

July 14, 1942.

J. FIEUX

2,289,766

POWDER CATAPULT

Filed March 10, 1939

2 Sheets-Sheet 1

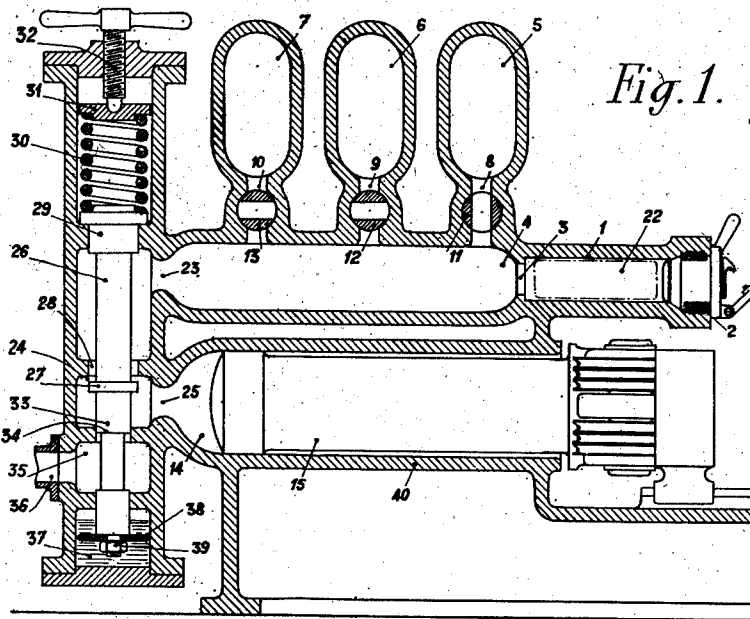
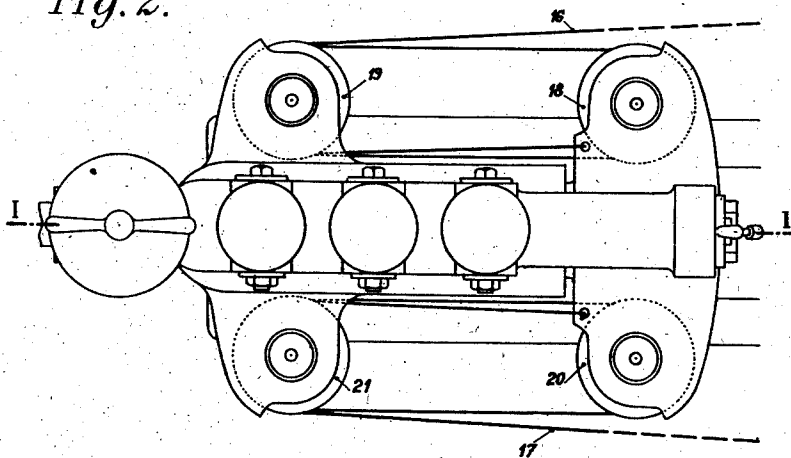


Fig. 2.



