

PATENT SPECIFICATION

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(54) A FIREARM FOR TANK

- (71) We, AKTIEBOLAGET BOFORS, a joint-stock company organised according to the laws of Sweden, of S-690 20 Bofors, Sweden, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 5 The present invention relates to a device for a firearm which has a barrel supported in a recoil jacket and which is provided with loading members for the firearm arranged to convey rounds to the firearm from a magazine which is separate from the firearm via the under side of the recoil jacket.
- 10 The primary purpose of the invention is, for a weapon arranged on a tank, to provide protection for vital parts of the firearm during the major portion of the time the tank is in use. Through the invention, it will be possible to achieve a very high protective effect at the firearm, which need be neglected only during a very short period of time at the moment when the actual ramming takes place.
- 15 An embodiment proposed at present of a device which has the characteristics significant for the invention will be described in the following, with reference to the accompanying drawings, in which
- 20 Figure 1 in a side view and partly in cross-section shows a tank utilizing the device, Figure 2 in a horizontal view shows the tank according to Figure 1,
- 25 Figure 3a shows an enlarged view of the parts comprised in Figures 1—2, Figures 3b—3c in various views show the parts comprised in Figure 3a,
- 30 Figure 4 in perspective shows the parts of the tank comprised in Figures 3a—3b, Figure 5 in perspective from below shows an embodiment which differs from the embodiment according to Figure 6 of sealing covers arranged at the recoil jacket and the barrel, and
- 35 Figure 6 in a side view shows the principle of a hinge which can be used for a cover. Figures 1 and 2 are intended to illustrate a tank provided with a small turret 1, a so-called miniturret, which is rotatably arranged in a frame 3 arranged in a tank chassis 2 via a ball bearing 4 applied on the outside of the part 1a of the turret which extends downwards. The miniturret has been given little extent vertically, and is made with upper parts which are to a slight extent above the other parts of the top of the tank, so that it essentially adapts itself to the latter, and with parts which likewise have a limited extent downwards. Under the turret, inside the tank, a seat is arranged as well as a foot plate for a crew member. The seat and plate are connected to the turret via a fastening member from below so that they follow its movements in traverse in relation to the tank. On the top of the turret a cradle carrier is fastened comprising side parts 5 for trunnions 7 for a large-calibre (e.g. 105 mm) firearm 6. The extent vertically of the turret corresponds substantially to one-half the height of the side parts which, together with their position on the turret in question involves that the firearm will have a marked high position on the tank. The firearm thereby obtains comparatively large angles of depression and elevation. The elevation and depression of the weapon are performed by means of an elevation rod which extends down into the tank where it can be actuated with a motor via a gear device. The side parts are provided with recesses in order to provide for the application of side viewing apertures on the turret. Furthermore, farthest to the rear, the tank is provided with a so-called externally suspended magazine 8 for ammunition carried in the tank in the form of a number of rounds which can be fed out via one or two feed-out positions on the magazine, depending on the internal embodiment and disposition of this. The magazine is rotatably suspended in the tank so that when driving on uneven ground it can be swung out of the way, upwards. In its normal position when firing with the tank, the upper side of the magazine is essentially in the same plane as the upper side of the tank at the rear parts, which involves that the magazine at the transfer of
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rounds is placed comparatively far below the ramming position at the rear parts of the firearm. The front plane of the magazine is moreover somewhat to the rear of the rear plane of the rear parts of the firearm.

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In the space located in front of the magazine and between the lower parts of the firearm and the upper parts of the top of the tank (in Figure 1) there is a loading pendulum 9 which is described and claimed in our co-pending Application No. 37708/76, (Serial No. 1,563,397). The pendulum 9 comprises sections 9a and an arm 9b which can coact with a round and which supports a fork-shaped front part. The pendulum is rotatably arranged around a turning centre 9c which it has at one end of the arm, which turning centre is located below and at the side of the trunnions 7 of the firearm and the original position of the loading pendulum. By means of its turning centre, the loading pendulum is also rotatably arranged in relation to the tank chassis and the firearm (the turret) around a traversing axis which coincides with the traversing axis 10 of the firearm. In this way, the loading pendulum, independent of the elevation and vertical position of the firearm can be set in a magazine position (see Figure 1) where rounds can be fed into the pendulum, after which the pendulum can be swung in the traversing direction to the position in traverse which the firearm has, where the actual movement of the pendulum, i.e. the ramming movement, takes place.

