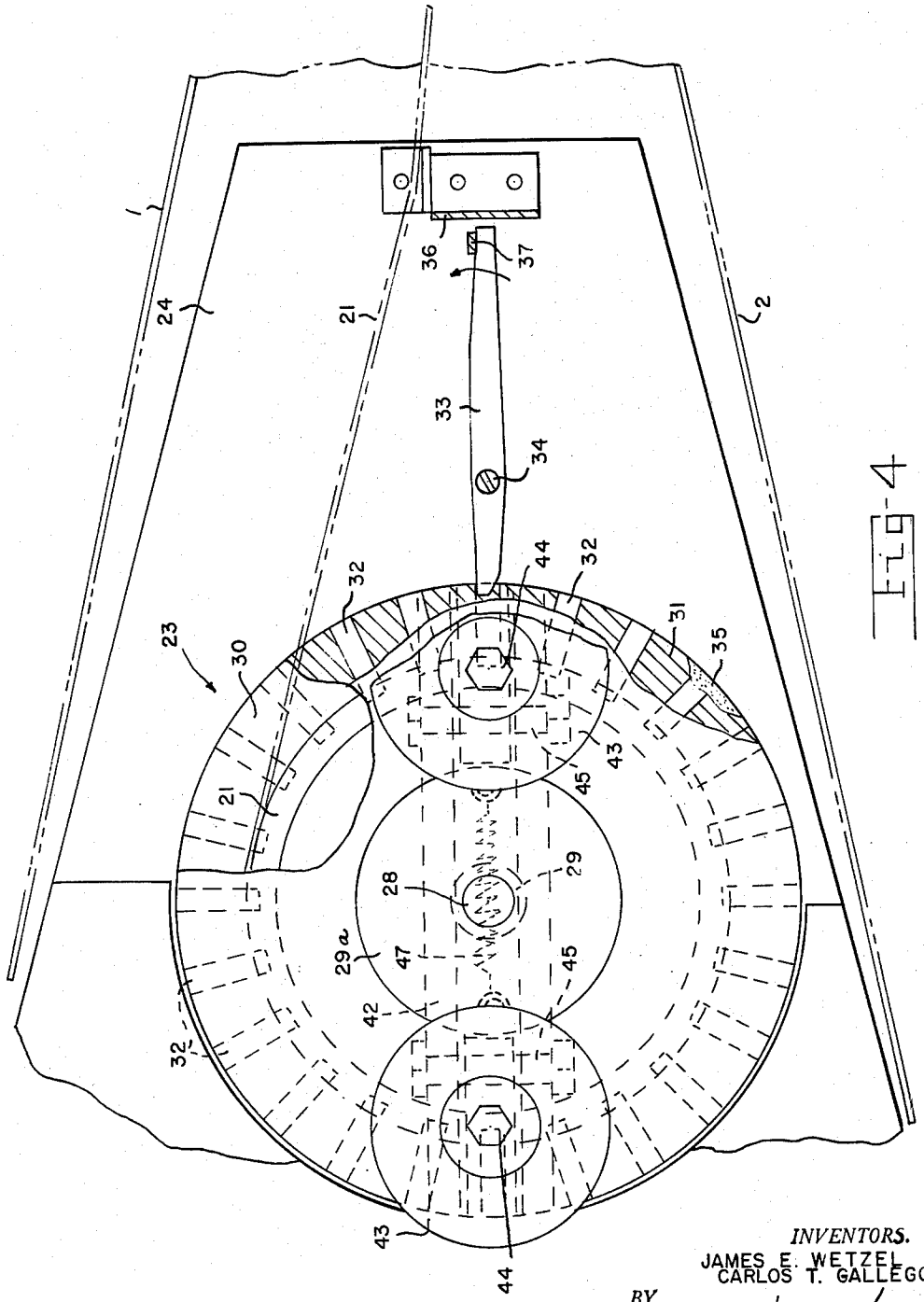


Fig. 4

INVENTORS.
JAMES E. WETZEL
CARLOS T. GALLEGOS

BY Wade Koontz and Charles T. Wagner
ATTORNEYS

United States Patent Office 3,002,708 Patented Oct. 3, 1961

3,002,708
AIRCRAFT TOW REEL SYSTEM

James E. Wetzel, Hawthorne, Calif. (AFBMD—A.F. Unit P.O., Los Angeles 45, Calif.), and Carlos T. Gallegos, Star Rte., Box 146H, Fort Walton Beach, Fla.

