April 23, 1963 R. S. CHAMBERLIN ETAL 3,086,423

DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 1

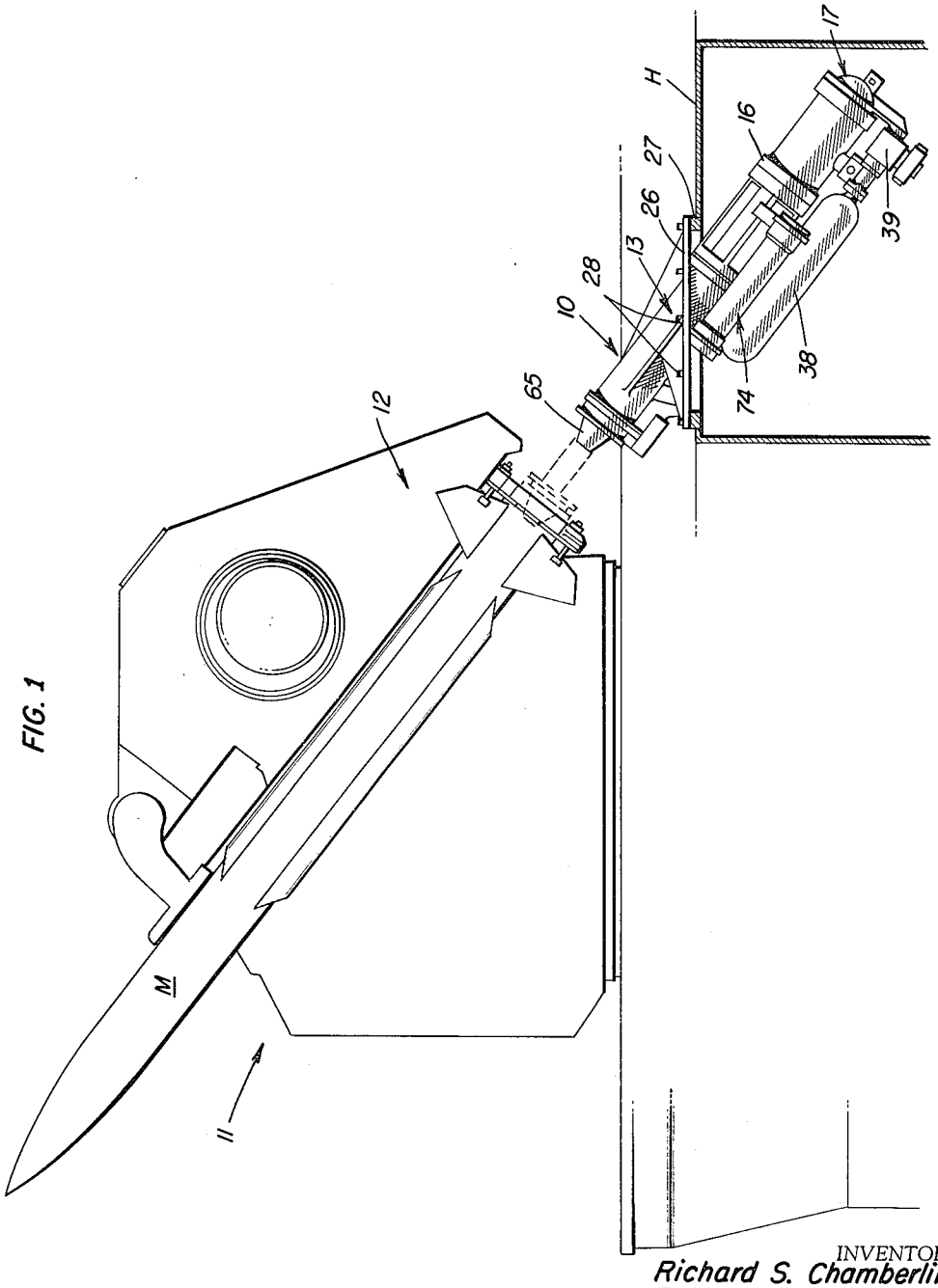


FIG. 1

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DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 2