Figures 3a—3c and 4 are intended to show the function and design of the loading pendulum and turret in more detail. The sections 9a of the loading pendulum which can coact with the round consist of an armour tube which has a longitudinal upper through slot 9d which provides for coaction with the rammer unit in the ramming position. At its front part, the loading pendulum is made with an extended bottom part 9e which is directed towards the turning centre 9c for the pendulum. The pendulum supports the round with the front parts of the round resting against said extended bottom part. The arm 9b is supported in one end on a journal which extends at right angles to the arm and which is supported in bearing brackets 11. In its other end, the arm is fastened via its fork-shaped section, the prongs of which extend on either side of the armour tube to the central parts of the armour tube, and this fastening is also made rotatable by means of fastening journals which extend out from the armour tube. At the fastening journals, helical springs 12, 13 are arranged on either side of the tube, which helical springs are arranged to keep the armour tube essentially parallel to the barrel even after it has been turned up from the magazine position. This fixing of the

position by means of the helical springs is intended to prevent such an oblique position of the armour tube at the turning movement in the traversing plane that the rear or front parts of the armour tube would hit the top of the tank and/or the underside of the barrel. On either side of the armour tube, the helical springs are fastened to the armour tube and the prongs 9b of the arm in such a way that one spring strives to turn the tube clockwise and the other spring strives to turn the tube counter-clockwise. The rotatable fastening of the arm is necessary due to the fact that the pendulum and the firearm have different elevation bearings, and that the armour tube must be capable of adapting itself to the different elevation positions of the barrel.

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The bearing brackets 11 of the pendulum are fastened to a ring 14 which via ball bearings 15 is rotatably fastened in relation to the turret 1, and particularly via a further ball bearing in relation to the fixed frame 3 of the tank chassis. The frame 3 has a box-shaped cross-section with a special design which permits the application of ring, turret, ball bearing and frame favourably from the point of view of protection and functioning in relation to each other. The turret is made with an overlapping flange at the ring which in the corresponding way is provided with an overlapping flange at the frame so that contaminations are prevented from entering between the parts in question. The turret, ring and frame moreover have positions at such levels in relation to each other that e.g. water will have a certain path to run off along the different parts.

The swinging movements of the loading pendulum are thus achieved by means of the turning of the ring around its centre line which coincides with the axis 10. The ring 14 is made with an outer gear arc 14a, not shown in detail, via which the ring can be driven by means of a hydraulic or an electric motor, the shaft part of which is designated 16, while the driving teeth of the shaft are designated 17. The shaft part 16 and the gear 17 are arranged at recesses in the box-shaped frame 3. The turret 1 also has an external gear arc 1b at its part 1a which extends down into the tank.

The armour tube 9a, in the magazine position of the loading pendulum, i.e. the position according to Figure 1 is intended to be extending down into a special shaft 18 made in the tank chassis together with a part of the arm 9b. The shaft is made with sealing covers which can be opened and closed, which when the pendulum is raised from the magazine position open upwards and when the pendulum goes down into the shaft can be closed again, so that effective sealing against contaminations is obtained.

When the loading pendulum swings

around the axis 10, it is supported on a fixed and essentially circular slide track 20. In order to permit the armour tube to go down into the shaft, however, the arm 9b will need to cross the slide track. The slide track is therefore made with a small part 20a which can be lowered to a level below the other part of the slide track. Said part 20a is located in front of and above the front parts of the shaft. The raising and lowering of the slide track 20a between the positions where the armour tube is lowered into the shaft and where the armour tube is swung up from the shaft is carried out by means of a control device 21 in the form of a lifting cylinder or the like. The loading pendulum coacts with the slide track via a wheel 22 or a corresponding part which is arranged in the arm with its supporting axis coinciding with or parallel to the longitudinal direction of the arm. When the pendulum is swung along the slide track 20, it is assumed to clear the upper parts of the tank and the lower parts of the firearm. In the case shown, a straight slide track has been foreseen. However, it is, of course, conceivable to give the slide track different height levels along different parts of its extent so that the pendulum can be considered to swing in a wavy lateral plane. The wheel is located on the arm at the inner half of this, e.g. at a distance from the turning centre 9c which is essentially equal to one third of the length of the arm.

