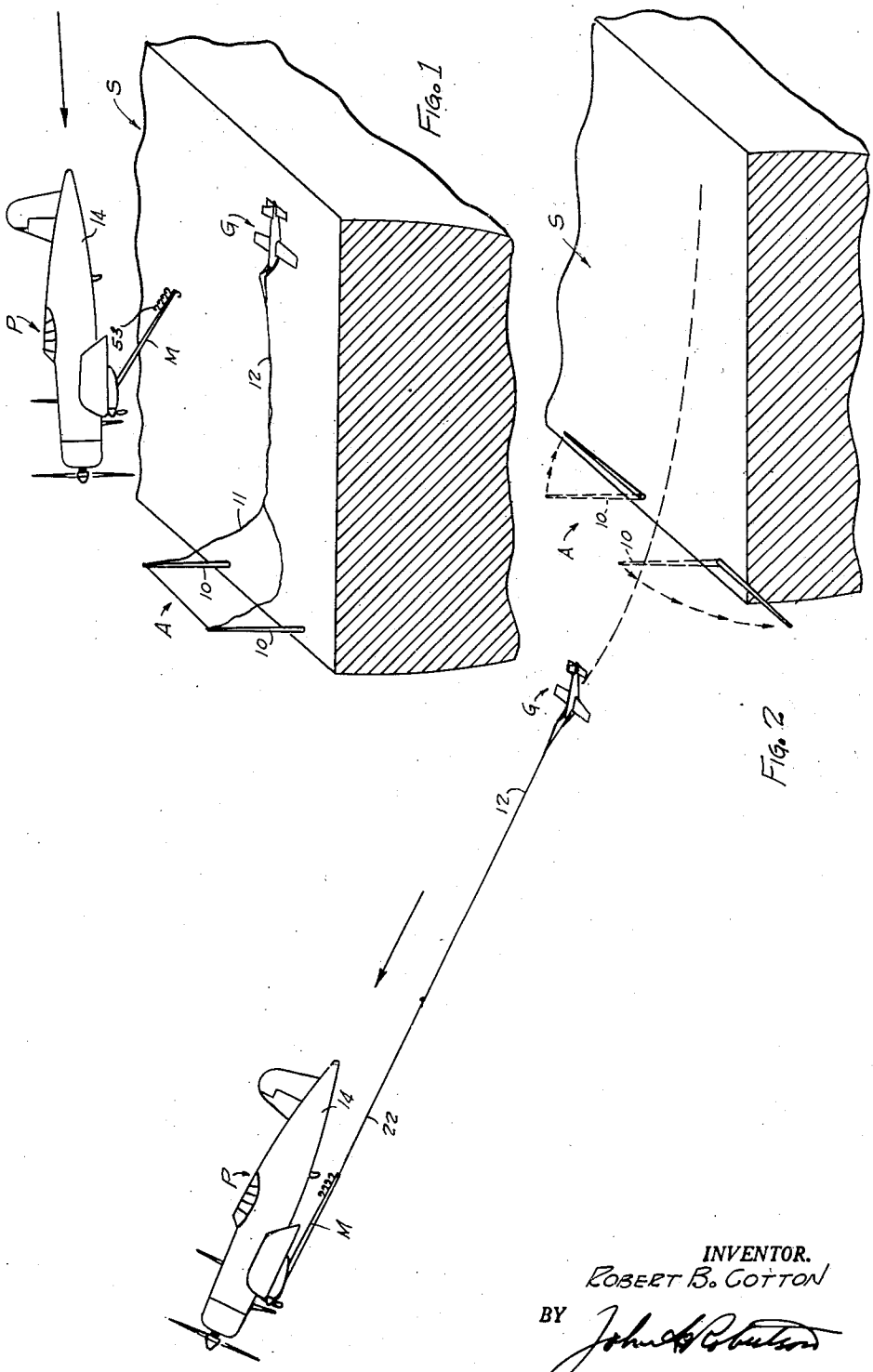
March 8, 1949. R. B. COTTON 2,464,073

CONTINUOUS GLIDER TARGET PICKUP UNIT

Filed March 31, 1947 7 Sheets-Sheet 1



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CONTINUOUS GLIDER TARGET PICKUP UNIT

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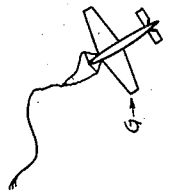


Fig. 3

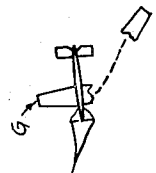
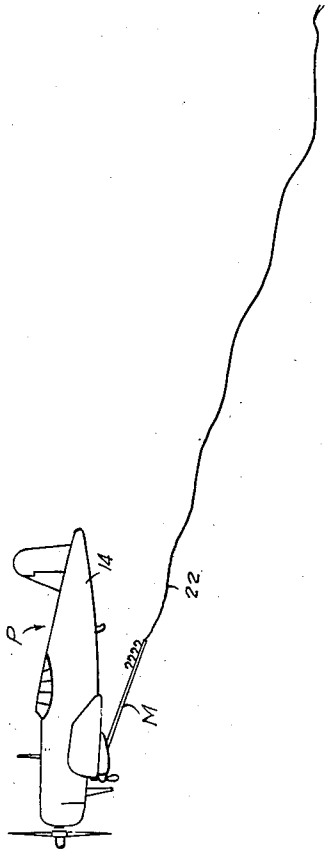
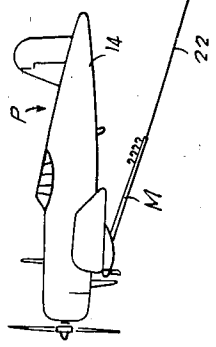


