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AIRPLANE CATAPULT

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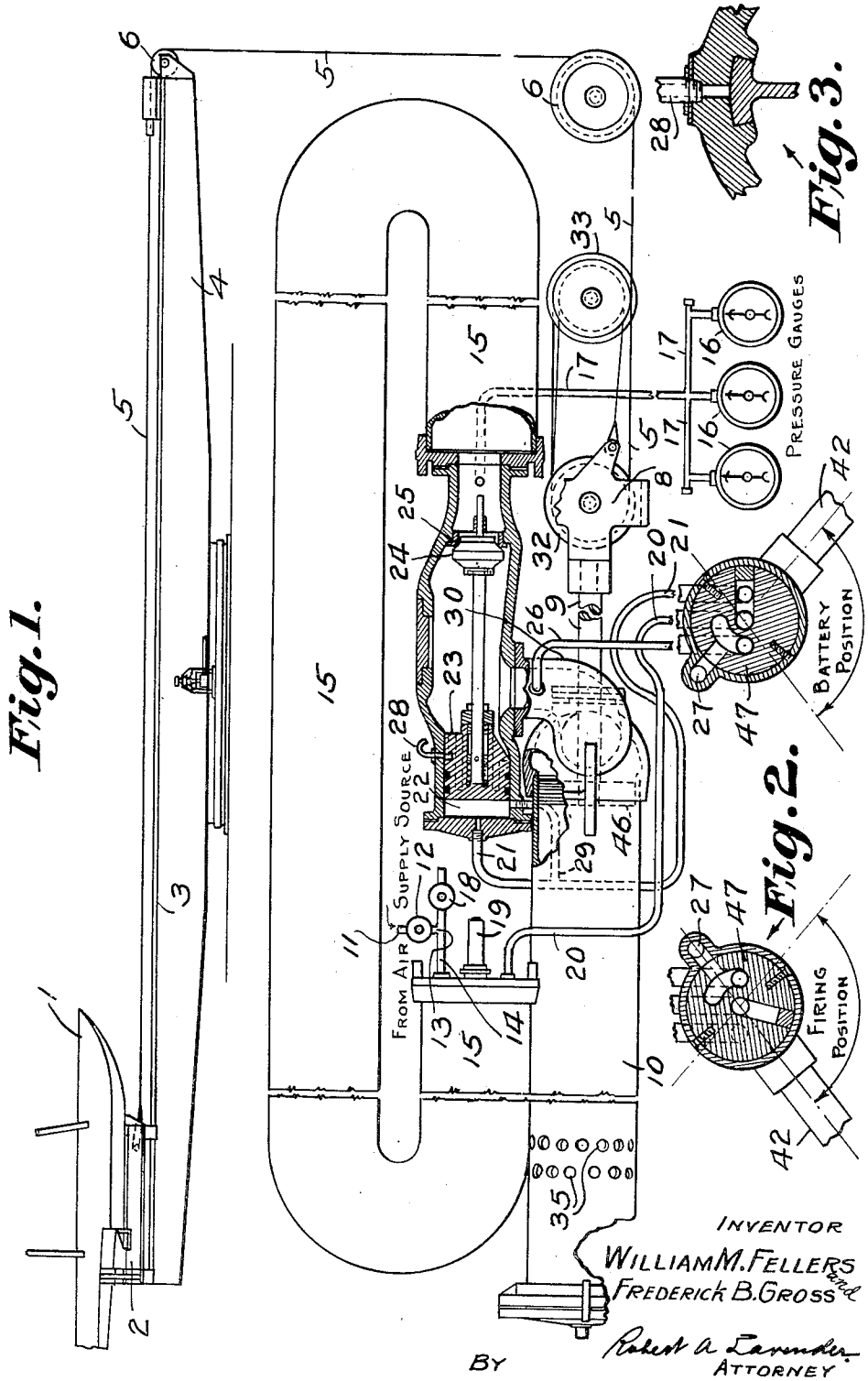


Fig. 1.

Fig. 2.

Fig. 3.

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AIRPLANE CATAPULT

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This invention relates to catapults and particularly to that type of catapult adapted for use in launching airplanes from barges, ships, limited land areas or like restricted spaces, or in launching other types of vehicles or projectiles.

Specifically, the invention relates to the class of catapults wherein the expensive force of a compressed fluid, such as air, is utilized in launching the airplane or other device to be launched.