35 In the raised position, where the loading pendulum can coact with the entire slide track, in accordance with the design shown the loading pendulum is adjustable via the gear 17 to a traversing position which coincides with the traversing position which the firearm has. In said coinciding traverse positions, the pendulum can be swung up from the position coacting with the slide track to the ramming position at the firearm. This swinging up in the point 9c is carried out by means of a pulling part 23 supported in the turret in the form of a hook fastened in one end of a straight gear rack 24. In said coinciding traverse position, the hook can coact with a member 25 fixed to the pendulum arm which in the coinciding traverse positions will be exactly opposite the hook 23. The movement of the gear rack is achieved with a motor via its driving shaft 26.

55 In the case shown, the recoil jacket 27 of the firearm is provided with lower covers 28, and covers 29 are fastened to the breech ring. Said covers 28 and 29 are intended to seal against foreign objects when firing is not taking place, and at the same time with their insides to constitute surfaces for empty cartridge cases when these are ejected, which takes place via a cover 30 arranged at the rear section of the recoil jacket which is

pushed up by the cartridge cases from the inside and falls down of its own weight. As will be noted from Figure 3a, the covers 28 and 29 can be swung up by means of the loading pendulum when this enters from below in relation to the recoil jacket and the breech ring. The covers 28 and 29 are arranged at different levels, so that they cannot be pushed over each other at the recoil.

Because of the different supporting points for the elevation movements for the firearm and the pendulum, a space which exceeds the length of the armour tube will be necessary at the ramming position inside the recoil jacket. The ramming movement will also be comparatively long, and therefore, in the present case, so-called two-stage ramming has been chosen, and in the first stage a first ramming arm 31 first moves the round a predetermined distance and thereafter a second ramming arm 32 moves the round the rest of the way so that the round will be inserted in the chamber. The two-stage rammer used is made in such a way that it permits smooth ramming. By ramming position is meant the position the round has before the ramming arms 31, 32 enter into coaction with the round. The recoil buffers have the designation 33.

The magazine 8 is also made with a rammer 34 which, as in the case described above, shows a two-stage rammer that can be made in a way which is known in itself. The rammer 34 moves the round out of the magazine and into the armour tube.

The magazine can be made with one or two feed-out positions for rounds. When there is one feed-out position, the position of the armour tube in the shaft will be one and the same. In the case of two feed-out positions arranged close to each other, the shaft is made comparatively wider, so that the armour tube can perform a small lateral movement in the shaft between two different angular positions, where the loading pendulum in one of the angular positions is opposite one of the feed-out positions and in the other angular position is opposite the other feed-out position.

The magazine can be made in two different part units which have different kinds of ammunition. On the basis of the design of the magazine and the disposition within the magazine, one or two feed-out positions may be chosen.

Briefly, the equipment described above functions in the following way. The loading pendulum is set in the magazine position according to Figure 3a so that a round can be fed into it or has been fed into the armour tube from the magazine by means of the rammer 34. Thereafter the pendulum is turned up out of the shaft in connection with the covers being opened, particularly

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by means of the armour tube. It is also possible to have the covers open while firing is being carried out. The turning up takes place by means of the hydraulic cylinder 21. Thereafter the ring 14 is turned via the gear 17 so that the loading pendulum assumes the traverse position of the firearm. Thereafter the pendulum is turned up further by means of the gear rack 26 to the position shown in Figure 3a where the round is moved out of the loading pendulum by the rammer, and in the reverse order in relation to the one described above can it return to the magazine to fetch a new round.

In accordance with what is stated above, the driving can take place by means of hydraulic or electric motors, and in the case of the electric motors can be driven by the spare batteries in the tank, so that they will not be dependent on whether or not the engine of the tank is running. When a gun which has been deflected more than 45° from the direction in which the tank is being driven is loaded, the loading pendulum will swing outside the tank, but not more than approx. 0.5 m outside the side of the tank.