Fig. 4





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CONTINUOUS GLIDER TARGET PICKUP UNIT

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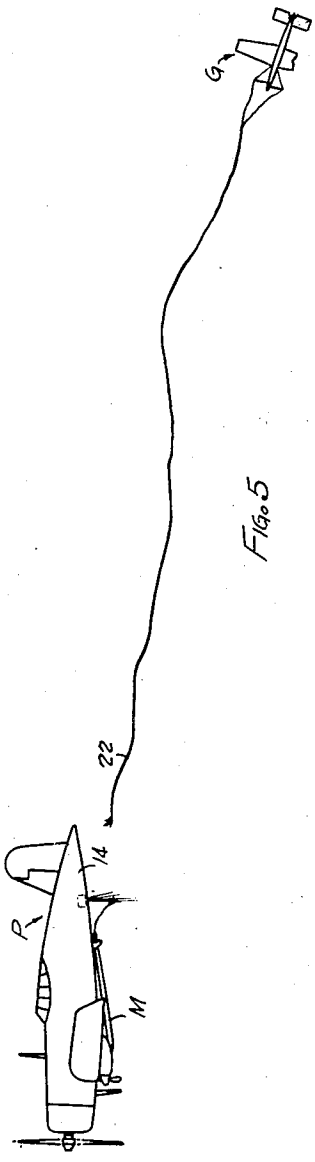


FIG. 5

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CONTINUOUS GLIDER TARGET PICKUP UNIT

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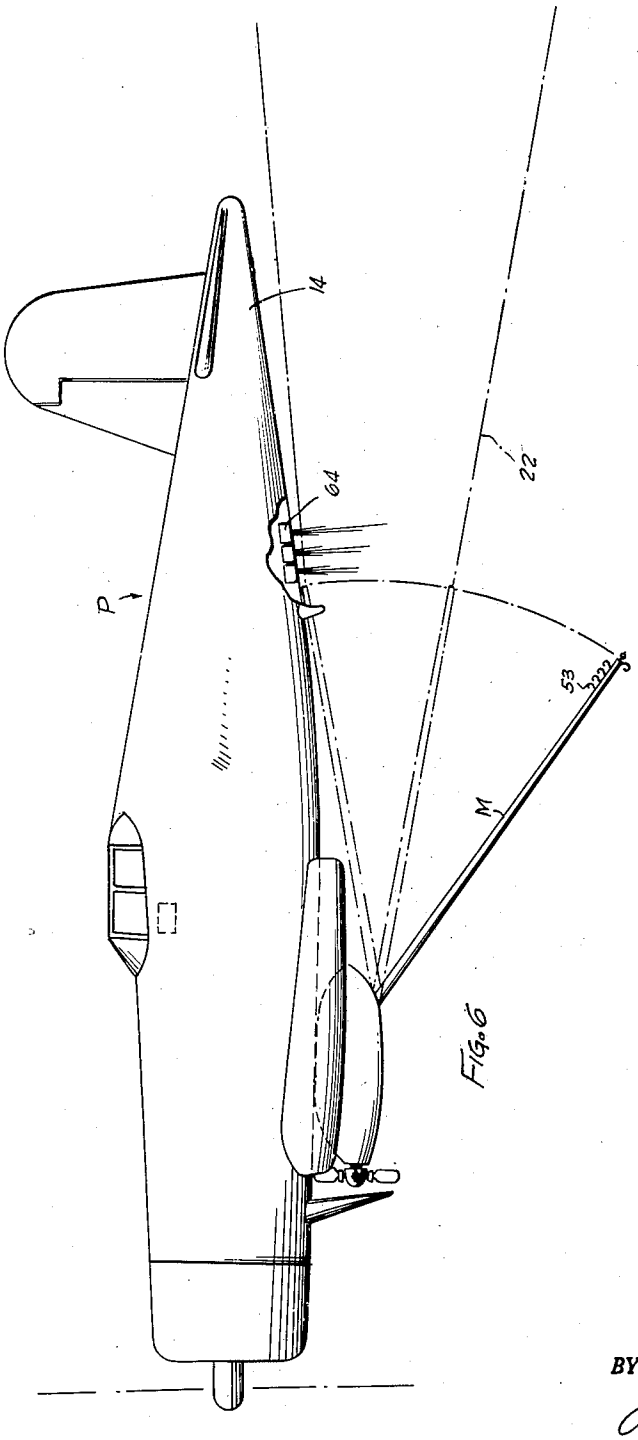


FIG. 6

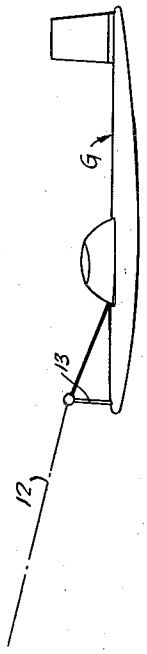


FIG. 7

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CONTINUOUS GLIDER TARGET PICKUP UNIT

