April 14, 1953 O. BROWN 2,634,924

MEANS AND METHOD FOR CONDUCTING WARFARE

Filed Nov. 1, 1946 3 Sheets-Sheet 1

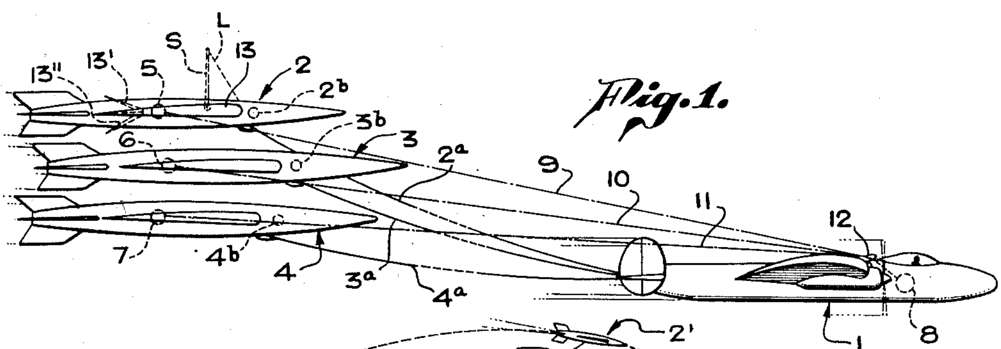


Fig. 1.

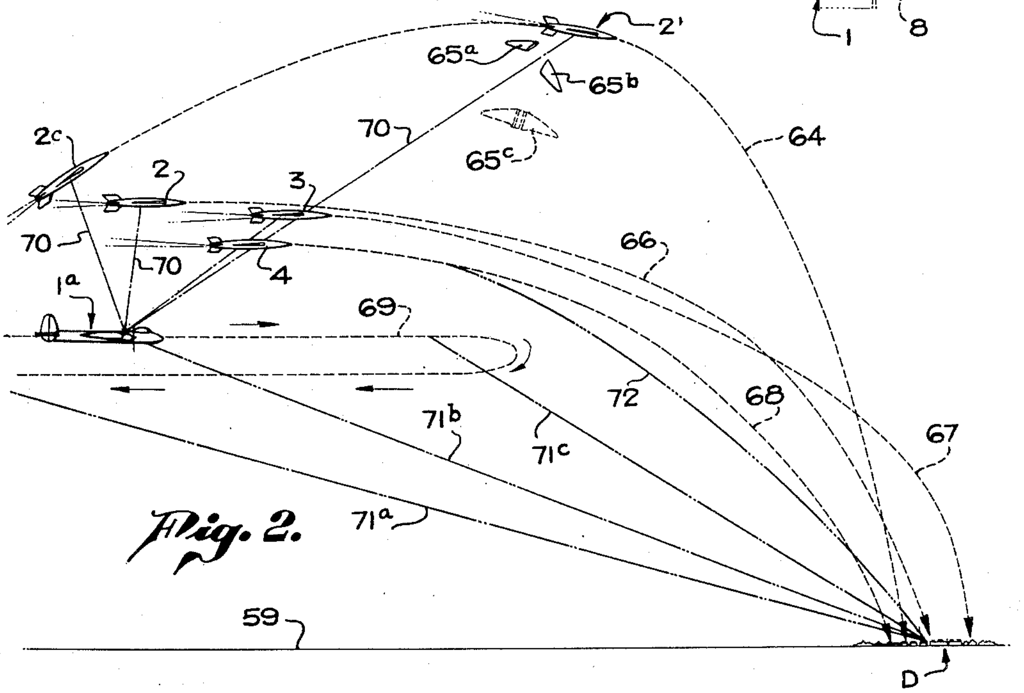


Fig. 2.

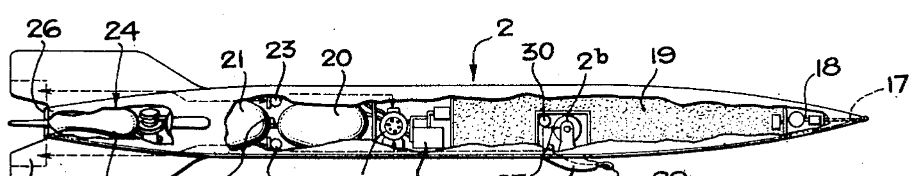


Fig. 3.

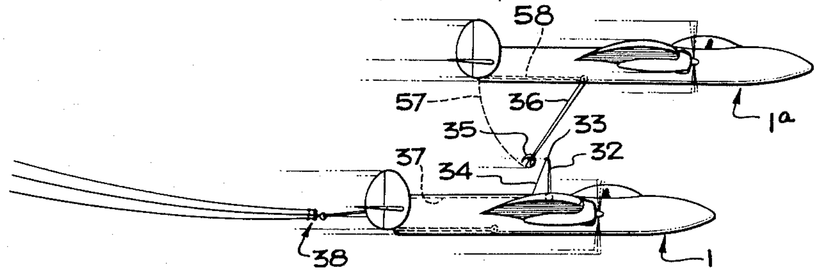
Oscar Brown
INVENTOR.

April 14, 1953 O. BROWN 2,634,924

MEANS AND METHOD FOR CONDUCTING WARFARE

Filed Nov. 1, 1946 3 Sheets-Sheet 2

Fig. 4.



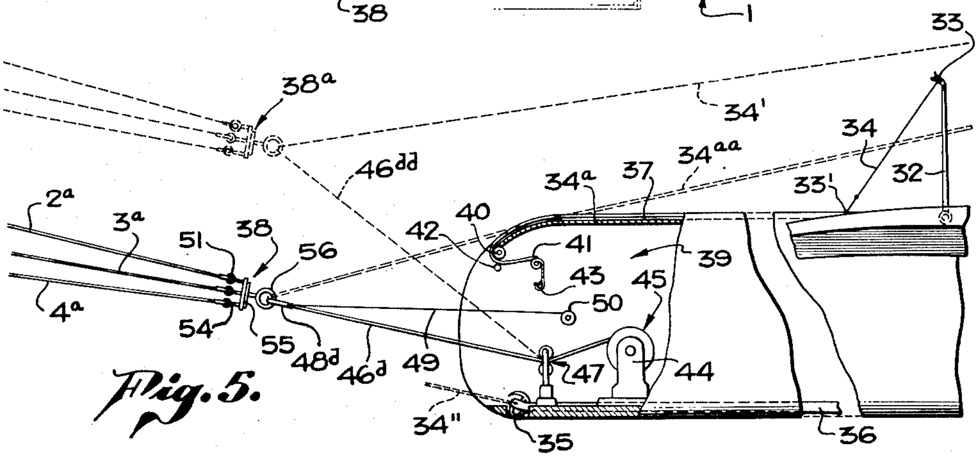


Fig. 5.

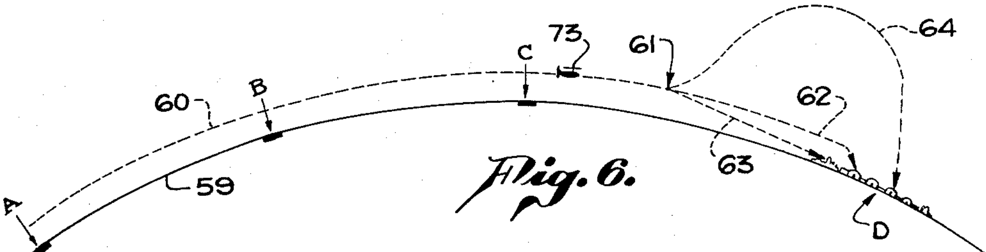


Fig. 6.

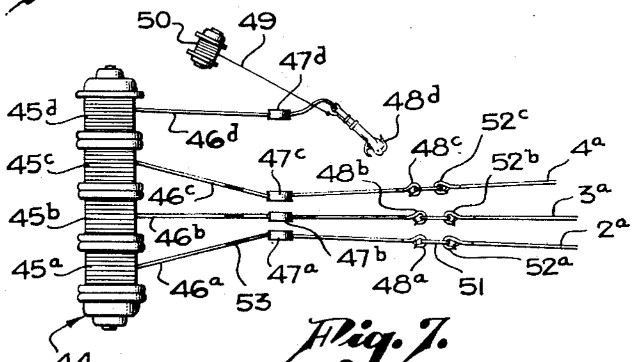


Fig. 7.

INVENTOR.

April 14, 1953 O. BROWN 2,634,924

MEANS AND METHOD FOR CONDUCTING WARFARE

Filed Nov. 1, 1946 3 Sheets-Sheet 3

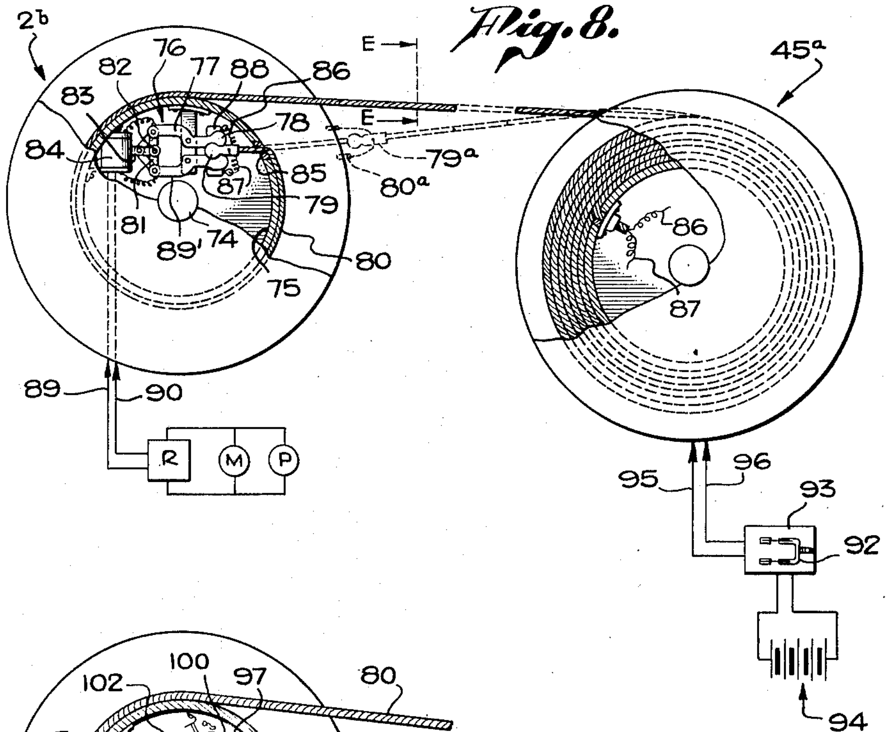


Fig. 8.