The loading procedure described will be fully automatic, and can be carried out very rapidly. For guidance of the loading pendulum in the traverse direction, mechanical blocking devices should appropriately be used which are activated when the angles of traverse of the pendulum and the firearm coincide, but which are deactivated when the pendulum is to return to fetch a new round. The guidance is also carried out in such a way that the pendulum takes the shortest way in traverse, which involves that the blocking devices must be made so that they can function for both directions of swinging. Examples of such blocking devices are designated 35a and 35b. The blocking devices can be made in many alternative ways, and in the turret they consist of plungers which can be activated which coact with holes in the ring 14. In the case shown, both the turret and the tank chassis are provided with movable plungers (35a and 35b) which coact with holes in the ring. The plungers are controlled by electromagnets or hydraulic cylinders in order to achieve the disactivation function. The disactivation can, for instance, also be carried out by means of the member 25 which in the ramming position is entirely retracted by the hook 24, and the member in the entirely retracted position is arranged to actuate the plungers for disactivation. It is also conceivable to use a gripping fork which in the traversing position in question engages the member 25 and which is moved aside by the member in its entirely retracted position.

The traversing of the turret and the

firearm is achieved by means of a driving motor 36. When swinging in to the ramming position, the rear/upper parts of the armour tube will first hit the top at the recoil jacket, and will then finally be adapted to the present angle of elevation of the firearm. In the corresponding way, the rear/lower section of the armour tube will hit the bottom of the shaft, after which it will adapt itself to the latter.

Said gear rack 24 is guided in a recess in the turret which is made with a protruding overhead guard 37 which protects the hook and the gear rack from above against foreign objects. A unit with a seat and foot plate for a crew member is also connected to the turret, which follows the movements of the turret in traverse as explained in our co-pending Application No. 37707/76 (Serial No. 1,565,069). Elevation of the firearm takes place by means of the rod 38 (Figure 1) which extends into the tank in a way which is known in itself.

The covers according to the present invention are particularly shown in Figure 3c and Figure 5, which show two different embodiments of the design of the firearm and the way in which the covers are fastened.

In principle, the covers consist of two first covers 28 comprised in a first pair of covers which are supported on the recoil jacket and two second covers comprised in a second pair of covers 29 which are supported on the breech ring of the firearm. In the embodiment according to Figure 3c the first covers 28 are supported on the inside of an obliquely mounted plate 39 which supports an outer surface of the recoil jacket at the lower part of this, the covers in question then being supported at the upper parts of said plate. The second covers 29 are fastened in brackets 40 in the breech ring.

The actual supporting of the covers takes place by means of hinges 28a and 29a. In its sealing position, the first cover can coact with a mechanical stop 41 which fixes the sealing position of the cover. In Figure 3c the turned down position (=the sealing position) of the cover is shown with dash lines designated 28' for one of the first covers, and it will then be noted that the stop coacts with the outside of the cover near its support 26a.

The respective second cover is made with a special hinge 29a, the principle of which will be noted from Figure 6. One of the parts of the hinge is designated 42 in said figure, while the other part has the designation 43. In the turned-up position of the cover, the parts of the hinge are at an angle in relation to each other as shown by the solid lines in Figure 6, while in the turned-down position of the cover which is shown with dash lines

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and designated 43' two surfaces 42a and 43a of the hinge parts come into contact with each other for achieving a fixing of the position. In Figure 3c the sealing position for one of the second covers is shown with dash lines and indicated 29'.

Covers 28 and 29, respectively, assume their sealing positions through their own weight. The cover can be opened by means of the loading pendulum, which in Figure 3c is represented by its arm 9b and its round-carrying part 9a. In Figure 3c also a rammer is designated 44. When the covers are entirely opened, they are in an oblique position (see Figure 3c) so that the covers can fall back of their own weight when the loading pendulum returns after the round has been moved out of it by means of the rammer 44.

