

- 1 -

A SHELL RAMMING APPARATUS

FIELD OF THE INVENTION

The invention relates to a shell ramming apparatus and in particular although
5 not solely to a flick ramming apparatus for displacing projectiles such as ammunition
to be loaded into a gun for firing the same.

BACKGROUND AND PRIOR ART

In order to fire a projectile such as ammunition from a gun, it is necessary to
10 load the projectile to be fired into the barrel of the gun. For large caliber artillery
weapons of say, 105mm and above, this is normally done by manual loading of the
projectiles into the gun barrel by a human operator. However, such manual loading is
repetitive in nature and can be too slow for modern warfare. It may also potentially
cause physical injuries to the operator. Such a loading function should preferably be
15 mechanised to improve the rate of fire and efficiency. Therefore, various mechanisms
have been implemented to achieve automatic or semi-automatic loading of projectiles.

Figure 1 illustrates a mechanism as described in US 4956028 for loading
ammunition into the breech assembly of a gun wherein a double acting hydraulic ram
is used which acts directly onto the ammunition for delivery. Representation of a
20 similar arrangement has been illustrated in Figures 15 and 16. In such prior art, the
speed of delivery of the ammunition is dependent on the nature of the hydraulic ram
that is utilised. Factors such as the speed at which hydraulic fluid can be delivered to
and displaced from the appropriate portions of the cylinders limits the speed at which
the hydraulic piston can travel within the cylinder of the ram. For rapid operation,
25 complicated cylinder design may be needed in order to achieve good acceleration and
delivery speeds. With reference to Figures 12 and 13, it can be seen that this type of
mechanism will require a greater demand on acceleration of the hydraulic cylinder over
distance Y in order for the projectile to carry itself a free flight distance X. The
distance Y, over which the ramming block is in engagement for acceleration of the
30 shell is limited to the length of stroke provided by the hydraulic cylinder. Where
compact design is desired, the apparatus is normally no longer than the length of the
shell and hence in such prior art apparatus the length of stroke of the hydraulic cylinder
is slightly less than half the length of the shell. Should a longer length of stroke be
desired, then the overall length of the apparatus would be greater than the length of the
35 shell hence effecting its compact nature. Greater demand for acceleration to achieve a
certain final delivery velocity and where such acceleration is only able to be achieved

over a limited distance will place significant demands on the strength of the apparatus.

US Patent No. 5440966 discloses a mechanism which utilizes a pendulating arm to deliver material to a load station which cooperatively engages the arm. The mechanism is suited to transfer ammunition from a storage station into a gun barrel chamber and the ammunition is rammed into the gun barrel chamber using a flick ram mechanism. The mechanism operates in cooperation with an arm and enables a sure ram of ammunition to be achieved. The ramming mechanism utilises a continuous chain including two pawls. The actuation distance by the electro-hydraulic servo valve motor is equal to the distance the pawl remains in contact with the ammunition, i.e. the ramming distance. A further pawl is used to complete the ram in order to avoid the problem of the projectile not being successfully rammed or latched into the gun barrel.

Mechanised loading of a projectile into a gun barrel by use of a flick ram is different from full stroke ramming devices in that the former involves pushing the ammunition only part way to the gun barrel. The inertia of the projectile is then relied upon to complete the ram. Whilst the flick ram has an advantage of reducing the ramming cycle time, it may introduce other problems from the need to have greater acceleration and force required to ensure the projectile carries the full free flight distance. The possibility also exists that the projectile may not engage adequately into the gun barrel chamber. Inadequate engagement of the projectile into the barrel may cause the projectile to fall out of the barrel or to fire undesirably.

Figure 2 illustrates an alternative arrangement and one typified by US 4754688 wherein a lever arm is provided on which the hydraulic ram acts to provide a mechanical advantage and increase the acceleration of that portion of the arm with which the ammunition is engaged for its delivery into the breech assembly of a gun. In US 4754688 the hydraulic ram acts on the arm which is pivotable about point 9. The distance travelled by the end of the arm is greater than the distance travelled by the hydraulic ram. The devices of US 4957028 and US 4754688 may provide a full stroke delivery of the ammunition into the breech assembly or may provide a reduced stroke relying for full delivery on the inertia of the projectile thereby flicking the projectile into the breech assembly.

