United States Patent

[11] **3,552,689**

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[21] Appl. No. **806,210**
[22] Filed **Mar. 11, 1969**
[45] Patented **Jan. 5, 1971**

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[32] Priority **Sept. 4, 1968**
[33] **Canada**
[31] **No. 029,184**

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[54] HELICOPTER LANDING SECURING DEVICE

5 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** **244/115**
[51] **Int. Cl.** **B64f 1/12**
[50] **Field of Search** 244/115, 116, 114, 17.17; 114/43.5

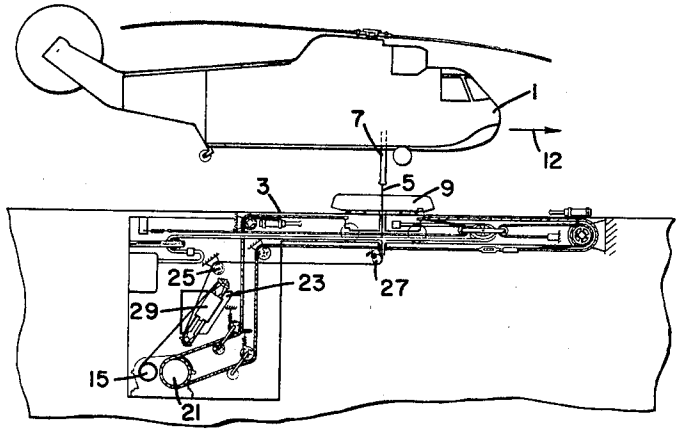
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Primary Examiner—Milton Buchler
Assistant Examiner—Paul E. Sauberer
Attorney—Cushman, Darby and Cushman

ABSTRACT: A trap device for grasping a probe carried by a helicopter when that helicopter lands on the deck of a ship; in the trap device two parallel arresting beams are moved towards one another to grip between them the probe, which probably is not in a dead central position, so that one beam must travel further than the other; clutch means operating on the means for moving the two beams, to lock the beams in their probe-engaging positions; the clutch means according to the described embodiment including two teethed clutch members normally held together by springs but movable apart (to free the clutch) by hydraulic piston means.



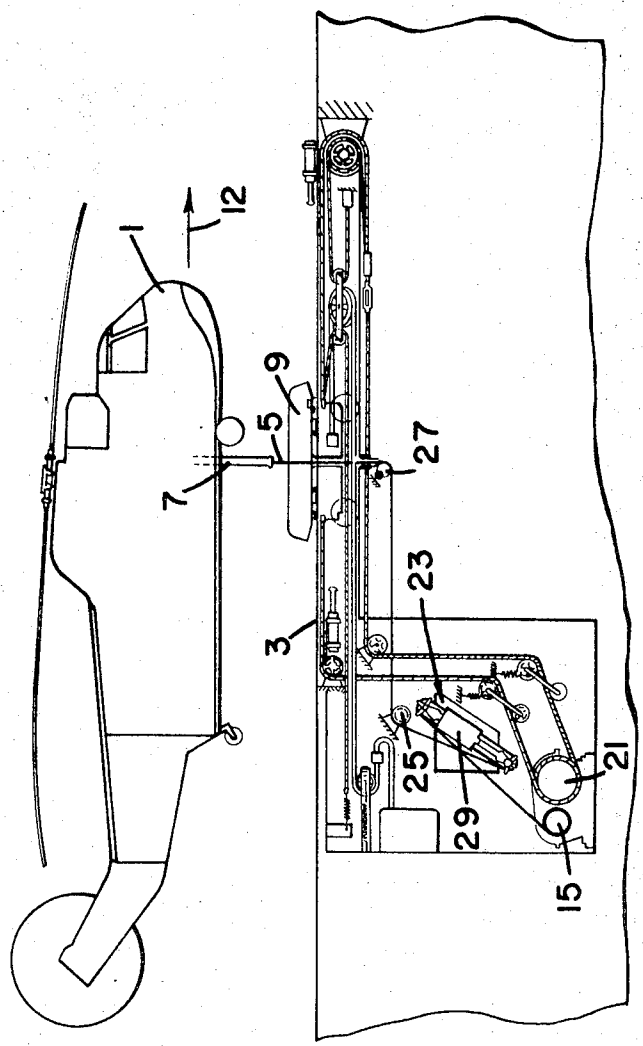


FIG. 1

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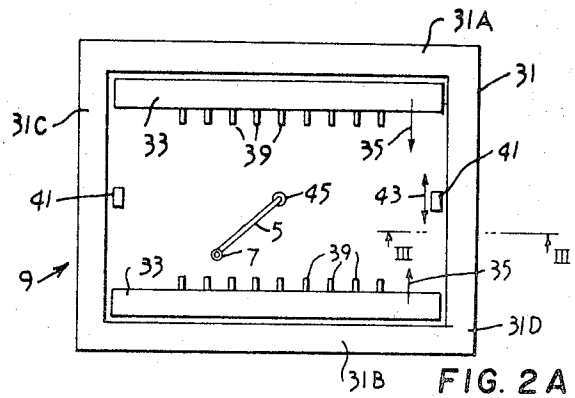