A principal object of the invention is to provide novel control means which will operate to produce a decided lessening of the danger inherent in the rapid acceleration necessary to successfully launch an airplane or similar device. In this connection a feature of the invention is the provision of a novel master control means whereby a multiplicity of parts and operations are made subject to the manipulation of a single manually operated control.

One of the principal advantages to be derived from the use of the novel master control just referred to lies in the fact that the various operations in the process of launching are made to occur automatically and in proper sequence and time relation, one to the other, in response to a single initiatory invariable, simple act of the operator in charge of the master control.

Another object of the invention is to provide a mechanism capable of producing the foregoing results by the use of a construction which is radically safer, simpler and more compact, efficient and durable than any heretofore employed in this art for a similar purpose.

Other features and advantages will be found in the specific construction, combination, inter-relation and coordination of the parts, as will be evident from an inspection of the following specification and claims, when read in the light of the accompanying drawing exemplifying a concrete embodiment of the invention, in which drawing:

Fig. 1 is a diagrammatic view showing the arrangement of a catapult with its associated operating parts;

Fig. 2 is a detail view of the manually controlled device showing the control valve in a setting varying from the setting of the same device as shown in Fig. 1;

Fig. 3 is an enlarged detail view of a safety relief port associated with the launching chamber.

In the drawing, wherein like reference characters in the several views refer to like parts, the reference numeral 1 indicates that portion of an airplane to which is ordinarily secured the launching car, shown at 2, the car being movable along ways 3 on the beam or table 4 by actuation of the cables 5, the latter passing over the sheaves 6 to the usual motion multiplying sheaves 32 and 33, the former being mounted on the movable cross-head 8 to which is attached the piston rod 9.

From the foregoing it is evident that the construction of the motion transmitting mechanism between the piston rod 9 and the launching car 2 is similar in all respects to that heretofore employed. Likewise we preferably employ a known type of pneumatic cylinder 10 containing a piston 46 as the power means for actuation of the piston rod 9.

The use of a power chamber of this character, with exhaust ports as indicated at 35, is not in itself new; but we are the first to disclose means for governing the application of power to cylinder 10 of such a character that a single, simple initial manual invariable act is all that is required, not only to set the mechanism in operation, but also to effect a complete and properly timed execution of all the essential steps which collectively constitute the launching operation, the parts involved in such steps being controlled so that they operate automatically in response to the performance of said single manual act. The novel control means by which this result is effected will now be described.

The reference character 15 designates a compressed air storage tank of the character commonly referred to as a cumulator tank 15. Air from the source of supply comes through the pipe 11, valve 12, pipes 13 and 14 into this tank 15. Suitable pressure indicating gages 16 are in communication with the tank 15 by means of the usual connections as shown at 17, multiple gages being preferred because they afford added assurance of accurate readings by the process of comparison. A safety relief valve 18, of the pop or blow-off type, is preferably inserted in the line 13 and set to "blow" when the pressure in the tank 15 exceeds a predetermined amount, say 200 lbs. per square inch in excess of the operating pressure for the power cylinder 10.

When it is desired to effect a launching of the plane whose launching car or float is indicated at 1, the air under pressure in the tank 15 is introduced to the power cylinder 10 by the manipulation of a single device, to wit, the handle or hand lever 42 attached to the spindle of the master control valve 47 and which handle is adapted to be moved about a quarter turn. This valve 47 is shown only schematically in the drawing, but it will be recognized as of the rotary, or plate, type having a plurality of disks or plates relatively movable and provided with ports and passages adapted to register one with another, as desired, in response to rotation of the crank or hand lever 42.

When the valve 47 is in the designated "battery" position, Fig. 1, air under pressure flows from the tank 15 through the pipe 20 and valve 47 to the pipe 21, and thence to the cylinder of the piston valve 22. This air exerts a force against the head of the piston in the globe valve 23 equal and opposite to the pressure exerted

against the disk of the globe valve 24, but due to the fact that the area of the piston 23 is greater than the area of the disk 24, the force exerted on the piston is greater than that exerted on the disk, with the result that the disk is held firmly on its seat 25 so that air cannot flow through the globe valve when the firing valve is in the battery position.

Any air that leaks past the rings of piston 23 or past the disk 24 and its seat, escapes through the pipe 26, the firing valve, and out to the atmosphere through port 27 of the firing valve. Any air that leaks past the piston of the globe valve may also escape through pipe 28. An enlarged view of pipe 28 and its port is shown in Fig. 3. The reason for installing pipe 28 is to provide a larger exhaust line than would be practical to provide through the firing valve. The firing valve exhaust line is used because it brings the exhaust port close enough to the operator so that he may hear the hiss of the escaping air and judge from its intensity whether or not the mechanism is leaking excessively.