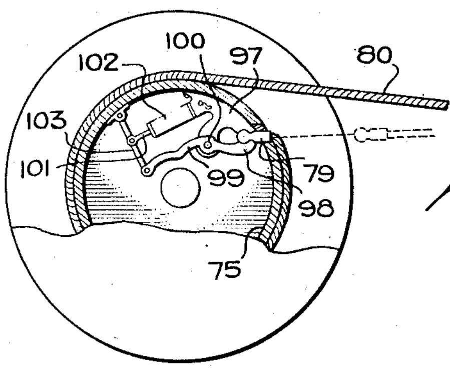


Fig. 10.

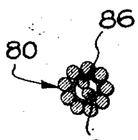


Fig. 9.

INVENTOR.

Patented Apr. 14, 1953

2,634,924

UNITED STATES PATENT OFFICE

2,634,924

MEANS AND METHOD FOR CONDUCTING WARFARE

Owen Brown, Los Angeles, Calif.

Application November 1, 1946, Serial No. 707,152

10 Claims. (Cl. 244—3)

1

My invention comprises a new method of waging warfare. It also comprises the physical means for waging such warfare.

In general, it is the primary object to provide both a means and a method whereby, following adequate preparation, it would be possible (1) to demolish a major portion of an enemy's industrial and military plant on the first offensive and (2) to thence transport sufficient armed forces to enemy terrain to complete the saturation of the leading objectives.

According to the invention, flyable, guidable bombs of the new type to be hereafter described could be launched initially within the borders of continental United States if need be, and, following an airborne journey to any predetermined area on the globe within a matter of hours, could be trolleyed down upon the enemy objectives with great accuracy, landing with warheads equalling 50% or more—if desired—of the total inboard load, the necessary fuel component occupying no more bulk, necessarily, than that reserved for the exceedingly small existing warheads.

The precise techniques for accomplishing this result, along with sundry more specific objectives, will be detailed following a brief explanation of the drawings, wherein:

Fig. 1 discloses, in side elevation, a towplane speeding over the first segment of an air route toward an enemy objective, with a plurality of towable type rocket bombs entrained therewith.

Fig. 2, also side elevational, shows diagrammatically how the flyable, towable rockets of Fig. 1 may disconnect at great altitude from the parent tow-plane, may be thereafter self-propelled, and may be guidably directed electronically from means aboard the two-plane, or otherwise, upon a relatively nearby target according to either V–1 or V–2 techniques, to be further explained.

Fig. 3 is a side elevational view of one of the towable rocket bombs seen in Figs. 1 and 2, broken open primarily to illustrate one optional arrangement of an enlarged warhead load in relation to the correspondingly reduced but fully adequate reserves of fuel and liquid oxygen.

Fig. 4, in side elevation, shows how the locomotive plane of Fig. 1, on arriving aloft of a predetermined relay station, as later explained, is met by a similar tow-plane which has been heavily fueled for tow duty along the next segment of said air route to said objective, and equipped with means to take over the tow-burden from said first plane at coordinated speeds therebetween.

2

Fig. 5 is side-elevational, and is a detail view of the rear-end portion of the tow-plane of Fig. 1, minus the empennage airfoils, and broken away to show certain burden-switching apparatus thereon which cooperates with means complementary thereto on said similar tow-plane of Fig. 4.

Fig. 6 is a diagrammatic view of a segment of the earth's surface, blocked off into an air-ground and/or air-water route having thereon, at predetermined intervals intermediary of a primary launching point and an enemy objective, a plurality of refueling and relay stations according to the invention.

Fig. 7 is the plan view, in schematic lay-out, of burden-handling and burden-transferring tackle such as employed in connection with the burden-switching operation of Fig. 4, and as seen, in part, in the detail view of Fig. 5.

Fig. 8 is the side-elevational, schematic and partly broken open view of a cable-release mechanism which may be employed, respectively, on the tow-bombs and the locomotive plane of Fig. 1.

Fig. 9 is a cross-section of the tow-cable of Fig. 8 taken at line E—E, and

Fig. 10 is the broken open side-elevation of another cable drum applicable to the tow-bombs of Fig. 1, being a minor modification of the cable-release arrangement shown in the upper of the drums of Fig. 8.

It will be understood, of course, that like reference characters in the drawings indicate parts of like structure and like functions unless otherwise specifically noted.

Referring to Fig. 1, the tow-plane **1** is observed to be towing a triality of glidable, towable rocket bombs **2**, **3** and **4**, although, by option, the glider train may include but a single glider or any other desirable plurality thereof in any preferred formation. Obviously, no effort has been made to indicate a particular airborne arrangement of the tow-bombs, other than to clearly visualize the respectively named components as aforesaid.

These "tow-bombs," as hereafter conveniently so-called, are connected to plane **1** by respective glider-lines **2**ᵃ, **3**ᵃ, and **4**ᵃ, said lines being appendant from inboard reels **2**ᵇ, **3**ᵇ and **4**ᵇ respectively on the gliders. Said reels are operated by remote control from plane **1**, as required; and, in like manner, other auto-control mechanisms on each of the gliders, indicated schematically at **5**, **6** and **7**, are adapted for actuation from the hypothetical control-panel or the like **8** on plane **1**, as further indicated by electronic control beams **9**, **10** and **11** emitted from suitable sending means; the latter being conveniently indicated only by the loop antenna 12.

In practice, the means for receiving and releasing radiant energy at plane 1 could be located on the wings or elsewhere as desired. Controls 5, 6 and 7 are not shown in graphic detail, since they may be similar to instrumentalities which have long been employed for the electronic remote control of flyable bodies from master-pilot means; that is, such as used, for illustration, on so-called parent or mother planes for operating so-called drones. The same are, however, further represented in the larger view of Fig. 3, to be shortly referred to, and are operable mainly to actuate the flight controls and related devices.

Thus, similarly, reels 2^b, 3^b and 4^b may also be operated directly from controls 5, 6 and 7, following master actuation from control point 8 on plane 1. The detailed mechanism for operating these reels can readily be supplied by any of various designers in this division of the art, after the benefit to be derived from my disclosure; and while it would be unprofitable to dwell here in detail upon these features, it may be pointed out that sundry patents, which deal with such devices, have been issued. (Later, means for direct electrical actuation of the reels will also be described.)

For example, one means for simultaneously controlling the flight of a plurality of gliders relative to the aerodynamic movements of a locomotive plane is set out in Patent No. 2,400,400 to John Van Buren Duer; and, as another reference, Patent No. 2,399,215 to Delmer S. Fahrney may be mentioned. However, these and particular other patents touch only upon special features of pilotless flight control, which art has been well developed in recent years. The same applies equally to cable-release mechanisms; and, depending upon which of the possible options are to be employed relative to glider-lines 2^a, 3^a and 4^a, one or another of the releasing devices used in the late war by the Air Transport Command will doubtless fulfill the requirement.

One type of cable-release, for instance, is detailed in the patent to said Fahrney while another, more preferred version was mentioned relative to Figs. 8 to 10.

Plane 1 is an hypothetical aircraft, and while shown as a twin-motored, propeller-driven tractor of medium size, it may be of any desirable size and configuration for the services required, depending—for example—upon the size and number of the tow-bombs to be towed; and said plane may be driven by pure jet thrust, by propeller-jet, or otherwise.

The tow-bombs are fitted with the required airfoils, such as a wing or wings 13, and, with special reference to Fig. 3, control vanes 14 which are operable from radio controls 15 in conjunction with the gyro-stabilizer 16. Other obvious features of the tow-bomb of Fig. 3—identified as rocket bomb 2—are fuse 17, target-seeker 18, warhead 19, fuel tank 20, oxygen tank 21, fuel line 22, control vane motor or motors 23, rocket motor 24 including the usual fuel and oxygen injection lines, burners, turbines, cooling jacket, combustion chamber 25 and efflux nozzle 26.

The target-seeker may include television equipment, or any other standard mechanism having, in general, a comparable relation to the remainder of the bomb. Other minor features are, of course, well known in the art, hence need not be graphically indicated; and some of these, especially as related to improved types of atomic weapons, remain military secrets.

Reel 2^b pays off cordage over sheave 27, and through the belly fixture 28, to the terminal 29; which latter is formed for connection in any suitable manner to the glider-line 2^a (Fig. 1). According to specific structures and techniques, a cable terminal such as disclosed in said patent to Fahrney could be utilized.

Obviously, too, the required flaps, tabs, and the like on wings 13 (not shown in the broken away view of Fig. 3) may be operated from controls previously mentioned; and if it is desired to segregate the operation of reel 2^b from the other auto-control fixtures, the same could have a separate servomotor 30, and said motor, as elected, direct-connected to the reel. Motor 31 may be an auxiliary flight control motor. Element 13 can be in the form of a single, unitary wing or in two separate sections. And whether one or a plurality, the adjustable dive-flaps 13′—13″ could either be set automatically or variably remote-controlled.