Figure 5 shows an embodiment according to which the first covers 28 are supported in brackets on the inside of the recoil jacket, while the covers 29 are fastened to the breech ring 6a of the barrel, which corresponds to the case described above. In this figure, the covers are shown in their sealing position (closed position) and it will be noted that the inner covers 29 are located at a higher level than the covers 28, so that when the barrel recoils in the jacket the first-mentioned covers can slide over the last-mentioned covers. In accordance therewith, the insides of the covers also constitute a track for empty cartridge cases which are ejected from the firearm when firing via the cover 30 which is supported at its upper parts in the hinge 30a. Said covers are made of comparatively heavy steel plate or armour plate.

40 WHAT WE CLAIM IS:—

1. A firearm which has a barrel supported in a recoil jacket, for a tank provided with loading members for the firearm to convey rounds to the firearm from a magazine which is separate from the firearm, the rounds being conveyed to the firearm via the under side of the recoil jacket, wherein the underside of the recoil jacket has covers which can be opened and closed, at least one first cover being supported by the recoil jacket and at least one second cover being

supported by a breech ring of the barrel and the first and second covers being located at different levels so that when the firearm recoils in the recoil jacket the covers will move one over the other without hindrance. 55

2. A firearm according to Claim 1, comprising a pair of first covers and pair of second covers, the covers in the respective pairs being supported on opposite longitudinal sides of the respective recoil jacket and breech ring. 60

3. A firearm according to Claims 1 or 2, wherein the first cover(s) is/are supported in brackets fastened to the inside of the recoil jacket. 65

4. A firearm as claimed in Claim 3 wherein the first cover(s) is/are supported in brackets fastened to an upright wall defining a longitudinal gap in a lower surface of the recoil jacket. 70

5. A firearm according to Claim 3 or Claim 4 wherein at least the first cover(s) coacts with a mechanical stop in its closed position. 75

6. A device according to any one of Claims 1 to 4 wherein each second cover is supported on a hinge with a built-in stop.

7. A tank comprising a firearm according to any one of the foregoing claims, the tank having a loading member comprising a loading pendulum carried on the outside of the tank chassis, and wherein each cover can be turned up to the open position by said loading pendulum and turned down to the closed position by its own weight. 80

8. A firearm substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings. 85

9. A tank substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings. 90

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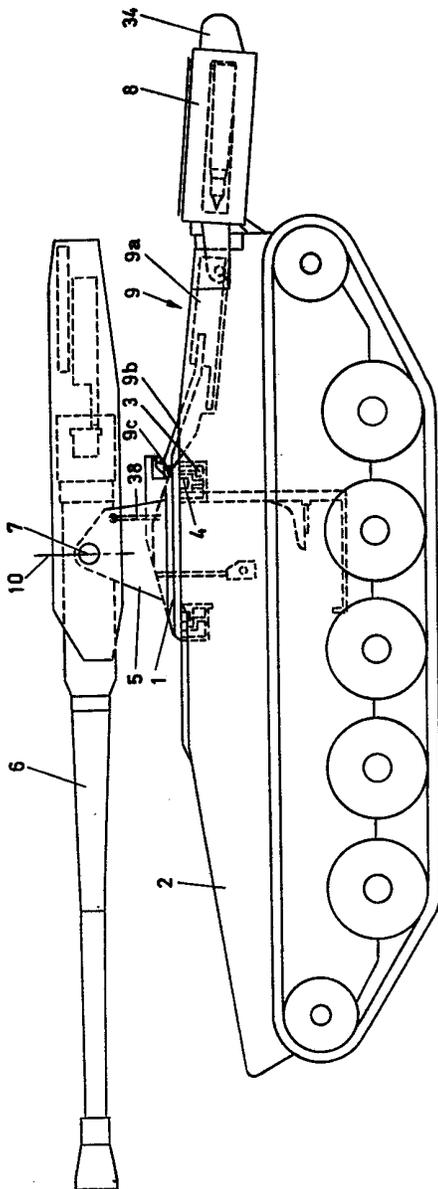