In US 3241447 there is described the use of a chain and sprocket arrangement wherein two sprockets are able to be displaced by a ram. The chain is fixed at one point and drives a catch which engages with a shell at another point. A first sprocket is provided to act on the chain to displace the catch for moving the shell forward and another sprocket is provided to return the catch to the original position. The arrangement is such as to provide a double displacement of the catch to the distance

5 moved by the ram. The arrangement does not lend itself to an advantage greater than twice the rams' displacement merely by adding a greater length of chain to then run around two further sprockets which say may be provided coaxial with and to move with the first two sprockets. A displacement of twice the rams displacement is still maintained.

10 Accordingly it is an object of the present invention to provide a shell ramming apparatus for displacing projectiles such as ammunition into a gun wherein the displacement of an actuator is multiplied to effect improved delivery of a shell yet maintaining compact design, or to at least provide the users of ammunition loading mechanisms, with a useful choice.

SUMMARY OF THE INVENTION

15 In a first aspect the present invention consists in a shell ramming apparatus for rapid linear displacement of a shell towards a gun for barrel loading said gun with said shell, said apparatus comprising:

- a base structure,

- an actuator having a portion fixed relative to the base structure and a movable portion movable relative to said portion fixed between a first point and a second point which are at an actuation distance D apart,

- 20 a ramming block to act on and displace a shell towards said gun, means to mount at least two pulleys to said movable portion of said actuator to be moved by said movable portion a distance D ,

- a movement transmission and multiplier arrangement comprising

- 25 a cable fixed at a first location relative to said base structure and fixed at a second location relative to said ramming block ,

- at least two pulleys mounted for rotation to said means to mount,

- at least one other pulley mounted for rotation about an axis fixed relative to said base structure ,

- 30 wherein said cable intermediate of said first and second locations is in operative engagement with said at least two pulleys and said at least one other pulley to, during displacement of said movable portion of said actuator which displaces said at least two pulleys a distance D , displace the cable at said second location a distance ("the ramming distance") corresponding to the multiplying effect provided by the movement transmission and multiplier arrangement, to thereby displace the ramming block from a retracted position

35 to a delivered position for displacement of said shell towards the gun for its

delivery into the barrel of the gun.

Preferably said ramming block is moveable relative to said base structure in a linear manner.

Preferably said ramming block is guided by rails fixed to said base structure.

5 Preferably said rails are linear rails and for use extend substantially parallel to the elongate axis of the barrel of said gun such that the ramming block is displaced in a direction parallel to the elongate axis of the barrel of said gun and thereby displace the shell linearly and coaxially with the barrel of the gun for loading the shell into the barrel of the gun.

10 Preferably said base structure includes a loading tray to provide at least vertical support to the shell, at least whilst the ramming block is in the retracted position.

Preferably the loading tray provides vertical support to the shell during movement of the ramming block from the retracted to the delivered positions.

15 Preferably said loading tray provides linear guidance to said shell during movement of the ramming block from the retracted position to the delivered position in a direction substantially parallel to the direction of the barrel of the gun for the shell said guidance limiting the movement of the shell within the loading tray in directions other than in the direction parallel to the barrel of the gun.

20 Preferably said means to mount provides an axis of rotation for each of said at least two pulleys wherein the axis of rotation of said at least two pulleys is transverse to the direction between said first point and said second point.

Preferably said axes of said at least two pulleys are coaxial.

Preferably said axes of said two pulleys are substantially parallel to each other.

25 Preferably said axes of said two pulleys are mounted to said moveable portion to be moved thereby in a collinear relationship when viewed in a direction of the axes.

Preferably the axes of said at least two pulleys are provided to said means to mount to move by said moveable portion of said actuator in a non collinear relationship but in a relationship which is linear and parallel to each other, when viewed in a direction of the axes.