FIG. 2A

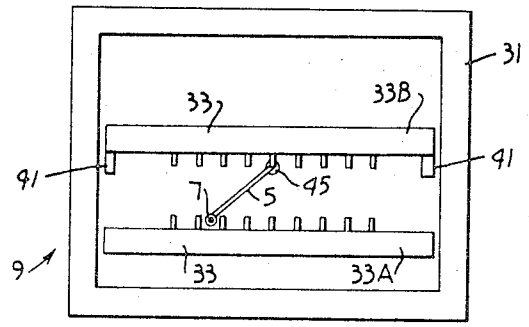


FIG. 2B

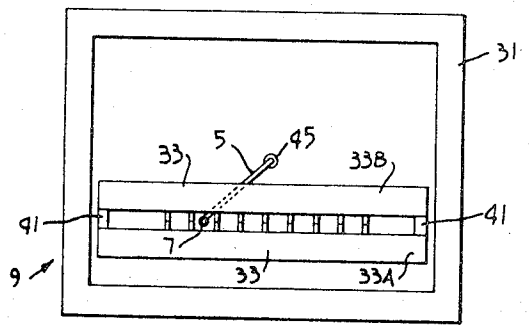


FIG. 2C

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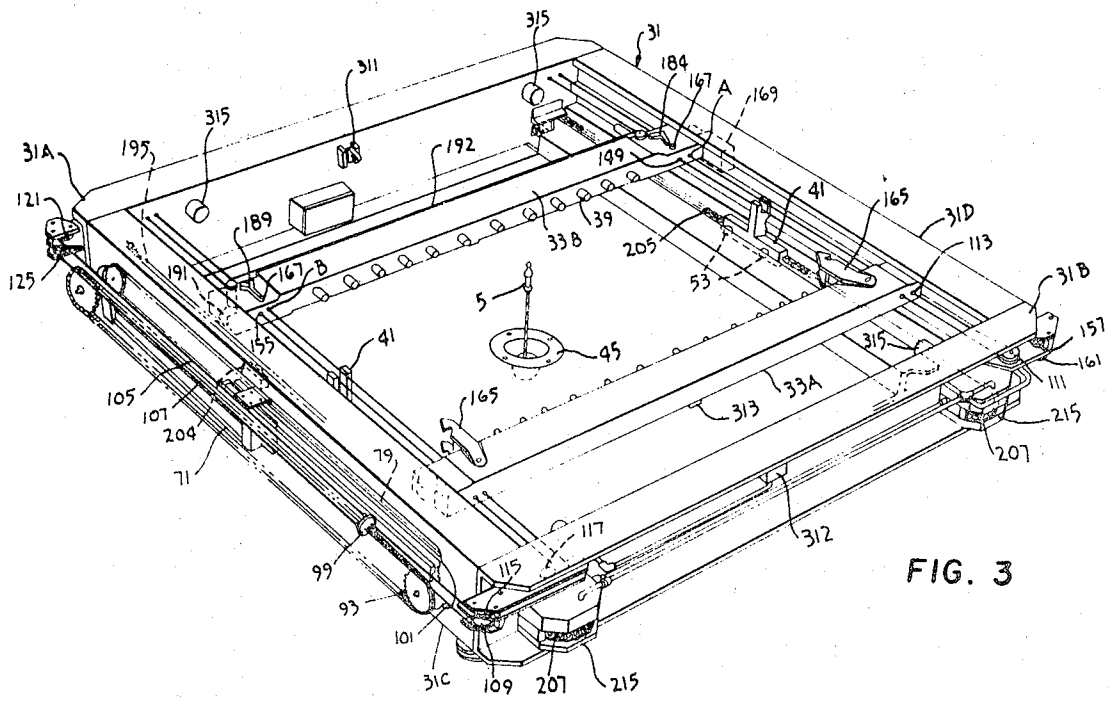
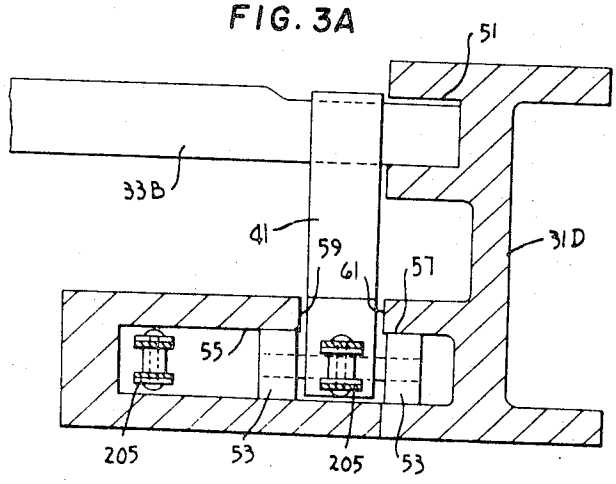


FIG. 3

FIG. 3A



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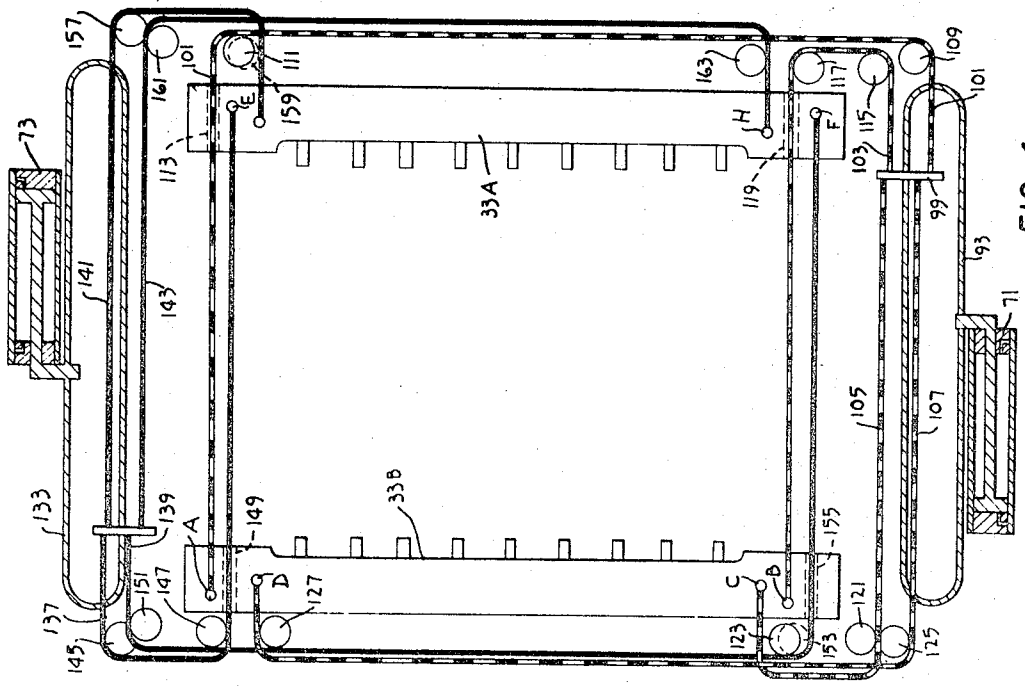