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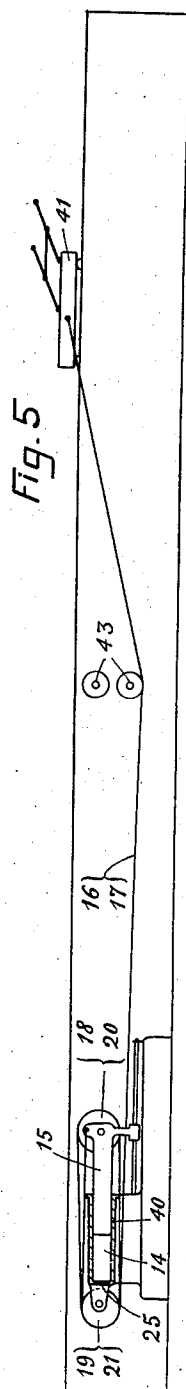
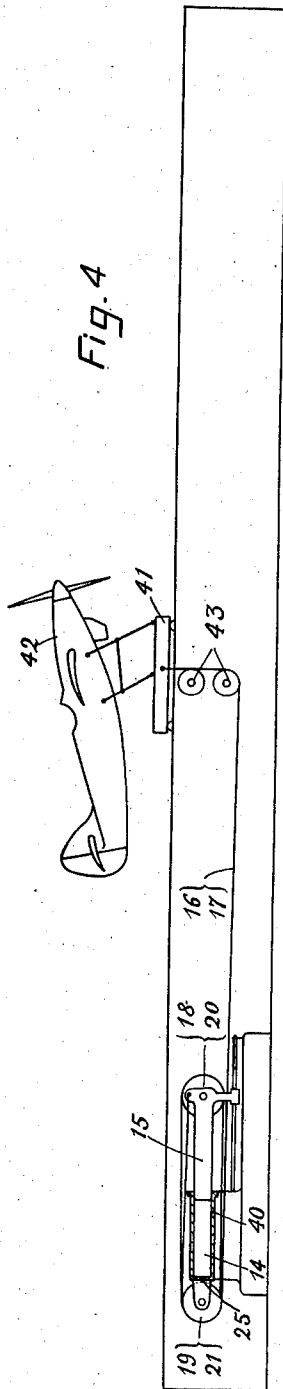
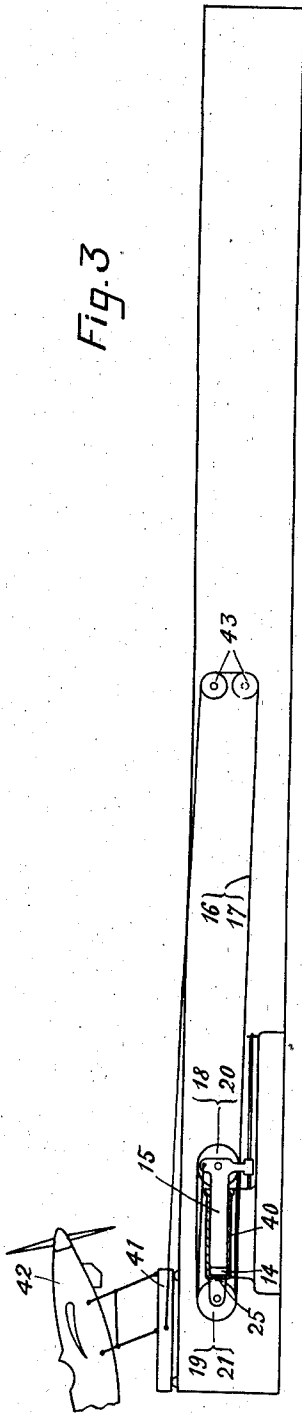
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UNITED STATES PATENT OFFICE

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POWDER CATAPULT

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stock company of France

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In France September 13, 1938

10 Claims. (Cl. 244-63)

A certain number of propulsion devices are already known which are applicable more particularly to the launching of aeroplanes, and which employ for this purpose the energy of the combustion gases of fusing products (powder or the like) operating in a driving cylinder, the piston of which they repel in the same way as a gun drives a projectile, a traction cable device suitably provided between the said piston and the mass to be propelled serving to apply to the latter the effort which is to ensure the launching thereof.

The ordinary diagram of work of the gases considered, however, which diagram, starting from zero passes through a maximum and then decreases up to the end of the expansion zone employed, is such that it imposes on the different members of the transmission mechanism, and also on the masses launched and their occupants, constantly varying fatigues or accelerations which, in order to attain the necessary launching speed for an aeroplane, for example, have to pass beforehand through a value very considerably greater than the mean value of the force which, if constantly applied, would be capable of furnishing the same work in the same time.