Filed Sept. 28, 1959, Ser. No. 843,023
3 Claims. (Cl. 244—3)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to us of any royalty thereon.

This invention relates to improvements in aircraft tow reel systems and more particularly a tow reel system primarily for use with "drone" aircraft targets for use in connection with ultra-high speed missiles, such as "IR" missiles, and has for an object the provision of a simple reliable IR (Infrared) target system which provides greater drone aircraft recovery, with minimum likelihood of impact or damage to the drone aircraft target by the IR missiles.

A further object is the provision of tow reel and pyrotechnique flare target which is radio controlled to extend the tow cable and flare to a safe towing distance behind the drone aircraft after the same is airborne in flight and ready for IR missile interception.

A further object is the provision of radio controlled means for severing the tow cable from the drone aircraft, preferably close to the drone aircraft to permit the drone aircraft to be landed without the flare target or tow line attached.

A further object includes centrifugal brake means for the reel to cause the unreeling of the tow line and flare at a predetermined controlled rate, which is radio control released.

A still further object is the provision of radio controlled means for releasing the reel for unreeling the tow cable and means for igniting the flare means as the tow reel is released.

Another object is the provision of remote controlled cable cutter means for separating the tow cable and attached flare at any time from the reel.

A further object is the provision of a wing tank for a drone aircraft in which is mounted the improved tow reel, centrifugal governor, reel locking means, cable cutting mechanism, and radio remote control means therefor.

A further object includes guide and supporting means for supporting the tow target flare means on the rear end of the wing tank of the drone aircraft and includes resilient means between the flare target device and the tow cable for resiliently tensioning the flare device against the rear end of the wing tank, and cushioning the pull of the flare device or the tow cable.

A further object includes a multi-flare device and electrical means for simultaneously releasing the tow cable for extension and igniting the flares.

Other objects and advantages of the invention will become apparent from the following description and accompanying drawings in which:

FIG. 1 is a somewhat diagrammatic perspective view of the rear portion of a drone aircraft wing tank, parts being broken away and/or shown in section, and disclosing the invention incorporated therein.

FIG. 2 is a fragmentary vertical longitudinal sectional view taken through the rear end of a drone aircraft wing tank, parts being broken away, and schematically showing the radio remote control receiving apparatus for releasing the tow reel, and igniting the flare, and the means for actuating the tow cable cutter means.

FIG. 3 is a fragmentary detailed transverse sectional view taken about as the plane indicated by the line 3—3 in FIG. 2, parts being broken away and shown in section.

FIG. 4 is a fragmentary longitudinal vertical sectional view taken through the rear portion of an aircraft wing tank incorporating the invention, taken about on line 4—4 of FIG. 2, part of the wing tank and tow cable being shown in phantom.

In the drawings the reference numeral 1 denotes a portion of a "wing tank" of a drone or target aircraft and has a rearwardly flaired or tapered end portion 2 terminating in a circular extremity 3, which is open rearwardly.

The upper intermediate portion of 2 has an access opening 4 which may be closed by a door or other suitable closure 5 which is removably secured in any suitable manner.

Extending rearwardly from the rear extremity of the structure 2 are supporting guide means 6, which may consist of parallel rearwardly extending guide rods bolted or otherwise secured to the shell 2 by bolts 7 passing through a suitable mounting and reinforcing plate means 8.

The plate means 8 is preferably shaped to fit the interior of the tapered end portion 2 and is provided with a terminal or common plug quick disconnect 9 for the electrical "firing" connection 10 to the flares 11 of a flare unit 12.

The flare unit 12 includes a front plate 13, preferably having flare holders 14 for the flares, four being disclosed in the drawings. The plate 13 is also provided with guide openings 15 for supporting relation of the flare unit 12 on the supporting parallel guide rods 6. The plate 13 is also provided with a central guide opening or bushing 16 for a tow bar 17 which is slidably disposed therein.

The tow bar 17, as shown in the drawings, is in the form of a bolt having a transverse opening under its head 18 and a washer and nut 19 secured on the opposite or threaded end, a compression coil spring 20 being interposed between the washer just mentioned and the rear face of the front plate 13.