Reverting to tow-plane 1: It is important to consider that its primary function is (*a*) to carry one or more gliders aloft from a given take-off point; (*b*) to travel a predesignated aerial pathway thence to a particular station or transfer point on said pathway; and (*c*) to meet a similar tow-plane at said transfer point, in order to effect delivery thereto of said tow-burden at altitude, and without necessarily lessening its speed materially or that of the tow-bomb or bombs during the delivery. Therefore, having been designed with these ends in view, plane 1 need have no excess passenger or cargo space, and every available cubic foot of the fuselage and wing interiors may be utilized to carry the fuel load.

This substantially all-fuel type of carrier, then, having no other pay load whatever, should make possible cruising ranges substantially greater than the ranges of most piloted aircraft. Moreover, as the weight of the fuel load becomes decreased in flight, the cruising speed may be increased accordingly.

If, therefore, to be extremely conservative, a cargo transport of like construction but with greatly restricted fuel reserves can fly non-stop a given distance—say 2,500 miles—such a specially designed tow-plane should be able to extend this range under moderate tow duty to 3,500 or possibly to 4,000 miles or more non-stop; it being well known that a plane can tow far more glider tonnage than it can carry as cargo load. Thus, should the distances to be negotiated call for the maximum mileage of non-stop flight from station to station, it would be elementary to merely provide extra large tow-planes.

Such a mode of operation, obviously, makes possible the aforesaid over-size warheads whereby smaller and lighter tow-bombs of equal or even greater demolition power could be towed.

If, however, the total distances to be traveled would not be great, or—whether great or not—if surface depots are available at frequent intervals, relatively small tow-planes would be adequate; and these could be produced at relatively small cost. The term "surface depots" or "stations," as herein used, is intended to embrace continental airports, island outposts, seadromes, or aircraft carriers—the latter being preferred to anchored seadromes since more mobile. And in the event of submarine carriers being constructed, hereafter, of adequate sizes, the latter would have the advantage of being able to quickly take up outpost positions without prior detection.

Later a typical transglobal operation will be described, wherein tow-bombs 2, 3 and 4 are transported swiftly, at high continuous speeds, over thousands of miles of land and sea for ultimate spot delivery upon an enemy objective. First, however, it is necessary to understand clearly how the tow-bombs are switched from plane to plane, at non-stop speeds; and this will now be explained with reference to Figs. 4, 5, 6 and 7, as complemented by Fig. 2.

In Fig. 4 the tow-plane **1** is depicted a brief instant before an initial engagement is made, and prior to switching a glider burden therefrom to the relay plane **1**ᵃ thereabove. As such a burden may be a glider craft or crafts of more than one class, and, hence, not necessarily be bombs **2**, **3** and **4**, all requisite details concerning the preferred tackle and techniques to be employed can be had by reference to my co-entered application entitled Intercooperative System for Airborne and Surface Carriers, Ser. No. 707,153, filed November 1, 1946. Therein are provided burden-switching means and modes between plane and plane as well as between locomotive planes and new types of high-speed rail carriers. It will therefore be understood that such rail carriers could, if and when provided, be readily incorporated into the presently featured system, for expediting the overland movements of troops and materiel.

Furthermore, it is clear that while said copending application defines a preferred type of burden-switching apparatus, applicable especially to large size tow-planes having so-called tow-rooms of commodious sizes in the approximate locations of the tail-gunner's quarters on B29 superfortresses, for example, obvious substitute arrangements may hereafter be readily adapted to tow-craft of smaller sizes.

In the preferred arrangement shown, plane **1** of Fig. 4 has a suitably disposed complement of burden-releasing tackle, which may include a duality of standards **32** desirably, but not necessarily pivotally mounted contiguous the upper right and left wing surfaces, for extensible and retractive movements alternatingly away from and toward one another, said standards are conveniently tipped with conventional break-out clips **33**, such as are used in mail pickup systems, for releasably supporting the upper cross-cord of a loop-line **34** in the path of a snatch hook **35**, the latter being carried at the end of a boom **36** on tow-plane **1**ᵃ. According to a less desirable arrangement—not shown—a simple dragline having a grapnel at its outboard end could be substituted for boom **36** and hook **35**.

The unlooped or single strand portion of line **34**, in this version, may be releasabily clipped additionally at a midway location between standards **32**, as at **33'** in Fig. 5, whereby to thence enter and nest, readily releasably, within an upper dorsal grooving indicated generally by the broken line **37** of Fig. 4. This arrangement provides for a cooperative hook-up, when required, with other tackle including the harness **38** connected to glider lines **2**ᵃ—**3**ᵃ—**4**ᵃ (see now Fig. 5), according to inter-connecting means therefor provided within the tow-room **39**.

On passing downward from the clips **33** of the standards **32** to clip **33'**, and thence along the grooving **37**, the loop-line **34** at the single strand segment **34**ᵃ thereof is preferably of a length to be carried to the rearward terminus of said grooving and thence over a pulley or the like **40** to member **41** within the tow room. Member **41** is any satisfactory support for the lower inboard segment of line **34**; and in order to maintain the segment **34**ᵃ in relatively taut relation within grooving **37**, there is also provided an auxiliary snubber **42** adapted to bear removably or yieldably against said line when contiguous the pulley **40** approximately as indicated.

In the drawing, the inboard segment of line **34** is merely loosely wound around a wall peg **41**, permitting its terminal **43** to dangle as indicated. Element **43** may be a relatively simple snap-hook adapted for ready engagement with harness **38** in the manner to be shortly explained. The loop proper, before extension, may be coiled within a conveniently located and closable box therefor (as see details concerning a like arrangement said co-entered application, having Serial Number 707,153).

Other tow-room facilities include the multiple winch **44**, having a plurality of drums **45** identified as drums **45**ᵃ, **45**ᵇ, **45**ᶜ and **45**ᵈ. See view from above in Fig. 7. Carried from these drums are the respective drum-lines **46**ᵃ, **46**ᵇ, **46**ᶜ and **46**ᵈ, said lines passing, by option and by preference, through the upper-lower twin-sheaves **47** (Fig. 5) which are swivelly mounted and are severally indicated in Fig. 7 as sheaves **47**ᵃ, **47**ᵇ, **47**ᶜ and **47**ᵈ respectively. And these lines are each fitted with the snap-hook terminals **48**ᵃ, **48**ᵇ, **48**ᶜ and **48**ᵈ approximately as shown.

Hook **48**ᵈ, however, differs from the other snap-hooks in that it is fitted with a safety locking and unlocking jaw (as fully detailed in said copending application); said jaw being normally releasable only upon actuation of an embodied slide-bar (not here featured) controlled from the pull-cord **49**. Cord **49**, as shown, is payable from the small reel **50** located at any convenient anchorage within tow-room **39**.

It is apparent, in this version, that the drum-lines relate specifically to the drums of the aforesaid multiple winch, and that they are interlinked, by means of rings **51**, to the snap-hook terminals **52**ᵃ, **52**ᵇ and **52**ᶜ of the glider-lines **2**ᵃ, **3**ᵃ and **4**ᵃ.

One obvious advantage of the last aforementioned contrivance resides in the fact that each of the towable objects may be individually reeled forwardly toward or unspooled rearwardly from the tow-plane, independently of any others which may be trailing therefrom at the same time. That is, each of the individual winch drums may, by election, be operated independently. But if desired, they—any elected plurality thereof—may be operated simultaneously. Thus if the respective glider lines are of a proper length initially to predetermine the preferred distances of each of the glidable objects from plane **1**, rings **51**, if desired, could be directly abreast of one another as seen in Fig. 7. Hence if the rings are so maintained, within the view of the flight mechanic (that is, the tow-room operator), the latter can tell at a glance just what the relative distances of the burdens are from the tow-plane.

But if, for any reason—such as in case that one of the tow burdens is differently characterized aerodynamically—it is found advisable to pay out more line to one than to another, or to reel in one of the same relative to the remainder, I also provide that each of the drum lines may have the colored or otherwise identifiable bands or annular markings **53**. If, for a further illustration, all of the bands **53** are presumed to be red, and they are brought alongside of one another, the flight mechanic would know immediately what the relative positions of the tow-burdens are without reference to whether rings **51** are, or are not, within his range of vision. Such indicia will be particularly advantageous for night work. Moreover, any predetermined plurality of other complementary bands, of other colors for instance, and at predetermined spacings from one another, may be provided to readily visually operate the tow-burdens either simultaneously or independently of one another by merely visually checking the bands as they are paid off from or as they are reeled in to the winch drums.

Any satisfactory fleeting or level-wind attachments (not shown) may be employed. And it is normally, but not always necessarily, preferred that the drums shall be electively and collectively controlled from a single control panel (not shown); it being a simple matter to operate them from a single motor, through a suitable multiple clutch mechanism as further explained in said last mentioned co-pending application.

It is apparent that while the drum-lines provide direct towable control over the respective burdens, such control is maintained through the auxiliary glider-lines; and these, in turn, according to one desirable arrangement, are also adapted to be individually spooled or unspooled from the respective reels located on each of the tow-bombs—such as reel 2^b on the tow-bomb 2 of Fig. 3. While this particular structure is not absolutely essential in order to perform a burden-switching operation, the advantages thereof are obvious from the standpoint of flexibility of individual or collective control over the tow-bombs. See later reference, also, to Figs. 8, 9 and 10.

Thus, when it is desired to reel in the rings **51** to an accessible inboard position, whereby to connect in the transfer harness **38**, later more fully detailed, this can be done without disturbance of the relative airborne positions of all or any of the tow-bombs by the simple expedient of operating reels 2^b, 3^b and 4^b (Fig. 1) by remote control to feed out footages of glider line equivalent to the footages of the drum-lines which must be reeled in to bring said rings **51** inboard of the tow-room. Or a particular bomb could be reeled in independently, and independently switched.