It is, therefore, of primary importance to discover, among the installations of the kind referred to, arrangements which, due to a judicious intermediate transformation of the applied effort, permit the ordinary diagram having the aforesaid accentuated maximum to be replaced by a damped and compensated diagram, which is on the whole rendered regular and comprises an extended mean zone, along which the curve of work will in practice be horizontal or substantially horizontal.

According to the invention, this result is obtained by subdividing the working chamber of the combustion gases into two separate chambers which are connected in series with one another, and between which there is interposed a variable-action regulating pressure-reducing device ensuring permanently the maintenance in the second chamber, that is to say in the chamber in which the launching piston moves, a substantially constant pressure having the desired mean value necessary for ensuring the propulsion to be effected.

As it is in addition desirable, especially in the case of high power catapults, to provide a device permitting rational, that is to say sufficiently progressive, braking of the launching carriage after the load to be launched has left the latter, the device according to the invention has been

designed for satisfactorily ensuring the braking in question.

To this end, the balanced pressure-reducing valve referred to above is combined with an exhaust device operating automatically by a differential action of the internal pressures on a suitable extension of the piston of the reducing device, the operation of the said piston both for pressure reduction and for opening the exhaust being controlled by means of a dash-pot device provided at the end thereof.

Finally, as it is still desirable that the same catapult should be adaptable to the launching of masses of very different values, for the propulsion of which distinct, adequate fusing charges will be employed, the device according to the present invention also comprises the application of an additional arrangement whereby the aforesaid adaptation may be immediately effected.

The arrangement referred to comprises adding to the first working chamber of the combustion gases a certain number of supplementary or auxiliary chambers or capacities which, by means of a simple cock device, may at will be each put separately into communication with the said first chamber or be isolated therefrom.

It is thus possible to adapt at will the volume of the said first chamber to the charge to be employed, this latter being itself determined in proportion to the mass to be launched.

A particular form of construction of the invention is shown on the accompanying drawings and described hereinafter by way of example, but it is understood of course that the said form of construction may be modified in its constructional details and may be completed by any useful accessory device, without for that purpose departing from the scope of the invention.

In the drawing referred to, Figure 1 shows a diametrical section of the apparatus, the said section being made along the line I—I of Figure 2, which represents a plan. Figures 3, 4 and 5 are diagrammatic views of the type of catapult in which the carriage braking feature of the present invention is particularly adapted for embodiment, these three figures showing the relative positions of the launching carriage and piston (a) just before the catapult is fired, (b) when the carriage reaches the position in which the aeroplane leaves it, and (c) after the aeroplane has been launched. In order to simplify the showing of these diagrammatic views, the powder and expansion chambers and the automatic pressure control means have been omitted, and the guide pulleys associated with the launching piston and

cylinder have been shown as vertical instead of horizontal, as they appear in Figures 1 and 2.

As will be seen in these figures, the device according to the invention comprises a powder chamber 1 closed by a breech-block 2 and communicating by an orifice 3 with a first chamber 4 along which are disposed, in any number according to requirements, auxiliary chambers or capacities 5, 6, 7 and so forth, communicating with the chamber 4 by passages 8, 9, 10 and so forth, which may be opened or closed at will by means of cocks 11, 12, 13 and so forth.

The apparatus furthermore comprises a second chamber or capacity 14, in the interior of which moves the launching piston 15 to which the launching carriage 41 carrying the mass or aeroplane 42 to be propelled is connected by cables 16, 17 passing over the guide pulleys 18, 19, 20, 21 and 43 of a suitable tackle.

In order to pass from the first chamber 4 to the second chamber 14, the gases resulting from the combustion of the charge or cartridge 22 have to pass through the orifice 23, the pressure-reducing orifice 24 and the orifice 25.

The regulating piston 26, the intermediate collar 27 of which has the same diameter as the edge 28 of the orifice 24 and as the upper collar 29 is subjected at its upper end to the pressure of a spring 30 which bears on a movable abutment plate 31 and the action of which may consequently be regulated by means of a hand screw 32 fixing the position of the movable plate 31.