A tow cable 21 is provided for the flare unit and is fastened through the opening in the bolt 17 and the spring 20 functions as a "shock absorber" for the flare unit, particularly when it is drawn up tight against the rear end 3 of the tapered portion 2, and for any turbulence effect in the air stream on the flare unit while the flare unit is being towed on the tow cable 21.

The tow cable 21 extends forwardly through, or past, the reinforcing plate 8 and passes through an electrically operated cable cutter 22 onto a cable reel of a centrifugally brake controlled, electrically released cable reel unit 23.

The cable unit 23 is mounted on a horizontal cable reel supporting plate 24 which is flanged upwardly at its forward end at 25 and is bolted or otherwise secured to a pair of complemental flanged circular plates 26 and 27 forming a sort of supporting and reinforcing bulkhead across the wing tank portions 1 and 2.

The horizontal supporting plate 24 is provided with an upwardly extending stub axle or trunnion 28 having an enlarged head or bushing 29a therein for retaining the cable reel 30 and preventing upward movement of the cable reel 30.

The lower portion 31 of the cable reel 30 is provided with a plurality of locking notches 32 evenly spaced around its lower edge for latching engagement with a pivoted horizontal locking lever 33 pivoted at 34 on the horizontal supporting or base plate 24.

A disk of brake or friction material plate or lining 35 is interposed between the lower surface of the cable reel lower portion 31 and the upper surface of the base plate 24.

As before inferred the tow cable 21 passes substantially centrally through the conical portion 2 from its anchored

connection or attachment to the flare unit 12 and is wound or reeled on the cable reel 30 with its other end firmly secured in the cable reel 30 in any suitable or preferred manner, the tow cable 21 passing through the explosive cable cutter 22 which is fixed on the base plate 24, on an angle plate 36, substantially as shown.

A vertical locking lever 37 is pivoted on the angle plate 36 at 38, intermediate its ends, the short end of which, when in locking relation, retaining the horizontal latching lever 33 with the short end thereof disposed in one of the notches 32, prevents rotation of the cable reel 30 under influence of the pull or tension of the tow cable caused by the slip stream on the flare unit, and the tension of the spring 20 while the cable reel 30 is locked, as mentioned, with the tow cable fully reeled in.

Thus the horizontal latching lever 33 is disposed to swing in a horizontal plane, when released by the vertical lever 37 to allow the short end to disengage the notches 32 and free the reel for rotation under influence of the tow cable, also the vertical locking lever is disposed, when locked, with its lower end in the path of the long end of the horizontal lever 33, and when released swings in a vertical plane, under the influence of the tension or pressure of the long end of the lever 33, and pivots in a vertical plane about the pivot 38, out of the path of the long end of the horizontal lever 33.

The means for locking and releasing the long end of the vertical lever 37 consists of a solenoid 39 mounted on a plate extension 40 carried by and above the angle plate 36 and is located above the cable cutter 22.

The axis of the solenoid 39 is disposed parallel to the axis of the vertical lever pivot 38 and preferably directly above the same and the "plunger" of the solenoid has an axial extension 41 moved by the plunger from a locking position in the path of the upper end of the vertical locking lever 37 to a position out of the path of the locking lever 37 to free the locking lever 37 for its swinging movement when the solenoid 39 is energized.

As before mentioned the cable reel 30 is centrifugally brake controlled and this preferably comprises a pair of transverse brake arms 42 extending across the top of the cable reel in parallel horizontal relation at opposite sides of the trunnion and bushing 29 and under the head or plate 29^a, the arms being fixedly secured for rotation with the cable reel 30.

Fly weights 43 carried on fly weight arms 44 which are pivoted in offset relation between the cross bars or brake arms 42 at pivot points 45 and have camming toe portions disposed to cam the cable reel downwardly into rotation resisting engagement with the brake lining 35 when the fly weights swing outwardly during rotation of the cable reel, and thus limit the rate of out-haul of the tow cable when the cable reel is released by energizing the solenoid 39. While not essential the fly weight arms may be provided with toe portions extending outwardly under the cross or stop pins 46 to limit the inward swing of the fly weights toward each other, also some yieldable connection such as a light spring 47 may be provided between the weights or arms having a predetermined tension for yieldably controlling the outward swing and centrifugal braking action of the fly weights when the cable reel or drum 30 is rotated by out-haul on the tow cable.