FIG. 4

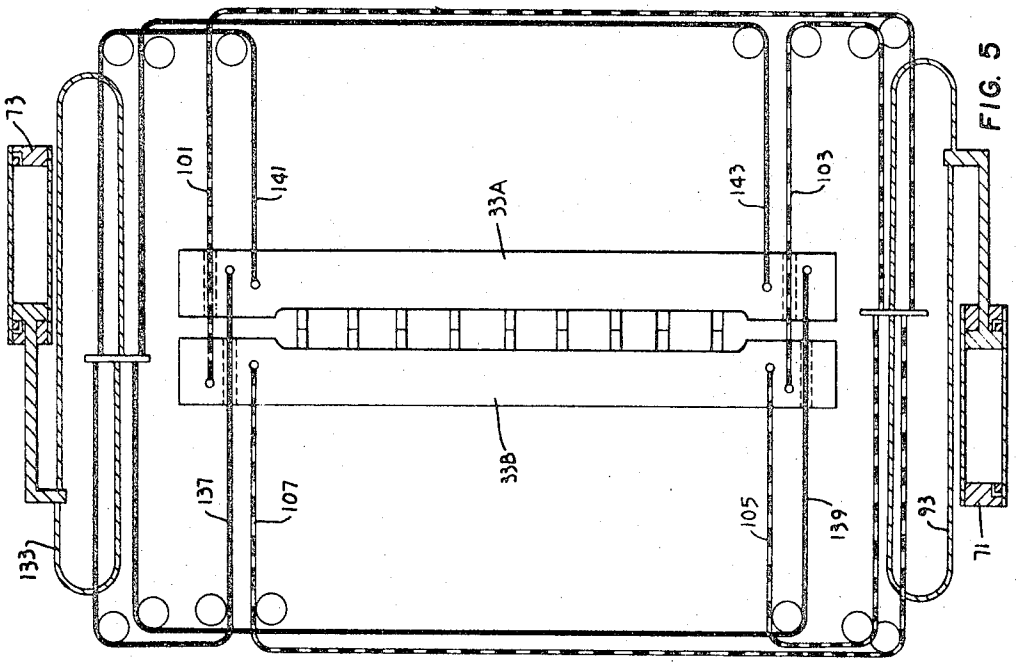


FIG. 5

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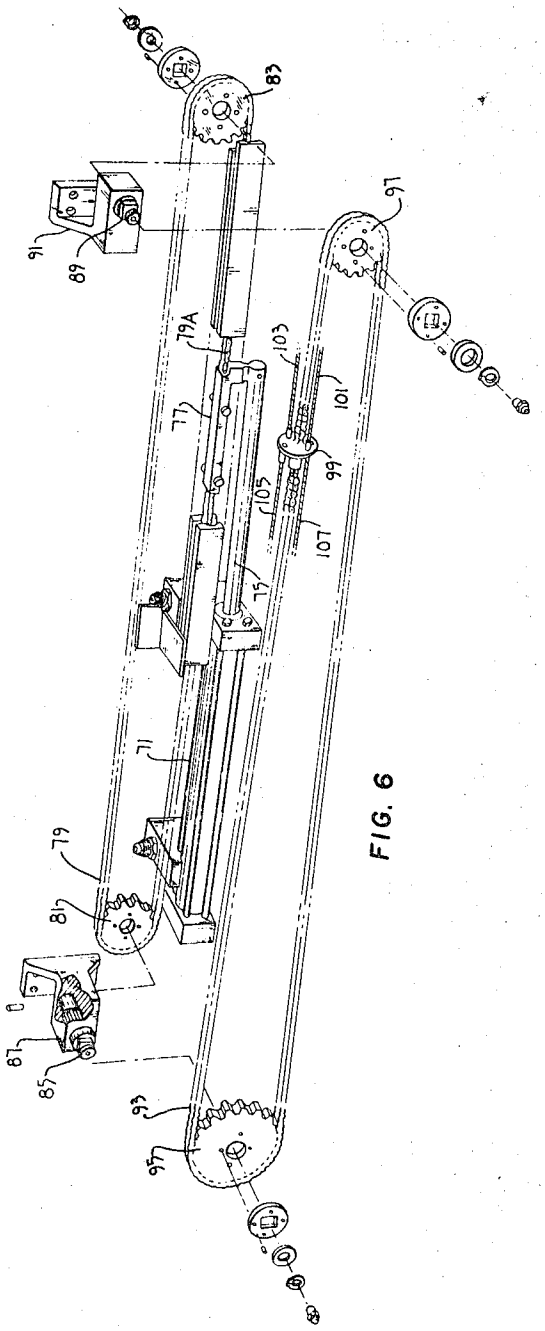


FIG. 6

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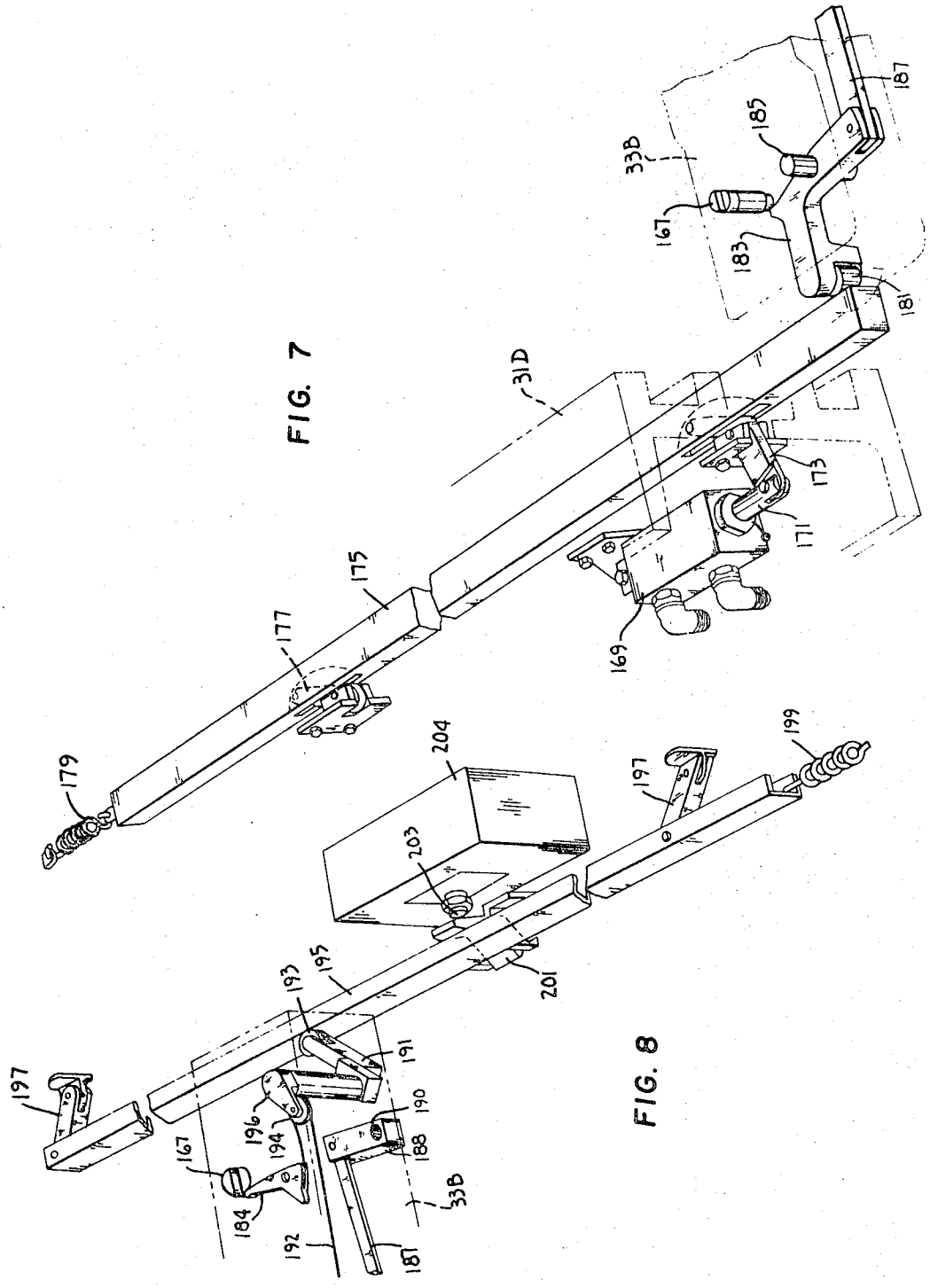