30 Preferably said means to mount is in an axle onto which and coaxial to, the at least two pulleys are mounted.

35 Preferably said at least one other pulley is mounted for rotation about an axis fixed relative to said base structure, at a location more proximate to the retracted position of said ramming block than the at least two pulleys mounted for rotation with said means to mount.

Preferably said cable is in operative engagement with said at least two pulleys

and said at least one other pulley in at least a quadruple purchase configuration to act between said actuator and said ramming block.

Preferably said actuator is a hydraulic or pneumatic ram which moves said moveable portion rectilinearly to said portion fixed.

5 Preferably said hydraulic or pneumatic ram is double acting.

Preferably a means to return said ramming block from the delivered position to the retracted position is provided.

Preferably said means to return said ramming block consists of
a (second) movement transmission and multiplying arrangement comprising
10 a cable (whether said cable or another cable) fixed at a first location relative to said base structure and fixed at a second location relative to said ramming block,

at least two pulleys mounted for rotation with said means to mount of said actuator,

at least one other pulley mounted for rotation about an axis fixed relative to said
15 base structure,

wherein said second mentioned cable intermediate of said first and second locations is an operative engagement with said second mentioned at least two pulleys and said second mentioned at least one other pulley to, during displacement of said moveable portion of said actuator displacing said second mentioned at least two pulleys
20 a distance D, displace said second mentioned cable at its second location a distance corresponding to the multiplying effect provided by the second mentioned movement transmission and multiplying arrangement and to thereby move said ramming block corresponding to the movement of said second location.

Preferably said at least two pulleys of said second movement transmission and
25 multiplying arrangement are mounted coaxially with the at least two pulleys of the first mentioned movement transmission and multiplying arrangement.

Preferably said means to mount moves in a region between said at least one other pulley of said second movement transmission and multiplying arrangement and said at least one other pulley of said first mentioned movement transmission and
30 multiplying arrangement.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known
35 equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration of a prior art device is for example to provide by US 4957028,

5 Figure 2 is a prior art device as for example to provide by US 4754688,

Figure 3 is a perspective view of an alternative arrangement of the present invention wherein the ramming block is in a retracted position,

Figure 4 is an illustrative representation of the configuration of the two of the preferred four cables of the configuration of the invention as per figure 3,

10 Figure 5 is a perspective view of the configuration of the present invention as shown in Figure 3 but wherein the ramming block is in a delivered position,

Figure 6 is an end view of the configuration of the present invention as shown in Figure 3 wherein the loading tray and guide track for the ramming block are shown.

15 Figure 7 is a perspective view of a portion of the flick rammer of the present invention wherein the loading tray is also shown,

Figure 8 is a side view of the flick rammer of the present invention as for example shown in Figure 3,

20 Figure 9 is an illustration of another configuration of the ramming device of the present invention wherein illustrated is only the movement transmission and multiplier arrangement for moving the ramming block from the retracted position to the delivered position,

25 Figure 10 is an illustration of yet another configuration of the ramming device of the present invention wherein illustrated is only the movement transmission and multiplier arrangement for moving the ramming block from the retracted position to the delivered position,

Figure 11 is a perspective illustration of the ramming device of the present invention which includes a shell prior to being rammed into the barrel of a gun,

Figure 12 is a sectional view of a prior art apparatus similar in operation to US4957028 wherein the shell is in a pre-rammed condition,

30 Figure 13 is a sectional view of Figure 12 but wherein the ramming block has been displaced,

Figure 14 is a sectional view of the ramming device of the present invention prior to the shell being rammed, and

35 Figure 15 is a sectional view of Figure 14 but wherein the ramming block has advanced to the fully advanced condition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