The remote or radio controlled means for controlling release of the cable drum locking means, solenoid 39, and the cable cutter 22 and igniting the flares is schematically illustrated in FIG. 2 and may comprise an antenna 48 for the reception of suitable radio control signals from the ground or "mother" airplane, the signals being fed into a discriminating network or circuit and suitable amplifiers, and fed into a radio control unit 49 for the release of the cable reel 30. Energy from the radio control unit 49 for the release of the reel and ignition of the flares is supplied to solenoid 39 by the circuit wires 51, and to the flare igniting squibs by the wires 52 through the disconnect plug 9 and the firing pigtail connection 10 to the flares 11.

Thus, as shown, the flares 11 are ignited and the flare unit 12 is released for rearward travel or displacement substantially at the same time. Of course, delayed action squibs may be used, if desired, to delay the ignition of the squibs until after a considerable amount of tow cable is reeled out.

The cable cutter 22 is preferably of the "explosive" actuated type, but the details thereof form no part of the invention and are not shown. Any type, such as a piston cutter actuated by a powder charge which is exploded by an electrically initiated squib may be employed.

The cable cutter signal from the cable cutter unit control box 50 is led to the cable cutter through the circuit wires 53.

Briefly describing the operation, the reel will be rotated in "loading" with the horizontal lever 33 disengaged from the notches 32 to reel in the tow cable 21 until the flare unit 12 is drawn into contact with the rear end 3 of the conical section 2, with the supporting guide rods 6 disposed in the guide openings 15 in the front plate 13. This can be accomplished manually through the access opening 4.

The reel can be rotated further causing some compression of the spring 20 on the bolt 17. The horizontal locking lever 33 can now be swung to dispose the short end or nose in latching engagement with one of the notches 32.

The vertical locking lever 37 can now be swung into locking engagement in front of the longer arm portion of the lever 33, thus locking the first lever, and the reel as seen in FIG. 2. The extension 41 on the plunger of the solenoid 39 is now projected forward, in front of the long arm of the vertical lever 37, locking the vertical lever against the release of the lever 33.

In assembly, when, or just before the front plate 13 of the flare unit 12 is drawn into contact with the rear end of the tail section 2 the cannon slip plug 9 is assembled and the device is now assembled and ready for take off of the drone tow plane, the parts being now in the position shown in FIG. 2.

When it is desired to release the flare unit 12 for towing behind the drone tow plane and ignite the flares 11 a proper radio signal from a predetermined frequency is transmitted, either from the ground or another accompanying airplane is received by the antenna 48 which, after reception and amplification, energizes the solenoid 39 to withdraw the plunger extension 41 out of the path of the vertical lever 37, unlocking the same. The pull of the flare unit on the tow cable plus the compression of the spring 20 rotates the reel 30 to swing the horizontal lever 33 out of latching engagement with the notches 32, which swings the locking lever 37 out of the way and the flare unit 12 is released for rearward movement off of its supporting guide rods 6. Simultaneously current from the conductors 51 through the conductors 52, cannon plug 9, and connector 10 fires the squibs to ignite the flares. By employing a "time delay" squib the ignition of the flares may be delayed until the flare unit 12 is disposed on the tow line at a material distance behind the tow aircraft.

As the tow reel 30 is rotated by the tow cable 21 the fly weights 43 move outwardly under centrifugal force so that the lower camming ends of the arms 44 engage the top of the cable reel 30, forcing the same downwardly on the bushing against the brake or friction lining 35 and thus limits the rate at which the tow cable 21 and flare unit 12 are payed out.

When all of the tow line provided is played out the flare unit is or should be ignited and trailing the drone aircraft at a sufficient safe distance to avoid the danger of "heat seeker" and "infrared" directed missiles intercepting the drone airplane instead of the trailing flare target.

When it is desired to land the drone aircraft, as usual, under radio control, a radio signal of proper predetermined frequency is transmitted from the ground or accompanying aircraft and is received by the antenna 48 and discriminating control network, and transmitted through the conductors 53 to the ignitor for the powder charge in the cable cutter 22, energizing the same to sever the tow cable 21 from the drone aircraft and the drone aircraft can now be landed in the usual manner.