Obviously, at the sacrifice of flexibility, the positions of the tow-bombs relative to plane **1** could remain static, for both towing and switching purposes, in which case the reels 2^b, 3^b and 4^b, Fig. 1, could be omitted in the manner further referred to hereinafter.

In the actual switching of one or a plurality of burdens, several options are possible. According to one procedure, when it has been determined that plane **1**, for example, is nearing the end of the first segment of a relay route, as designated at station B, Fig. 6, the flight mechanic may "make ready" by rigging up the necessary tackle in preparation for the actual switching operation upon arrival of plane 1^a, which latter, of course, has been heavily fueled in readiness for taking over and towing the burdens non-stop between stations B and C.

It being assumed that all three of the tow-bombs **2**, **3** and **4** are to be switched simultaneously, the make-ready or preliminary rig-up includes the operation of winch **44**, Fig. 7, to position each of the links **51** within the tow-room **39**, Fig. 5, and sufficiently close to sheaves **47** to bring the links abreast of one another at the correctly spaced distances therebetween. The harness **38**, which until now may have been idly disposed within the tow room, is connected in to each of the links **51**, alongside of terminals 48^a, 48^b and 48^c, since said harness has swivelly mounted snap-on terminals **54** for separate engagements with each of the rings **51**.

Obviously, if desired, these terminals may be affixed to the ends of short lengths of flexible cordage, and suitably connected to the harness plate **55**, in order to better facilitate such engagements if the rings are not conveniently in the exact locations required for precision couplings. Other, further modified types of harness may be used within the general scope of these suggestions.

At this point the harness ring **56** is hanging downward, preferably, below rings **51** and the burdens are still carried from the several drum-lines. The flight mechanic now picks up hook 48^d and snaps it on the ring **56** of the transfer harness, after which the winch drums are operated to feed out short additional lengths of tow-line. That is, all but drum 45^d, the object being to make line 46^d, which pays off from this drum, perfectly taut relative to hook 48^d and the transfer harness. Or drum 45^d, only, may be operated in reverse to achieve a like result. Thus, by then unsnapping the terminals 48^a, 48^b and 48^c from their complementary rings **51**, drum-lines 46^a, 46^b and 46^c become idle while drum-line 46^d will now have become the one, only, master tow-line.

Plane 1^a, having climbed to altitude and turned into, or entered upon a course adjacent, the main flight path, and having radioed ahead as to its location as it prepares to close in on plane **1**—or otherwise as desirably pre-arranged—the mechanic on plane **1** next removes snap-hook **43**, Fig. 5, including the inboard section of loop-line **34** from peg **41**, and snaps this hook, also, on ring **56** of the harness. Everything is now in readiness for the junction with plane 1^a and for the actual burden-switching. (Or, as the case may be, until plane 1^a, having arrived at altitude, in the same approximate flight path, allows itself to be overtaken by plane **1**, as a preliminary maneuver.)

Plane 1^a, in the final jockeying, normally overhauls plane **1** under this preferred procedure, and having let down its boom **36**, bearing snatch-hook **35**, stacks itself over the latter tow-plane at the required spacing therebetween whereby to bring hook **35** into engagement with the cross-cord of loop-line **34** (see Fig. 4). Thence, moving forward slightly, at nearly coordinated relative speeds, plane 1^a picks off said loop-line **34** from the break-out clips **33** of standards **32**, which latter then retract automatically into suitable grooving therefor.

(Other methods are possible, whereby, for one example, the positions of the planes could be reversed, according to a technique detailed in my co-pending application entitled Buren-Switching Apparatus, Including Methods Therewith, Ser. No. 707,151, filed November 1, 1946.)

At this juncture, or just previously, the flight mechanic in tow-room **39** frees the inboard section of line **34** from snubber **42**, permitting it to thereafter glide freely over and thence to lift entirely off the pulley wheel **40**. See position 34^{aa}. And this latter sub-operation will occur directly thereafter as plane 1^a, now continuing to advance slowly and further ahead of plane **1**, causes the line **34** to become quite taut. (If snubber **42**, perhaps inclusive of element **41**, is replaced by a break-out clip, the foregoing operation can be made entirely automatic.)

Meanwhile, drum 45^d was further operated to feed out the master line 46^d, auxiliary reel **50** automatically paying off the pull-cord **49** quite freely as required, until harness **38** was approximately at the lower position indicated in Fig. 5, hook **48**^{d} also being substantially as there shown.

Once the loop-line **34**, however, was engaged, earlier, by hook **35**, and snubber **42** having been removed as explained, it is obvious that as soon as said line subsequently became taut in cotowing relation to the burdens—a result which will have occurred automatically as plane **1**^{a} moved still further forward, ahead of plane **1**—the harness will normally have risen slowly to a somewhat monkey-on-the-string attitude as now seen in Fig. 5, at phantom **38**^{a}, except that a substantially three-way instead of a two-way pull is exerted thereagainst.

Obviously, any required additional length of line **46**^{d} and pull-cord **49** may be paid out until harness **38** is in the preferred position to complete the transfer with little or no jerk being passed along either to the tow-bombs or to plane **1**^{a}. Assuming this position to be at location **38**^{a}, or somewhat higher, whereby lines **46**^{d} and **34** are now in angular relation to one another as at tensions **46**^{dd} and **34'**, the final transfer is accomplished in a brief instant by the flight mechanic, who, at a given signal, gives a quick, sharp jerk on the pull-cord **49**. This opens the safety jaw of hook **48**^{d} instantaneously, causing it to let go of ring **56** of the transfer harness. The harness may then rise very slightly higher, perhaps, as the gliders become finally reoriented, while hook **48**^{d} will drop down and trail until hauled inboard of plane **1**.

It may be of some slight precautionary advantage to further attach line **49** to line **46**^{d} by means of a break-out clip, anchored slightly to the rear of hook **48**^{d} or on the hook itself, against premature actuation.

During the aforesaid burden transfer, it is apparent that boom **36** assumed the required position or positions along the arc **57**; and that it subsequently was later received back, in a well braced position, within a longitudinal belly slot therefor indicated at line **58**, which is the desirable initial full towing position. As the tow-bombs assume their correct revised flight attitudes, however, relative to plane **1**^{a}, it will be normal to remove the transfer line **34** from hook **35** whereby to pull in the harness **38** to an inboard position, and whereby to re-switch the glider lines to each of a complementary plurality of drum-line terminals according to the similar arrangement earlier described, with regard to plane **1**, which made it possible to tow each of the tow-bombs independently. As the tow-room equipment of plane **1**^{a} will usually be the same as that on plane **1**, this re-switching procedure may now be clearly explained by again referring, first, to the detail view of Fig. 5.

Assuming that hook **35**, in this particular figure, is that of plane **1**^{a}, and that the train of tow-bombs is now appendant from loop-line **34** at position **34''**—the loop-line forming two sides of a tautly straightened out bight at this area—it is a simple matter for the flight mechanic to take hold of snap-hook **48**^{c}, for example, Fig. 7, resting in a previously idle position; and, bending down, he snaps this fixture securely over just one side of the bight of loop-line **34** closely adjacent the latter's contact with the jaw of hook **35**. This hook, incidentally, may be structurally quite similar to the safety hook **48**^{d} and similarly operable to open the jaw of the same. See said first mentioned co-pending application, or said first and second named applications, for more detailed arrangements.

The last mentioned detail having been accomplished, drum **45**^{c} is operated slightly to make line **46**^{c} taut, after which hook **35** may be opened and to release line **34** therefrom to tensed relations with respect to hook **48**^{c} and line **46**^{c}, which latter now becomes the master tow-line. It having been predetermined that line **46**^{c} was to be employed in this manner, and since it will be necessary to reel in the full length of loop-line **34** before access can be had to harness **38**, and before the glider-lines can be removed therefrom and connected up to the respective drum lines, it is provided that the grooving of the upper-lower sheave wheels **47**^{c} shall be quite ample to accommodate the double strand of the bight passing therethrough to drum **45**^{c}. Alternatively, however, wheels **47**^{c} may be of the split-sheave type, dividable through their centers and adapted to be thrown to right and left, as half-wheel assemblies, to entirely free line **46**^{c} therefrom.

A like result may be had wherein the upper of the sheaves **47**^{c} is adapted to be disconnected on one side only from the lower assembly, and thence thrown back upon a hinge at the other side to free line **46**^{c} directly to drum **45**^{c}. This accomplished, the loop-line **34**, including hook **48**^{c}, is reeled in over drum **45**^{c} until harness **38** is inboard of plane **1**^{a}, being connected on the aft side of the same to all three of the glider-lines **2**^{a}, **3**^{a} and **4**^{a} but only to line **34** on the towing side, through snap-hook **43**.

As the harness is now within easy access of the flight mechanic, the latter simply takes hold of each of the other terminals **48**^{b} and **48**^{a}, in consecutive order, or vice versa, and snaps them onto the smaller rings **51** with which the harness is individually linked to the glider lines complementary thereto. Drums **45**^{b} and **45**^{a} are then operated to bring these two lines to tension and hook **43** of the slackened line **34** may then be unsnapped from ring **56**, leaving lines **2**^{a}, **3**^{a} and **4**^{a} trailing from the harness with the tow-pull being exerted through all three of the rings **51**, two only of which, however, are as yet connected up to the drum-lines as aforesaid.

Drum **45**^{c} is now operated to entirely unwind the relatively short length of the loop-line **34** therefrom; after which this line may be removed entirely from hook **48**^{c}, and the latter then manually snapped into the last of the remaining rings **51** connecting the harness with the glider lines. When this line, also, has been replaced between sheave-wheels **47**^{c}—if dividable wheels were employed as explained—and the slack removed from same, it is apparent that the harness will now have become a useless appendage and may be quickly uncoupled from the respective glider lines, to fully free the same to each of the respective drums **45**^{a}, **45**^{b} and **45**^{c}, and retired from active tackle duty.