After the plane and catapult have been fully prepared for a launching operation, the firing valve handle is moved from battery position to firing position, shown in Fig. 2. In this position air that was formerly contained in space 22 of the globe valve is vented through pipes 21 and 29, the firing valve and exhaust port 27 to the atmosphere. The force acting against the piston of the globe valve 23 is thereby diminished to such an extent that the force exerted against the disk 24 of the piston valve is greater than that exerted against the piston, with the result that the disk, the valve rod and piston all move to the left, allowing air to enter from the tank 15 between the disk 24 and its seat 25 and to flow through pipe 30 into the main cylinder 10. This air operates the power cylinder and causes the group of speed multiplying sheaves 32 attached to the piston to move away from the group of sheaves 33, with the result that the cable 5 is actuated and the launching car and airplane are carried forward on the catapult at a smoothly accelerating speed sufficiently high to launch the plane in the limited extent of track 4.

When the piston 46 passes the exhaust ports 35, the air of the main cylinder rushes out to the atmosphere. The operator then moves the firing valve back to the battery position, the result of which is to close the globe valve 24, thereby saving the air supply in the tank 15 that would otherwise exhaust through the main cylinder into the atmosphere.

When a catapult is used on a rolling platform, such as the deck of a ship, it is necessary to synchronize the operation of the catapult with the motion of the platform, otherwise the plane might be launched almost directly into the ocean. To accomplish the desired synchronization, pipe line 29 is used. This pipe communicates with space 22 and has a large enough area so that air contained in space 22 is very quickly exhausted through pipe 29. Consequently the valve 24 is lifted from its seat 25 the instant the valve 47 is shifted to firing position. The motion of the piston to the left covers up the port of pipe 29 and the air remaining in space 22 is forced to leave through the comparatively small pipe 21. The size of this pipe is arranged so that the motion of the piston 23 to the left is cushioned by the air remaining in space 22, with the result that the valve opens to its full capacity without slamming against the cylinder head at the end of its travel.

From the foregoing it will be apparent that the control means above described has the advantages of simplicity and compactness in structure as well as in operation, the entire process of launching the catapult being effected by a single, simple and invariable motion of the valve lever 42, which act being adapted to produce the desired result because our utilization of the principle of differential pressures permits the use of a simple and direct-acting valve mechanism in place of the more complicated multi-stage valves and connections heretofore employed with their multiple sequence manipulations which, if varied, inadvertently tends to cause liability to life and property.

Although we have not illustrated in detail the locking and releasing mechanisms, it is to be understood that standard and suitable devices for these purposes are contemplated for use and association with the mechanism specifically illustrated herein; but these per se form no part of the present invention. At 20, however, there is shown a portion of a novel braking mechanism which is claimed in another pending application.

While we have illustrated and described in detail what we now consider to be the best mode of embodying the present invention in an operative device of the class described, we anticipate that changing conditions to be encountered may render it expedient to make certain departures from the specific construction here shown; and we therefore refrain from limiting ourselves to the use of these specific details, the claims being intended to embrace all mechanical equivalents and modifications not expressly excluded therefrom, and not outside the scope of the invention as described in the specification above and defined in the claims below.

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

What we claim is:

1. In a catapult, in combination, a launching car, means for propelling said launching car comprising a piston connected thereto, a source of power supply for actuating said piston, means having an unrestrictable definite path of movement and having a portion exposed to said power for restraining as well as directing the power from said source against said piston to propel said launching car, means for exposing an opposite portion of said direction means to said power for withholding the power from said piston, and a single manually controlled device for releasing the power on said opposite portion and initiating the operation of said directing means.

2. In a catapult, in combination, a launching car, means for propelling said launching car comprising a piston connected thereto, a source of power supply for actuating said piston, differential pressure operated means having opposite surfaces subjected to opposing portions of said power supply for restraining as well as directing the power from said source against said piston to propel said launching car, and a single manually controlled device having a simple invariable movement for releasing one of said opposing portions of said power supply to enable the other opposed portion of said power supply to operate said directing means.

3. In a catapult, in combination, a launching

car, a piston for propelling said car, motion multiplying means connecting said car and piston, a source of compressed fluid supply having a passageway to and for actuating said piston, valve means in the pathway for restraining as well as directing the fluid from said source against said piston to propel said launching car, a cylinder and piston therein communicating with the passageway beyond its entrance to the first stated piston, means for connecting this second stated piston to said valve means, means for leading compressed fluid from said source to the head of the second stated piston for withholding by said valve means the supply of fluid pressure to the first stated cylinder, and a single manually controlled valve for releasing the fluid pressure on the head of the second stated piston for initiating the operation of said valve means.

