Oct. 1, 1957 R. G. VICKERS 2,807,987

DIRECTIONAL MOUNTING FOR A GUN

Filed July 16, 1954 3 Sheets-Sheet 1

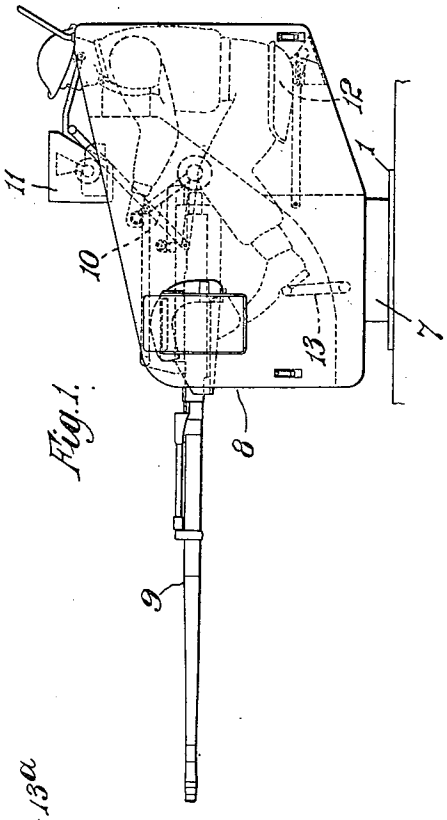

Fig. 1.

Fig. 2.

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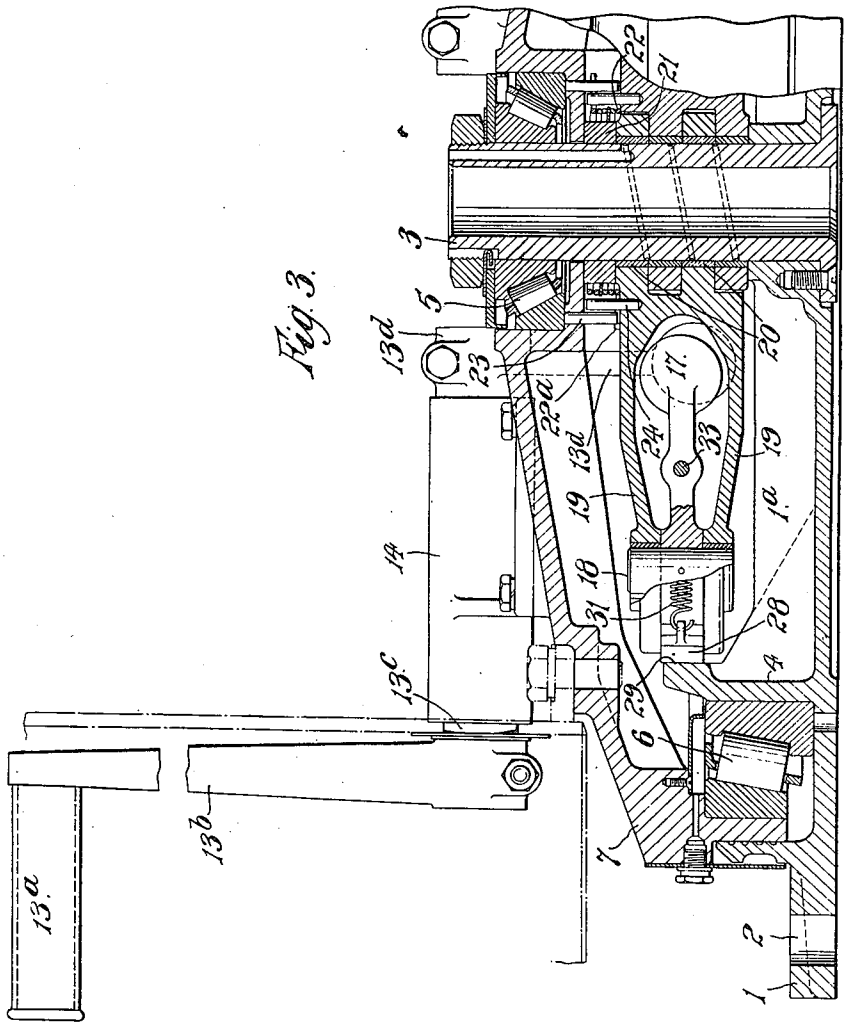
Fig. 3.



