May 21, 1957 R. N. LAHDE 2,792,755

HIGH SPEED LAUNCHING DEVICE

Filed Oct. 31, 1952 2 Sheets-Sheet 1

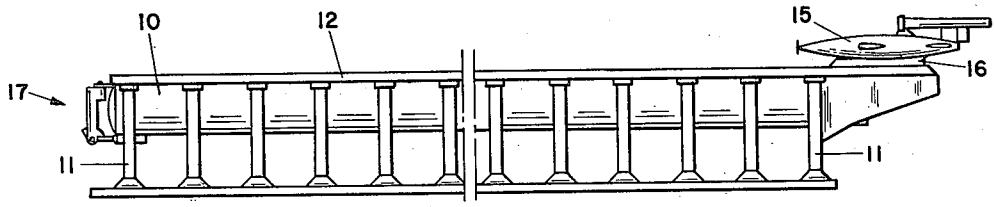


Fig. 1

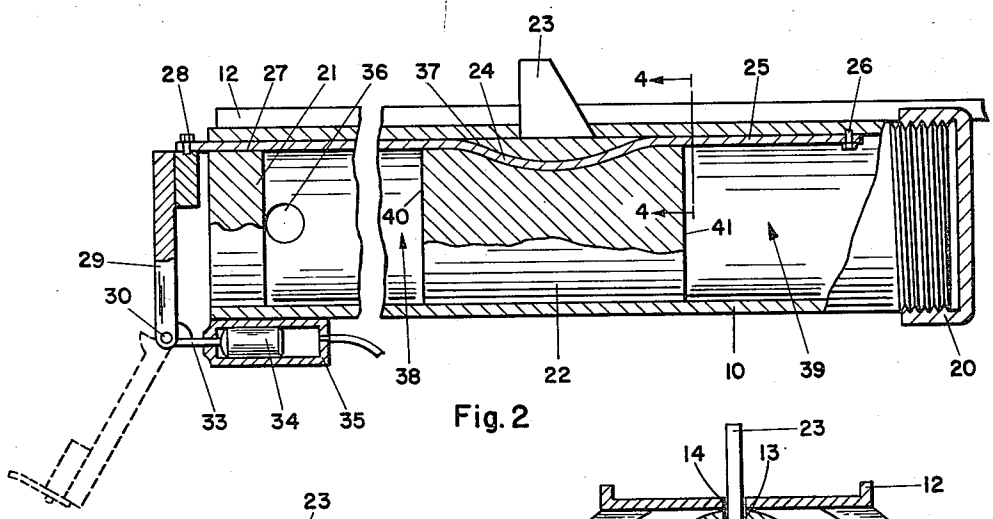


Fig. 2

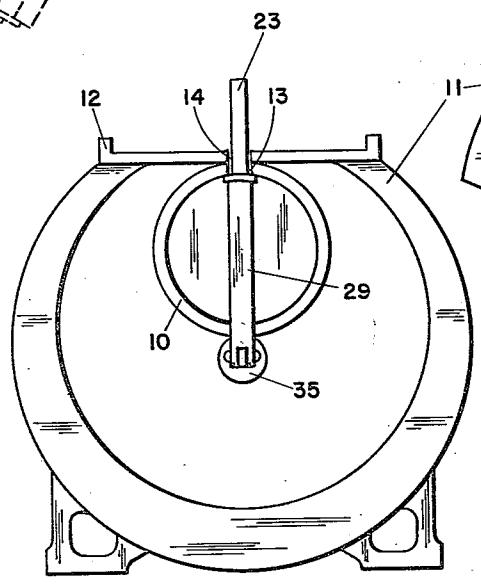


Fig. 3

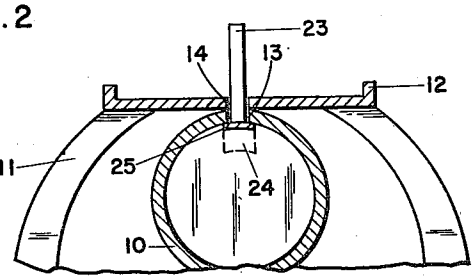


Fig. 4

INVENTOR.
REINHARD N. LAHDE
BY
Max Geldin
ATTORNEYS

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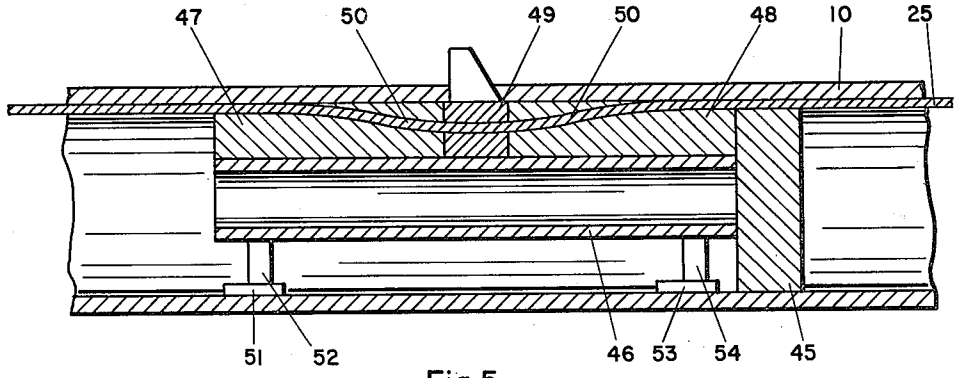


Fig. 5

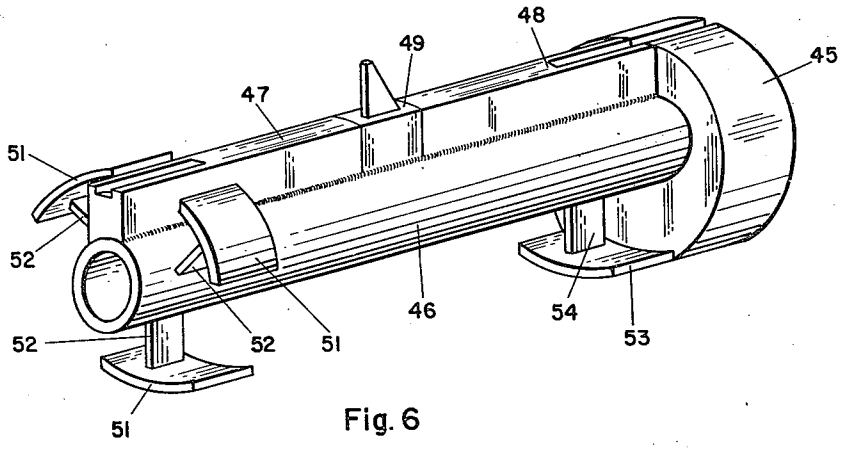


Fig. 6

INVENTOR.
REINHARD N. LAHDE
BY
Mast Geldin
ATTORNEYS

United States Patent Office

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HIGH SPEED LAUNCHING DEVICE

Reinhard N. Lahde, Camarillo, Calif., assignor to the United States of America as represented by the Secretary of the Navy

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4 Claims. (Cl. 89—1.7)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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 of any royalties thereon or therefor.

The present invention relates to a high speed launching device and more particularly to a high speed launching device utilizing a piston operating within a slotted cylindrical member and a sealing strip which is adapted to seal the slot in the cylinder.

Although the present invention is adapted to launch various objects into space, it is particularly adapted for use in the launching of high speed missiles wherein it is desirable to obtain launching speeds in excess of 500 ft. per second.

Launching devices utilizing a piston operating within a slotted cylindrical member and a sealing strip are well known. Such a launching device is shown for example in United States Patent No. 2,485,601.

In launching devices previously used, the sealing strip extending from the piston to the open end of the cylinder has been supported by means of hangers passing through the slot in the cylinder and by applying tension to the end of the strip by means of a pneumatic jack. In such devices, the sealing strip extends through a passage in the piston whereby as the piston moves longitudinally within the cylinder the sealing strip is forced into sealing relation with the slot extending behind the piston. It is evident that the pressure developed behind the piston by the source of propulsion such as expanding gases will maintain the strip in sealing position relative to that portion of the slot which extends from the rear of the piston to the closed end of the cylinder.

Prior art launching devices of the above type have proved satisfactory in obtaining launching speeds up to 500 ft. per second; however, when it is attempted to drive the piston and an attached missile at speeds greater than 500 ft. per second, the strip tends to buckle at the mouth of the passage in the piston, thereby causing the strip to jam within the passage and consequently to be often broken. Such buckling is caused by the fact that since the sealing strip is not firmly supported throughout its length, waves are produced in the strip forwardly of the piston as the piston moves within the cylinder. It is apparent that if the sealing strip breaks, the propulsive energy behind the piston may escape through the slot in the cylinder and propulsive force may no longer be effectively applied to the piston.