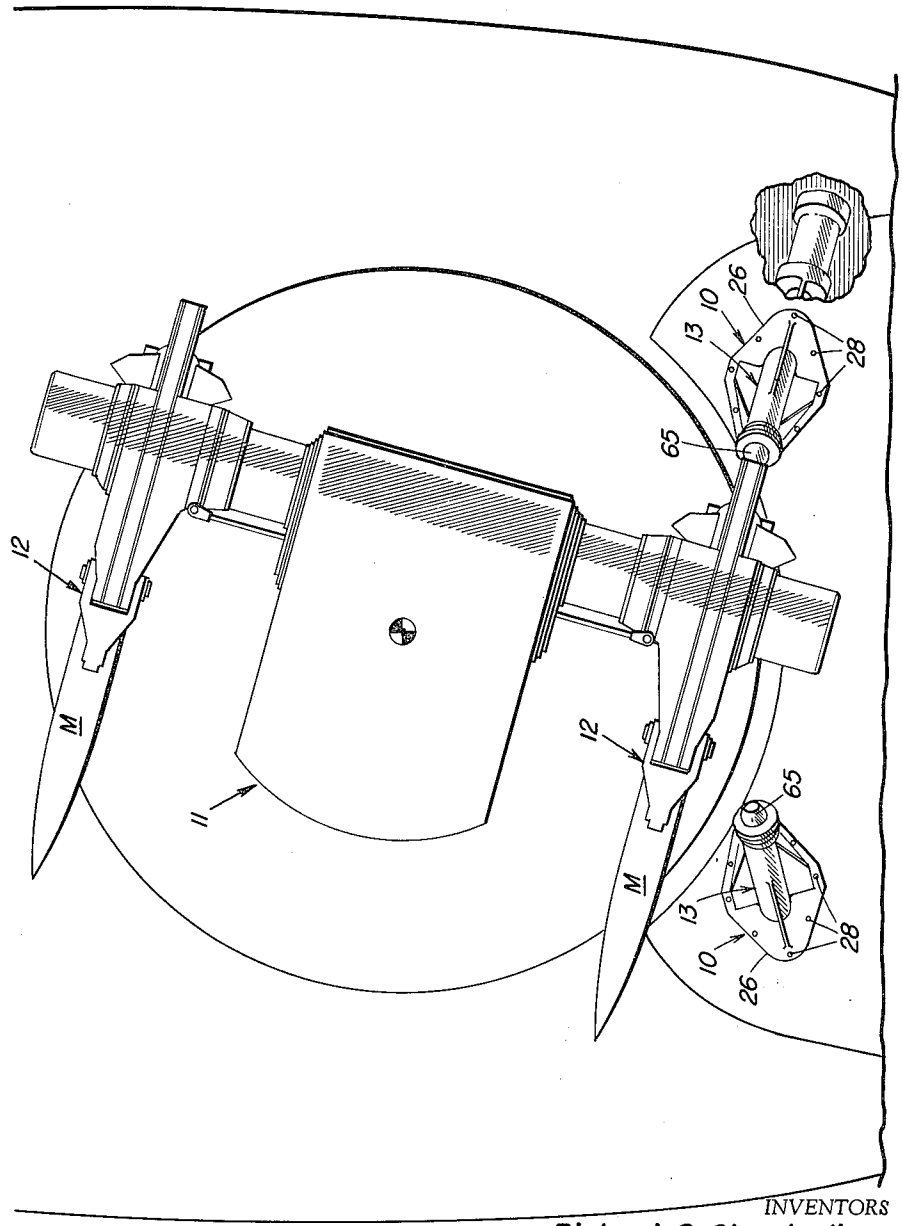


FIG. 2

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DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 3

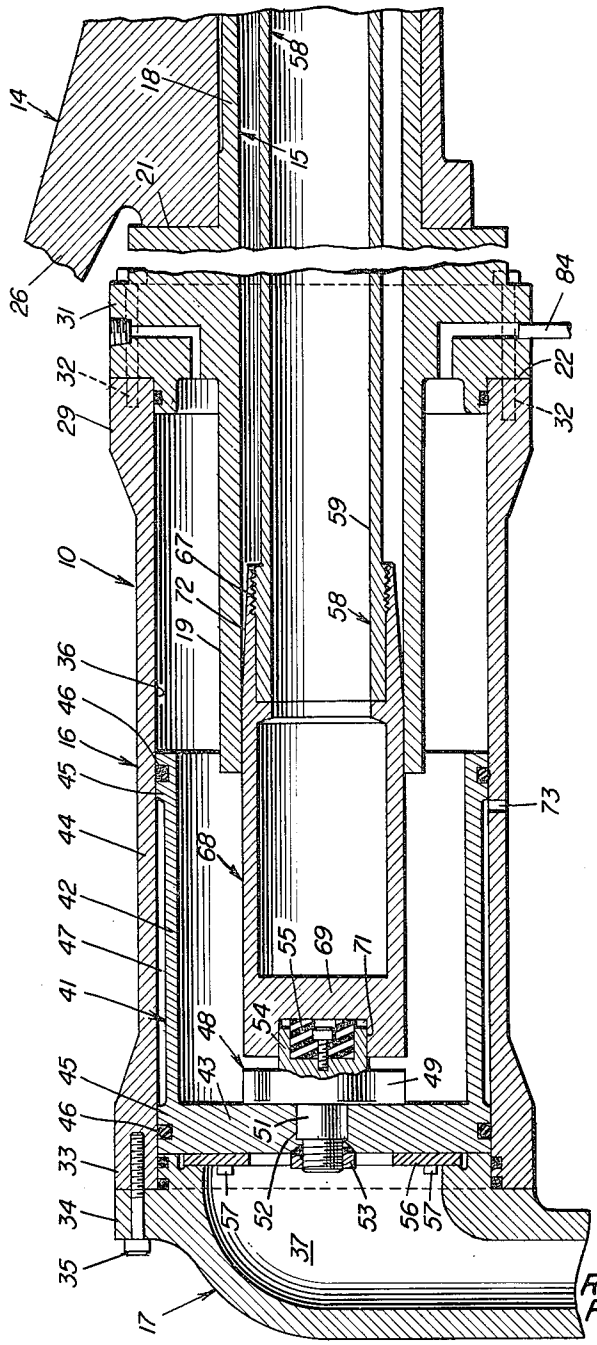


FIG. 3

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DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 4