Fig. 1

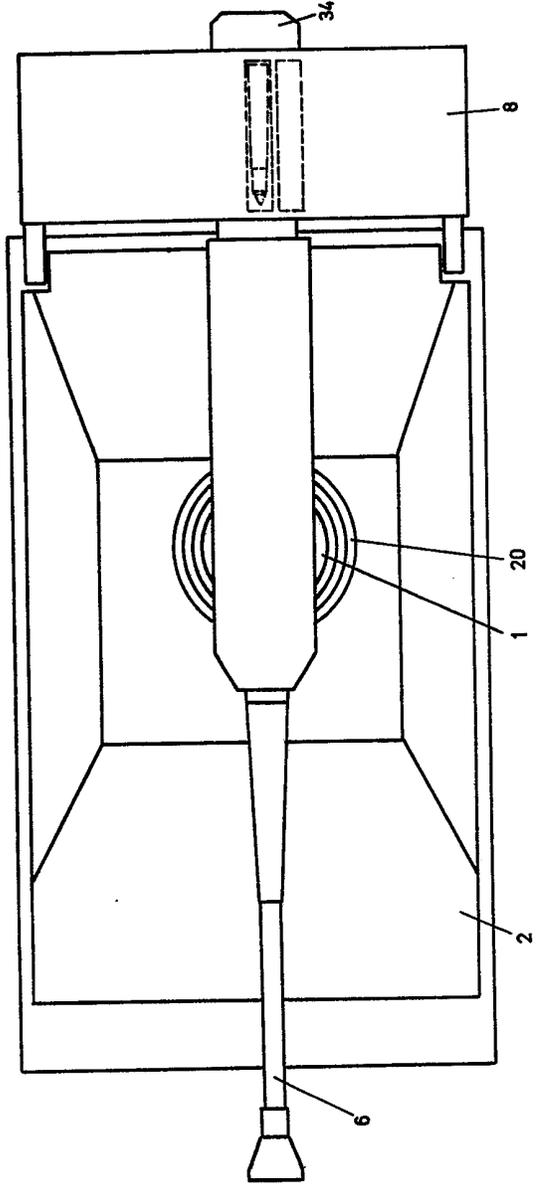


Fig. 2

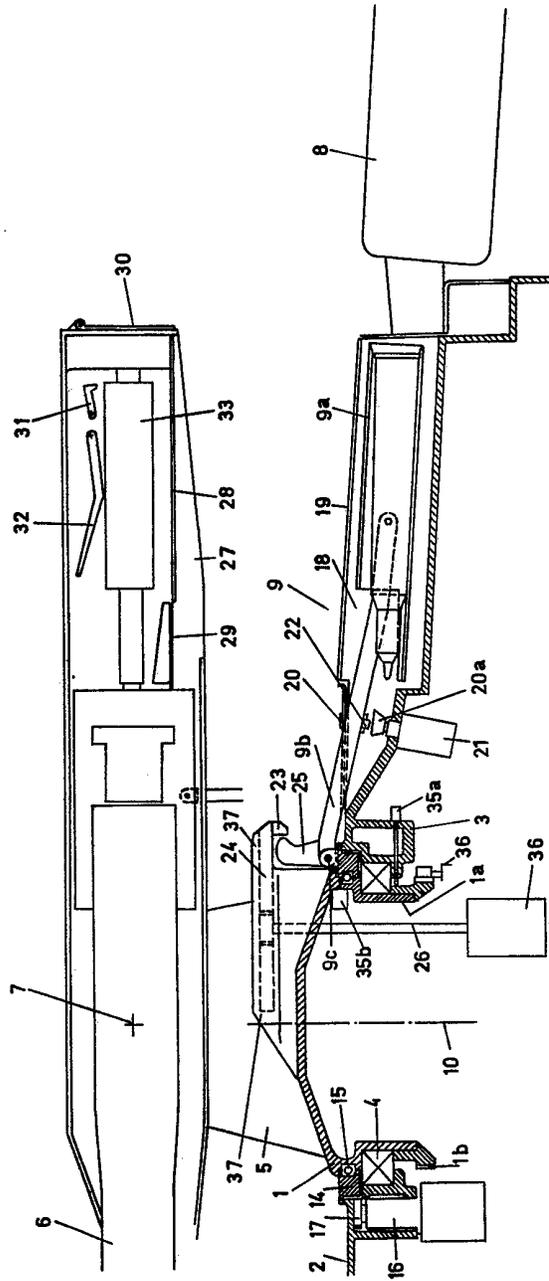


Fig. 3 a

