Sept. 27, 1932. A. RICHARDS 1,879,765

APPARATUS FOR LAUNCHING AIRCRAFT

Filed Aug. 13, 1931 2 Sheets-Sheet 1

Fig. 1.

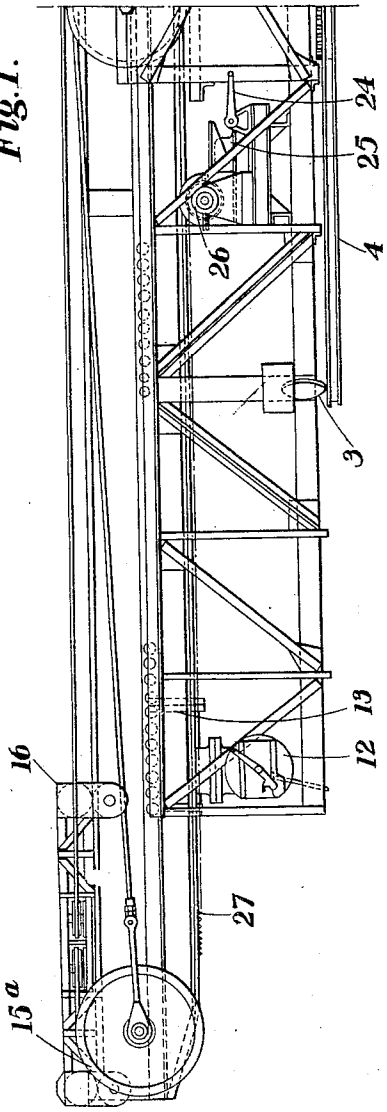
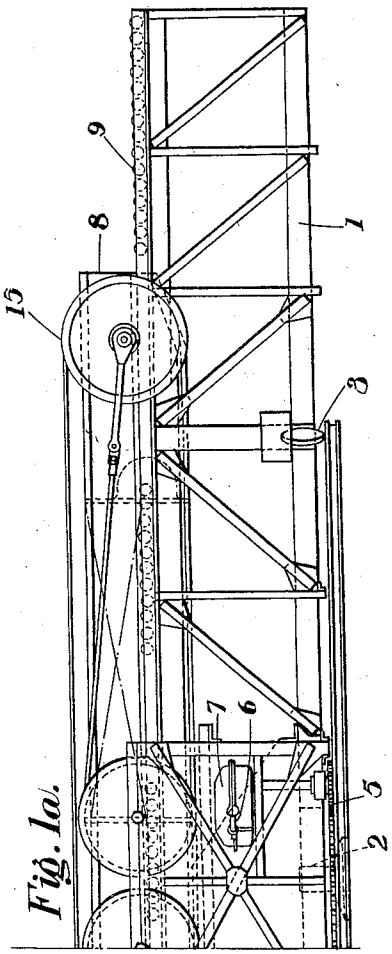


Fig. 1a.



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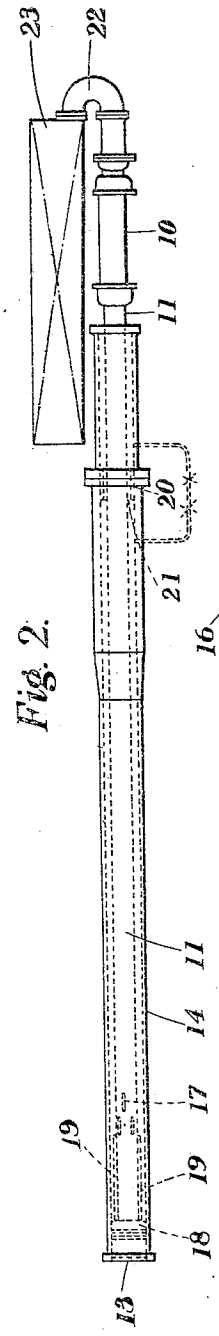


Fig. 2.