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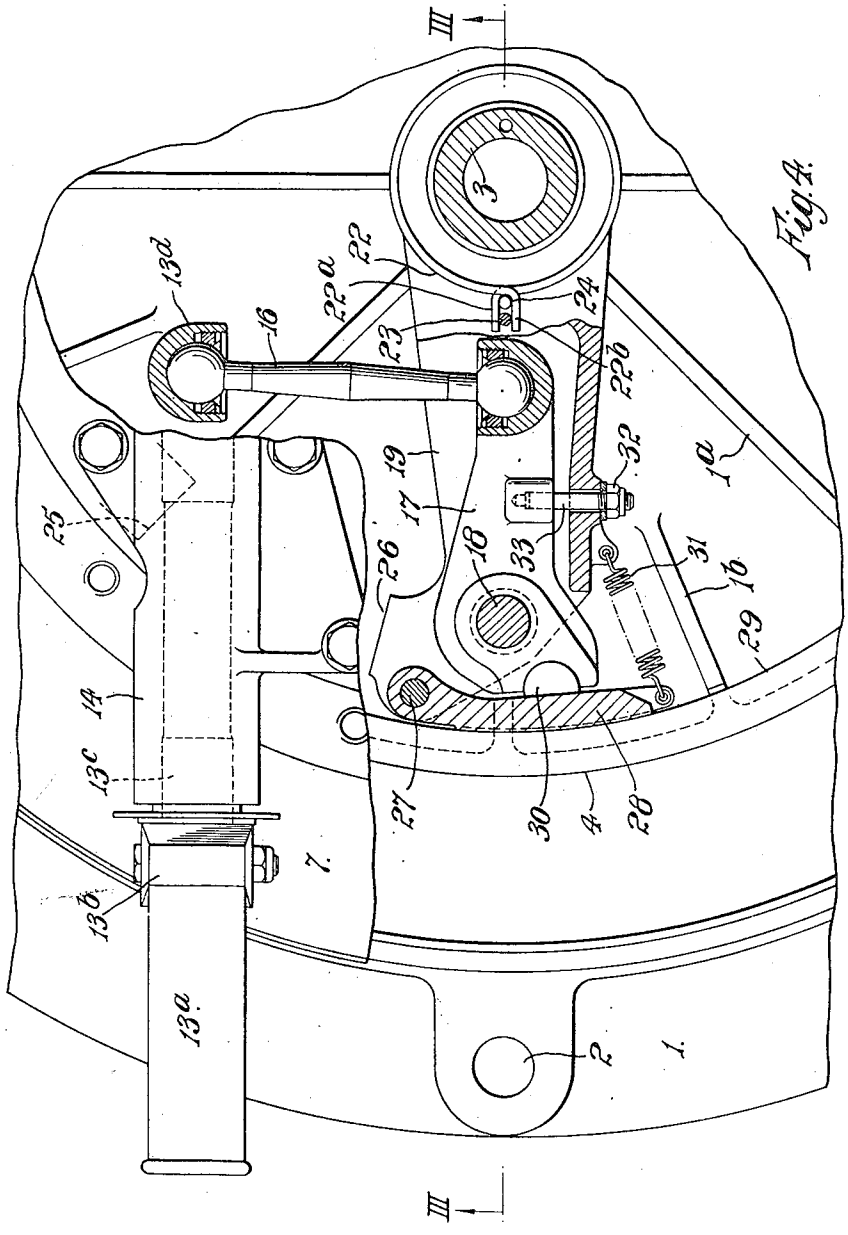

Fig. 4.

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United States Patent Office 2,807,987 Patented Oct. 1, 1957

2,807,987

DIRECTIONAL MOUNTING FOR A GUN

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Application July 16, 1954, Serial No. 443,861

Claims priority, application Great Britain July 22, 1953

6 Claims. (Cl. 89—41)

This invention relates to mountings for apparatus to be directed or aimed by an operator on the mounting and it will be described as applied to a gun mounting. The invention can however be applied to other directional mountings such as for searchlights, radar apparatus or television or other cameras.