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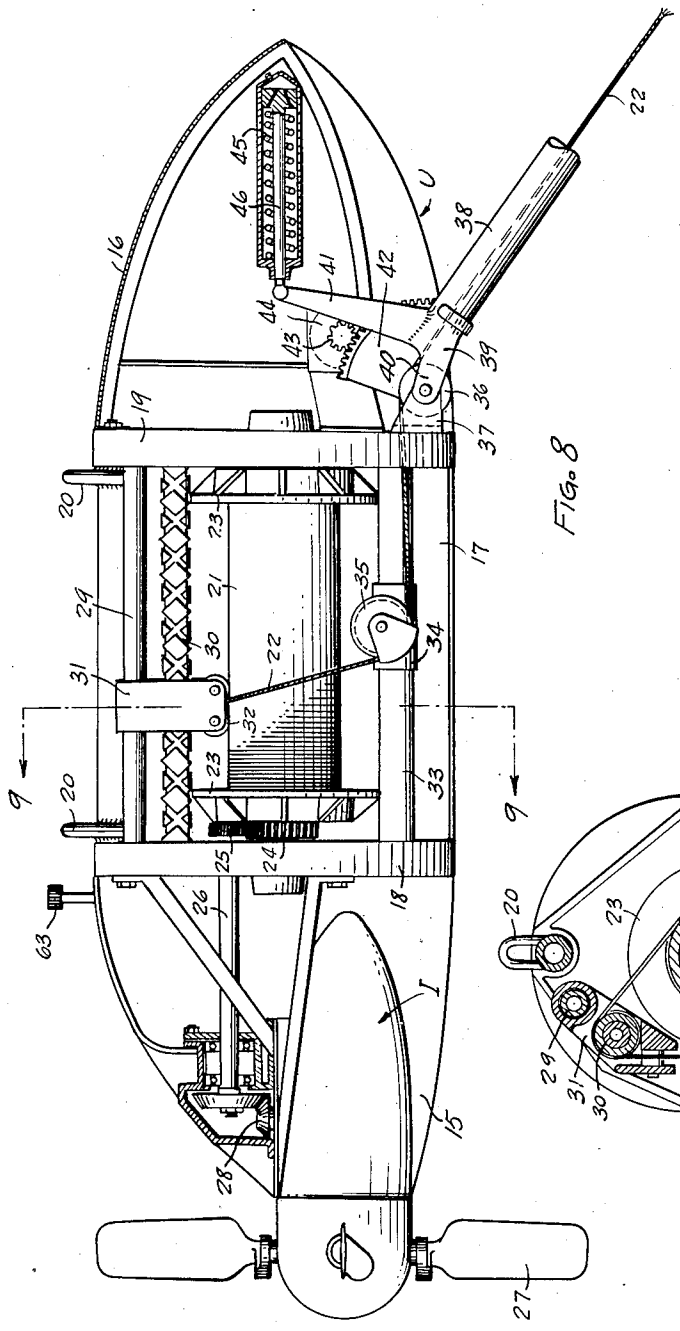


FIG. 8

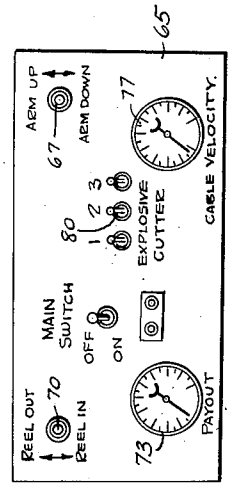


FIG. 10

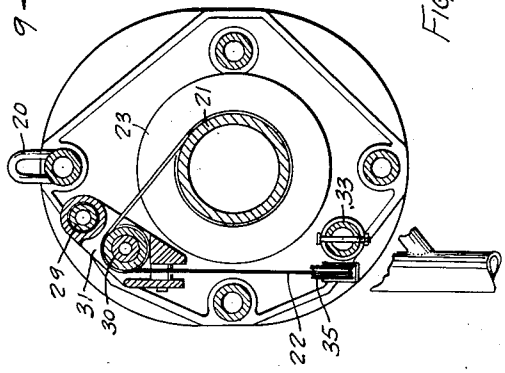


FIG. 9

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CONTINUOUS GLIDER TARGET PICKUP UNIT