FIG. 7

FIG. 8

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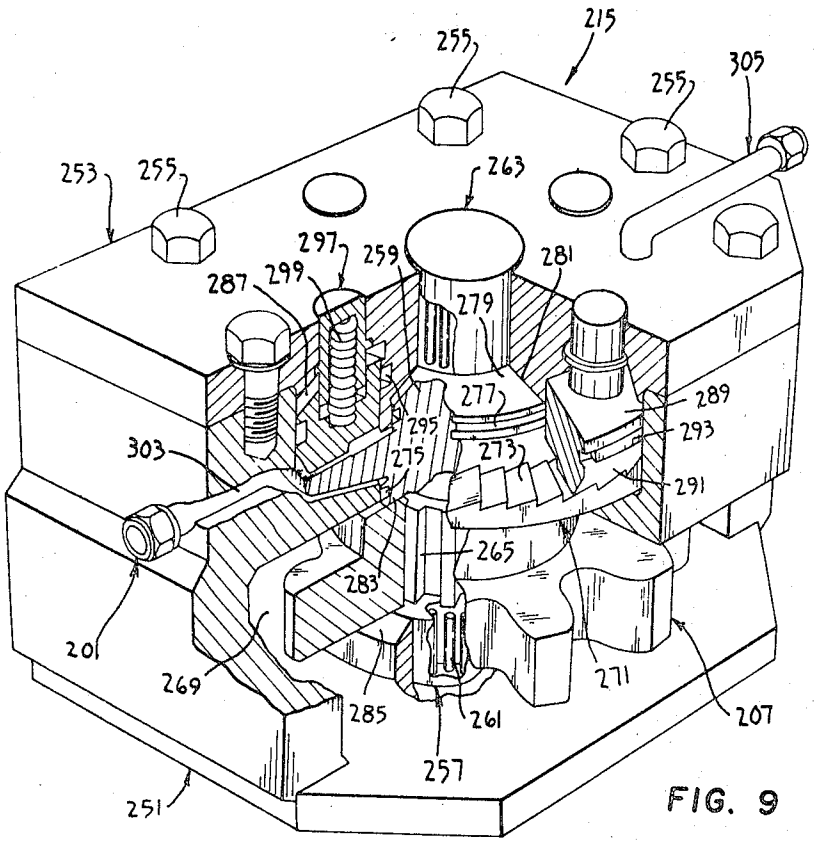


FIG. 9

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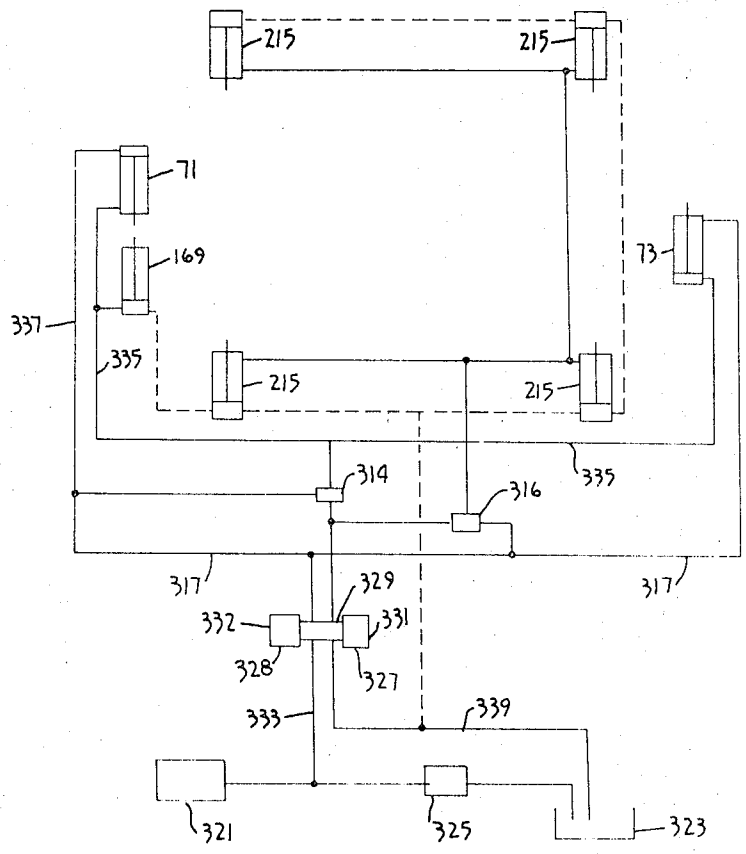


FIG. 10

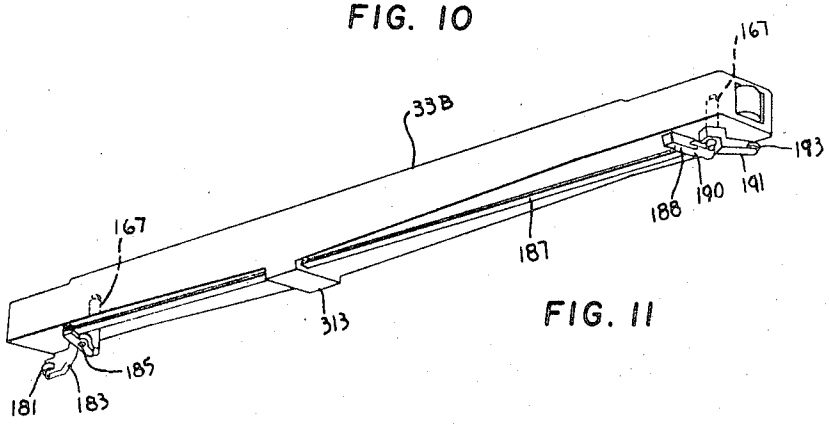


FIG. 11

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HELICOPTER LANDING SECURING DEVICE

In copending Canadian Pat. application No. 887,011, filed on Oct. 18, 1963, in the names of myself Asbjorn Baekken and William G. Stewart, (U.S. Pat. application Ser. No. 404,374, filed Oct. 16, 1964, now U.S. Pat. No. 3,303,807) is described and claimed a device for landing and securing a movable object with respect to a fixed platform and comprising:

a. a probe adapted to be secured to said aircraft;
b. a winch on said platform;
c. a cable on said winch, one end of which is adapted to be secured to said aircraft; and
d. means on said platform for seizing said probe whereby when said probe and cable are secured to said aircraft, said aircraft is hauled down to said platform by said cable and on landing said probe is seized by said means on the platform for seizing said probe.

That Pat. application further describes and claims a device for landing and securing aircraft of the rotor sustaining or hovering type on a deck of a ship, said device comprising:

a. a housing adapted to be secured to said aircraft and forming the female member of a coupling;
b. a first winch adapted to be secured to said platform;
c. a first cable on said first winch;
d. a probe adapted to be secured to an end of said first cable, said probe forming the male portion of said coupling;
e. a winch carried by said aircraft;
f. a second cable secured to said second winch and adapted to be secured to said probe for raising said probe into said housing;
g. means adapted to be secured to said platform for grasping said probe;
h. a pair of parallel rails mounted on said carriage and adapted slidably to be moved towards each other to secure said probe between said rails, said movement being effected by at least one cable secured to each said rail and a drum associated with each cable;
i. locking means carried by one said rail to cooperate with means on said other rail to lock said rails together;
j. spring biased pins on at least one said rail extending toward the other said rail, said pins being adapted to limit longitudinal movement of said probe with respect to said rail; and
k. means for selectively preventing movement of said rails, said means comprising an endless belt disposed transversely of said rails and entraining spaced apart pulleys, a block secured to said belt between said rails and adapted to be engaged by at least one of said rails; and friction braking means adapted to be applied to at least one of said pulleys.