4. In a catapult, in combination, a launching car, means for propelling said launching car comprising a piston connected thereto, a source of power supply for actuating said piston, differential pressure operated means for directing the power from said source against said piston to propel said launching car, a single manually controlled device for initiating the operation of said directing means, and an audible signaling means operable relative to said piston for indicating the functioning or non-functioning condition of said piston.

5. In a catapult, in combination, a launching car, means for propelling said launching car comprising a piston connected thereto, a source of power supply for actuating said piston, differential pressure operated means for directing the power from said source against said piston to propel said launching car, a single manually controlled device for initiating the operation of said directing means, and an audible signaling means in juxtaposition to said device and operable relative to said piston for indicating the functioning or non-functioning condition of said piston.

6. In a catapult for launching airplanes, the combination of a cylinder and piston, a launching car, speed multiplying means connecting said car to said piston, means having a passageway for supplying power fluid through an outlet to said piston, connected differential pressure means in said passageway and on opposite sides of said outlet, and a single manually operable control means for controlling the pressure differential of the last stated means for permitting or preventing the passage of fluid pressure to the cylinder.

7. In a catapult for launching airplanes, the combination of a cylinder and piston, a launching car, speed multiplying means connecting said car to said piston, a fluid pressure operated valve normally cutting off the supply of power to said cylinder and piston, and a single manually operable control device adapted to have a simple invariable movement for effecting a movement of said valve from its normal position and a resultant application of power to said piston to drive said launching car in a direction to launch said airplane.

8. In a catapult for launching airplanes, the combination of a storage tank for fluid under pressure, a cylinder and piston, a launching car, speed multiplying means adapted to connect said car to said piston, a fluid pressure operated valve normally cutting off the supply of fluid under pressure in said storage tank from communication with said cylinder, means for maintaining a part of said fluid pressure against said valve to hold it in cut-off position against the force of the remaining part of said fluid under pressure in said storage tank, and means for introducing the fluid from said tank into said cylinder to drive said piston and car in a direction to launch said airplane.

9. In a catapult, the combination of a piston operated means for launching an object, fluid pressure supply means leading to the piston, valve means subjected to the fluid pressure in one direction for admitting the pressure supply to the piston, means for maintaining the fluid pressure in an opposite direction on said valve means for preventing the admission of the pressure supply to the piston, and means having a single movement for shutting off said maintaining means and releasing its maintaining pressure for enabling the fluid pressure to open said valve means for launching the object.

10. In a catapult for launching airplanes, the combination of a storage tank for fluid under pressure, a cylinder and piston, a launching car, speed multiplying means adapted to connect said car to said piston, a fluid pressure operated valve intermediate said tank and piston for normally cutting off the supply of fluid under pressure in said storage tank for communication with said cylinder, means for maintaining a part of said fluid pressure against said valve to hold it in cut-off position against the force of the remaining fluid under pressure in said storage tank, a single manually operable control device for releasing the fluid pressure against said valve, and thereby causing an opening movement of said valve by the force of the fluid under pressure in said storage tank, said device being located remotely with respect to said launching car.

11. In a catapult, the combination of claim 9 characterized by its last named means in its stated movement also venting the piston while the fourth stated means is preventing the admission of the pressure supply to the piston and closing the piston vent while the valve means is open.

12. In a catapult, the combination of piston operated means for launching an object, fluid pressure supply means having a pathway leading to and past its outlet to the piston, valve means between said outlet and pressure supply and movable in said pathway towards its outlet to supply pressure to said piston, a second piston movable in said pathway beyond said outlet, means for connecting said second piston and valve means, and a second valve means for admitting fluid pressure from said supply means to said second piston to hold the valve means closed and for closing the last stated pressure admission and venting the admitted pressure for enabling the pressure on the valve means to open said valve means and launch the object.

13. In a catapult, the combination of piston means for launching an object, fluid pressure supply means having a pathway leading to the piston, valve means for shutting off said supply to the piston, and audible signal means intermediate said valve means and piston for indicating the presence of pressure intermediate the valve means and piston.

14. In a catapult, the combination of claim 13 characterized by its last named means being a restricted vent taken off at a point intermediate the valve means and the initial position of the piston.

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