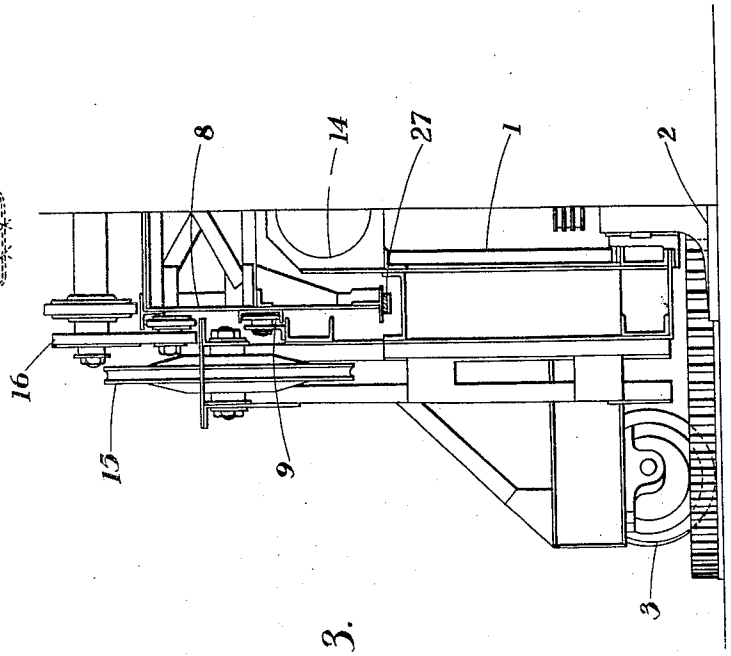


Fig. 3.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR LAUNCHING AIRCRAFT

Application filed August 13, 1931, Serial No. 556,874, and in Great Britain August 15, 1930.

This invention relates to apparatus for launching aircraft of the "heavier than air" type and generally known as catapults. More particularly the invention relates to the slider type of catapult, that is to say a construction in which on a trackway of fixed length a slider or carriage is mounted to travel thereon to form an automatically increasing length of trackway within the working limit, a trolley carrying the aircraft being mounted to slide on the said slider, the arrangement being that the functioning of the prime mover employed effects the travel of the slider at a certain velocity along the trackway and simultaneously effects the travel of the trolley along the moving slider but at an increased velocity. The advantage of this type of construction is that the normal stowage length of the catapult is comparatively short, and it is only in actual operation of the prime mover for launching that the length of the trackway is continuously increased within the limits required to obtain the requisite air borne speed for the aircraft, with a prescribed acceleration for a prescribed length of run.

According to the present invention a slider catapult is characterized by a construction in which the moving element of the prime mover which may be a pressure-operated ram or nest of rams is connected directly to the slider so as to move with the same as one unit and therefore the slider and the moving part of the prime mover connected to it move at the same velocity, rope multiplying gear being interposed between the slider and the trolley mounted thereon to increase the velocity of travel of the trolley with respect to the slider, retardation means being provided for bringing the slider and consequently the trolley to rest after a prescribed length of run consisting of a fluid system in which the fluid during the retardation period is forced through a passage or passages of gradually diminishing area into a receiving vessel mounted on the slider. Further, for manoeuvring the trolley and slider into any position relative to the main structure, a rope and drum gear, or chain and sprocket gear, or rack and pinion, or equivalent is employed operated by power or hand with declutching or disengaging means which are manually operated prior to launching or automatically operated when the slider has reached the predetermined starting position.

A typical construction of catapult in accordance with the present invention will now be described with reference to the accompanying drawings, in which

Figure 1 is a side elevation.

Figure 1*a* is a continuation of Figure 1.

Figure 2 is a partial side elevation of the working cylinder and hydraulic retardation means, shown detached from the catapult.

Figure 3 is a part sectional elevation through the training axis of the catapult, drawn to a larger scale.

An openwork or girder structure forms the main or supporting structure 1 which is mounted on a pedestal bearing 2 and is provided with wheels 3 running on a circular and fixed trackway 4 so as to be capable of being trained into the wind for flying off purposes. As illustrated training is effected by rack and pinion gear 5 which can be manually operated from a handle 6 through a train of gearing enclosed in the gear box 7. If desired the rack and pinion gear 5 can be power-operated. Any suitable means such as screw clamps or the like are provided for locking the supporting structure in any position of training.

Mounted on the supporting structure 1 is a carriage or slider 8 which may slide on machine faces or as shown on rollers or the like 9 carried by the supporting structure. If desired, the rollers may be mounted on eccentric pins so that alignment of the rollers can be preserved in the event of distortion of the catapult structure.