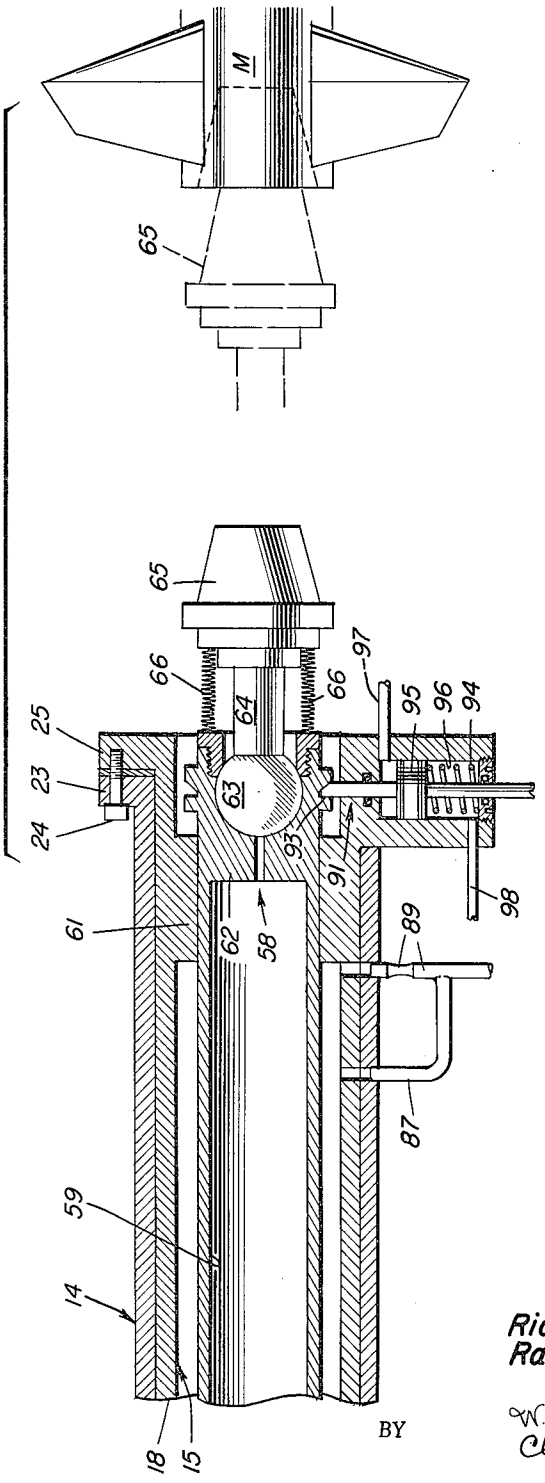


FIG. 3A

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April 23, 1963 R. S. CHAMBERLIN ETAL 3,086,423

DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 5

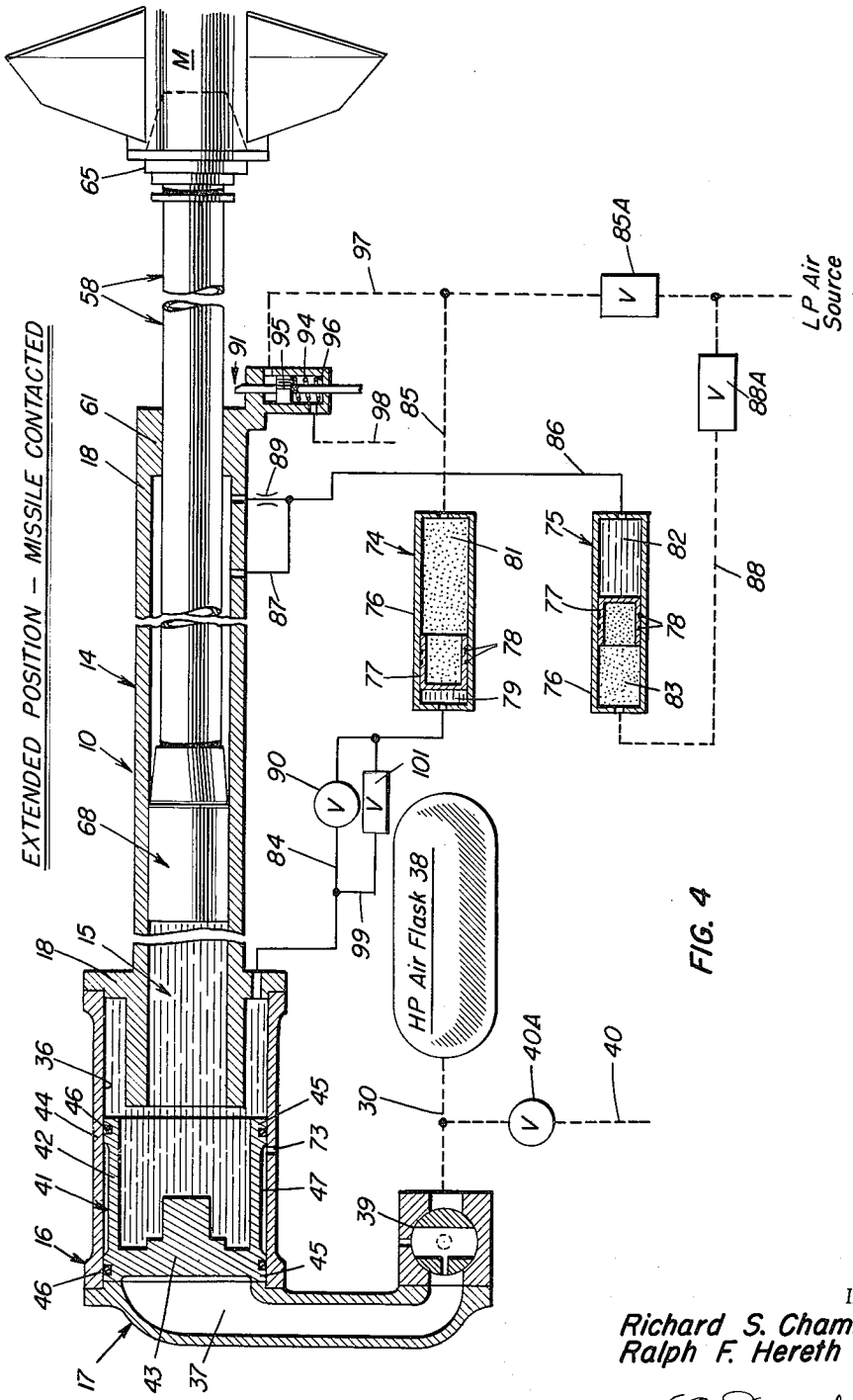


FIG. 4

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DUD JETTISONING DEVICE

Filed Sept. 27, 1961 6 Sheets-Sheet 6

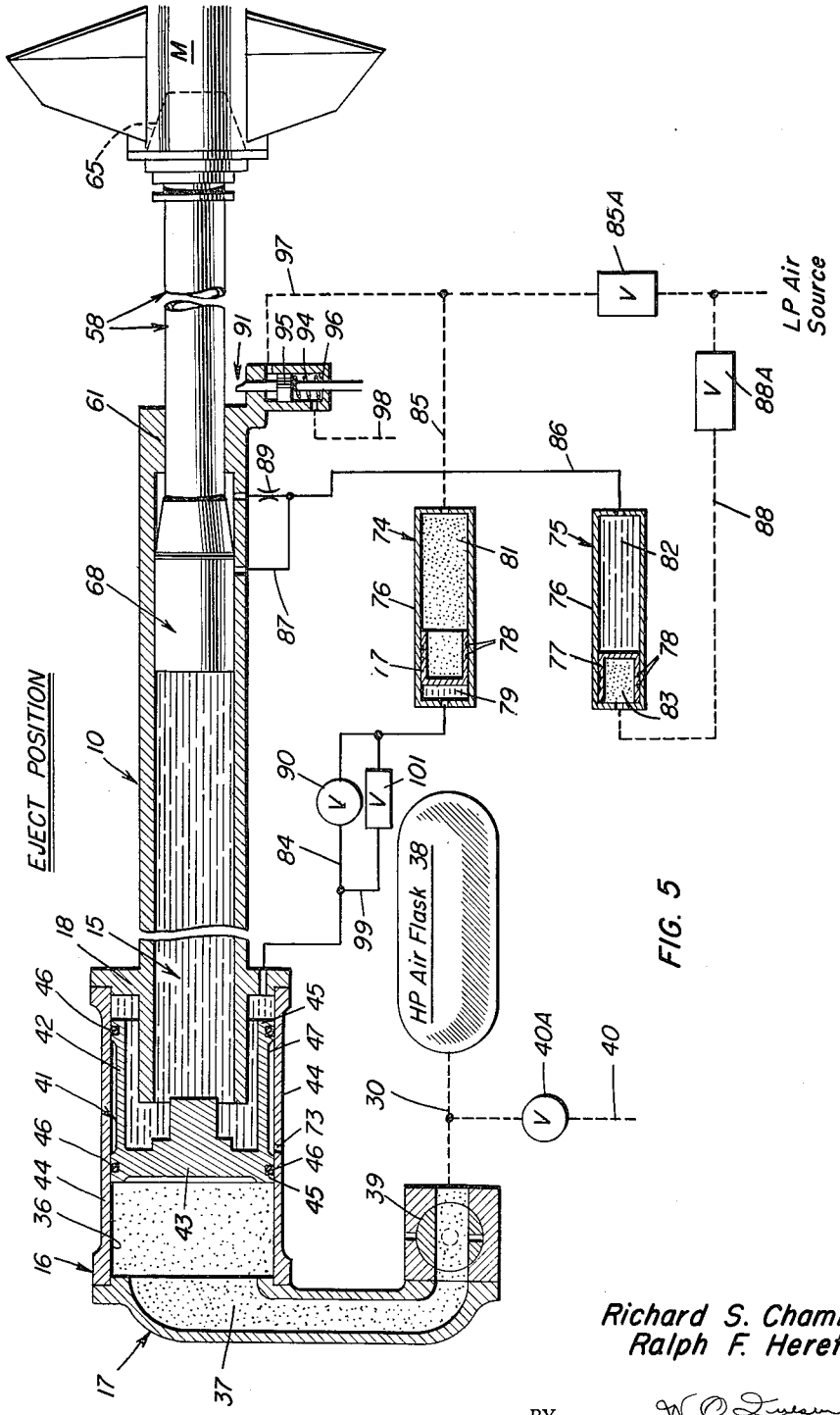


FIG. 5

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United States Patent Office 3,086,423 Patented Apr. 23, 1963

3,086,423

DUD JETTISONING DEVICE

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Filed Sept. 27, 1961, Ser. No. 141,218
5 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 invention relates to a jettisoning device and more particularly to a dud jettisoning mechanism for use with an automatic missile or rocket launcher of the type comprising two pairs of launching rails which oscillate between an inclined firing position and a vertical loading position in which latter position the rails are in alignment with missiles stowed in the conventional magazine so that the missiles may be moved onto the rails by a rammer mechanism.

During the operation of a rocket or missile launcher of the type to which this invention relates misfires occasionally occur with the result that a missile remains on one pair of launching rails after the firing switch has been actuated, and in such cases the operation of the launcher must be suspended until the missile is removed from the rails. Heretofore it has been necessary, on such occurrences, for the operator either to wait for the missile to be expelled under its own force or to obtain volunteers to manually eject the missile from the rails, which latter step can be taken only after numerous safety precautions. Moreover, when a misfire occurs a prime disadvantage lies in the time loss involved in the launcher being incapacitated for service during the presence of a dud on one of the launching rails, and further disadvantages reside in the time loss involved in the manual removal of the dud and the possibility of injury to the dud removal crew due to possible delayed ignition of the missile propellant during such removal operations.

Dud jettisoning devices heretofore used operated in response to pneumatic pressure only and for this reason have not proven entirely satisfactory. The primary disadvantages of pneumatic dud jettisoning devices heretofore employed resides in the difficulty encountered in stopping the moving mass or piston ejecting means by the use of air. Furthermore, if oil alone is used in attempting to stop the aforesaid mass it has been found that difficulties are encountered in that a surface of oil or a film of oil accumulates on the interior walls of the piston cylinder as the piston reciprocates therein and creates an effect known to those skilled in the art as dieselizing which, because of the high pressure air and movement of the parts, results in temperature build-up sufficiently high to ignite the aforesaid film of oil.