A slight modification of this procedure may be followed, if desired, as outlined co-pendingly in said first-named co-entered application.

It is, of course, apparent that if and when remote control devices are perfected to the point wherein the present great advantage of controlling each towable object from its particular drum component may be outweighed by the desire for smaller tow-planes and the maximum of compactness, the multiple winch **44** can be replaced, according to one procedure, by a compact two-drum compound winch. That is, instead of operating the tow-bombs **2**, **3** and **4** from separate drums on planes **1** or **1**^{a}, the same could be trailed at all times from the harness **38**, for example, or its equivalent, with only a single master tow-line—from one of the drums—coupled to ring 56. With the harness and glider-lines thus pre-coupled, transfers could, and more rapidly, be performed in the manner already explained except that the preliminary procedure of rigging up the harness to disconnect it from the several drum lines—and a like procedure in reverse after switching from plane to plane—may be obviated entirely.

The transfer hook 48d, in that case, being connected to the line 46d, would operate independently, as would said line 46d, from the other of the drums of the aforesaid two-drum compound winch, such a drum arrangement being of course preferred to two separately mounted drums. An auxiliary reel 50, however, would also be indicated, by preference. According to a more primitive arrangement, even the drum winch on plane 1 could be dispensed with; the master tow-line having a fixed anchor point (not shown); but normally, an automatic winch is preferable, especially for launchings.

The remainder of the procedure, or procedures, in accord with the foregoing simplified apparatus, and in view of the data already given, will be so obvious to those skilled in such matters as scarcely to warrant any meticulous recital of the same. The same comment applies relative to the transfer of one or more of the towable objects from plane 1 to plane 1a, while leaving one or more in the tow of plane 1. For details thereon, my aforesaid co-pending case, as first mentioned, may be consulted, as may also be done with respect to the details of both hooks 48d and 35 and other structural features of the burden-switching tackle.

It may be found advantageous to provide only one small tow-plane for each of the flyable bombs to be towed; or, again, it may be unnecessary to provide bombs of very large sizes, so that one or even a plurality of the same could readily be towed by a single relatively small locomotive. This could be accomplished by changes which will hereafter readily occur to skilled designers of the art.

As another of the possible alternatives, it may however be mentioned that the tow-winch could be movably mounted with a pinion wheel engagement, adapted for limited travel along a rack member complementary thereto in a manner similar to that set forth in my second aforesaid co-pending patent application entitled Burden-Switching Apparatus, Including Methods Therewith; thus enabling the flight mechanic to occupy ample quarters in the main fuselage section, and operating therefrom the required mechanism for retracting and extending the double-drum winch according to whether the burdens are to be normally trailed, at particular times, or whether they are about to be switched from one tow-plane to another.

With regard to the option whereby the so-called glider lines are not to be separately switched to and separately controlled from individual drums complementary thereto, it may—in the latter case—be deemed unnecessary to provide the reels 2b, 3b and 4b on each of the tow-bombs. That is, the lines 2a, 3a and 4a, of the necessary fixed lengths, could merely be connected to the tow-bombs through a suitable device, such as fixture 28 of Fig. 3. This arrangement might provide more readily for the employment of cable-release mechanisms which, by circuit-closing or other suitable auxiliaries, could start up the motors, as generally indicated by combustion chamber 25, at the exact instant the tow-bombs are disconnected from the tow-plane, and while still substantially at co-velocity therewith, including, if desired, the simultaneous actuation of particular flight controls to turn each of the bombs quickly upwardly over the path of the tow-plane.

In short, the powerful motors of the tow-bombs, once actuated, might otherwise so greatly accelerate the latter as to quickly run down the tow-plane before it could dive therebelow and assume the correct attitude for remote-control guidance of the tow-bomb or bombs. This assumes, of course, that the bombs are to be guidably controlled from the escort plane and not otherwise, according to a different system mentioned elsewhere herein. Obviously, such options can best be left for the final determination of skilled specialists.

One specific cable-release means will now be described which contemplates retention of reels 2b, 3b and 4b, whereby to instantaneously free the tow-bombs 2, 3 and 4 from the escort, a feature which has not been earlier explained because of possible confusion arising incident to the detailing of the same—and to the required interruption therefor—along with the more basic techniques. And said means may also be employed for actuating the bomb-motors, along with the required auto-pilot mechanisms, the instant the tow-bombs are released.

Clearly, if reels 2b, 3b and 4b are to be fully operable reciprocally in connection with master towing drums mounted on the last of the tow-planes of a relay system, it is advisable that, at the time of the release of the tow-bombs, the respective tow-cables should be disconnected at the bombs for retrieval aboard the escort, rather than vice versa for their retrieval aboard the tow-bombs. Therefore, in Fig. 8 is shown a relatively simple means for accomplishing this, as generally illustrated by the larger detail of reel 2b—for example—in coaction with a master towing drum conveniently designated as drum 45a.

In addition to shaft 74 and drum casing 75, reel 2b has the cable-release mechanism 76, including levers 77 pivotally carried on an element appendant from the interior of the casing wall, as indicated, and formed with tong-grips 78 adapted to lock releasably over the ball-headed terminal 79 swaged or otherwise affixed to the tow-line 80; which line, in the drawing, is shown as having been payed out to the last winding thereof on said reel. Levers 77 are pivotally linked to the toggles 81, substantially as shown, and these toggles may have safety end-abutments—to prevent over-travel of the locking position beyond a predetermined point—adjacent their center pivot 82; which feature precludes opening of the toggle-joint until actuated by a pull from pin 83 of the solenoid 84.

Normally such an actuation would not occur until line 80 had first been entirely unwound from reel 2b, as indicated at phantom 80a, and is at such normal towing tension from drum 45a that, at the very instant the pull of pin 83 caused tong-grips 78 to release the terminal 79, the latter would be jerked through aperture 85—as at phantom 79a—and the tow-bomb 2 would be entirely released from its escort. That is, from the last of the tow-planes in sequence.

However, while the aforesaid cable-releasing operation may be readily performed by electronic remote control from the escort, through the agency of suitable relay means (not specifically shown, but see schematic lay-out of Fig. 3), it may be more desirable to operate solenoid 84 electrically. That is: according to a master electrical control arrangement on board the escort plane, as will shortly be explained, direct actuation may be transmitted to the solenoid 84 by means of suitable electrical conductors 86—87 which are preferably carried through the center of tow line 80, as graphically seen in the small sectional view of Fig. 9, taken along line E—E of Fig. 8. Conductors 86—87, in this version, are threaded through suitable side openings in terminal 79, substantially as shown, and are contactably affixed to the small break-out plugs which are seen contactably socketed within the small upper and lower sleeves 88 secured to the levers 77.

The conductor components of the circuit-to-be-formed are carried, thence, through upper and lower conformable conduits 89′ and thence again to upper and lower entries into the housing of solenoid 84 as shown. Thus when terminal 79 is released by tong-grips 78, the break-out plugs can also escape through aperture 85, and may be used again without necessitating an unhandy re-wiring job.

Since it is desirable, at this juncture, to produce an automatic actuation of the flight controls, through the autopilot, whereby to turn the tow-bomb 2 upward and above the escort plane, and while also actuating its motor to begin blasting, means are indicated for accomplishing these results coincidentally.

While I do not show the detailed parts of the solenoid 84, or associated relays on tow-bomb 2, it will be elementary for specialists in robot control hook-ups to further wire said solenoid for the actuation—upon movement of pin 83—of the aforesaid motor and the aforesaid autopilot, as schematically indicated by controls 89—90 leading first to the relay or relays R and thence to motor M and automatic pilot P. Other obvious alternatives are possible.

Drum 45^a, as intimated previously, has a commutator (not shown) connecting with complementary brushes as indicated by arrow pointers 95—96; and whenever it is desired to cast off the tow-bomb 2—thereby automatically and instantaneously starting motor M and actuating the autopilot P at the same time—it is merely necessary to throw a switch or the like 92 on control panel 93, which closes an electrical circuit from the battery 94, or other electrical supply source, through conductors 95—96 to solenoid 84 and coincidentally, by suitable other commutator means (not shown) and commutator contacts 89—90, which are to be regarded as schematic only, to the relay, motor and automatic pilot group.

The modified device of Fig. 10 is largely self-explanatory, indicating merely one of variable other mechanisms which may be employed in lieu of the structure of Fig. 8. Obviously, in Fig. 10 the tow-line 80, having terminal 79, is locked within the drum casing 75 by the half-jaw 98 of lever 99, the latter being carried at pivot 100. Lever 99 is engaged to toggle 103; and toggle 103 engages plunger 101, which latter is adapted for movement relative to cylinder 102. Cylinder 102 may be operable, through a suitable stuffing box arrangement, pneumatically hydraulically, or hydro-pneumatically. Obviously, however, cylinder 102 could be replaced by a solenoid, just as solenoid 84 could also be beneficially replaced; as, for instance, by a cylinder 102 or other efficient means.

The required electrical hook-ups, as well as the feed hook-up to cylinder 102, are not shown; but all necessary arrangements to cause half-jaw 98 to release terminal 79 will be apparent in view of earlier references to Figs. 8 and 9. Naturally, it will be quite a simple matter to produce a like automatic actuation of motor M and auto-pilot P, by utilizing this alternative device in coordination with the group comprising said elements R, M and P as explained with regard to Fig. 8.