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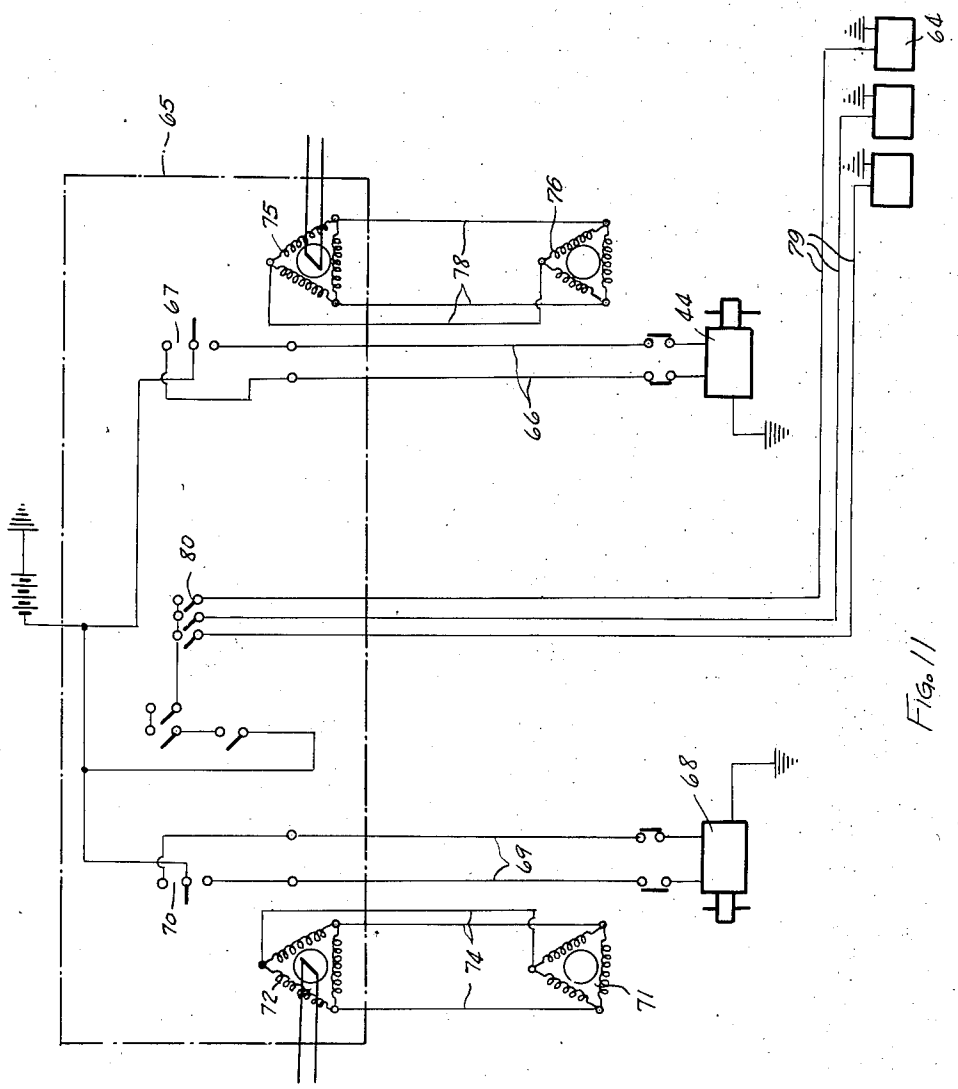


FIG. 11

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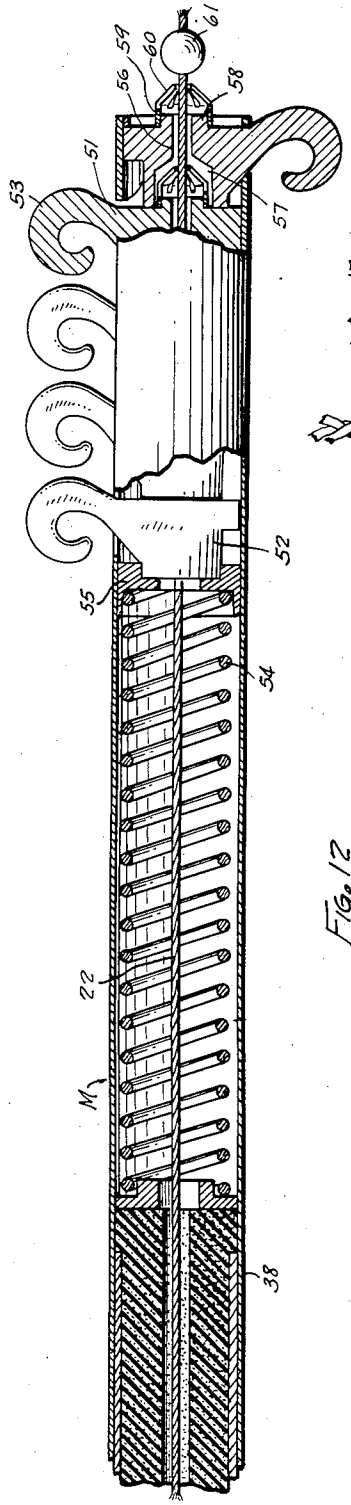


FIG. 12

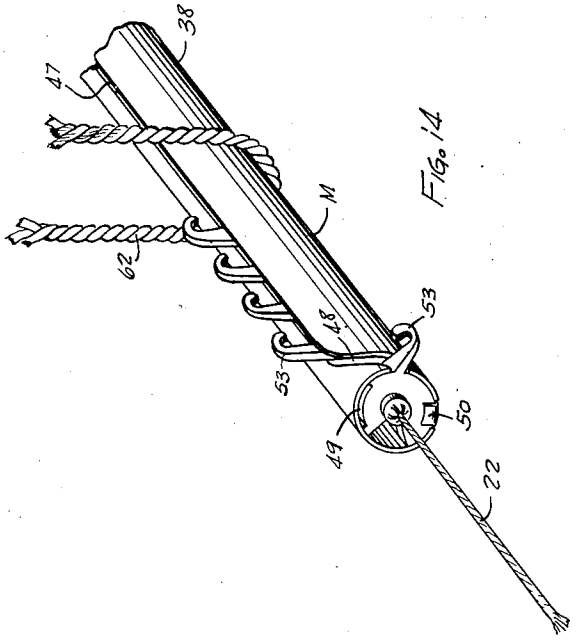


FIG. 14

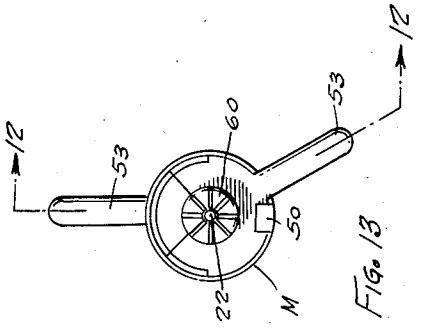


FIG. 13

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Patented Mar. 8, 1949

2,464,073

UNITED STATES PATENT OFFICE

2,464,073

CONTINUOUS GLIDER TARGET PICKUP UNIT

Robert B. Cotton, Lansdowne, Pa., assignor to All American Airways, Inc., a corporation of Delaware

Application March 31, 1947, Serial No. 738,373

15 Claims. (Cl. 258—1.2)

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The present invention relates to air pick-up and is concerned primarily with the problem of making successive pick-ups of gliders without landing.