The present invention contemplates the provision of a new and improved dud jettisoning device which overcomes the aforementioned disadvantages encountered in prior art devices by providing a remotely controlled automatic dud jettisoning device mounted on a housing near the launcher so that a dud missile may be quickly ejected from the launcher rails without exposing the dud removal crew to danger and possible injury. The invention further provides a dud jettisoning device which will substantially eliminate the need for decelerating a large mass of oil or other hydraulic fluid, as heretofore practiced in devices of this type and wherein a large pressure may be created instantaneously over a large piston area by the use of a high pressure source of pneumatic fluid and in which low pressure oil acting on a piston moves the piston rod into engagement with the end of the missile

and high pressure air acting on a piston which acts on the oil after the first piston rod is in engagement with the missile imparts movement to the first piston and consequently movement to the missile sufficient to jettison the missile over the side of the ship.

An object of the present invention is to provide a new and improved dud jettisoning mechanism for missile launchers whereby a dud missile may be quickly ejected from a launcher and over the side of the vessel.

Another object of the invention is to provide a jettisoning device for jettisoning a dud missile over the side of a vessel in such a manner that personnel will not be involved in the jettisoning operation.

Another object of the invention is to provide a dud jettisoning device which will eliminate the need for decelerating a large mass of oil or other hydraulic fluid as heretofore necessary in prior art jettisoning devices.

Another object of the invention is to provide a dud jettisoning mechanism in which a large pressure may be created instantaneously over a large piston area by the use of a high pressure source of pneumatic fluid connected to the input end of the mechanism.

A further object of the invention is to provide a combination pneumatic hydraulic jettisoning device wherein a source of low pressure air or other pneumatic fluid is introduced into a first cylinder to move a piston against a head of oil to introduce such oil under low pressure into a second cylinder to thereby cause the oil in the second cylinder to move a piston in the first cylinder and move the piston rod carried thereby into engagement with the end of the missile.

A still further object of the invention is to provide a device wherein pressure actuated means quickly jettison the missile from the launcher after contact of the ejecting means with the missile and when the oil pressure reaches a predetermined value.

Another object 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 is a view in side elevation of a launcher and the jettisoning device of the present invention showing launcher and jettisoning device in a jettisoning position, with the housing for the jettisoning device broken away;

FIG. 2 is a view in plan illustrating the arrangement of FIG. 1;

FIG. 3 is an enlarged longitudinal sectional view illustrating the aft portion of the dud jettisoning device with the components thereof shown in an initial position;

FIG. 3A is a view similar to FIG. 3, illustrating the forward portion of the device of FIG. 3;

FIG. 4 is a view in diagrammatic form illustrating the spud of the jettisoning device in a missile engaging position; and

FIG. 5 is a view similar to FIG. 4 except with parts shown in a changed position and illustrating the spud in a missile jettisoning position.

Referring now to the drawings and more particularly to FIGS. 1 and 2, the jettisoning device constructed in accordance with the present invention is generally indicated by the numeral 10 and as best shown on FIG. 2 is mounted in proximate relation with respect to a missile launcher 11, similar to the launcher disclosed and claimed in the copending application of Sverre Kongelbeck, Serial No. 819,517, filed June 10, 1959, for Turret Launcher. Briefly, the launcher is provided with a pair of launching arms 12, FIG. 2, and operates through loading, firing and jettisoning cycles. Since the present invention is particularly concerned with the jettisoning cycle of the operation, it is deemed unnecessary to describe in detail the operational cycle of the launcher.

It will be noted, FIG. 2, that a pair of jettisoning devices are employed in connection with the launcher **11**, each device being arranged to cooperate with its respective launching arm **12** so that a dud missile may be ejected therefrom when the launcher and arm are in a jettisoning position, FIG. 1.

The jettisoning devices **10** are identical in structure and operation and comprise an elongated ejector cylinder, generally indicated by the numeral **13**, which includes cylinder housing **14**, an elongated tube **15**, a booster housing **16**, and a booster head **17**. The tube **15** comprises forwardly and rearwardly extending tubular members **18** and **19** carried by and integrally formed with an enlarged cylinder portion **21**. It will be noted on FIG. 3 that the housing **14** is disposed about the tubular member **15** having one end thereof in engagement with a shoulder **22** formed on the juncture of members **18** and **21**, the other end thereof having a flange **23** which is bolted as at **24** to a flange **25** formed on the forward end of tubular member **18**. The housing **14** further includes a mounting flange **26** cooperating with a flange **27** formed on housing H which is adapted to contain the conventional launcher control mechanism, not shown, and secured thereto, as by bolts **28**, as best shown on FIG. 1. Thus by this arrangement the dud jettisoning devices **10** are supported in proper relationship with respect to launcher **11** so that either one or the other of the jettisoning devices can be used during a dud ejecting operation.

The booster housing **16** is provided at one end with a flange **29** in engagement with a flange **31** formed at the aft end of member **15** and secured to flange **29** as by bolts **32**, the other end of housing **16** being provided with a flange **33** in engagement with a flange **34** on the booster head **17** and secured to flange **33**, as by bolts or the like **35**. The booster housing is further provided with a relatively large bore **36** extending therethrough in communication with a relatively large passageway **37** formed in the booster head, FIGS. 3, 4, and 5, the aforesaid passageway **37** being adapted to accommodate a sudden surge of air from the air flask **38** connected thereto by pipe **30** and controlled by an automatically operated valve **39** arranged in the booster head. The air flask **38** may be charged by any means suitable for the purpose such, for example, as by air from the ship supply source (not shown) by way of pipe or conduit **40** which may be provided with a conventional reduction valve **40A** to reduce the customary air pressure from 3000 p.s.i. to 2000 p.s.i., the air being prevented from entering the booster head **17** by valve **39**.