The object of the invention is to provide improved means to enable an operator seated on a mounting to train the mounting, that is to turn the mounting about a normally vertical central axis, by the power and control of his feet on a pair of pedal levers.

Pedal lever training mechanism for gun mountings already known comprises, fixed on the base of the mounting, a horizontal circular rack coaxial with a turntable or equivalent part of a training structure which carries a pinion meshing with the rack and driven, through transmission gearing, by a pair of pedal levers to turn the training structure about the rack.

Rack and pinion training mechanisms with other drives, such as hand-wheel drives, also are known and in fact some form of rack and pinion, or worm and worm-wheel, has been the standard means of training mountings.

The present invention has a different principle, requiring no toothed gearing, and provides means enabling an operator to thrust with his feet on pedal levers and obtain a purchase against the base of the mounting from which to turn, just as though he were able to apply his feet directly to the base but with the advantages of additional leverage and a simple leg action as compared with the rather complex action of a thrust exerted through the operator's seat from the ground or a fixed pedal.

The invention is applied to a directional mounting comprising a base rotatably supporting a turntable or equivalent part of a training structure provided with a pair of pedal training levers for actuation by an operator on the training structure and, according to the invention, the base has a fixed circular track coaxial with the training axis, the turntable has, journalled relatively thereto and coaxially therewith, a pair of arms extending radially in opposite directions from the training axis to the circular track, each arm is spring-loaded, to a given angular position relatively to the turntable, and each arm has a shoe to engage against the track, to provide a fixed point from which the turntable can be turned, under thrust transmitted through connecting means from one of the pedal levers respectively.

Conveniently the track is provided by the smooth inside cylindrical surface of an upstanding base ring, the shoes are simple friction shoes pivoted in the arms and the connection between each shoe and its respective pedal lever consists of a cam lever pivoted in the arm to bear on the shoe and a connecting rod universally jointed to the cam lever and pedal lever respectively.

The spring-loading of each arm, conveniently provided at the axis by a helical torsion spring with crossed ends, is effective also on the pedal lever to which its shoe is connected and preferably it is arranged so that in the

normal position the pedal lever is vertical and the arm and the pedal lever have movement, relatively to the training structure, equally in both directions from the normal position, against the spring-loading, up to the limit of stops on the training structure.

The invention as applied to a gun mounting is illustrated on the drawings accompanying the provisional specification, in which:

Fig. 1 is a side elevation of a light anti-aircraft gun mounting.

Fig. 2 is a side elevation on a larger scale, partly broken away, of the base and of the turntable which carries the remainder of the training structure of the mounting shown by Fig. 1.

Fig. 3 is an axial half-section through the base and turntable of Fig. 2, taken on the line III—III of Fig. 4, and

Fig. 4 is a fragmentary plan, partly broken away and partly in section, of the base and turntable of Fig. 2 with some parts omitted for clarity of illustration.

The mounting shown by the drawings has a circular base **1** held down on a horizontal support, such as the deck of a ship, by bolts passed through holes **2**. (See Fig. 3.) The base has a stout central pivot **3** and, towards its periphery, an upstanding flange ring **4** which respectively support roller bearings **5** and **6** at the inner and outer peripheries of an annular turntable **7** which is thus mounted to turn easily but truly on the base and to carry the load of the remainder of the training structure. The turntable **7** is of inverted dish shape.

As shown by Fig. 1, on the turntable **7** is built a turret cabin **8** in which is cradled a pair of guns **9**, only one of which appears in Fig. 1, provided with hand-lever elevating or laying controls **10**, and a sight **11** for a gunner on a seat **12**. The detailed construction and operation of the cabin and guns are not relevant to the present invention which is concerned only with training the mounting by turning of the turntable **7** on the base **1**.

The training mechanism will now be described with particular reference to that part operated by thrust of the gunner's left foot for training the mounting to the right. This left-foot mechanism is shown in detail by the drawings and it will be remembered that it is duplicated, with the necessary lateral inversion, on the other side of the mounting for the right-foot drive.