At the present time, the personnel of our military and naval forces are trained by shooting at aerial targets. Such targets are ordinarily towed behind an aircraft an appreciable distance. Obviously when a direct hit is scored the target is destroyed and there are times when the towline is severed. Thus, the aircraft must come down and pick up another target to continue the operation. With the equipment now available, this necessitates the landing of the plane to adjust the pick up apparatus so as to ready it for the next pick up.

With the foregoing conditions in mind, this invention has in view as its foremost objective, the provision of pick up equipment adapted to be attached to an aircraft for making successive pick ups of aerial targets without landing.

The type of target with which this invention is particularly concerned is a glider. The apparatus of this invention is designed primarily for use with a target of this type. A further object of the invention is the provision of a unit which is substantially complete in itself and which is adapted to be attached to or detached from an aircraft with a high degree of simplicity.

A further object is the provision of such a unit which includes means for controlling the paying out and reeling in of a towline to which the target is attached. Inasmuch as it is important that the pilot of a plane know the relative position of the target being towed, it is important to provide instruments which will give him this information. Accordingly, a further object lies in the provision of an electrical system providing gauges in the plane, together with instruments in the unit, for indicating the rate at which the towline is payed out and the length of the line which has payed out. This is accomplished by the use of Selsyn motors which are readily adapted for the quick assembly and detachment above referred to.

It often becomes necessary for the power of the plane to cut the towline so as to release a damaged target. A further end in view is the provision in an aircraft including a unit of the character aforesaid of explosive means for cutting the towline and which means is included in the electrical system aforesaid so as to be under the control of the pilot.

In accordance with now well accepted technique in the art of air pick-up, a ground station presenting an erected loop to which the object to be

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picked up is attached and a contact arm on the pick-up aircraft, and which arm carries a releasable hook attached to the towline, are essential elements to a pick up apparatus. This invention proposes to follow this technique. However, in order to provide for successive pick ups without landing, it is necessary that the contact arm carry a magazine of pick-up hooks. A further object, therefore, is the provision in air pick-up mechanism of the type indicated, of a contact arm, together with a magazine including a supply of pick-up hooks, with means for urging each hook successively into effective position.

For the initial pick-up of any series, it is entirely practical to provide the towlines with a knot obstruction or other comparable element which is engaged by a hook, so as to fix the connection between the two. However, once the line is severed, it becomes necessary to provide means for establishing a fixed engagement between the hook and the line. Accordingly, a further objective is the provision, in air pick-up equipment, of a towline on which is threaded a plurality of pick-up hooks and each of which includes means for engaging the line at a point closely adjacent to where it is severed. Whether the line is shot away or cut by an explosive cutter, the end of the line is left in a frayed or distorted condition which is adapted to be caught by a so called "snarling element" on the hook. Particular features and advantages of the invention are tied in with the provision of this particular element.

In providing a unit of the character above indicated it becomes important to accurately control the reeling in and paying out of the towline. Another object, therefore, is the provision of a unit of the type aforesaid which includes a winch, together with an impeller for rotating the winch under air power, together with new and improved level wind for controlling the winding of the towline on the winch.

Various other more detailed objects and advantages of the invention such as arise in connection with carrying out the above noted ideas in a practical embodiment will in part become apparent and in part be hereinafter stated as the description of the invention proceeds.

The invention, therefore, comprises a pick-up unit adapted to be quickly attached to or detached from an aircraft and which includes a winch, control instrumentalities therefor, and a towline that is taken up on said winch, together with a contact arm carrying a magazine of pick-up hooks, each of which includes means for fixing an engagement with the towline on which

they are threaded. For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawings wherein:

Figure 1 is a perspective, largely diagrammatic, showing an aircraft about to pick up a glider target in accordance with the principles of this invention.

Figure 2 is another perspective similar to Fig. 1 showing the relation of the parts immediately after the pick-up.

Figure 3 is a side view, somewhat diagrammatic, showing the condition when the towline is severed.

Figure 4 is a view similar to Fig. 3, depicting a damaged glider target.

Figure 5 is another view similar to Figs. 3 and 4 illustrating the severing of the towline at the aircraft by an explosive cutter.

Figure 6 is a side view showing the unit of this invention applied to an aircraft.

Figure 7 is a side view showing the attachment to the glider.

Figure 8 is a longitudinal section through the unit bringing out details of the mechanism therein.

Figure 9 is a transverse section taken about on the plane represented by the line 9—9 of Fig. 8.

Figure 10 is a front view of the instrument panel for the unit.

Figure 11 is a wiring diagram for the unit and associated instrumentalities.

Figure 12 is mostly a longitudinal section through one end of the contact arm with a portion shown in elevation, being taken about on the plane represented by the lines 12—12 in Figure 13.

Figure 13 is an end elevation of the contact arm, and

Figure 14 is a detailed perspective of the free end of the contact arm.