As best shown on FIGS. 3, 4 and 5 a booster or large area piston generally indicated by the reference character **41** is slidably disposed within the bore **36** in booster housing **16** and comprises an annular wall **42** connected by an end wall **43** and in spaced relation with respect to the wall **44** of the booster housing **16**. The piston **41** is further provided with a pair of annular flanges **45** integrally formed with the walls **41** and **43**, with one of each of the flanges being disposed at the terminal ends of the wall **41** and fitted with an O-ring **46** in sealing engagement with the wall **44** of housing **16** thereby to provide a sealed chamber **47** within piston **41**. A buffer plug **48** is centrally disposed within the end wall **43** of piston **41** and includes a flange **49** in engagement with the wall **43**, a stem **51** disposed at one end of the flange **49** and extending through a bore **52** formed in wall **43**, the plug **48** being secured to the wall **43** by a retaining and sealing ring **53** threaded on the terminal end of the stem **51**. Disposed at the other end of the flange **49** and formed therewith is a cup-shaped member **54** having a buffer ring **55** disposed therein and secured thereto, the ring being composed of any material suitable for the purpose such, for example, as rubber. The piston **41** may also be provided with a buffer ring **56** secured to wall **43** by bolts or the like **57** thereby to prevent metal to metal contact during the return stroke of the piston **41** such, for example, as when the piston reaches a position, as shown in FIG. 3.

A spud or missile ejecting device generally indicated by the reference character **58** is disposed within the aforesaid tube **15**, FIGS. 3, 4 and 5. The device **58** comprises an elongated hollow tube or piston rod **59** slidable through a guide or bushing **61** disposed at or near the forward end of tubular member **15**, the forward end of the tube **59** being provided with a plug **62** secured therein in any suitable manner such, for example, as press fitted therein. The plug **62** has mounted therein a ball **63** which carries a shank **64**, the shank having a spud head or missile engaging head **65** secured to the terminal end thereof. If desired suitable compression springs **66**, FIG. 3A, may be employed to maintain the spud head in axial alignment with the spud rod or tube **59**. By the aforesaid arrangement the spud head may shift and correct slight misalignments, should this occur, upon contact of the head with the missile. The aft end of the piston rod or spud **59** is threaded, as at **67**, for engagement with a hollow piston **68** movably disposed within and guided by the inner walls of the members **18**, **19**, and **21** forming tube **15**. The piston **68** is provided with an end wall **69** having a recess **71** formed therein for receiving the buffer ring **55** on plug **48** to provide a buffing action for spud **58** during its retracting stroke and a forwardly disposed tapered portion **72** to provide a buffing action as the spud reaches the end of the ejecting stroke. The piston **68** is disposed between a mass or volume of oil since oil is disposed within the booster housing **16** rearwardly of the piston and in the member **15** forwardly of the piston.

It will be noted, FIGS. 3, 4 and 5, that the booster housing **16** is provided with an orifice **73**, the orifice or vent being in communication with the channel or chamber **47** in piston **41**, regardless of the extent of movement or position of the aforesaid piston within the booster housing. By this arrangement and in the event that either air or oil leaks by the O-rings **46** in piston **41** and into channel **47**, it will be vented into the atmosphere by way of orifice **73**, and this mixing of the air and oil is prevented.

A pair of accumulators **74** and **75** are mounted on opposite sides of the ejector in any suitable manner such, for example, as by bolts or the like, accumulator **74** being employed to extend the spud during a dud missile ejecting operation, the accumulator **75** being employed to retract the spud after the ejecting operation has been completed. The aforesaid accumulators are identical in structure and include a casing **76** which supports and guides a piston **77** as it is actuated by hydraulic and/or pneumatic pressure. The pistons **77** are each provided with O-rings **78** to provide a hydraulic fluid chamber **79** and a pneumatic air chamber **81** in accumulator **74** and a hydraulic fluid chamber **82** and a pneumatic air chamber **83** in accumulator **75**, the aforesaid arrangement being best shown on FIGS. 4 and 5. It will be noted, FIGS. 4 and 5, that pipe **84** is further provided with a bypass **99** provided with a conventional control valve **101** whereby the fluid within chamber **36** may be returned to chamber **79** during a spud return cycle. It will be further noted in FIGS. 4 and 5 that the hydraulic fluid chamber **79** in accumulator **74** is connected to the booster housing **16** by a pipe or conduit **84** provided with a suitable check valve **90**. Air is admitted into the pneumatic chamber **81** in accumulator **74** from a suitable source (not shown) by way of pipe **85**, the air being controlled by a conventional control valve **85A**. The hydraulic fluid chamber **82** of the accumulator **75** is connected to the forward end of tubular member **18** by a pipe **86** and a branch pipe or bypass **87**, air being admitted into the pneumatic chamber **83** thereof from the aforesaid source by way of pipe **88**, the air being controlled by a conventional control valve **88A**. The pipe **86** is provided with an orifice or valve, as at **89**, arranged in such a manner to restrict

the flow of oil into and out of the tubular member 15 and supplied thereto by the accumulator 75 according to the position of the piston 68 in member 15 and piston 77 in accumulator 75.

As more clearly shown on FIGS. 3A, 4 and 5, the ejector unit or spud 58 is provided with a conventional locking device 91 which may be controlled in any suitable manner such, for example, as by either pneumatic or hydraulic pressure. The locking device comprises a detent 92 normally in locking engagement with the spud head 65, as at 93, and maintained in locking engagement therewith by a spring 94 thereby to maintain the ejector unit in an initial position. It will be noted that the detent 92 is provided with a piston 95 slidably mounted within a chamber 96 formed at the forward end of the member 18 and controlled by pneumatic pressure supplied to the chamber 96 by way of pipes 97 and 98 from the aforesaid air supply source.