The most preferred form of the shell ramming apparatus of the present invention is as for example shown in figure 10 and 6. The ramming apparatus consists of a base structure 1 which can be engaged to a gun structure in a manner to provide the shell ramming apparatus in a mode for use wherein a shell can be linearly displaced by the apparatus towards the barrel of a gun for loading the shell into the barrel. The apparatus as shown loads the shells into the barrel of the gun to in position, ready for firing. The linear displacement of the shell along for example the axis 2 shown in figure 7 is preferably coaxial with the axis of the general elongate nature of the barrel of the gun. The ramming apparatus is preferably fixed to the structure of the gun but alternatively may be moveable relative to the gun structure to move it to and away from a position to be operative for displacing shells towards the gun. For use when displacing a shell towards the gun, the ramming apparatus is preferably securely fixed at least relative to the barrel structure of the gun to ensure that the linear path travelled by the shell allows the shell to enter the barrel of the gun. The ramming apparatus is preferably of a kind which provides a ramming distance (which is the distance at which the ramming block is an operative engagement with the shell) which is shorter than the total distance travelled of the shell in reaching its loaded position within the gun. The shell ramming apparatus of the present invention may hence be classified as a flick ramming apparatus which is of a kind to accelerate and create a velocity of the shell which is sufficient to carry it from a pre-loaded position to a fully loaded position in the gun without a ramming force in the direction of displacement having to be maintained over the entire distance travelled by the shell.

With reference to figure 7, a shell may be placed for rapid linear displacement by the shell ramming apparatus of the present invention in a loading tray 3. The loading tray provides a guide to the shell as it is moved from a retracted position towards the barrel by the ramming apparatus. The tray 3 provides at least vertical support against gravity for the shell but preferably also provides support lateral to the direction of travel along the axis 2. The tray 3 as for example shown in figure 6 may in cross section have an operable mouth region to allow for a shell to be placed into the tray in a direction lateral to the axis 2 or may be such or may require for the shell to be loaded in an axial direction along the axis 2 from either end. The shell is linearly displaceable by the ramming apparatus of the present invention towards the barrel by engagement of a ramming block 4 to the trailing end of the shell positioned within the tray 3. The ramming block 4 engages the trailing end of the shell when in the retracted

position as for example shown in figure 6, and for linear displacement, the ramming block travels in a direction parallel to the axis 2 thereby delivering the shell towards the barrel. The movement of the shell by the ramming block is sufficient to achieve a "free flight" of the shell for its engagement within the barrel of a gun.

5 Associated with the base structure 1 is an actuator 5 as for example shown in figure 3. The actuator 5 consists of a portion 6 fixed relative to the base structure and a moveable portion 7. The actuator 5 is preferably a hydraulic or pneumatic ram and the fixed portion includes the cylinder whereas the moveable portion 7 is the extension arm moveable dependent on displacement of a piston within the cylinder. Most preferably
10 the actuator is double acting.

The moveable portion 7 provides a mounting for mounting at least two pulleys 8. These pulleys are provided on an axis of rotation 9 which is substantially transverse to the direction of rectilinear travel of the moveable portion 7 of the actuator 5.

Most preferably the rectilinear movement of the actuator is substantially parallel
15 to the axis 2 along which the shell is displaced for movement towards the barrel.

The moveable portion 7 of the actuator moves between a first and second point and when the movement is rectilinear, define the limits of linear travel of the moveable portion. In the most preferred form the pulleys carried by the moveable portion 7 are provided coaxially on the axis of rotation 9 however with reference to figure 9 and 10,
20 such coaxial relationship is not essential but is preferred. As shown in the representations the axes of rotation of all pulleys are substantially parallel to each other save for a slight offset which may be provided to ensure that the cable extending between pulleys does not foul on itself or other components of the device. As can be seen it is preferably the pulley fixed to the base structure that have such an offset. The
25 axes of the pulleys is substantially transverse (preferably at 90 degrees) to the direction of movement of the shell. The axes are in use preferably horizontal but the entire configuration may be placed on its side such that the axes are vertical.

Figures 9 and 10, show alternative arrangements of the present invention wherein a single direction displacement of the ramming block is provided by the arrangement.

30 However in the most preferred form the movement of the ramming block is controlled both ways between the retracted position and the delivered position and visa versa. With reference to figure 3 there is accordingly provided on the moveable member 7 at least two pulleys 8 for delivery and at least two pulleys 10 for retraction. A duplication of the pulley arrangement is preferably provided on each side of the
35 rectilinear axis of movement of the moveable member and accordingly at least two pulleys 8A and 10A are provided for delivery and retraction respectively. The

duplication which provides a pair of co-acting pulley and cable arrangements is substantially a mirror image about a plane vertically through the axis 2. The provision of co-acting pulleys is to reduce bending moments during the operation of the ramming apparatus of the present invention. It helps with the geometry and placement of pulleys to avoid any fouling.