The present invention utilizes a novel construction whereby a means is provided which furnishes a firm support for the sealing strip forwardly of the piston during launching. Therefore, substantially no waves are produced in the sealing strip, and as a result, buckling and breaking of the strip are prevented. Consequently, much higher launching speeds may be obtained with the present invention than have been possible with launching devices previously used.

An object of the present invention is the provision of a new and novel launching device in which high launching speeds are obtainable.

Another object is to provide a launching device utilizing a sealing strip wherein buckling and breaking of the strip are prevented at high launching speeds.

A further object of the invention is the provision of a launching device which is simple in construction, yet sturdy and reliable in operation.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 shows a side view of the launching device with a missile to be launched mounted thereon,

Fig. 2 illustrates a longitudinal section of the launching device,

Fig. 3 is an end view of the device of Fig. 1,

Fig. 4 shows a section of the device taken on the line 4—4 of Fig. 2 looking in the direction of the arrows.

Fig. 5 illustrates a modification of the device, and

Fig. 6 is a perspective view of the piston shown in Fig. 5.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 an operating cylinder or barrel member **10** supported by a plurality of standards **11** which are adapted to rest on suitable foundations fixed in the ground. An elongated deck or ramp **12** is also supported by the standards **11** such that the ramp and the cylinder are fixed in parallel relationship closely adjacent to one another. The standards **11** also serve as a lateral support for the wall of the operating cylinder **10** as may be more clearly seen in Fig. 3, thereby strengthening the cylinder to enable it to withstand the high pressures developed within the cylinder during launching.

As shown in Figs. 2 and 3, cylinder **10** and ramp **12** have longitudinally extending elongated slots **13** and **14** respectively formed therein, said slots being aligned with one another and extending throughout the length of the cylinder and ramp, whereby communication may be effected between the piston within the cylinder and the missile supported on the ramp.

Referring again to Fig. 1, a missile **15** is mounted upon a suitable sled **16** which is adapted to travel along the ramp during launching. A pneumatic jack indicated generally by numeral **17** is mounted at the front end of the device and is adapted to apply tension to the end of a sealing means as will be hereinafter more fully described.

In Fig. 2 it may be seen that the cylinder **10** is closed at one end by a removable cap **20** and is closed at its opposite end by a close-fitting plug **21**. The piston **22** which fits tightly within cylinder **10** has an arcuately shaped passage **24** formed therein and a tow fitting **23** is secured thereto, said fitting having a width slightly less than slots **13** and **14** and passing therethrough. The tow fitting may be formed integrally with the piston if desired, and is adapted to be suitably secured either directly to the missile or to a sled upon which the missile is mounted.

A ribbon-like sealing strip **25** is suitably secured at one end thereof as by means of a bolt **26** to the interior of the cylinder **10** adjacent to member **20** and extends through the passage **24** in piston **22** and thence through a close-fitting slot **27** in plug **21**. Strip **25** is secured at its opposite end as by means of a shear pin **28** to an arm **29** which is pivoted at **30** to arm **33** which is secured to piston **34** tightly fitting slidably within cylinder **35**. Conventional means is provided for applying fluid pressure to cylinder **35** whereby upon the introduction of fluid pressure within the cylinder **35** to the right of piston **34**, the piston will be urged to the left causing arms **29** and **33**

to move to the left thereby applying tension to the sealing strip.

In accordance with the present invention, a means is provided for firmly supporting the sealing strip forwardly of the piston. As shown in Fig. 2, a suitable orifice **36** is formed in the wall of the cylinder **10** whereby a compressible fluid such as air under pressure may be introduced into cylinder **10** forwardly of the piston, and this fluid pressure will force strip **25** into sealing position such that a closed chamber **38** is formed forwardly of the piston. Since the sealing strip is pressed firmly against the inner periphery of the cylinder **10**, the strip is supported throughout that portion of its length within the cylinder which extends forwardly of the piston.