During a dud jettisoning cycle the air flask 38 is charged with a predetermined amount of air under pressure such, for example, as 2,000 p.s.i. from the ship supply source (not shown) by way of pipe 40 and the reducing valve 40A, the air pressure in the air flask being prevented from entering the booster head 17 until valve 39 is actuated to an open position. Upon charging the air flask in the aforesaid manner, air pressure in the neighborhood of 100 p.s.i. is ported into the chamber 96 by way of pipe 97 and actuates piston 95 therein an amount sufficient to move the detent 91 out of locking engagement with the spud 58 thus releasing the spud for movement to a dud jettisoning position. Simultaneously, with the release of the detent 91 from the spud or ejecting unit, air pressure of about 100 p.s.i. is supplied to chamber 81 of the extend accumulator 74 by way of pipe 85 and control valve 85A to drive piston ring 77 in a direction so that the hydraulic fluid in chamber 79 is forced therefrom and into booster housing 16 by way of pipe 84. As the hydraulic fluid from chamber 79 enters the booster housing, the pressure therein increases an amount sufficient to slowly move the spud 58 an amount sufficient to engage the spud head 65 with the missile M, FIG. 4. During the movement of the spud in the aforesaid manner the hydraulic fluid ahead of piston 68 and within tube 15 is forced therefrom into chamber 82 of the retract accumulator 75 by way of bypass 87 and pipe 86. It will be understood that since pipe 86 is restricted, as at 89, in advance of the connection between the bypass 87 and pipe 86, most of the fluid will be directed into chamber 82 by the aforesaid bypass 87. The fluid entering chamber 82 causes the piston 77 in accumulator 75 to move in a direction to force air in chamber 83 into the atmosphere by way of pipe 88 and control valve 88A.

With the spud extended and the spud head in engagement with the missile, FIG. 4, the valve 39 in booster head 17 is actuated to an open position, whereupon the 2,000 p.s.i. pressure contained in air flask 38 is ported into the booster head by way of pipe 30, valve 39 and passageway 17 in the booster head and applied to piston 41 to move the piston 41 toward piston 68. During the aforesaid movement of piston 41, the hydraulic fluid in the booster housing is compressed between pistons 41 and 68 an amount sufficient to apply a force or thrust to the small area piston 68 to forcibly move the piston at a high rate of speed to the jettisoning position, FIG. 5, thereby to jettison the dud missile from the launching arm. The fluid under high pressure and within the booster housing is preventing from entering the extend accumulator 74 by the check valve 90 in pipe 84.

It will be understood that during the forward or dud jettisoning stroke of the spud or ejecting unit the hydraulic fluid in tube 15 between the piston 68 and the closed end thereof will be forced into the chamber 82 of accumulator 75 by way of bypass 87 and pipe 86, the fluid entering chamber 82 moving the piston 77 in a downwardly direction, forcing the air in chamber 83 into the atmosphere by way of pipe 88 and valve 88A. However, as the spud nears the end of the jettisoning stroke and piston 68 seals the bypass 87, the fluid is forced through the restricted orifice 89 in pipe 86 thereby providing hydraulic buffing action for the spud.

When the dud missile has been ejected from the launcher arm in the aforesaid manner the valve 39 in the booster head is actuated to a position so that the air in the booster housing is ported into the atmosphere. Thereafter air at about 100 p.s.i. is ported into chamber 83 in accumulator 75 by way of valve 88A and pipe 88 to move piston 77 therein in a direction to force the fluid from chamber 82 into tube 15 by way of restriction 89 in pipe 86, the fluid exerting a relatively small amount of pressure on spud piston 68 and slowly moves the spud in a rearwardly direction and toward the booster housing 16. When the piston 68 has been moved an amount sufficient to unseal port 87 a relatively large amount of fluid from chamber 82 enters the tube 15 and an increased amount of pressure is exerted on the piston 68, whereupon the spud is moved at a relatively high rate of speed to an initial or retracted position. During the retracting stroke of the spud the piston 68 thereon forces hydraulic fluid out of the booster housing 16 and into chamber 79 of accumulator 74 by way of bypass 99 and control valve 101 and returns piston 77 thereon to an initial or retracted position, such movement of the piston 77 forces air from chamber 81 into the atmosphere by way of pipe 85 and control valve.

It will be understood that during the dud jettisoning and spud retracting cycles the detent 91 is maintained in an unlocked position or out of engagement with the spud by a predetermined amount of pressure admitted into chamber 96 above piston 95 by way of pipe 97. However, when the spud has been moved to an initial position, air admitted into chamber 96 below piston 95 by way of pipe 98 returns the detent 91 to locking engagement with the spud, the aforesaid valve 85 being adapted to control the flow of air into chamber 95.

From the foregoing it will be apparent that the invention provides a combination pneumatic-hydraulic dud jettisoning device wherein a source of low pressure air or other pneumatic fluid is introduced into a cylinder to move a piston against a head or volume of oil to port oil under low pressure into a relatively large cylinder thereby to increase the oil pressure within the large cylinder an amount sufficient to move a small area piston at a low rate of speed into engagement with a dud missile and thereafter compressing the oil in the large cylinder by movement of a large area piston within the large cylinder until the pressure therein reaches a predetermined value such, for example, as a value sufficient to move the small area piston at a high rate of speed to a dud jettisoning position.

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.