While only one embodiment of the invention has been illustrated and described, other changes and modifications, which will now appear to those skilled in the art may be made without departing from the scope of the present invention, reference being had to the appended claims for a definition of the scope of the present invention.

We claim:

1. In a drone aircraft a wing tank formed with a tapered rear end portion, a horizontal support plate fixed within said tapered portion, flare target supporting guide means fixed to said tapered rear end portion and extending rearwardly therefrom, a multiple flare unit supported against the rear end of said tapered portion on said target supporting guide means, a tow cable secured at one end to the forward end of said flare unit for towing thereof, a resilient towing connection between the tow cable and the flare unit, a cable reel rotatably mounted on said support plate with the tow cable wound thereon having its other end secured to said cable reel, centrifugal speed governor control means between said cable reel and said support for controlling the rate of rotation of the cable reel and rate of pay-out of the tow cable, releasable locking means carried by said support plate in locking engagement with said cable reel to resist rotation thereof in a direction for paying out said tow cable, radio signal actuated control means carried by said tapered portion responsive to radio signals of a predetermined frequency for releasing said releasable locking means to free said cable reel for paying out said tow cable, including means operable thereby for igniting said flares of said flare unit substantially simultaneously with the release of said cable reel and the outward reeling of said tow cable.

2. In a drone aircraft, a wing tank formed with a conically tapered rear end portion open at its rear end, a horizontal support plate fixed wholly within said tapered rear end portion, vertically spaced flare target supporting guide rods extending rearwardly from said tapered rear end portion in parallel relation at opposite sides of the axis of said tapered rear end portion, a multiple flare unit supported against the rear end of said tapered rear end portion having an apertured front plate with vertically spaced apertures receiving said guide rods therethrough, a tow cable secured at one end to the center of said front plate between said apertures, including spring tension means between the cable and the front plate for tensioning said multiple flare unit on said guide rods against the rear end of said tapered rear end portion when said cable is drawn in taut, a cable reel rotatably mounted on said support plate with said tow cable wound thereon having its other end secured to said cable reel, centrifugal speed control governor means between the cable reel and said support for controlling the maximum rate of rotation and rate of payout of said tow cable, a locking lever pivoted on said horizontal support plate for holding engagement with said cable reel to prevent rotation thereof in a direction for paying out said tow cable, solenoid release means carried by said support plate for normally retaining said locking lever in reel locking position, a flare igniting circuit within said rear end portion for igniting said flares including a detachable electrical connection therebetween, and radio signal actuated control means carried by said tapered end portion, connected to said solenoid release means, and to said flare igniting circuit for simultaneously releasing said locking lever for releasing said cable reel for paying out said tow cable and igniting said flares.

3. In an aircraft target towing system, a wing tank having a conically tapered rear end portion terminating in a vertical open end face, a horizontal support plate fixed wholly within said tapered rear end portion, vertically spaced flare target supporting guide rods fixed to said tapered rear end portion at opposite sides of said vertical open end face and extending rearwardly therefrom in parallel relation, a multiple flare unit having an apertured vertical front face plate having vertically spaced apertures receiving said guide rods, a tow cable secured at one end to said front face plate intermediate said apertures therein including spring tension means between said cable and said front face plate for tensioning said front face plate against said vertical open end face, a cable reel rotatably mounted on said supporting plate, said tow cable wound on said cable reel with its opposite end secured thereto, a locking lever horizontally pivoted intermediate its ends to said support plate having one end disposed for holding engagement with the periphery of said cable reel, a second locking lever pivoted on said supporting plate intermediate its ends in a vertical plane having its lower end disposed for holding engagement with the other end of the first mentioned lever, a release solenoid carried by said supporting plate for holding engagement with the other end of the second lever, a release circuit including radio control energizing means therefor within said tapered end portion for energizing said solenoid and simultaneously igniting said multiple flare unit, and radio controlled means for severing said tow cable from said tow reel while said tow cable is extended.

References Cited in the file of this patent

UNITED STATES PATENTS

2,813,719	Hopper	Nov. 19, 1957
2,869,120	Lolmaugh et al.	Jan. 13, 1959
2,923,549	Hopper et al.	Feb. 2, 1960