At least one other pulley, and with reference to figure 3 preferably two other pulleys 11 are provided to be rotatable about axes of rotation fixed relative to the base structure. The pulleys 11 in conjunction with the pulleys 8 and 8A and in utilising a cable 12 spanning in operative arrangement with said pulleys, allow for a multiplying effect of the motion of the pulleys 8 and 8A to occur as a result of displacement of the moveable portion of the actuator to displace the ramming block 4. The cable 12 which is engaged in an operative condition with the pulleys 8, 8A and 11, 11A create a multiplying effect in the displacement of the ramming block 4 by the displacement of the moveable member 7. The cable 12 is preferably fixed to the base structure at a point 13 and is engaged to the ramming block at for example point 14. A schematic layout of the arrangement of the cable 12 is for example shown in figure 4. Fixed at point 13 to the base structure and at point 14 to the ramming block, the cable extends from point 13 about a first of said at least two pulleys 81, the first of the other pulley 111 fixed relative to the base structure back towards a second of the at least two pulleys 82 then to a second of another pulley 112 fixed to the base structure to the other point of the cable fixed at it second location to the ramming block 14. The cable 15 is provided in a substantially similar manner but for the purposes of moving the ramming block in the opposite direction to the direction that the cable 12 moves the ramming block. By use of a double acting actuator movement of the pulleys 8 (81 and 82) and pulleys 10 (101, 102) in both directions allows for the actuator to control movement of the ramming block 4 in both directions between the retracted (figure 6) and delivered (figure 8) positions. In the configuration where a quadruple purchase is provided by the cable and pulleys as shown in figure 3 and 5, the moveable portion 7 of the actuator travels a distance D causing the ramming block 4 to travel a distance 4D. This effect is provided by a doubling of the cable twice about at least one stationary pulley (preferably two but where one is optional and used to redirect the cable as shown in figure 6) and two moving pulleys where one point of the cable is fixed and the other is provided to displace the shell. Such points of the cable are preferably the distal ends but need not necessarily be so. With the addition of further pulleys multiplication in multiples of two of the distance D to effect motion of the ramming block 4 can be achieved. For example with the provision of three pulleys for both the delivery and

retraction directions on the moveable member 7 (i.e. six pulleys in total or twelve if mirrored about the vertical mirror axis) can create a multiplying effect of 6D for the ramming block. Coaxial addition of further pulleys on the axle of the movable member is the most preferred mode of expansion of the multiplying effect. In this way the width
5 of the device is increased and since the width of the pulleys is less than their diameter, space wise it is more efficient than an expansion which is upwards (as for example show in figure 10). Figure 9 shows another way of expansion. Alternative to using a cable and pulley arrangement, the present invention may alternatively use a chain/sprocket arrangement. However the use of a cable and pulley arrangement is the
10 most preferred.

During operation the ramming block 4 travels substantially linearly between the retracted and delivered position and is guided by rails 16 as for example shown in figure 6. The rails 16 which support bearings 18 of the ramming block guide the ramming block 4, for movement between the retracted and delivered positions.

15 The rails 16 are preferably parallel to each other and extend a length sufficient to allow for the ramming block 4 to move between the retracted and delivered positions.

In use a shell is loaded into the tray 3 and has its trailing end engaged against the ramming block 4 when the ramming block is in the retracted position as for
20 example shown in figure 3. A pressure pad 23 of the ramming block 4 locates against the trailing end of the shell to thereby apply a force to the shell to displace the shell towards the breech of the gun. For delivery the cable 12 as shown in bold in figure 3 (as well as its co-acting cable on the other side of the actuator 6) are operative for delivering the rammer 4 and hence the shell towards the gun. Extension of the
25 movable portion 7 as a result of an application of hydraulic pressure in the cylinder causes the pulleys 8, 8A to displace away from the pulleys 11, 11A. The cable 12 spanning between the pulleys, fixed at point 13 to the ramming structure and at point 14 to the ramming block 4, causes the ramming block to travel to its delivered position as for example shown in figure 5. The displacement of the ramming block 4 is
30 proportional to the displacement of the pulleys 8, 8A and in the configuration as shown in figure 3 and 5 is a quadruple displacement of the displacement of the pulleys 8, 8A. The shell is accelerated from rest in the retracted position to be accelerated by the rammer of the present invention such that although the stroke of the actuator is for example only 200mm, the resultant ramming stroke of the ramming block 4 is in fact
35 multiplied by 4 and increased to 800mm. The velocity and acceleration aspects of the movement are hence also proportional to the multiplying factor.