It has been found that in practice it is not necessary or desirable to use friction braking means for holding the pulleys associated with the endless belt for selectively preventing movement of the arresting rails or beams. The friction braking means shown and described in Canadian application No. 887,011 do not immediately lock the pulleys and thus the rails or beams, because a short further travel of the pulley is necessary to cause effective wrapping, and thus braking of the pulley, by the brake band **142** shown in FIG. **15** of that earlier application.

According to the present invention, in a trap device suitable for rapidly securing a probe once that probe is properly positioned relative to the trap device, and including a housing, two arresting beams extending parallel to one another across an opening in the housing, firing means by which the two arresting beams can be moved towards one another to engage and trap the probe when positioned in the opening, catch means arranged to lock the two arresting beams together in the engaged position, stop means including a stop disposed between the two beams and movable by the beams as the beams travel to engage a probe lying anywhere in the opening, and a flexible cable or chain extending transversely of the arresting beams and wrapped around two spaced apart pulleys or chain sprockets, the stop being secured to the cable or chain, and readily releasable holding means arranged when activated to hold the stop against further movement and thus to hold the arresting beams and the trapped probe against further movement, the readily releasable holding means being arranged to act on at least one of those pulleys or sprockets to hold the cable or chain and thus the stop and the beams against displacement, the readily releasable holding means includes a first rotatable member provided with a first circular set of teeth and a second member held against rotation with the first member and provided with a second circular set of teeth complementary with the first set of teeth, and hydraulic piston means arranged to control the engagement and the disengagement of the first set of teeth with the second set of teeth, whereby the second set of teeth can be made effective to anchor the rotatable member, the cable or chain, the stop and the two beams.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. **1** is a side elevation of a helicopter in the final stages of being winched down onto the deck of a ship;

FIGS. **2A**, **2B** and **2C** are diagrammatic representations in plan view of a trap shown in FIG. **1**, these FIGS. showing the general operation of the trap in seizing a probe carried by the helicopter;

FIG. **3** is a perspective drawing of the trap shown in FIGS. **1** to **2C**;

FIG. **3A** is a sectional side elevation of a small part of a trap frame shown in FIG. **2A**, and is taken on the line III–III of that FIG. and as viewed in the direction indicated by the arrows;

FIG. **4** is a diagrammatic representation of operating parts of the trap, in positions corresponding to the situation of FIG. **2A**, and intermediate drive chain being omitted to clarify the FIG;

FIG. **5** is a diagrammatic representation of the operating parts shown in FIG. **4** but in positions corresponding to the situation of FIG. **2C**;

FIG. **6** is an exploded perspective drawing of driving means for two arresting beams shown in FIGS. **2** and **3**;

FIG. **7** is a perspective drawing of release means for arresting beam locking catches shown in FIG. **3**, and is shown as viewed from the right of FIG. **3**;

FIG. **8** is a perspective drawing of position indicating means for the arresting beam locking catches, and is shown as viewed from the right in FIG. **3**;

FIG. **9** is a perspective drawing of a holding device shown in FIG. **3**, but drawn to a larger scale than in that FIG. and partly broken away to show detail normally hidden;

FIG. **10** is a schematic representation of a hydraulic system provided on the trap frame; and

FIG. **11** is a perspective drawing of an arresting beam shown in FIG. **2A**.

Referring to the drawings of the present application, Canadian Pat. application No. 914,140 filed Oct. 16, 1964, in the names of William G. Stewart and Asbjorn Baekken discloses a system (see FIG. **1**) for hauling a helicopter **1** down onto the deck **3** of a ship at sea, the helicopter first picking up by messenger line a cable **5** from the ship flight deck **3**, and then, after that cable has been secured to the helicopter, a controller on the ship by means of a constant tension winch hauling the helicopter down by the cable **5** against the lift of the helicopter rotor until a probe **7** on the underside of the helicopter is clamped within a trap **9** in the present drawing. The trap can then be moved forwardly of the ship (i.e. in the direction of the arrow **12**), taking the helicopter with it, into a hanger.

As described in that earlier Pat. application, an electric motor (not shown) is coupled to the driving shaft of a variable displacement hydraulic pump, connected in close circuit to a fixed displacement hydraulic motor. Such an arrangement is well known in the art, and commonly makes use of a pump with a tiltable swash plate or, as in the embodiment described, a pump with a fixed swash plate but an adjustable tilt head. The output shaft of this hydraulic motor is connected through a gearbox alternatively either to a drum **15** of a haul down

winch or to a drum 21 of a trap traversing winch. The cable 5 has one end wound on the drum 15 and extends from the winch drum first over pulleys of a rope accumulator 23 and then round a guide sheave 25 and finally over a sheave 27 before passing upwardly through the deck 3 to the helicopter 1. The rope accumulator includes a first set of pulleys and a second set of pulleys, the two sets being biased apart by a pneumatic cylinder device 29 which has a force/displacement characteristic such that the force biasing the two sets of pulleys apart increases progressively as the two sets are forced closer together by the tension in the cable 5.

FIGS. 2A to 2C illustrate how the trap 9 operates: it includes a substantially rectangular frame 31 in which are mounted two parallel arresting beams 33. These beams can be forcibly moved in the directions of the arrows 35 towards one another from an initial "cocked" position shown in FIG. 2A. Each beam has on its inward side nine spring-loaded plungers 37 as shown. Between the two beams, at about the centerline of the frame 31, are disposed two shuttles 41 which initially are free to move in the direction of the arrow 43. When the helicopter is in the position shown in FIG. 1, its probe 7 will lie between the two arresting beams 33. This is partly due to the skill of the pilot but mainly due to the pull in cable 5, which extends out of the bottom of the probe and into a port 45 in the deck 3 at the center of the frame 31. However, since there are lateral forces acting on the helicopter as well as the vertical component of the force in the cable 5, the probe 7 will usually strike the deck 3 at a point displaced from the port 45, e.g. as indicated in FIGS. 2A to 2C.

During the landing of the helicopter, the trap 9 is cocked to the state shown in FIG. 2A, and once the probe is suitably disposed between the two arresting beams 33 an operator "-fires" these beams so that they are forced towards one another. After a travel which will depend upon the positioning of the probe 7, one of the arresting beams 33 will be stopped by engagement with the probe, and in FIG. 2B the lower arresting beam 33A is shown stopped in this manner. The other arresting beam 33B will continue to travel and in due course will engage the two shuttles 41. During continued travel, this arresting beam will carry the two shuttles with it, and eventually this arresting beam will come up against probe 7. This is the situation shown in FIG. 2C. In this situation, the probe 7 is held tightly between the two beams 33. The beams extend fore-and-aft of the ship, and thus prevent lateral movement of the helicopter probe 7 and thus the helicopter, while the butting spring-loaded plungers 39 prevent fore-and-aft movement of the probe 7 and thus of the helicopter.