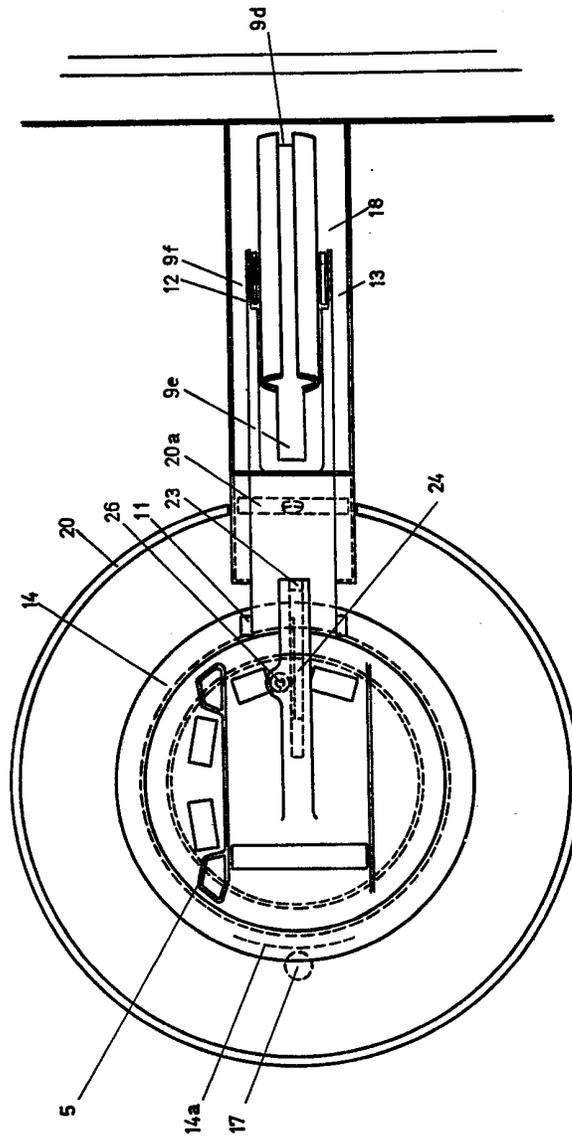


Fig. 3b

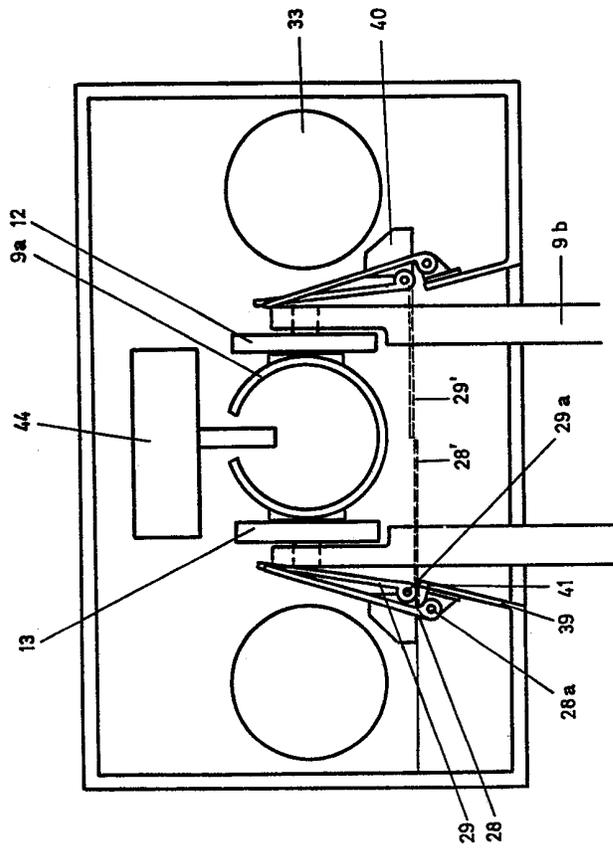


Fig. 3 c

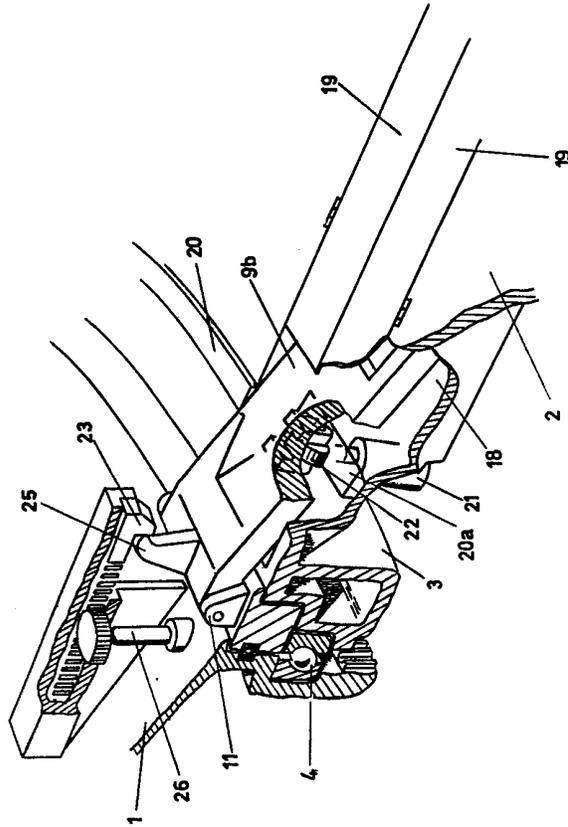