Preferably, a maximum velocity of 8 metres per second is attained before the shell is allowed to continue the remaining free flight distance. In this case, the free flight distance is about 1300mm into the barrel (shown in figure 15). By the provision of a longer ramming distance which can be achieved in light of the multiplying arrangement allowing a shorter stroke length for the actuator, the acceleration of the shell is reduced to 5G. With a shorter stroke length the rigidity of the ram is not compromised and most of the components of the ramming apparatus of the present invention are subjected to lower acceleration forces than those that are ultimately applied by the present invention to the shell. The velocity of the hydraulic cylinder is also significantly able to be reduced and importantly allows for a hydraulic cylinder accordingly to normal industrial standards to be utilised and to meet the requirements of the system. Hydraulic cylinders able to exert a force required to achieve the velocity of the shell are readily available and since the distance required to travel by the hydraulic cylinder to achieve such velocity is reduced, no special modifications are required to be made to the hydraulic cylinder.

To further explain this and with reference to figures 6 and 8, the total distance $4D$ between the retracted and delivered position over which the force applied to the shell acts on the shell, is longer than the distance D travelled by the actuator. The acceleration is also less than what would need to be applied to the shell if the distance between the retracted and delivered position was shorter in order to achieve the same final velocity. Such decrease in acceleration (thereby still meeting the same final velocity as applied by the ramming block 4 to the shell) reduces the forces at the ramming block and on the cable attached to the ramming block. Thus, the ability to avoid heavy reinforcement to the whole structure leads to weight saving. The overall length of the apparatus is also not needed to be significantly longer than the shell, hence providing compact design.



CLAIMS

1. A shell ramming apparatus for rapid linear displacement of a shell towards a barrel for loading said gun with said shell, said apparatus comprising:

a base structure,

5 an actuator having a portion fixed relative to the base structure and a movable portion movable relative to said portion fixed between a first point and a second point which are at an actuation distance D apart,

a ramming block to act on and displace a shell towards said gun,

means to mount at least two pulleys to said movable portion of said actuator
10 to be moved by said movable portion a distance D,

a movement transmission and multiplier arrangement comprising

a cable fixed at a first location relative to said base structure and fixed
at a second location relative to said ramming block ,

at least two pulleys mounted for rotation to said means to mount,

15 at least one other pulley mounted for rotation about an axis fixed
relative to said base structure ,

wherein said cable intermediate of said first and second locations is in
operative engagement with said at least two pulleys and said at least one other
pulley to, during displacement of said movable portion of said actuator which
20 displaces said at least two pulleys a distance D, displace the cable at said
second location a distance ("the ramming distance") corresponding to the
multiplying effect provided by the movement transmission and multiplier
arrangement, to thereby displace the ramming block from a retracted position
to a delivered position for displacement of said shell towards the barrel for its
25 delivery into the barrel of the gun.

2. A shell ramming apparatus as claimed in claim 1 wherein said ramming block
is moveable relative to said base structure in a linear manner.

3. A shell ramming apparatus as claimed in claims 1 or 2 wherein said ramming
block is guided by rails fixed to said base structure.

30 4. A shell ramming apparatus as claimed in claim 3 wherein said rails are linear
rails and for use extend substantially parallel to the elongate axis of the barrel of said
gun such that the ramming block is displaced in a direction parallel to the elongate axis
of the barrel of said gun and thereby displace the shell linearly and coaxially with the
barrel of the gun for loading the shell into the barrel of the gun.