Referring now to the drawings wherein like reference characters denote corresponding parts, and first more particularly to Figs. 1 and 2, a surface from which pick-ups are to be made is referred to generally as S. This surface may be any appropriate ground location or the deck of a ship. The target being picked up is shown in the form of a glider G and may be any type of glider found suitable for target purposes. A ground station is identified in its entirety by the reference character A. This station A comprises spaced poles 10 which hold in erected position a loop 11 having a top ply that is tensioned whereby it is adapted to be engaged by a contact arm and pick-up hook as will be later described. A line 12 connects the loop 11 to the glider G. A bridle such as shown at 13 in Fig. 7 may be employed to establish the connection with the glider and at the same time maintain the relation necessary for good flying characteristics.

An aircraft which is to be used in picking up and towing of gliders is designated P. The aircraft P includes the usual elements found in an airplane, but this invention is concerned particularly with the fuselage designated 14. The unit which is attached to the aircraft P for the purpose of accomplishing successive pick ups of the gliders G is identified in its entirety by the reference character U. This unit U houses substantially all of the mechanisms and devices necessary to achieve the successive pick-up operations hereinafter to be described.

Referring now more particularly to Figs. 8 and 9, the unit U is shown as comprising a housing that is divided into three sections. Thus, it is

made up of a nose 15, a tail section 16, and an intermediate or body section 17. A head or partition 18 divides the sections 15 and 17, while a similar partition 19 marks off the sections 16 and 17. It will be noted that the outer casing of the intermediate section 17 carries hooks or bails 20 which are employed to secure the unit U to the underside of the fuselage 14 as is clearly shown in Fig. 6.

Mounted for rotation between the heads 18 and 19 is a drum 21 on which is wound a towline 22, one end of the towline being anchored to the drum in a well-known manner. The line 22 is coiled between end flanges 23 in an orderly arrangement as will be later pointed out. A gear 24 is drivably associated with the drum 21 and is driven by a pinion 25, carried by a shaft 26.

An air driven impeller referred to in its entirety by the reference character I is mounted in the nose section 15 and serves to derive power from the motion of the aircraft P through the medium of the adjustable vanes 27. This power is transmitted through the bevel gears shown at 28 to the shaft 26. Air driven impellers of the type depicted at I are generally known. Such an impeller is illustrated and described in detail in the co-pending application of Robert B. Cotton, Serial No. 693,044, filed August 26, 1946, for Air driven impeller. So far as this invention is concerned, it is notable that the vanes 27 may be adjusted anywhere from a fully feathered position in which no power is developed, up to an angular position of maximum power. This will be controlled by the operator as will be hereinafter pointed out.

Extending between the heads 18 and 19 is a guide rod 29 and immediately therebeneath is a double threaded screw 30. A slide 31 is fitted over the guide 29 and has parts which cooperate with the threads of the screw 30 so that as the latter is rotated the slide is caused to move along the drum 21. The towline 22 passes between guiding rollers 32 which are carried by the slide 31. Thus, as the slide 31 is moved longitudinally, the line 22 is wound on the drum 21 in an orderly manner. The screw 30 may be driven from the shaft 26 and pinion 25 as illustrated in Fig. 8.

A supporting arm 33 extends between the heads 18 and 19 and carries a bracket 34 on which is mounted a sheave 35. The towline 22 passes around the sheave 35 and extends through the partition 19 and over a second sheave 36 that is mounted on a bracket 37 carried by the head 19 and which extends into the tail section 16.

A contact arm 38 of tubular construction carries at its upper end a bell crank 39. The bell crank 39 has an arm 40 which is pivotally attached to the bracket 37 and long arm 41. The bell crank 39 also carries a gear sector 42 with which meshes a pinion 43 that is driven by a motor represented diagrammatically at 44. This motor 44 is shown in the wiring diagram of Fig. 11.

Mounted within the tail section 16 is a dash pot 45 having a piston 46 which is connected to the free end of the bell crank arm 41.

After passing over the sheave 36 the tow line 22 passes down into the bottom of the tubular contact arm 38. The lower end of the arm 38 carries a magazine referred to in its entirety by the reference character M and which is illustrated in Figs. 12, 13 and 14. This magazine comprises that portion of the tubular arm 38 adjacent to the free end which is formed with a longitudinal slot 47 that ends in a screw or cam

slot 48, that opens into the free end edge of the tube. This free edge carries inwardly projecting retaining tabs 49 and 50. A supply of pick-up hooks 51 have cylindrical body portions 52 which are received in the bore of the tube 38, and bills 53 which are positioned exteriorly of the tube 38 and connected to the cylindrical body portion 52 by necks that are received in the slot 47.

As clearly shown in Fig. 14, a plurality of these hooks 51 are positioned within the end of the tube 38 and urged against the retaining tabs 49 and 50 by an expansion spring 54. The latter bears against a spring follower 55 formed with a central opening to accommodate the towline 22 and which spring follower in turn engages the innermost of the hooks 51.

Upon referring to the right-hand side of Fig. 12 wherein one of the hooks 51 is shown in section, it will be noted that each cylindrical body portion 52 is formed with a center bore 56 that is enlarged at one end to provide a socket 57 and is surrounded at the other end by a lip 58. Secured around the lip 58 is a snarling member 59 having a plurality of converging spring fingers, the extremities of which are spaced sufficiently to allow for the passage of the line 22 therethrough.

The end of the line 22 originally carries adjacent to its extremity some form of obstruction, such as the ball shown at 61. This ball is engaged by the snarling member 59 to prevent the end hook 51 from pulling off the line. After the line is severed for any reason, its end will be distorted or frayed, in which condition it is readily adapted to have the spring fingers 60 of any subsequent hook catch thereon.