As the sealing strip is supported against the cylinder wall, it becomes necessary to provide a means to quickly and efficiently divert the strip into the passage in the piston as the piston moves within the cylinder. Accordingly, the passage **24** is arcuately shaped, extending from the top of the piston at its front end **40** and sloping slightly downward to the center of the piston and then upwardly to the top of the piston at its rear end **41**, so that the displacement of the strip may be as gradual as possible. The piston has formed thereon a beveled edge **37** which is forced between the cylinder wall and the sealing strip as the piston moves within the cylinder, thereby serving to displace the strip away from the cylinder wall and to guide it into the passage in the piston. The upwardly directed rearward portion of the passage forces the strip back into sealing position relative to the cylinder and the pressure produced by the propulsive energy in chamber **39** behind the piston will maintain the strip in sealing position rearwardly of the piston as shown in Fig. 4.

The propulsive energy to drive the piston within the cylinder may be produced by conventional sources of energy such as fluid pressure, smokeless powder or the like.

There is shown in Fig. 5 a modification of the device wherein a modified piston is utilized which is fabricated of a number of separate members which are suitably secured in position. The piston consists of a circular head portion **45** which fits tightly within the cylinder **10** and a hollow cylindrical tube **46** is suitably secured concentrically to head piston **45**. Guide members **47** and **48** and a tow fitting **49** are secured as by welding to member **46**, and opposite ends of the tow fitting abut against adjacent ends of the guide members. The guide members and tow fitting have passages formed therein such that when in assembled position as shown in Fig. 5, the complete passage **50** has an arcuate configuration similar to the passage **24** in the device shown in Fig. 2. Sealing strip **25** extends through passage **50** and the strip is adapted to be firmly supported forwardly of the piston similarly to the device as shown in Fig. 2 and in accordance with the principles of the invention.

Referring to Fig. 6, tube **46** is supported within the cylinder at its forward end by a plurality of shoes **51**, shown as three in number, which are connected to member **46** by means of support members **52**. Tube **46** is supported within the cylinder at its rear end by means of head portion **45** and a shoe **53** connected to member **46** by means of support member **54**. The shoes are adapted to slide along the inner wall of the cylinder and the bearing surfaces thereof are preferably formed of antifriction material so as not to impede the travel of the piston. It is evident that the shoes may be of any suitable configuration and dimensions and that any desired number may be employed.

Although it is not necessary to apply tension to the end of the sealing strip of the present invention since the sealing strip is firmly supported forwardly of the piston, such tension serves to originally position the sealing strip closely adjacent to slot **14** forwardly of the piston whereby the fluid pressure introduced through orifice **36** is only required to displace the strip a small distance to force it into contact with the inner wall of the cylinder and to seal the slot in the cylinder in front of the piston. Such tensioning also assists in maintaining the strip flat against the inner wall of the cylinder should the strip tend to buckle during launching.

The operation of the invention device as shown in Fig. 2 is as follows: The piston **22** is initially positioned in cylinder **10** adjacent to cap **20**, and a missile **15** is mounted upon a sled **16**, which is supported on the deck **12** and is suitably secured to the tow fitting **23**. The pneumatic jack is actuated so as to apply tension to the sealing strip and fluid at approximately two p. s. i. pressure is introduced into cylinder **10** through orifice **36** such that the sealing strip is forced into sealing position and is thereby firmly supported forwardly of the piston. Propulsive energy is then suitably introduced into cylinder **10** to the right of piston **22** whereby the piston is forced to move to the left within the cylinder. As the piston moves within the cylinder **10**, the edge **37** forces the strip away from the inner wall of the cylinder and guides it into the passage **24**. The strip **25** is displaced laterally away from the inner wall of the cylinder and then forced into sealing position at the rearward portion of the piston due to the arcuate shape of passage **24**, thereby forming a closed chamber behind the piston. As pointed out previously, propulsive energy of the device maintains the strip in sealing position behind the piston. Piston **22** travels between 145 and 150 feet during the launching stroke, and when end **40** of the piston has traveled approximately 75 feet, or at about the midpoint of the launching stroke, the pressure in front of the piston has built up sufficiently such that plug **21** is blown out of the cylinder, shearing off pin **28**, and rotating arm **29** into the dotted line position shown in Fig. 2. The piston continues to travel along within the cylinder until it passes through the open end of the cylinder whereupon it drops to the ground and the missile becomes airborne. It should be noted that although the plug is blown out of the cylinder about halfway through the launching stroke thereby releasing the fluid pressure which was introduced through orifice **36**, the face pressure built up by end **40** of the piston is greater than the pressure initially acting to hold the strip in place and will tend to maintain the strip in engagement with the cylinder. Furthermore, depending on the launching speed, only a period of approximately .05 to .15 second elapses between the time the plug blows out of the cylinder and the time the piston reaches the open end of the cylinder, and since the sealing strip has a relatively small mass, the force of gravity does not materially affect the position of the strip in such a short period of time. It is also an advantage to have the relatively slow moving plug strike arm **29** rather than the fast moving piston thereby preventing possible distortion of and damage to the arm. Since the fluid pressure introduced through orifice **36** positions the sealing strip in engagement with the inner wall of the cylinder, and the strip is maintained in engagement therewith during substantially the entire launching procedure, the formation of waves in the strip is prevented. Furthermore, edge **37** and passage **24** are so designed as to produce as smooth and gradual a displacement of the strip as possible, whereby any tendency of the strip to double up or jam within the passage is eliminated. Consequently, buckling and subsequent breaking of the strip is prevented, enabling the device to be operated at speeds greater than 500 feet per second. The operation of the device shown in Figs. 5 and 6 is similar to that of the device shown in Fig. 2.