Although reference was earlier made to the cable-release mechanism in the patent to Fahrney, the same is not favored since inherently operable against the heavy frictional load of the tow-burden. In order to clear the lock-pin (as see said patent), the Fahrney solenoid must be operated over too long a stroke for good efficiency. The mechanism of Fig. 8, on the contrary, provides for a minimum of pull and stroke on the solenoid. A very short stroke of pin 83 is all that is necessary to release the terminal 79 from tong-grips 78, thereby obtaining a maximum of efficiency from the magnetic field. In fact, the elements 78—79 may be so formed to one another that the normal tension on line 80 will cooperate with, and not tend to defeat—as in the Fahrney device—the action of the solenoid to release terminal 79 once pin 83 has but partially opened the toggle joint at pivot 82. Or solenoid 84 could be actuated to open or partially open grips 78 just before the final unwinding of cable 80, which latter would be automatically freed and cleared by the last subsequent turn of the drum.

A somewhat less secure method could include any suitable means for insecurely holding terminal 79 in position, whereby to maintain at least one spiral of the tow-line about the drum during normal towing operations, the flight mechanic carefully checking the banded indicators 53 (Fig. 7) during all in or out spooling of the tow-cable or cables to make sure that there is a sufficiency of the tow-line on reel 2^b until tow-bomb 2 is to be released. This last operation would be accomplished by the simple expedient of paying out line 80 to its end, and without benefit of any other cable-release mechanism or remote-control instrumentalities as aforesaid—thereby making possible a cheaper and more simplified construction.

The particular assembly shown in Fig. 8, of course, is subject to any changes which may be dictated by spacing requirements, or otherwise. Likewise, while reel 2^b is shown in coaction with drum 45^a, it will, in the light of these disclosures, fall within the realm of simple mechanical skill to work out variable minor adaptations of the same conformable to the previously shown burden tackle, including other options which will readily occur to practitioners of the art. And sundry other uses—as in the marine field, for one example—may be found for such tackle.

Since it does not become necessary to release the tow-bombs until they are appendant from the last of the tow-planes, it is apparent that, if the compound winch 44, Fig. 7, is to be further utilized on the last leg of the journey, very small connections 51 may be employed, which will, on release of the bombs, wind readily over the respective drums; and sheaves 47, according to this option, may be omitted. A simpler procedure, however, on said last relay operation, is to haul each of the glider lines 2^a, 3^a and 4^a inboard of the tow-plane, after release of the tow-bombs, over a separate stand-by spool (not shown) since these lines will no longer be required for the time being.

The above mentioned "very small connections 51," on the last of the escort planes, could be provided with interconnecting electrical contacts (not shown) for full utilization of the cable-releasing and motor-starting devices detailed in Figs. 8 to 10 inclusive. And it is evident that the type of cable-release here shown may be employed in connection with other species of glidable aircraft.

The tow-bombs may be launched, originally, according to any satisfactory technique which has been or may hereafter be employed in connection with other types of towable glider-planes, including droppable wheel gear if need be; or the glider-launching technique outlined in said first co-pending case may be utilized. It is thought that parallel, somewhat upwardly sloping skidways (not shown), or a single elongate platform, bearing rollable, wheelborne cradles—one for each, preferably wheelless, skidless glider-bomb—with any simple means for releasable interconnections therebetween, would fulfill all requirements without having to utilize droppable gear of any nature. One optional system, which may be considered in this relation, is disclosed in the Italian Patent No. 380,921, issued June 13, 1940, to Aldo Guglielmetti.

The phantom standards S, extensible from the wings of the tow-bomb 2 of Fig. 1, in cooperation with a loop-line L, which could be carried in any convenient outboard manner to fixture 28 (Fig. 3), and inclusive of tow-line hookups as required extending to the other two tow-bombs, may be considered in relation to comparable apparatus disclosed in said first named co-entered case. It is also apparent that such tackle, in the event of an unforeseen emergency, could be employed to transfer any elected one of the tow-bombs from a given train of the same to another tow-plane.

See also later reference to a method for transferring such bombs to auto-controlled, pilotless escorts whereby, in a certain sense, one blind object may literally "lead" another blind object.

The general operation of the apparatus as herein disclosed, including some specific applications, will have become evident from the preceding description. However, certain additional features which have to do with the choice of techniques (that is, for example, whether well known V-1 or V-2 procedures, or both, are to be employed) call for some further explanation; and these will now be dealt with while reconstructing a typical hypothetical blitz operation.

Referring again, therefore, to Fig. 6, it will be noted that line 59 represents the earth's surface at any designated area thereof intermediary of station A and objective D. Station A could be within the continental United States or any outpost point accessible therefrom and thereto. It could even be one or more aircraft carriers in the open sea, within flight range from one or more primary land bases. The successful operation of the system presupposes that every required preliminary detail will have been discharged; so that no single essential feature would require last minute attention. This is paramount. Obviously, therefore, in addition to said preliminary preparation, scheduled rehearsals would be performed over remote regions at satisfactory intervals. Much of this preliminary routine could take place in the course of peacetime commercial operations, as generally outlined in my first-mentioned co-entered application.

If it is assumed that stations B and C are within United States control and are ground depots, underground storage facilities would be there provided for caching large reserves of fuel supplies, including the establishment of landing and take-off facilities which could be used regularly in non-military operations. But lacking ground facilities at one or more strategic points, the deficiency could be made up with one or more aircraft carriers, operating as landing and take-off stations.

Thus, between said land outposts and the available open sea approaches, it would be possible to rapidly travel by the required stages to within relatively close-up—and high up—rocket bombing range of nearly any area of the earth's surface. Moreover, the airborne, towable equivalents of V-2 supersonic missiles could thus be self-launched without benefit of launching racks, and from such previously attained altitudes as to measurably facilitate aiming and control thereof from the launching points to the points of detonation.

Since there would appear to be the least possible likelihood of future hostilities between the United States and Britain, it may, in good grace, be assumed—for a very simple illustration—that the English have begun an aerial attack on Americal centers, via Canada; that in addition to a swift counterreprisal on Canadian objectives, the munitions centers of England are to be demolished. Station A, in that case, could be La Guardia and Idlewild airports and the route of travel approximately according to the trade routes. And station B, 2,000 miles, more or less, offshore in mid-Atlantic, could be one or more quickly dispatched aircraft carriers; while station C could be any one or more other carriers, such as large submarine carriers, a relatively short distance off the British Isles.

If the Azores were available, no carriers would be required; wave after wave of tow-trains, flying directly thereto from New York or from any other Atlantic seaboard point or points, and being met at altitude by the requisite number of relay planes which, from that range, could complete the mission with sufficient fuel reserves for the return trip to the Azores. So much for the general outline of procedure.

The more detailed method may be as follows: The first wave of tow-planes—the advance guard—would proceed to stations B and C without burdens, but possibly accompanied by adequate interceptor units. These planes would quickly re-fuel and stand-by for the arrival of the first contingent of tow-planes 1, each bearing tow-bombs 2, 3 and 4 and flying at considerable altitude (line 60) above station B. The refueled tow-planes 1a would take-off before the arrival of said first contingent of planes 1, and would engage the same at non-stop speeds in the manner already explained. Planes 1 would thereafter land at station B for re-fueling while planes 1a, having taken over the tow-bombs, would speed on to, or rather aloft of, station C, where they, in turn, would be met at altitude by the first of the advance guard of tow-planes previously mentioned. Above this outpost, similar burden-switching operations would occur, and the last wave of burden-bearing tow-planes would proceed thence to within a brief striking distance of the target or targets, such as objective D.

Assume, then, that point 61—the midair launching point—is within easy rocket range of objective D, possibly within 100 miles thereof but so far away and at such great altitude that successful interception from surface anti-aircraft batteries would presumably be impossible. Arriving close to point 61, the aerial armada could, if desired, spread out arcuately in a partially encircling manoeuvre whereby to direct the attack from a plurality of points 61. Observe, too, that rocket "shots" initiated from a high altitude would not consume the fuel required by surface launchings—thus greatly extending the lineal ranges of the tow-bombs, should V-2 procedures be indicated.

Obviously, from such a height, even a glidable bomb (V-1 type), having once arrived adjacent to the objective, and having begun to plummet downward thereon—as a dive bomber—under the last remaining portion of its not yet exhausted fuel load, could attain a supersonic speed which would make it extremely difficult if not impossible to follow with interceptor devices. If this latter procedure is followed, the bombs, upon detachment from the tow-planes, could proceed along the flight path or paths 62; or, if launched sufficiently close to the objective, and from sufficient heights, could be self-propelled along glide-path or paths 63.

If launched upon true-rocket trajectories, or partial rocket trajectories, the bombs 2, 3 and 4 could, on leaving point 61, climb speedily under their own power to the top of parabola 64, or higher, from which altitude they could then hurdle downward at several times the speed of sound.

If V-2 techniques are employed, it may be advantageous to provide each of the tow-bombs 2, 3 and 4 with shedable wings 13, as seen at 65^a—65^b in Fig. 2. Or some of the tow-bombs could be "launched"—at altitude, that is—according to V-1 techniques and others according to V-2 techniques as generally indicated. Thus bombs 2, 3 and 4, upon release from plane 1^a, could proceed under their own power along the flight paths 66, 67 and 68 of Fig. 2. Or rocket 2^c, having the droppable wings 65^a—65^b, could follow the trajectory line 64 or one much higher in actual scale, shedding its wings either by remote control actuation from plane 1^a, from fiducial bases as later explained, by mercury switch actuation, by delayed-action time-mechanism set in operation at the instant of midair "launching" or as otherwise desired at any predetermined position before or after the conclusion of self-powered flight, such as at position 2′.

If desired, a single upper or lower wing 65^c may be employed, instead of dual wings 65^a—65^b. In either case, the means for releasably attaching wing members to flyable devices comparable to rocket 2^b, is already well known. For one specific illustration, see said earlier mentioned patent to Fahrney, No. 2,399,215. In view of these suggestions, therefore, and said Fahrney patent, it would be elementary for skilled engineers to readily provide the most preferred type of specific wing structure, as well as means by which the same may be jettisoned in flight.