The trap as described above and as shown diagrammatically in FIGS. 2A to 2C is substantially the trap in the prior Pat. application referred to above, whereas the trap to be described hereafter is an improved trap utilizing the same general principles. The embodiment of the improved trap described below is not adapted for traversing into a hanger, as is the trap of FIG. 1, but can readily be modified to provide that facility if and when required.

Referring now to FIGS. 2A to 3A, the frame 31 is built up from massive channel end sections 31A and 31B and from massive forged and welded composite side sections 31C and 31D, the cross section of section 31D being shown in FIG. 3A. These four sections are bolted together to form a massive and rigid frame which in the embodiment described is bolted down to the ship's deck, but which can if desired be fitted with wheels or rollers by which it can be moved by the winch 21 along the deck 3. Sections 31C and 31D are formed along their inner sides each with an upper groove 51, and grooves 51 accommodate the two ends of each of the two arresting beams 33. Each shuttle 41 is generally T-shaped as viewed in side elevation, as will be seen in FIG. 3, and is provided with four wheels 53 which run on the floor of grooves 55 and 57 in the side sections 31C and 31D, the shuttle being guided laterally by facing surfaces 59 and 61 on the side section.

Each arresting beam 33 is movable between its limiting positions by an arrangement of two double-acting hydraulic cylinders 71 and 73 shown in FIGS. 3, 4, 5 and 6. As will be seen most easily from FIGS. 3 and 6 the hydraulic cylinder 71 is provided with a ram 75 extending from one end and connected by an offset coupling 77 to an endless roller chain 79 having a lower run 79A to which the coupling is fitted and an upper run 79B. This chain extends over a first sprocket 81 and a second sprocket 83. Sprocket 81 is keyed to one end of a shaft 85 journaled in a bracket 87 mounted near one end of the frame side section 31C. Similarly, idler sprocket 83 is journaled on one end of a shaft 89 keyed in a bracket 91 mounted near the other end of the frame side section 31C. A second chain 93 is carried by two sprockets 95 and 97 respectively mounted on the two shaft 85 and 89, sprocket 95 being keyed to the shaft 85 and idler sprocket 97 journaled on shaft 89, and since sprocket 95 has twice as many teeth at the same pitch as the sprocket 81, movement of the chain 79 by the ram 75 is accompanied by travel of the chain 93 through twice the distance. The two ends of the chain 93 are connected respectively to opposite sides of a crosshead member 99. This member 99 is apertured to accept nipples at the ends of four wires 101, 103, 105 and 107. The arrangement of these wires may be seen most clearly from FIGS. 3 and 4. It will be seen that wire 101 extends from the crosshead member 99 round an idler pulley 109, across the width of the frame 31, round an idler pulley 111, through a passage 113 in arresting beam 33A to arresting beam 33B, where it is anchored at anchor point A. Wire 103 extends from the crosshead member 99 round an idler pulley 115 and an idler pulley 117 and an aperture 119 in the arresting beam 33A to an anchor point B on arresting beam 33B. It will be seen that anchor points A and B are disposed at opposite ends of arresting beam 33B, and that movement of the crosshead member 99 will tend to cause equal movements of both ends of that rail. Wire 105 extends from the crosshead member 99 round an idler pulley 121 and an idler pulley 123 (disposed near the end of side section 31C which is remote from pulleys 109 and 117) and is connected to anchor point C on arresting beam 33B. The forth wire 107 extends from the crosshead member 99 round an idler pulley 125 disposed adjacent the pulley 121, along the side of the frame 31, round an idler pulley 127, and is anchored to arresting beam 33B at anchor point D.

The hydraulic cylinder 73 is similarly connected to an endless chain which drives a second chain 133 having a crosshead member 135. Four wires 137, 139, 141 and 143 extend from that member 135. Wire 137 extends from crosshead member 135 round an idler pulley 145 and an idler pulley 147 and through an aperture 149 through the arresting beam 33B, and at its end is connected to arresting beam 33A at anchor point E. Wire 139 extends from crosshead member 135 round an idler pulley 151, along the side of the frame 31, round an idler pulley 153 adjacent the pulley 123, through an aperture 155 in the arresting beam 33B, and is connected to the beam 33A at the anchor point F. The wire 141 extends from the crosshead member 135 round an idler pulley 157 and round an idler pulley 159 disposed adjacent the pulley 111, and is connected to the beam 33A at anchor point G. Wire 143 extends from crosshead member 135 round an idler pulley 161 disposed adjacent the pulley 157, along the side of the frame 31, round an idler pulley 163 disposed adjacent the pulley 117, and is connected to the beam 33A at anchor point H.

FIGS. 4 and 5 have been simplified by the omission of chain 79 and its equivalent and by showing the rams of the hydraulic cylinders 71 and 73 connected directly to the chains 93 and 133 respectively.

Movement of the ram of cylinder 71 pays out two of the associated wires and takes in the other two wires, and thus provides restraint of the two ends of arresting beam 33B which ensures that at all times that beam shall remain parallel to the fore-and-aft axis of the frame 31. Similarly, movement of the ram of cylinder 73 pays out two of the associated wires and takes in the other two wires, and thus provides restraint of the two ends of arresting beam 33A which ensures that at all times that beam shall remain parallel to the fore-and-aft axis of the

frame 31. By the use of two uncoupled mechanisms to move the two arresting beams, one can be stopped by the probe, as described above in connection with FIG. 2B, and the other still be free to continue to move until it also engages the probe.

It is necessary to lock the two arresting beams 33A and 33B together, and to this end the beam 33A (see FIG. 3) carries two pivoted catches 165 and beam 33B carries two complementary lugs 167. The catches 165 are spring biassed to the "secured" position, and as the two beams come together these catches are first forced to the open position against the action of their springs, and then snap into place to hold the two beams together. In order to enable an operator to disenable the two catches 165, a hydraulic actuator 169 is mounted on the side section 31D of frame 31 and has its ram 171 connected by a cranked lever 173 to an actuating bar 175 which extends along inside the side section 31D in a groove below that containing the ends of the arresting beams. This bar 175, being carried by two swinging levers, namely lever 173 and a second lever 177, remains parallel to the side section 31D but moves inwardly or outwardly relative to the ends of the arresting beams. A tension spring 179 biases bar 175 axially in such a direction that it tends to move outwardly of these beam ends. When the actuator 169 is operated to move the bar towards the rail ends, it engages a roller 181 provided on a cranked lever 183 pivotally mounted on the arresting beam 33B. The arrangement is such that this lever is rotates in a clockwise direction (viewed from above) (see FIGS. 7, 8 and 11) on the pivot pin 185 of this lever 183, engaging the catch 165 to rotate it away from its position of engagement with lug 167. A connecting rod 187 connects the lever 183 to a further lever 188 mounted on a pivot pin 190 at the other end of beam 33B, so that this lever 188 is also rotated in such a manner as to move the adjacent catch 165 from its "engaged" position. Lever 189 is connected with cable 192 to lever 184. This cable runs over a pulley on a lever 196 attached to lever 191 which extends towards this end of the beam and carries a roller 193 (see FIG. 8). The frame side section 31C carries an indicating channel 195 (see FIG. 8) disposed in a groove underneath that containing the beam ends and carried by two parallel pivoted links 197 and biased by a spring 199 so that the bar is always biased inwardly of the ends of the end of the beams 33. When the two catches 165 are in their "engaged" positions, the roller 193 presses the channel 195 outwardly away from the beam ends, and the beam then through a pivoted rocker 201 engages the operating plunger 203 of a switch 204 to provide a remote electrical indication that the catches are closed.