The slider 8 is connected by means of a crosshead (not shown) to a part 10 of a ram 11 of a pressure system which may be pneumatic, hydraulic, or operated by gases produced from the combustion of a suitable propellant. The part indicated by 12 represents an explosion or combustion unit carried by the ram cylinder and seating on a spring mounted on the supporting structure 1. The purposes of the spring seating are to relieve

the ram cylinder of the overhung weight of the explosion or combustion unit 12 and to accommodate for any deflection between the unit and the supporting structure. In the unit 12 a charge of propellant is ignited, the gases from the unit 12 being led to the admission end 13 of the working cylinder 14 mounted in the required position in the supporting structure.

A single ram as illustrated may be employed, or a nest of rams, in which latter case the smallest ram would be connected to the slider and the largest be under the working pressure.

A double set of rope multiplying gears 15, 15*a* connect the slider 8 to the trolley 16 on which the aircraft is carried. The rope multiplying gear 15 is used for the launching stroke while the rope multiplying gear 15*a* comes into operation in the retardation stroke.

It will be observed that since the slider 8 and its connected ram 11 move together at the same velocity the speed of the trolley will depend upon the speed of the ram and the ratio of the rope multiplying gear. For example, for a 3 to 1 rope multiplying gear the trolley will move at three times the speed of the slider and consequently the actual speed of trolley will be three times the speed of the ram, so that the speed of the ram is a factor of importance. Since the slider has to be a strong structure in that it has to take the weight of the trolley and the aircraft, a high velocity and a large overhang at one or both ends of the stationary structure is undesirable. By eliminating rope multiplying gear between the ram and the slider the drawback of having heavily loaded rope multiplying gear is overcome. Further, by having a high ratio rope multiplying gear between the slider and trolley whereby the trolley moves at several times the velocity of the slider the length of the overhang of the slider can be made comparatively small in order to get the requisite overall trackway length in which air borne speed of the craft is attained for flying off.

Any suitable means may be incorporated for maintaining the requisite tension in the rope multiplying gear employed to prevent any slackness having to be taken up in the launching operation.

The retarding means illustrated is hydraulic in character and the arrangement of it is as follows. The ram 11 is hollow and has a number of holes 17 adjacent to the ram piston 18, and one or more inclined keys or the like surfaces 19 between the holes 17 and the piston 18. In the working cylinder 14 at the position of the limit of stroke of the ram piston 18 is an internal flange or packing piece or the like 20 with slots 21 to receive the inclined keys 19, and therefore the keys will gradually diminish the areas of the slots until they are entirely filled by the keys. The hollow ram is connected by means of a pipe or the like 22 to a tank 23 secured in any suitable manner to or built in the slider, as an integral part thereof.

Before the launch, the hollow ram 11 and the spaces between it and the cylinder 14, the pipe 22 and the required portion of the tank 23 are filled with liquid. On the prime mover agent being applied to the ram piston 18 to cause it to travel outwards, the liquid displaced by the movement of the ram freely passes through the holes 17 into the hollow ram and so into the tank 23. As soon as the inclined keys 19 commence to engage the slots 21 in the part 20, the liquid passing through the slots is subjected to an increasing degree of throttling and consequently resistance is set up to the forward movement of the ram with the result that within the length of retardation stroke provided and by correctly designing the slots 21 and inclined keys 19, the ram is brought to rest.

A suitable connection indicated in broken lines may be provided to connect the two portions of the cylinder 14 on either side of the slots 21, in which connection a stop valve and a spring-loaded valve are fitted to allow for variation in the launching load and weight of propellant used for discharge.

The tank 23 may be provided with any suitable means to absorb the energy of discharge of the liquid in the system and to prevent surging of liquid in the tank. For example suitable baffles such as perforated trunking and partition plates may be incorporated in the tank for these purposes.

For manoeuvring the trolley 16 and slider 8 into the required positions, a rope and drum, or chain and sprocket, or as shown a rack and pinion gear may be employed. The gear as shown is manually operated from a handle 24, train of gears in a gear box 25 operating pinions 26 engaging racks 27 on the slider. Any suitable means may be provided for declutching or otherwise rendering inoperative the manoeuvring gear during the actual launching. This can be provided by any suitable hand-operated gear or may be automatically operated when the slider and trolley have been manoeuvred to the launching position.