It is unnecessary to dwell in detail upon the precise instrumentalities which may be employed in these flying and diving operations, as the same are complicated mechanisms but well known to the art of robot flight control.

It is probable that, having been divested of tow-bombs 2, 3 and 4, or rocket 2^c as the case may be, plane 1^a would normally describe the circular path 69 while directing the flight control of the bomb or bombs, as indicated by beam-lines 70, returning thence to station C for refueling and subsequent duties. Other options, however, will be given shortly, including a means for guiding the bombs from so-called shoran base points.

While not preferred to the self-propulsive bombs particularly defined herein, it is obvious that other towable types may be employed; as, for one example: towable but motorless bombs adapted to be merely cast off from a towed position to the rear of the tow-plane for guidable descent along a preselected path to the target. Such bombs could have droppable wings or they could be directionally towed to and thence aimed on the target as falling, glidable bodies. It is apparent that bombs of this type could be towed and dropped by relatively small, fast-flying tow-planes, instead of being carried as cargo by expensive superfortresses, the bomb-release mechanisms being geared in with automatic bomb-sight and automatic pilot instrumentalities on the tow-plane. Thus it would be quite simple to employ the improved automatic Nordon device, for instance (not shown since well known), on the tow-plane, adjustable in a manner to actuate the tow-bomb releasing means at the proper pre-set moment.

For another illustration, the system disclosed in Patent 2,404,942 to Alda V. Bedford, could be readily altered to the demands of the present invention. This concept provides the means and a method whereby bombs of a non-towable type may be carried to within the visual range of the target on board a conventional bomber; after which each of the bombs is dropped in the usual way and trolleyed to the target by generating electronic energy on the bomber, which energy is picked up at the bomb while descending, for its guidance. Within a certain tolerance, the same may be thus steered to the target in coaction with the establishment and maintenance of a line-of-sight on said target throughout the flight of the bomb, the angle between the electronic beams and said line-of-sight being varied for the like period according to cooperating controls therefor on the bomber.

Thus, with reference again to Fig. 2, a tow-bomb—such as bomb 4—if lacking such coordinated controls, might land just short of a target or too far beyond the same; it being assumed, for this illustration, that the line 68, if followed, would be short of the objective. Plane 1^a, however, if provided with the required master control means, would make electronic contact with tow-bomb 4 coincident with the separation of the latter, and would also have established the line-of-sight 71^a. As plane 1^a moved forward, this line-of-sight would also have moved according to positions 71^b and 71^c; meanwhile the now self-propelled, remotely guidable bomb 4, being under the control of said synchronized beams of radiant energy, would subsequently describe the flight path represented by the arbitrary line 72, which last, for this illustration, is assumed to be the line of so-called "pin-point" accuracy.

It is scarcely necessary to point out that whereas, in Patent No. 2,404,942, a certain correction for accuracy may be made within narrow tolerances, my flyable, self-propellable bomb 4 could be directed with much greater precision if the aforesaid modified V-1 technique is employed. Another major advantage over the method of the patent resides in the fact that large towable, long-range bombs with a considerable wing spread may be utilized; so that the method primarily featured herein is of a distinct obvious advantage over one limited solely to missiles dropped through a bomb-bay, without having had the previous benefit of my relay system in approaching the target.

For naval use, it is evident that tow-bomb **2** could be employed in various ways. For one example, towable, hydraulically propellable torpedo bombs of this general but modified character could be directed against floating targets in a manner comparable to the method described in Patent No. 1,032,394 to Admiral Bradley A. Fiske, but in accord with such control devices as herein disclosed.

For the express ends of a blitz attack, however, it is thought that blind-bombing systems comparable to loran or shoran—as hereafter amplified—are to be preferred in conjunction with towable, switchable rockets **2**, **3** and **4**. And the shoran system, to cite one typical illustration, may be further modified.

Briefly, fiducial range points could be established at precise locations, such as at widely spaced continental and/or island outposts, which would substitute for astronomical bearings, the pilots of the tow-plane maintaining continuous coordinated dial readings therefrom by radio compass. This method, during at least the preculminating phase of an operation, would make possible exact reckonings as to the directional locations of the tow-planes relative to the target at all times.

By simple triangulation, as similarly employed in ground survey work, slight deviations—as in the case of allowances for reclination, etc.—need not be computed while in flight, the pilots merely navigating by autopilot coordinants, preferably, to a continuous null point or moving fix established from powerful beam-emitting reverse "homes" as such outposts. Or, for that matter, the latter could be supplied by submarines surfacing at predetermined points of longitude and latitude.

As the latitude and longitude of the target would be known, the armada of tow-planes and gliders would require no other guidance during the preliminary approach thereto, after leaving the last of the relay stations B, C, etc.

It is provided, moreover, that in the culminating phase of attack loran or shoran base points could be established at a desirable altitude by rotary wing aircraft, the latter, by preference, having retractable rotors and adapted to be swiftly towed to the base points by fast-flying tow-planes; so that they would arrive fully fueled and could maintain hovering flight at such exact locations for the required duration. If necessary, they could be replaced by tours.

These crafts, which could furnish every facility of a conventional shoran ground station, could be employed to steer the glider trains over the remaining intervening distances to the final fix or fixes, at which the tow-bombs would be released and thereafter directed to the target.

Such airborne base points could correct continuously for their own drift, as required, by triangulation with the aforesaid outpost range stations. If desired, the tow-bombs themselves could be fitted with computer mechanisms, coordinated to their autopilots, whereby to receive and translate the shoran data, so that their travel, after being released from the tow-planes, could be controlled from the stationary airborne bases instead of from the parent tow-planes; thereby relieving said planes from further hazards, after freeing the bombs, incurred by a closer up approach to the target.

Tow-bombs controlled in this manner could be guided with great exactitude by providing radar sending instruments thereon, reverse shoran in short, whereby their flight paths could be corrected by distant control en route to the target, to insure greater precision. The AAF bomb computer known as KIA, which is adapted to be connected to the automatic pilot whereby to fly either the parent-plane or the tow-bombs during a bombing mission, using shoran data substantially as the Norden bombsight uses optical data, may be employed. This device, which is well known to professionals in the art, supplies the necessary trajectory, time-of-release, miles-to-the-target, drift, and other requisites to a successful "blind" attack.

In this connection it is provided, by option, that the last contingent of the tow-planes employed to carry the tow-bombs to the release points **61**, Fig. 6, could themselves be robots, or semi-robots, operable by remote control from said airborne base points. Under this arrangement, many obvious other advantages may be gained. For example, such robot tow-planes could be relatively small, inexpensive craft, perhaps each adapted to tow only one of the tow-bombs to the release points **61**; and they could be initially piloted.

That is, such an escort could be a small scale replica of tow-plane **1**^{a}, Fig. 4, requiring only the boom **36**, with hook **35**, or their equivalents, for engaging the hypothetical loop-cord L from the standards S of bomb **2**, Fig. 1, for example. Upon arrival of bombs **2**, **3** and **4** over station C, each of these bombs could be plucked, and quickly released, from the towing plane by one such final escort plane in the manner previously described, and while initially piloted by only one operator.

Such operator, acting also as flight mechanic, would personally carry-out the simple burden-receiving operation necessary to trail bomb **2**, for instance, from hook **35**, as indicated by the hypothetical position of loop-line L at **34''** in Fig. 5. No winch **44** or other tow-room tackle would be required on such a plane, comparable to that shown in tow-room **39** for previously massing large numbers of the bombs at the last of the stations; namely, station C. After finally checking all inboard auto-pilot controls, this operator could be removed, through a suitable hatchway, according to the method for switching human burdens detailed in said co-pending applications bearing Serial No. 707,151. And for this particular duty—that is, snatching and transferring these operators from the semi-robot tow-planes—special light transfer planes can be employed.

The specific automatic pilot controls need not be graphically shown, in relation to said tow-plane **1**^{a}, since such devices have long been employed in so-called "drones" by the United States Air Force. The schematic auto-control means **5**, **6** and **7** on the gliders of Fig. 1, however, are comparable to the instrumentalities which could be installed on the so-called semi-robot tow-planes.

It is apparent that the robot escorts could be designed to carry only one-way fuel loads; and inasmuch as no return trips need be contemplated, their size and general design, with a view toward long ranges and low production costs, could merely accommodate the temporary requirements. Such escorts, fully fueled, could be originally towed in trains as gliders to station C. If desired, they could be provided with warheads and additionally employed as dive-bombers on target D.

A yet more simplified and possibly preferred procedure is to provide—instead of the semi-robots—a fleet of small tow-planes, each adapted to "pluck" one of the tow-bombs from newly arrived trains of the same at station C; from which point the bombs would be quickly escorted to the midair "launching" points **61**. At these points the bombs would be cast off—launched—and their subsequent guidance to target D delegated entirely to the airborne shoran base stations. The small, fast flying escorts could then return quickly to station C to meet the next wave of tow-planes arriving from station B. Thus, if each of the larger tow-planes arrived with three gliders in train therebehind, they would be met by three of the final escorts, the latter plucking one bomb each from the larger craft in rapid succession. According to this option, the rescue operation and the destruction of the semi-robot tow-planes would both be obviated, including the necessity for providing a fleet of craft to be used in rescue duty only.

The general modus operandi, as outlined above, will be clearly understood by professionals of the art and, therefore, scarcely calls for any graphic representations other than those already alluded to. Diagrammatically, however, it may be understood that the positions of the plurality of airborne shoran base-points are indicated at altitude locations occupied by said rotary wing craft **73**, Fig. 6, which same could be any predetermined distances apart from one another between station C and the tow-bomb release point or points **61**.