What is claimed is:

1. A device for ejecting a dud missile from a launching arm of a missile launcher comprising an elongated tubular member having a large area pressure chamber and a small area pressure chamber therein, a large area piston in said large area pressure chamber, said large area piston including a hollow member in sealing engagement with said tubular member and having a wall at one end thereof, a small area piston in said small area pressure chamber and sealing the small area pressure chamber, said small area chamber having a quantity of oil disposed in advance of the small area piston, said large area pressure chamber having a quantity of oil disposed between said end wall and small area pistons, pressure actuated means in communication with said large area

pressure chamber for increasing the pressure of the oil therein an amount sufficient to slowly advance the small area piston into engagement with a missile, means in communication with the large area chamber for applying high pressure to the end wall of the large area piston to move the large area piston against the oil therein until the oil pressure reaches a value sufficient to quickly and forcibly move the small area piston to a dud missile ejecting position, bypass means in communication with the small area chamber for quickly porting the oil therefrom until the small area piston moves into sealing engagement with the bypass during movement of the small area piston to said dud missile ejecting position, and flow restricting means in communication with the small area pressure chamber for slowly porting the oil therefrom when the small area piston is in sealing engagement with said bypass and close to a dud missile ejecting position.

2. A device for jettisoning a dud missile from a launching arm of a missile launcher, comprising an elongated unitary tubular member having a large area pressure chamber and a small area pressure chamber therein, a large area hydraulic-pneumatic actuated piston having an end wall disposed within said large area pressure chamber and movable from an initial position to an operating position, a small area hydraulic actuated piston head disposed within said small area pressure chamber and normally extending into the large area pressure chamber in sealing engagement with the large area piston, said small area pressure chamber having a quantity of oil disposed therein at one side of said piston head, said large area pressure chamber having a quantity of oil disposed therein at the other side of said piston head between the end wall on the large area piston and the small area piston head, a piston rod carried by said small area piston head, a dud missile engaging head fixed to the terminal end of said piston rod, means including a hydraulic-pneumatic device in communication with said large area pressure chamber for supplying additional oil to the oil therein to increase the pressure of the oil an amount sufficient to slowly advance the small area piston head, missile engaging head and rod until said engaging head contacts a dud missile, means including an air supply source in communication with said large area pressure chamber for applying high pressure fluid to the end wall of the large area piston to move the large area piston against the quantity of oil in the large area pressure chamber until the oil pressure therein reaches a value sufficient to quickly move the small area piston head, rod and dud engaging head to a dud missile jettisoning position, a bypass in communication with the small area pressure chamber for quickly porting the oil therefrom during movement of the small area piston head, rod and dud engaging head to said jettisoning position, said piston head sealing the bypass as the dud engaging head nears a jettisoning position, a restricted port in communication with the small area pressure chamber for slowly porting the oil therefrom after the piston head seals said bypass and the dud engaging head near said dud missile jettisoning position, and hydraulic-pneumatic actuated means in communication with said port means for receiving the oil as the oil is ported from said small area pressure chamber.

3. A device for jettisoning a dud missile from a launching arm of a missile launcher, comprising an elongated tubular member having a large area pressure chamber and a small area pressure chamber therein, a small area piston head disposed within and sealing said small area pressure chamber, said small area piston head having a head quantity of oil disposed in advance thereof and within said small area pressure chamber and a quantity of oil disposed rearwardly thereof and within said large area pressure chamber, jettisoning means carried by the small area piston head and movable thereby slowly from an initial position to a missile engaging position and forcibly and quickly from said missile engaging position to a missile jettisoning position, a first hydraulic-pneumatic actuated device in fluid communication with said large area pressure chamber and operable by low fluid pressure for supplying additional oil to the oil in the large area pressure chamber to increase the pressure therein to slowly move the small area piston head an amount sufficiently to move said jettisoning means from said initial position to said missile engaging position, means connected to said first hydraulic-pneumatic actuated device for supplying said low fluid pressure thereto, a second hydraulic-pneumatic actuated device movable within and against said quantity of oil within said large area pressure chamber by high fluid pressure for pressurizing said oil to move the small area piston head forcibly and quickly an amount sufficient to move the jettisoning means from said missile engaging position to a missile jettisoning position, said second hydraulic-pneumatic actuated device including a hollow piston in sealing engagement with said tubular member and having a wall at one end thereof, a source of high fluid pressure connected to said large area pressure chamber for directing said high fluid pressure against said end wall, means connecting said source of high fluid pressure to the large area pressure chamber, means disposed between said large area chamber and the source of high fluid pressure for controlling the flow of the high fluid pressure into and out of the large area chamber, a third hydraulic-pneumatic device in communication with the small area pressure chamber and operable by low pneumatic fluid pressure for receiving oil from the small area pressure chamber as the small area piston head is moved to the jettisoning position and for returning the oil to the small area chamber to move the small area piston an amount sufficient to move the jettisoning means from the jettisoning position to said initial position, means connected to said third hydraulic-pneumatic device for supplying said low pneumatic fluid operating pressure thereto, and fluid flow control means disposed between and in communication with the third hydraulic-pneumatic device and the small area pressure chamber for controlling the flow of oil therebetween during the jettisoning and return cycles.

4. A device according to claim 3 wherein said first hydraulic-pneumatic device includes a casing having a piston operable in response to said low pneumatic fluid pressure, a pneumatic fluid connection on the casing at one side of said piston, a hydraulic fluid connection between the casing and the large area chamber and at the other side of the piston and valve means in said hydraulic fluid connection for controlling the flow of oil into and out of the large area pressure chamber according to the position of the hollow piston.

5. A device according to claim 3 wherein said third hydraulic-pneumatic device includes a casing having a piston operable in response to said low pneumatic fluid pressure, a pneumatic fluid connection on the casing at one side of the piston, a hydraulic connection between the casing and the small area pressure chamber and at the other side of the piston, said connection including a bypass and a restricted orifice in advance of the bypass for controlling the flow of oil into and out of the small area pressure chamber according to the position of the small area piston head.

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