It should be understood that although fluid pressure is considered to be preferable in supporting the strip in front of the piston, that other means may also be provided for such purpose. For example, a suitable adhesive substance such as glue, cement or the like may be used to secure the strip to the cylinder. Further, the strip may

be formed at least partially of a magnetized material such as cobalt steel or the like in which case the strip would be tightly held against the interior of the cylinder by magnetic attraction. In the above modifications, the strip is firmly supported in front of the piston with or without the aid of tensioning means and the device functions in substantially the same manner as when fluid pressure is utilized.

It is apparent from the foregoing that a launching device is provided in which high launching speeds are obtainable without breaking the sealing strip utilized therein, and that the device is simple in construction, yet sturdy and reliable in operation.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A launching mechanism which comprises an elongated hollow cylindrical member having a longitudinally extending slot formed therein, a piston in said hollow member, a tow fitting connected to said piston and extending through said slot, means for sealing said slot and means acting substantially radially the member prior to and during launching movement of the piston for maintaining said foregoing means in sealing engagement relative to substantially the entire length of said slot forwardly of said piston.

2. A launching mechanism which comprises a barrel member closed at both ends and having a longitudinally extending slot formed therein, a piston in said barrel member, a tow fitting connected to said piston and extending through said slot, means for sealing said slot, said piston having means closely adjacent said wall for receiving said sealing means, and gaseous pressure means introduced in said barrel member prior to and during launching movement of the piston for maintaining said sealing means in engagement with that portion of the inner periphery of said barrel member directly in front of said piston during launching, and in sealing relation with said slot throughout substantially the entire length of said slot.

3. A launching mechanism which comprises a slotted tube closed at both ends, a piston slidably mounted within said tube and adapted to be initially positioned adjacent one of said closed ends, towing means on said

piston passing through said slot and adapted for connection with a missile, means for sealing the slot in the tube forward of and behind the piston so as to form closed chambers on each side thereof, and gaseous pressure means introduced in said tube prior to and during launching movement of the piston adapted to support said sealing means firmly against the inner periphery of said tube such that substantially the entire length of the tube slot forwardly of said piston is sealed, and means for releasing the pressure build-up before the piston at a predetermined time in the launching movement.

4. In a missile launcher, a ramp having a longitudinal slot formed therein, a rigidly supported cylinder located adjacent to said ramp and being closed at forward and after ends, said cylinder having a slot aligned with the slot in said ramp, the forward end of the cylinder being an ejectable plug, a piston slidably mounted in said cylinder, a tow fitting secured to said piston and passing through said aligned slots, means for sealing the slot in said cylinder and means for maintaining said sealing means in engagement with the inner periphery of said cylinder on both sides of said piston throughout substantially the entire length of said cylinder on both sides of the piston, thereby forming a closed chamber on both sides of said piston, said means for maintaining the sealing means in the forward chamber being a low pressure gas introduced in said cylinder prior to and during launching movement of the piston, said sealing means extending through an arcuate passage formed in a portion of said piston, said passage extending from the top of the piston at its front end downwardly to the center of the piston and then upwardly to the top of the piston at its other end whereby as said piston moves longitudinally in said cylinder, said sealing means is successively forced out of and back into engagement with the inner periphery of said cylinder.

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