Suitable releasing devices may be fitted between the supporting structure and the slider which can be disengaged in any suitable way, such for example, by means of hydraulic pressure working on a piston in a dashpot connected to the releasing device, the dashpot also functioning if necessary as a brake to absorb the energy of the releasing device on recoil after launching.

What I claim as my invention and desire to secure by Letters Patent is:—

1. Apparatus for launching aircraft comprising in combination a prime mover, a

sliding carriage directly connected to the moving element of such prime mover, a trolley adapted to travel along the sliding carriage, a movement multiplying rope linkage between the sliding carriage and the trolley, a hydraulic device of the cylinder and piston type for checking the launching movement of said moving element including members carried by the stationary and moving elements respectively of the prime mover, one of said members having an aperture through which the discharge from said hydraulic device is arranged to flow, and the other of said members being formed as an occluding element which registers with said aperture, during the latter part of the launching movement of said moving element, to diminish the effective area thereof in a progressive manner.

2. Apparatus for launching aircraft comprising in combination a cylinder having two end walls, a ram passing through an aperture in one of said end walls and having a diameter substantially less than that of the cylinder, a ram piston on the inner end of the ram, a sliding carriage directly connected to the outer end of the ram, a trolley adapted to travel along the sliding carriage, a movement multiplying rope linkage between the sliding carriage and the trolley, means for delivering fluid under pressure to the end of the cylinder remote from the ram, damping fluid in the annular space between the annular face of the ram piston and the said apertured wall, a relief aperture being formed in the said wall for permitting the escape of the damping fluid during the outstroke of the ram, and a tapered occluding projection on the ram, which, during the latter portion of such outstroke enters the said relief aperture and diminishes the effective area thereof in a progressive manner.

3. Apparatus for launching aircraft comprising in combination a cylinder having two end walls, a hollow ram passing through an aperture in one of said end walls and having a diameter substantially less than that of the cylinder, a ram piston on the inner end of the ram, means for delivering fluid under pressure to the end of the cylinder remote from the ram, a sliding carriage directly connected to the outer end of the ram, a trolley adapted to travel along the sliding carriage, a movement multiplying rope linkage between the sliding carriage and the trolley, a closed chamber through which the ram passes situated on the side of the said apertured wall remote from the ram piston, damping fluid in the annular space between the annular face of the ram piston and the said wall, a relief aperture being formed in the said wall for permitting escape into the said closed chamber of damping fluid during the outstroke of the ram and the hollow ram having an aperture so disposed as to come into communication with the said closed chamber during the latter part of the outstroke of the ram, and a tapered occluding projection which, during the latter portion of such outstroke enters the said relief aperture and diminishes the effective area thereof in a progressive manner.

4. Apparatus for launching aircraft comprising in combination a cylinder having two end walls, a hollow ram passing through an aperture in one of said end walls and having a diameter substantially less than that of the cylinder, a ram piston on the inner end of the ram, means for delivering fluid under pressure to the end of the cylinder remote from the ram, a sliding carriage directly connected to the outer end of the ram, a trolley adapted to travel along the sliding carriage, a movement multiplying rope linkage between the sliding carriage and the trolley, a closed chamber through which the ram passes situated on the side of the said apertured wall remote from the ram piston, damping fluid in the annular space between the annular face of the ram piston and the said wall, a relief aperture being formed in the said wall for permitting escape into the said closed chamber of damping fluid during the outstroke of the ram and the hollow ram having an aperture so disposed as to come into communication with said closed chamber during the latter part of the outstroke of the ram, a tapered occluding projection on the ram which, during the latter portion of such outstroke, enters the said relief aperture and diminishes the effective area thereof in a progressive manner, and a receptacle carried by the outer end of the ram, and communicating with the interior thereof, for receiving the fluid displaced during the outstroke of the ram.

5. Apparatus for launching aircraft comprising in combination a prime mover, a carriage associated with the moving element of such prime mover, aircraft supporting means adapted to travel along and with respect to the carriage, a movement multiplying connection between the carriage and said means, a hydraulic device of the cylinder and piston type for checking the launching movement of said moving element including members carried by the stationary and moving elements respectively of the prime mover, one of said members having an aperture through which the discharge from said hydraulic device is arranged to flow, and the other of said members being formed as an occluding element which registers with said aperture, during the latter part of the launching movement of said moving element, to diminish the effective area thereof in a progressive manner.

In testimony whereof I have signed my name to this specification.

ARTHUR RICHARDS.