35 5. A shell ramming apparatus as claimed in any one of claims 1 to 4 wherein said
base structure includes a loading tray to provide at least vertical support to the shell, at



least whilst the ramming block is in the retracted position.

6. A shell ramming apparatus as claimed in claim 5 wherein the loading tray provides vertical support to the shell during movement of the ramming block from the retracted to the delivered positions.

5 7. A shell ramming apparatus as claimed in claims 5 or 6 wherein said loading tray provides linear guidance to said shell during movement of the ramming block from the retracted position to the delivered position in a direction substantially parallel to the direction of the barrel of the gun for the shell said guidance limiting the movement of the shell within the loading tray in directions other than in the direction parallel to the
10 barrel of the gun.

8. A shell ramming apparatus as claimed in any one of claim 1 to 7 wherein said means to mount provides an axis of rotation for each of said at least two pulleys wherein the axis of rotation of said at least two pulleys is transverse to the direction between said first point and said second point.

15 9. A shell ramming apparatus as claimed in claim 8 wherein said axes of said at least two pulleys are coaxial.

10. A shell ramming apparatus as claimed in claim 8 wherein said axes of said two pulleys are substantially parallel to each other.

11. A shell ramming apparatus as claimed in claim 10 wherein said axes of said two
20 pulleys are mounted to said moveable portion to be moved thereby in a collinear relationship when viewed in a direction of the axes.

12. A shell ramming apparatus as claimed in claim 10 wherein the axes of said at least two pulleys are provided to said means to mount to move by said moveable portion of said actuator in a non collinear relationship but in a relationship which is
25 linear and parallel to each other, when viewed in a direction of the axes.

13. A shell ramming apparatus as claimed in any one of claims 1 to 12 wherein said means to mount is in an axle onto which and coaxial to, the at least two pulleys are mounted.

14. A shell ramming apparatus as claimed in any one of claims 1 to 13 wherein said
30 at least one other pulley is mounted for rotation about an axis fixed relative to said base structure, at a location more proximate to the retracted position of said ramming block than the at least two pulleys mounted for rotation with said means to mount.

15. A shell ramming apparatus as claimed in any one of claims 1 to 14 wherein said cable is in operative engagement with said at least two pulleys and said at least one
35 other pulley in at least a quadruple purchase configuration to act between said actuator and said ramming block.



16. A shell ramming apparatus as claimed in any one of claims 1 to 15 wherein said actuator is a hydraulic or pneumatic ram which moves said moveable portion rectilinearly to said portion fixed.

17. A shell ramming apparatus as claimed in claim 16 wherein said hydraulic or pneumatic ram is double acting.

18. A shell ramming apparatus as claimed in any one of claims 1 to 17 wherein a means to return said ramming block from the delivered position to the retracted position is provided.

19. A shell ramming apparatus as claimed in claim 18 wherein said means to return said ramming block consists of

a (second) movement transmission and multiplying arrangement comprising a cable (whether said cable or another cable) fixed at a first location relative to said base structure and fixed at a second location relative to said ramming block,

at least two pulleys mounted for rotation with said means to mount of said actuator,

at least one other pulley mounted for rotation about an axis fixed relative to said base structure,

wherein said second mentioned cable intermediate of said first and second locations is an operative engagement with said second mentioned at least two pulleys and said second mentioned at least one other pulley to, during displacement of said moveable portion of said actuator displacing said second mentioned at least two pulleys a distance D, displace said second mentioned cable at its second location a distance corresponding to the multiplying effect provided by the second mentioned movement transmission and multiplying arrangement and to thereby move said ramming block corresponding to the movement of said second location.

20. A shell ramming apparatus as claimed in claim 19 wherein said at least two pulleys of said second movement transmission and multiplying arrangement are mounted coaxially with the at least two pulleys of the first mentioned movement transmission and multiplying arrangement.

21. A shell ramming apparatus as claimed in claims 19 or 20 wherein means to mount moves in a region between said at least one other pulley of said second movement transmission and multiplying arrangement and said at least one other pulley of said first mentioned movement transmission and multiplying arrangement.