Fig.4

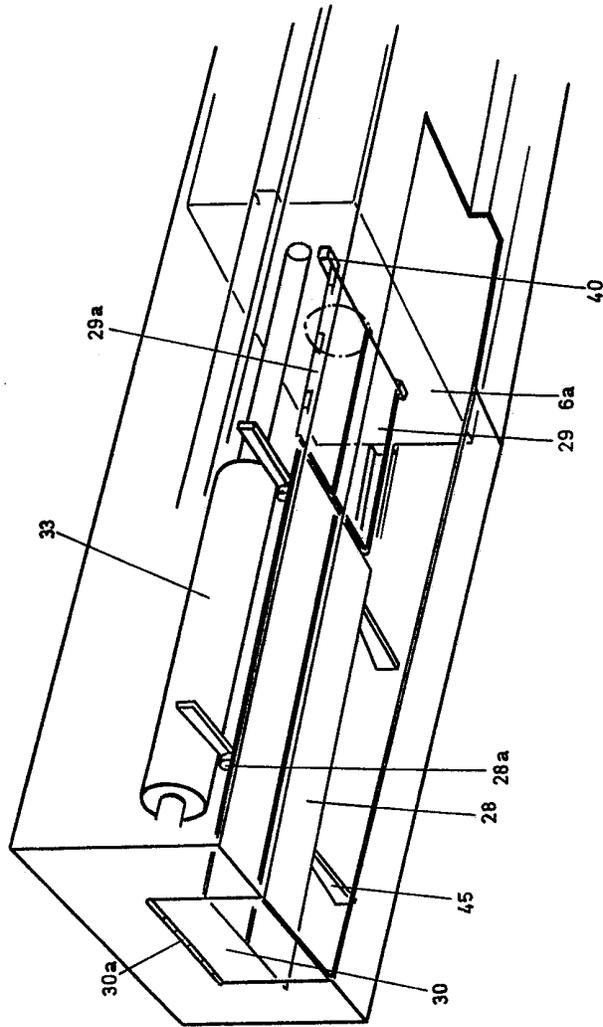


Fig. 5

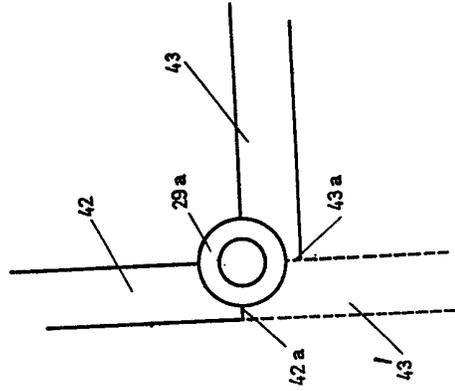


Fig. 6