The said piston comprises furthermore in its lower part an extension 33 entering an orifice 34 provided in the lower end of the pressure-reducing device, the chamber 35 situated below the said orifice communicating with the exterior through any suitable exhaust pipe 36. As will be seen from Figure 1, the collar 27 and extension 33 are so positioned relatively to the orifices 24 and 34, and are of such dimensions, that the orifice 34 is not uncovered until after the collar 27 has closed the orifice 24.

Finally, at its lower part, the said piston is extended still further to the interior of an oil chamber 37 forming a dash-pot due to the presence on the lower end of the piston of a disc 38, the diameter of which is slightly less than that of the chamber 37 and which is secured to the piston 26 by means of a nut 39.

The operation of the device is as follows:

At rest, the action of the spring 30 on the piston 26 maintains the pressure reducing orifice 24 open and the exhaust orifice 34 closed, as shown in Figure 1.

When the combustion of the charge 22 commences, the gases, after having filled the first chamber 4 (and whichever of the auxiliary chambers 5, 6, 7, etc., may be open), may therefore freely pass into the chamber 14; but as soon as the pressure in the latter chamber tends to exceed the value for which the action of the spring 30 on the piston 26 has been adjusted, the pressure which is exerted on the lower face of the collar 27 tends to drive the said piston upwardly, independently of the value of the pressure existing in the chamber 4, in view of the fact that, due to the equality of the surface of the upper face of the collar 27 and the lower face of the collar 29, the piston 26 is balanced relatively to the said pressure in chamber 4.

Finally, the collar 27 tends to close completely the orifice 24.

At the same time, however, the pressure exerted in the chamber 14 on the working piston

15 tends to drive the latter outwardly, thereby commencing to propel the launching carriage 41 to the right away from its at rest position, as shown in Figure 3.

This movement of the piston 15 causes the pressure in the chamber 14 to drop immediately, and under the action of the spring 30, which becomes preponderant, the piston 26 re-descends and the orifice 24 is re-opened, the combustion gases which are at a higher pressure in the first chamber 4 than the pressure considered again flow into the second chamber 14 and the movement continues, any oscillations which may be produced being attenuated by the dashpot 37.

When the piston 15 has arrived at the end of its outward stroke, that is to say at the moment when the launching carriage 41 is abreast of the guide pulleys 43 and the mass to be launched leaves the launching carriage (see Figure 4), the latter, continuing its course under the action of the momentum which it has stored up, tends to cause the piston 15 to enter the cylinder 40 as indicated in Figure 5.

In order to prevent the gases filling the said cylinder from opposing an excessive resistance to the inward movement of the piston and consequently imposing on the launching carriage an excessively sudden stop which might be harmful both for the traction cables and for the whole of the mechanism, it is necessary to allow these gases to escape.

This result is obtained due to the fact that under the action of the increase in pressure which is produced in the chamber 14 and which acts on the lower face of the collar 27, the piston 26, despite the antagonistic action of the spring 30, re-ascends sufficiently to uncover the orifice 34 and consequently to permit the gases contained in the chamber 14 to escape through the discharge pipe 36.

There is thus provided an extremely flexible and easily handled apparatus, capable of affording perfectly satisfactory service under the most varied conditions.

What I claim is:

1. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected in series with said pressure chamber, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas between said chambers, whereby the pressure in said second chamber producing the propelling movement of said piston may be maintained substantially constant.

2. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber through a pressure reducing orifice, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas through said pressure reducing orifice, whereby the pressure in said second cham-

ber producing the propelling movement of said piston may be maintained substantially constant.

3. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber through a pressure reducing orifice, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas through said pressure reducing orifice, said means comprising a control piston balanced with respect to the pressure in said pressure chamber and having a portion adapted to control the flow of gas through said pressure reducing orifice, yieldable means exerting a biasing force against said control piston tending to maintain the latter in a position such that the flow through said orifice is at a maximum, and means subject to the pressure of the gas in said second chamber for moving said control piston toward orifice closing position in opposition to the biasing force of said yieldable means.

4. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber through a pressure reducing orifice, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas through said pressure reducing orifice, said means comprising a control piston balanced with respect to the pressure in said pressure chamber and having a portion adapted to control the flow of gas through said pressure reducing orifice, and a spring tending to maintain said control piston in a position such that the flow through said orifice is at a maximum, said control piston also having a portion subject to the pressure of the gas in said second chamber and so arranged that said latter pressure opposes said spring and tends to move said control piston towards orifice closing position.

5. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber through a pressure reducing orifice, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas through said pressure reducing orifice, said means comprising a control piston balanced with respect to the pressure in said pressure chamber and having a portion adapted to control the flow of gas through said pressure reducing orifice, a spring tending to maintain said control piston in a position such that the flow through said orifice is at a maximum, means for adjusting the pressure exerted by said spring on said control piston, said control piston also having a portion subject to the pressure of the

gas in said second chamber and so arranged that said latter pressure opposes said spring and tends to move said control piston toward orifice closing position, and means for damping the oscillations of said control piston due to the variations in pressure in said second chamber.

6. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber containing a launching piston movable therein and operatively connected with the mass to be propelled, a cylinder communicating with both of said chambers, a control piston movable in said cylinder and controlling the flow of gas from said pressure chamber to said second chamber, yieldable means continually urging said control piston toward a position such that said flow of gas is at a maximum, and means responsive to the pressure of the gas in said second chamber for moving said control piston in a direction such as to restrict said flow.

7. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, means responsive to variations in the pressure of the gas in said second chamber for automatically controlling the flow of gas between said chambers, whereby the pressure in said second chamber producing the propelling movement of said piston may be maintained substantially constant, a normally closed outlet for exhausting the gas from said second chamber, and means associated with said first named means for opening said exhaust outlet when the pressure in said second chamber exceeds a predetermined value.

8. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber through a pressure reducing orifice, a launching piston movable in said second chamber and operatively connected with the mass to be propelled, and means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas through said pressure reducing orifice, said means comprising a control piston balanced with respect to the pressure in said pressure chamber and having a portion adapted to control the flow of gas through said pressure reducing orifice, yieldable means exerting a biasing force against said control piston tending to maintain the latter in a position such that the flow through said orifice is at a maximum, means subject to the pressure of the gas in said second chamber for moving said control piston toward orifice closing position in opposition to the biasing force of said yieldable means, an outlet for exhausting the gas from said second chamber, and an extension on said control piston so constructed and arranged as to normally close said outlet but to open the

same when the pressure in said second chamber exceeds a predetermined value.

9. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a pressure chamber into which the gas is delivered upon production, a second chamber containing a launching piston movable therein and operatively connected with the mass to be propelled, a cylinder communicating with both of said chambers, a control piston movable in said cylinder and controlling the flow of gas from said pressure chamber to said second chamber, yieldable means continually urging said control piston toward a position such that said flow of gas is at a maximum, means responsive to the pressure of the gas in said second chamber for moving said control piston in a direction such as to restrict said flow, an outlet from said cylinder for exhausting the gas from said second chamber, and means movable with said control piston normally closing said outlet, said last named means acting to open said outlet when the pres-

sure in said second chamber exceeds a predetermined value.

10. In a catapult of the character described wherein the energy of gas produced by combustion of a charge of powder is utilized for moving the mass to be propelled, the combination of a main pressure chamber into which the gas is delivered upon production, a second chamber connected with said pressure chamber and containing a launching piston movable therein and operatively connected with the mass to be propelled, means responsive to the pressure of the gas in said second chamber for automatically controlling the flow of gas between said chambers, a plurality of auxiliary pressure chambers associated with said main pressure chamber, and valve means for individually establishing and disestablishing communication between said auxiliary chambers and said main chamber, whereby the effective volume of the pressure chamber into which the gas is initially delivered may be varied at will.

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