Upon referring to Fig. 14, it will be noted that the lower end of the contact arm 38 is supported by the bight of a suspension line 62. This limits downward movement of the contact arm 38.

Upon referring to Fig. 8, it will be noted that the unit U carries on its upper side in close proximity to one of the bails 20, an electrical connecting element 63. A corresponding element (not illustrated) is mounted on the under side of the fuselage 14, and in proper position so that when the unit U is mounted on the fuselage by the bails 20, the two connecting elements meet and complete the several electrical circuits of the unit and of the plane.

Upon referring to Fig. 6, it will be noted that the rear part of the fuselage 14 carries a plurality of explosive cable cutters shown at 64. Any desired number of these cutters may be included. When one is exploded, it should be effective to cut the towline 22 when the latter is in its immediate proximity as will be the condition during a towing operation. Explosive cable cutters of this general type are generally known. One such cutter is fully illustrated and described in the application of Arthur B. Schultz, Serial No. 558,022, filed October 10, 1944, now Patent No. 2,460,194, dated January 25, 1949, and entitled "Apparatus for severing tow lines and the like." The cable cutters 64 are electrically detonated and the control wires therefor are included in the electric system now to be described.

Upon referring to Fig. 11, the various electrical devices, represented symbolically within the broken line rectangle, are assembled substantially at the control panel which is shown at 65 in Fig. 10. The cable cutters 64 are included in the fuselage 14 as above described, and the other electric instrumentalities are included within the unit U.

The motor 44 which raises the contact arm 38 is within the unit U. Conductors 66 extend through the connection 63 to the instrument panel where they are connected to a control switch 67. Another electric motor 68 is included in the nose section 15 and is operatively connected with the vanes 27 so as to control the pitch thereof. Conductors 69 extend from the motor 68 through the connection 63 to the panel 65 where they are connected to a control switch 70.

A Selsyn motor 71 is included in the unit U and is affected by the length of cable which is payed out from the drum 21. A corresponding Selsyn motor 72 is carried by the panel 65 and is operatively connected to the gauge 77. The Selsyn motor 76 is carried by the unit U and is affected by the rate at which the towline 22 pays out. Conductor 78 couples the motor 75 and 76 in a conventional manner.

Wires 79 extend from the cable cutter 64 to the bank of control switches shown at 80 on the panel 65.

Operation

While the operation of the above described mechanism is believed to be apparent from the description of the various elements, it will be noted that when a glider target G is to be picked up, the ground station A is first erected on the surface from which the pick-up is to be made. This may be the deck of a ship or another appropriate location. With the ground station erected, the loop 11 presents a top ply that is tensioned and adapted to be engaged by pick-up arm and pick-up hook. The line 12 connects the loop 11 to the glider target G.

The operator in the plane P first fills magazines M with an adequate supply of the hooks 51. The contact arm 38 is now lowered into the depending position illustrated in Fig. 1. In this position the outermost hook 51, i. e., the one at the end of the arm, will be twisted about under the influence of cam slot 48 into a position in which the bill 53 extends downwardly in contrast to the upper position of the remainder of the bills.

The operator now flies the plane in so that the contact arm 38 engages the top ply of the loop 11. The loop 11 slides down the under side of the arm 38 until it is engaged and caught by the bill 53 of the hook 51 at the end of the arm. This action causes the hook 51 to overcome the resistance of the retaining tabs 49 and 50 and come free of the arm. The towline 22 is now connected to the loop 11 and pays out from the drum 21. The operator may now avail of the control switch 70 to feather the vanes 27 and thereby cause the impeller I to generate the desired amount of power which controls the cable payout and reel the cable in when the occasion demands.

With the target glider G a safe distance behind the plane P, it may be shot at by those undergoing training. This may result in the towline 22 itself being severed, as shown in Fig. 3, or the target itself may be damaged, as illustrated in Fig. 4. In the latter event, the operator may avail of the control switch 67 to turn on the motor 44 and raise the arm 38. This brings the towline 22 into close proximity to the bank of cable cutters 64, whereupon one of them may be detonated to sever the towline and free it of the

damaged target. The operator may now lower the contact arm and the apparatus on the plane is in condition to make another pick-up, because when the hook 51 at the free end of the arm is pulled loose, the spring 54 moves the next hook into effective position, and when this hook is pulled free, as by the next engagement with the loop of the ground station, the spring fingers 60 of the snarling element 59 catch on the distorted end of the towline 22 and fix the connection between the hook and the towline.

It is evident that the unit U may be removed as a unit, because the several electrical circuits may be broken at connection 63 and the bails 20 released from the fuselage 14. The unit may be attached to any plane which is adapted to pick-up operations by fairly simple changes that are easily carried out.

While a preferred specific embodiment of the invention is hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact construction illustrated and described because various modifications of these details may be provided in putting the invention into practice within the purview of the appended claims.

What is claimed is:

1. In air pick-up apparatus, a tubular pick-up arm, means for mounting one end of said arm on an aircraft, a magazine at the other end of said arm, a supply of releasable pick-up hooks in said magazine, and means for feeding said pick-up hooks into effective position.

2. In air pick-up apparatus, a tubular pick-up arm, means for mounting one end of said arm on an aircraft, a magazine at the other end of said arm formed with a cam slot, a supply of pick-up hooks in said magazine and engaging said cam slot, and spring means urging said hooks into effective engagement with said cam slot.