Incidentally, this applicant assumes that such terms as "loran" and "shoran" are universally understood among those regularly engaged in the related arts. All features thereof, however, which are not dealt with herein may be readily clarified by consulting any of several standard works on such systems. Thus, in the volume entitled "Radar" by Orrin E. Dunlap, Jr., Harper & Bros., New York, N. Y. (revised edition of 1948), on page 227 the author says, in brief: Shoran is a type of radar system developed under the direction of Stuart W. Seeley of RCA Laboratories for high-precision, position-finding in aerial navigation. The term shoran is a contraction of the words 'short' and 'range,' although that is not exactly an accurate description in view of the fact that satisfactory performance has been obtained beyond 250 miles." The system is thence further explained to the end of paragraph 3 on page 230.

With reference to the term "loran" and a detailed exposition of the same, reference may be had to the Radiation Laboratory series published by McGraw-Hill Book Co., New York city, in 1948. Volume 4 thereof, entitled "Loran," Long Range Navigation, is especially authoritative. On page 3, chapter 1, the contributing authors B. W. Setterly and D. Davidson explain, in brief, that: "The Loran system is a radio aid to navigation. It provides means, independent of all other aids (including even the compass and the log or air-speed meter), for locating a moving vehicle at a given moment and for directing it to a predetermined point or along a predetermined path." Vol. 2 of the same series of books also deals expressly with shoran techniques, beginning on page 281.

It may be profitable to point out that the towable, releasable rotary wing airchaft **73** may be employed in other military as well as in peacetime services.

According to the invention, the first blitz offensive, as previously explained, may be followed by an invasion of enemy terrain, including the relayed transportation of troops and equipment in a similar manner, but employing standard types of glider craft instead of towable bombs. The means for and the method of switching such glider may be the same as described with reference to the tow-bombs. Gliders of the required types of this phase of the operations are not shown, since they may be similar, in general, to those graphically detailed and described in said first mentioned co-entered application.

It should be pointed out that many of the ambitious schemes for rocket warfare are yet far from having reached a stage at which they can be reduced to practice. The present invention, however, could readily be put into operation with the use of existing or of readily available structures.

The embodiments herein are subject to various changes, substitutions, and modifications within the scope of my general concept, and the latter is in no wise limited solely to such mere illustrative features—as in the drawings, for example—but only according to the hereinafter appended claims.

I claim:

1. In combination: a single tow-plane; a plurality of flyable, towable demolition bombs in trailing airborne relations thereto; and means, including multiple winch means on said tow-plane, for separately, reelably, towably controlling the aerodynamic movements of said bombs in cooperation with respective hawsers appendant between each thereof and said multiple winch means of the tow-plane.

2. In a system for conducting warfare, the combination including a duality of airborne tow-planes A and B capable of respective air speeds enabling them, at particular times, to be flown in closely adjacent flight formations, and at least one flyable, towable demolition bomb entrained with plane A, which is to be switched therefrom as an airborne tow-burden to plane B; a burden line on which said bomb depends, a master tow-line payable from means therefor aboard plane A, and an interlinking member releasably coupling each of said burden line and said master tow-line to one another; said A plane bearing auxiliary burden-switching tackle including a length of transfer line having a terminal portion which also is releasably connected to said interlinking member and the opposite end section thereof supported readily detachably, at an outboard location, in the path of travel of a line-engaging means extensible from towplane B; said bomb having automatically operable flight-control means thereon adapted to be actuated by apparatus complementary thereto on at least the last named of said tow-planes.

3. In combination: a first airborne towplane; a second towplane traveling an airway path adjacent the flight path of said first plane; at least one flyable, towable bomb in trailing relation to said first plane, which is to be switched therefrom as an airborne burden to said second towplane; a tow-line interconnecting said first towplane and said bomb; burden-switching tackle—including a transferable length of auxiliary towline—associated with said first towplane; and burden-receiving means on said second towplane;

one end of said auxiliary tow-line component of the burden-switching tackle being interconnected to the burden by way of intermediary means, comprising a coupling device which is, itself, readily releasably connected to another portion of the burden-switching tackle, and the opposite end section of which auxiliary line is formed with means enabling it to be releasably supported and snatched by a line-engaging element of said burden-receiving means of the second named towplane; said bomb having automatically operable flight-control means thereon adapted to be actuated by apparatus complementary thereto on at least the last named of said towplanes.

4. The method of conducting warfare which comprises: establishing one or more relay stations en route between a selected aircraft take-off point or points and an objective to be bombed from the air; dispatching each of a fleet of towplanes to tow, respectively, at least one flyable bomb from said take-off point or points to a given locality adjacent at least a first of said relay stations; dispatching an advance guard of freshly fueled other towplanes from said station to meet aloft corresponding numbers of said first towplanes on schedule; flying each complementary duality of said towplanes in relatively close formations; operating cooperative means on each thereof to switch the respective bombs from said first to said advance guard towplanes, in continuously towed relations; and the further operation of each of the advance guard planes to tow its newly acquired tow burden en route to said objective.

5. The method of claim 4 which includes the further transportation of said bombs and their ultimate arrival within final approaching and striking distance of said objective; the orderly release of said bombs from the last contingent of said towplanes; and their further travel along respective flight paths leading them to the proximity of the aforesaid objective.

6. The method which includes: operating a plurality of airborne objects to take up temporary positions in spaced relations to one another, and each thereof with respect to the known effective approaching and striking distance to be subsequently traveled by a flyable demolition bomb while in route from a given release point thereof to an enemy target; operating one of a series of towplanes, flying in relay relations, to receive such a bomb as a transferred, continuously airborne tow-burden from a towplane to which it had previously been engaged burdenwise; further operating said first named plane to tow said bomb to said given release point; the release of the bomb from said first mentioned towplane; the continued flight of the bomb under its own propulsion; the coincidental operation of means on each of said airborne objects to produce a remotely controlled actuation of flight-controlling means complementary thereto on said bomb; and the latter's guided navigation electronically along a path through the air leading it to the proximity of said target.

7. In combination: a first winch having a drum; a length of drum line having a terminal thereof anchored to this drum; a second winch having a drum; and subsidiary means in structure with said second drum which instantaneously releasably engages the other terminal of said drum line.

8. In combination: a flyable, towable burden and a device which towingly engages said burden; a winch, having a tow-drum, mounted on said device; a subsidiary winch, having a drum, mounted on said burden; a tow-line releasably interconnecting said first tow-drum with said subsidiary drum; and means on this latter named drum operable to actuate the line-releasing means to free that terminal of the line which is directly connected to said subsidiary drum.

9. In a cable-release combination: a tow-drum having an opening of adequate size for the normal entry of a tow-cable terminal therethrough; a length of tow-cable adapted to be electively wound or unwound on or from said drum, said cable having a terminal portion adapted to protrude through said opening into the drum interior; means, housed within said drum interior, for therein receiving and securing said terminal instantaneously releasable; and remotely controlled other means for imparting cable releasing movement to said cable securing and releasing means.

10. In combination: an airborne towplane; a flyable bomb in tethered relation thereto; and means, including jet-propulsive means, on said bomb for the aerodynamic sustentation and self-propulsion thereof upon its release normally from said towplane; a winch on said towplane and a drum on said winch; a winch on said bomb and a drum on this winch, this latter drum having an opening therein of adequate size for the entry of a tow-cable terminal therethrough; a length of tow-cable adapted to be wound or unwound on or from said last named drum, said cable having a terminal portion which protrudes through said opening into the drum interior; means, housed within said drum interior, for receiving and holding said terminal instantaneously releasable; means connecting the opposite end of said cable to said first named drum; and remotely controlled other means for imparting cable releasing movement to said cable receiving and holding means.

OWEN BROWN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
675,453	Sturgess	June 4, 1901
704,050	Klinger	July 8, 1902
1,152,226	Saladiner	Aug. 31, 1915
1,293,228	Sopwith	Feb. 4, 1919
1,304,314	Hiel	May 20, 1919
1,353,518	Chmielarski	Sept. 21, 1920
1,379,788	Stone	May 31, 1921
1,384,030	Fessenden	July 5, 1921
1,912,722	Perkins	June 6, 1933
1,913,508	Phillips	June 13, 1933
1,924,391	Bardon	Aug. 29, 1933
2,079,021	Malcolm	May 4, 1937
2,181,477	Chupp	Nov. 28, 1939
2,261,598	Tyson	Nov. 4, 1941
2,330,803	Andrews	Oct. 5, 1943
2,350,999	Beirise	June 13, 1944
2,352,308	Bailey	June 27, 1944
2,364,598	Beddow	Dec. 12, 1944
2,393,892	De Ganahl	Jan. 29, 1946
2,395,172	Dean	Feb. 19, 1946
2,397,088	Clay	Mar. 26, 1946
2,400,301	Lobelle	May 14, 1946
2,400,400	Duer	May 14, 1946
2,401,853	Bailey	June 11, 1946
2,402,918	Schultz	June 25, 1946
2,405,238	Seeley	Aug. 6, 1946
2,405,239	Seeley	Aug. 6, 1946
2,407,634	Du Pont	Sept. 17, 1946

(Other references on following page)

UNITED STATES PATENTS

Number	Name	Date
2,408,773	Goodall	Oct. 8, 1946
2,418,702	Du Pont	Apr. 8, 1947
2,420,946	Gille	May 20, 1947
2,421,788	Henry	June 10, 1947
2,422,662	Fahrney	June 24, 1947
2,425,309	Ennis	Aug. 12, 1947
2,443,114	Notestein	June 8, 1948
2,463,119	Pyle	Mar. 1, 1949
2,471,599	Young	May 31, 1949

FOREIGN PATENTS

Number	Country	Date
204,390	Great Britain	Sept. 27, 1923
276,911	Italy	Aug. 22, 1930
380,921	Italy	June 31, 1940
494,399	Great Britain	Oct. 25, 1933
540,724	Great Britain	Oct. 28, 1941
816,813	France	May 10, 1937