Each shuttle 41 has an endless chain 205 connected to one end of its elongated base, this chain extending along the groove 55 to a clutch sprocket 207 carried by frame member 31B, and returning from that sprocket along the groove 55 past the shuttle to a similar clutch sprocket 207 carried by the frame member 31A, and returning from that second sprocket to the shuttle 41, being connected to the second end of its elongated base.

The four clutch sprockets 207 respectively form parts of four holding devices 215 which are made effective, once the two arresting beams have gripped the probe to prevent the helicopter probe and thus the helicopter from moving laterally in a direction parallel to the lengths of the wires referred to above.

Referring now to FIG. 9, the holding device 215 includes a housing 251 provided with a cover plate 253 held in place by clamping bolts 255. The housing 251 is formed with a central bore 257 which accommodates a rotatable member 259 carried at its lower end by a needle roller bearing 261 carried by the housing and at its upper end by needle roller bearing 263 carried by the cover plate 253. An intermediate part of the member 259, disposed above the part engaging the bearing 261, is formed with splines 265 which engage a splined bore in chain sprocket 207. This sprocket lies within a tunnellike cavity 269 in a lower part of the housing 251, and the reason for the splined construction is to permit assembly of the sprocket 207 laterally into the tunnel and then engagement of the member 259 with the sprocket by lowering of the member in the bore 257. An integral radially extending flange 271 of the rotatable member 259 carries on its upper surface a first set of teeth 273 having a "saw-tooth" or ratchet profile. The part of the rotatable member 259 immediately below the flange 271 is provided with a hydraulic seal in the form of an O-ring 275 effectively engaging an encircling part of the bore 257 and similarly a part of the member 259 immediately above the flange 271 is provided with a hydraulic seal in the form of an O-ring 277 effectively engaging an encircling part of the bore 257. Axial movement of the rotatable member 259 is prevented in an upward direction by engagement of a frustoconical surface 279 on the member with a complementary surface 281 on the cover plate 253, and in a downward direction by engagement of an annular shoulder 283 below the O-ring 275 with an upper surface of the chain sprocket 207 and by engagement of an annular bearing surface 285 of the housing with a complementary surface on the underside of that sprocket 207.

An annular cylinder 287 concentric with the member 259 is defined on its radially outer side by the housing and on its radially inner side by a downwardly extending boss on the cover plate. Inside that annular cylinder is disposed an annular piston 289 formed on its underside with a second set of teeth 291 complementary to the teeth of set 273. This annular piston is provided on its radially outer side with a hydraulic seal in the form of an O-ring 293 and on its radially inner side acts against an O-ring 295 carried by the cover plate 253 to form a second hydraulic seal. The annular piston is held against rotation in its cylinder by four cylindrical steel plungers 297 extending downwardly from the cover plate 253 into complementary holes in the piston, these plungers 297 being formed with blind bores which contain compression springs 299 and being provided with external flanges which prevent upward movement of the plungers. Thus springs 299 can act to force the second set of teeth 291 down into effective contact with the first set of teeth 273.

A hydraulic supply pipe 301 is connected to a passageway 303 in the housing 251, this passageway terminating at the periphery of the cavity in the housing which accommodates the flange 271. A hydraulic vent pipe 305 is connected to the upper end of the cylinder 287, i.e. the part of the cylinder which lies above the annular piston 289, this vent pipe being connected to a suitable point to atmospheric pressure so that no appreciable pressure can build up in the space above the piston.

When the pressure of the hydraulic fluid supplied through pipe 301 is very low, the springs 299 are effective to lock the teeth of set 291 with the teeth of set 273, and this positively holds the sprocket 207 and thus the chain 205 with the shuttle 41 against displacement. By the use of teeth of "saw-tooth" profile, the danger that one set of teeth will lodge on the crests of the other set of teeth is removed. In order that no wedging apart of the teeth shall cause slipping of the holding device, the teeth of the two holding devices associated with the same shuttle have opposite "hands," so that one holding device will prevent movement of the chain 205 in a "clockwise" direction (viewed as in FIG. 3) and the other holding device will prevent movement of the same chain 205 in an anticlockwise direction.

When the pressure of the hydraulic fluid supplied through the pipe 301 is raised, for example to 1000 pounds per square inch, the upward force acting on the annular piston 289 forces that piston upwardly against the action of the four compression springs 299, and takes the second set of teeth 291 upwardly out of engagement with the first set of teeth 273. The rotatable member 259 is then free to rotate, and the shuttle 41 is no longer held against movement.

When it is desired to use the apparatus to land a helicopter, the shuttles 41 are disenabled by the application of fluid pressure to the pipe 301. The two shuttles 41 can then move freely, and the arresting beams 33A and 33B can trap the helicopter probe as described above. The pressure in the pipe

301 is then vented to a atmosphere, activating the locking devices and locking the two shuttles in place and thus also locking the two arresting beams and the helicopter probe against lateral movement.

The holding device now proposed locks the two shuttles in place without the need for any continued rotation of the holding means to make a wraparound band brake effective. The maximum slip which can occur at a holding device is equal to that produced by rotation through one tooth pitch, and in practice this is equal to a movement of about one-fourth of an inch of the shuttle 132. This is comparable with the running slack in the chain 135, and is within permissible limits.

When the two arresting beams are in the "cocked" position shown in FIG. 2A, the two levers 311 are depressed when contacting lugs 313, provided respectively on the beams 33A and 33B. This action closes two switches coupled in series and giving the controller a light indication that both beams are cocked. Rubber buffers 315 are engaged by the beams in this position.

Referring now to FIG. 10, this illustrates the use of a hydraulic system mounted on the trap frame 31 to activate the various parts of the trap. In this FIG. can be identified the double-acting hydraulic cylinders 71 and 73 which operate the arresting beams 33A and 33B; the hydraulic actuator 169 for the release of the catches 165 which lock the two arresting beams together and the four holding devices 215. Also mounted on the trap frame 31 is a hydraulic accumulator 321 partially filled with hydraulic fluid above which is trapped gas under a relatively high pressure, this gas serving to boost the flow of the working fluid. A hydraulic reservoir 323, working at atmospheric pressure, is also mounted on the trap frame, and is connected to the reservoir 321 by a pump 325 by which, when the trap is not in active use, hydraulic fluid can be pumped from the sump tank to the high pressure accumulator. Two electromagnetic actuators 327 and 328 provided on the trap frame controls the setting of a three-position four way hydraulic valve 329, and these actuators are connected by electric cables 331 and 332 to a controller's console by which a controller monitors the landing and the securement of the helicopter. These cables also include cores connecting the switches 204 and 312 (see FIG. 3) (providing an indication of the state of the locking catches 165) and beams cocked to suitable indicating lamps on the controller's console.