3. In air pick-up apparatus, a tubular pick-up arm, means for mounting one end of said arm on an aircraft, a magazine at the other end of said arm, a supply of releasable pick-up hooks in said magazine, yieldable means retaining said hooks in said magazine and adapted to be overcome by the force of a pick-up to release a hook at the end of said magazine, and spring means urging said hooks against said releasable means.

4. In air pick-up apparatus, a tubular pick-up arm, means for mounting one end of said arm on an aircraft, a magazine at the other end of said arm, a supply of releasable pick-up hooks in said magazine, each of said hooks being formed with a central opening, a line passing through said openings, and means carried by each of said hooks around said opening for catching on to a frayed part of said line.

5. In air pick-up apparatus, a tubular pick-up arm formed with a cam slot adjacent to one end, a pick-up hook comprising a main body part positioned in the bore of said tubular arm and formed with a center opening, a bill positioned exteriorly of the tubular arm, and a neck connecting said bill and main body part and positioned in said cam slot, spring means in said arm urging said hook toward the free end thereof, a line threaded through the opening in said main body part, and means on said body part to engage a frayed part of said line to prevent relative movement between said hook and line.

6. In air pick-up apparatus, a tubular pick-up arm formed with a longitudinal slot adjacent to one end and a cam slot communicating with said longitudinal slot, a plurality of pick-up hooks

in said arm, each of said hooks carrying a projection fitting in said slot, and yieldable means urging said hook toward the end of said arm.

7. In air pick-up apparatus, a tubular pick-up arm formed with a longitudinal slot adjacent to one end and a cam slot communicating with said longitudinal slot, a plurality of pick-up hooks in said arm, each of said hooks having a main body part in said arm, a bill exteriorly of said arm, and a neck connecting said bill and main body part, with the neck positioned in said slot, and a spring urging said hooks toward the end of said arm whereby the hook in end position is subject to the effect of said cam slot.

8. In air pick-up apparatus, a tubular pick-up arm formed with a longitudinal slot adjacent to one end and a cam slot communicating with said longitudinal slot, a plurality of pick-up hooks in said arm, each of said hooks having a main body part in said arm, a bill exteriorly of said arm, and a neck connecting said bill and main body part with the neck positioned in said slot, spring means urging said hooks toward the end of said arm, a line extending through said arm and on which said hooks are threaded, and means carried by each of said hooks for engaging a frayed part of said line.

9. In air pick-up apparatus, a tubular pick-up arm formed with a longitudinal slot adjacent to one end and a cam slot communicating with said longitudinal slot, a plurality of pick-up hooks in said arm, each of said hooks having a main body part in said arm, a bill exteriorly of said arm, and a neck connecting said bill and main body part with the neck positioned in said slot, spring means urging said hooks toward the end of said arm, yieldable means for holding said hooks in said arm against the influence of said spring means, a line extending through said arm and on which said hooks are threaded, and means carried by each of said hooks for engaging a frayed part of said line.

10. In air pick-up apparatus, a pick-up aircraft, a unit detachably carried by said aircraft, a pick-up arm pivotally mounted on said unit, a magazine of pick-up hooks included in said arm, a winch in said unit, and a line on said winch and threaded through said hooks.

11. In air pick-up apparatus, a pick-up aircraft, a unit detachably carried by said aircraft, a pick-up arm pivotally mounted on said unit, a magazine of pick-up hooks included in said arm, a winch in said unit, an air impeller operatively associated with said winch, a line on said winch and on which said hooks are threaded, and means on each of said hooks for engaging a frayed part of said line.

12. In air pick-up apparatus, a pick-up aircraft, a unit detachably carried by said aircraft, a pick-up arm pivotally mounted on said unit, a magazine of pickup hooks included in said arm, a winch in said unit, an air impeller operatively associated with said winch, a line on said winch and on which said hooks are threaded, means on each of said hooks for engaging a frayed part of said line, and an explosive cable cutter carried by said aircraft in a position to be effective on said line beyond the free end of said pick-up arm.

13. In air pick-up apparatus, a pick-up aircraft, a unit detachably carried by said aircraft, a pick-up arm pivotally mounted on said unit, a magazine of pick-up hooks included in said arm, a winch in said unit, an air impeller operatively associated with said winch, a line on said winch

and on which said hooks are threaded, means on each of said hooks for engaging a frayed part of said line, a battery of explosive cable cutters at the rear part of said pick-up aircraft, and means for setting off said cable cutters individually.

14. In air pick-up apparatus, a unit, means for detachably securing said unit to an aircraft, a winch in said unit, an air impeller in said unit operatively connected to said winch, a level wind associated with said winch, a line taken up on said winch and passing through said level wind, a tubular pick-up arm pivotally connected at one end to said unit, a magazine of pick-up hooks in said arm and threaded on said line, yieldable means for retaining said hooks in said arm, and means on each hook for engaging a frayed part of said line.

15. In air pick-up apparatus, a unit, means for detachably securing said unit to an aircraft, a winch in said unit, an air impeller in said unit operatively connected to said winch, a level wind associated with said winch, a line taken up on said winch and passing through said level wind,

a tubular pick-up arm pivotally connected at one end to said unit, means for limiting downward movement of said arm, means for raising said arm, a magazine of pick-up hooks in said arm and threaded on said line, yieldable means for retaining said hooks in said arm, and means on each hook for engaging a frayed part of said line.

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