The liquid space of the reservoir 321 is connected by a pipe 333 to an inlet port of valve 329. In a first "cocked" position of the valve, the valve spool connects pipe 333 to pipes 335 connected to open ends of the cylinders 71 and 73, and the other ends of the cylinders are connected through pipes 337, the valve spool and pipe 339 to the reservoir 323. In a second "fired" position of the valve, the valve spool connects pipes 335 to pipe 339 and thus the reservoir, and connects pipes 337 to pipe 333 and thus to the pump and accumulator. In the third or "neutral" position, pipes 335 are connected to pipe 337, i.e., the two ends of each cylinder are connected together. It will be appreciated that with the valve in the "cocked" position both arresting beams will be forced outwardly and that with the valve in the "fired" position the arresting beams are forced rapidly towards one another. With the valve in the "neutral" position, the two beams can be manually displaced, and in some circumstances this can be a useful facility since it allows the probe to be gripped and yet moved relative to the frame of the trap.

Actuator 169 which controls the freeing of the catches 165 on the beams 33A and 33B is used only during a cocking cycle and therefore fed directly from the cocking pipe 335. Clutches are released simultaneously, being fed from pipe 335 through shuttle valve 316.

The general procedure for landing a helicopter on the deck of the ship using the constant tension haul-down cable 5 has been disclosed in the earlier Pat. applications discussed above and has been further described above in connection with FIGS. 1 and 2A to 2C. In use of the improved trap described above, prior to the commencement of the procedure for landing the helicopter, the two arresting beams 33A and 33B are brought to the "cocked" position by operation of the valve 329. When they reach this position, they are automatically locked in place by the counter-balance valve 314. The helicopter landing procedure is then commenced, and when the probe 7 of the helicopter is in the trap the ship-based controller through the valve 329 pressurizes the two cylinders 71 and 73 driving the two arresting beams 33A and 33B together. At this state of readiness, all four holding devices 215 are in their "free" state, fluid under pressure be fed through the shuttle valve 316 so that the shuttles 41 are free to move with their chains 205, and the catch actuator 160 is not actuated so that the catches 165 are free to engage. As described previously, the two arresting beams move together and first one and then the other engage the probe 7, so that it is gripped between the two beams. Immediately this happens, the catches 165 engage the lugs 167 to clamp the two beams together. This moves the indicating channel 195 outwardly to close the switch 204, providing an indication to the controller that the probe is secured. He then by means of returning the valve 329 to neutral position vents fluid under pressure from the cylinders 287 of the holding devices 215, which immediately assume their locked positions. This prevents movements of the chains 205, and thus of the shuttles 41, and since the two shuttles are between the two arresting beams and the two beams are locked together, this locks the beams in place relative to the trap frame 31.

As mentioned above, the subsequent handling of the landed helicopter can take different courses, and the mounting of the trap 9 will be dictated by the desired manner of use.

It will be seen that the improved trap described above represents a considerable improvement as regards simplicity above the earlier proposals, and the improved simplicity brings improved reliability and thus improved safety.

In the embodiment of the invention described above, the connection between the trap and the controller's console is by electric cable having several cores, and this by enabling the use of short hydraulic conduits between the valve devices and the various hydraulic devices improves the speed of response of the mechanisms to the controller's actions. However, if desired the hydraulic actuators can be connected by suitable rigid or flexible hoses to a separate hydraulic system positioned below the deck 3, although even in this case it will usually prove desirable to use an electrical control from the controller's console.

I claim:

1. A trap device suitable for rapidly securing a probe once that probe is properly positioned relative to the trap device, the trap device comprising:

a. a housing;

b. an opening in the housing suitable for the reception of the probe;

c. a first arresting beam extending across the opening;

d. a second arresting beam extending across the opening parallel to the first arresting beam;

e. firing means mechanically connected to the two arresting beams and arranged when operated to move the two arresting beams towards one another across the opening to engage and trap the probe when positioned in the opening;

f. catch means arranged to lock the two arresting beams together in the engaged position;

g. stop means arranged to hold the two arresting beams in the engaged position against movement across the opening;

h. a stop, forming part of the stop means, disposed between the two beams and movable by the beams as the beams travel towards one another to engage a probe lying anywhere in the opening;

i. a flexible connector such as a cable or chain extending transversely of the two arresting beams;

j. a first pulley or chain sprocket;

k. a second pulley or chain sprocket spaced apart from the first pulley or chain sprocket, the flexible connector being wrapped around the two spaced-apart pulleys or chain sprockets;

l. the stop being connected to the flexible connector;

m. readily releasable holding means arranged when activated to hold the stop against further movement, and thus to hold the arresting beams and the trapped probe against further movement;

n. the readily releasable holding means being arranged to act on at least one of those pulleys or sprockets to hold the cable or chain and thus the stop and beams against displacement;

o. a first rotatable member forming part of readily releasable holding means and provided with a first circular set of teeth;

p. a second member forming part of the readily releasable holding means, held against rotation with the first member, and formed with a second circular set of teeth complementary with the first set of teeth; and

q. hydraulic piston means arranged to control the engagement and the disengagement of the first set of teeth with the second set of teeth; whereby the second set of teeth can be made effective to anchor the rotatable member, the cable or chain, the stop and the two beams.

2. A trap device according to claim **1**, and in which:

a. the second member is an annular member;

b. spring biasing means bias the annular member towards the first rotatable member, so as to bring the first set of teeth into operative engagement with the second set of teeth;

c. the annular member serves as an annular piston;

d. means are provided by which fluid pressure can be applied to a side of the annular member which is nearer to the first rotatable member; and

e. the fluid pressure so applied is effective to force the two members apart and so cause disengagement of the first set of teeth from the second set of teeth.

3. A trap device according to claim **1**, and in which:

a. the readily releasable holding means are associated with one of the pulleys or sprockets;

b. the first and second sets of teeth have a "saw-tooth" profile to provide a ratchetlike action;

c. similar readily releasable holding means are associated with the other of the pulleys or sprockets;

d. first and second sets of teeth of the said similar readily releasable holding means have a "saw-tooth" profile to provide a ratchetlike action; and

e. the arrangement of the two readily releasable holding means is such that one provides a ratchetlike action stopping movement of the stop in one direction, and the other provides a ratchetlike action stopping movement of the stop in the opposite direction.

4. A trap device according to claim **1**, and in which:

a. the stop is disposed near one end of the two parallel arresting beams;

b. a second similar stop is disposed near the opposite end of the two parallel arresting beams; and

c. a second similar arrangement of stop means and readily releasable holding means is associated with the second stop.

5. A trap device according to claim **2**, in which:

a. a plurality of hollow thimbles extend partly into the annular member in a direction parallel to the axis of movement of the annular member;

b. these thimbles extend partly into the housing and are effective to prevent rotation of the annular member relative to the housing; and

c. biasing springs are disposed partly within the thimbles and act at one end on the thimbles and act to spring bias the annular member towards the first rotatable member.