Convenient to each of the gunner's feet is a pedal lever which will be referred to generally by the reference number **13** but, as shown in Figs. 2 and 3, in fact comprises a pedal or foot-bar **13a**, a pedal arm **13b**, a cross-shaft **13c** in a pillow-block bearing **14** on the turntable **7**, and a drop-arm **13d** extending down into the interior of the turntable **7** through a slot therein (not shown). The pedal lever has a normal vertical position and a movement of about 30° on each side of the vertical. An abutment **15** on the turntable **7** to be encountered by the drop-arm **13d** provides a stop limiting forward movement of the pedal lever. (See Fig. 2.)

The lower end of the drop-arm **13d** is formed as a socket seat to make a joint with one ball-end of a dumb-bell shaped connecting rod **16** the other end of which (see Fig. 4) is similarly jointed to the radially inner end of a cam lever **17** pivoted by a vertical pin **18** in the outer end of a radial arm **19** journalled by plain bearing bushes **20** on the central pivot **3**. Fig. 3 shows how the two arms **19** are knuckle-jointed around the pivot **3** so as to lie in the same horizontal plane and have bearing surfaces of adequate overall length.

Around a spacer ring **21** on the central pivot **3** is coiled a helical torsion spring **22**, one for each arm **19**. The ends of the spring **22** are set to project substantially radially and the spring is pre-loaded so that its ends cross

one another and anchor circumferentially in opposite directions against axial pins **23** and **24** fixed in the turntable **7** and arm **19** respectively. (See Figs. 3 and 4.) Thus the spring **22** tends to maintain the arm **19** in a given position relatively to the turntable **7**. This position is shown in the drawings and is that in which the pins **23** and **24** are radially aligned, under the load applied equally and oppositely by the ends of the spring **22** against the pin **24**. The spring **22** acting on the arm **19** also thrusts or pulls on the pedal lever **13** through the connecting rod **16** and thus also acts as a return spring for the pedal lever tending always to return the pedal lever to its vertical position as shown.

Angular movement of the turntable **7** relatively to the arm **19**, in the direction to move the pedal **13a** rearwardly, is limited by an abutment **25** on the inside of the turntable arranged to encounter a boss **26** on the arm **19**. (See Fig. 4.) This also limits rearward movement of the pedal **13a**. The abutment **15** for the drop-arm **13d** (see Fig. 2), by limiting forward movement of the pedal, limits angular movement of the arm **19** relatively to the turntable **7** in the rearward direction away from the pedal lever.

In the extreme outer end of the arm **19** is pivoted by a vertical pin **27** (see Fig. 4) a shoe **28** having a plain friction surface presented against a track **29** provided by the smooth inside cylindrical surface of the rim of the flange ring **4**. It will be noted that the base **1** has radial ribs **1a** and integral gusset stays **1b** bracing and supporting the flange ring **4**.

The cam lever **17** has a half-round self-aligning pressure pad **30** (see Fig. 4) through which to apply the shoe **28** against the track **29** under the thrust of the pedal lever **13** acting through the connecting rod **16**. A pull-off spring **31** is stretched between the toe of the shoe **28** and an anchorage on the arm **19** and a nut **32** on a stud **33** adjustably limits turning of the cam lever **17** away from the shoe **28**.

The action of the mechanism is as follows:

In the normal position, the pedal lever **13** is vertical under the influence of the respective spring **22** on the arm **19**, the shoe **28** is clear of the track **29** and the turntable **7** carrying the training structure is free to move on its bearings about the central pivot **3** of the base **1**.

Initial thrust of the gunner's foot on a pedal lever **13**, acting through the connecting rod **16** and cam lever **17**, applies the shoe **28** firmly against the track **29**. This provides a purchase fixing the arm **19** relatively to the base **1** and continued thrust on the pedal lever, acting about the forward end of the connecting rod as a base-fixed fulcrum, turns the whole training structure until the drop-arm **13d** encounters the stop **15**.

It should be noted that the initial thrust on the pedal lever **13** must overcome the tension of the pull-off spring **31** in order to turn the shoe **28** towards the track and that the spring **22** must be strong enough to hold the arm **19** against such initial thrust until the shoe **28** holds against the track and thus fixes the arm **19**.

During the training movement under the thrust on the pedal lever **13**, the pin **23** fast with the turntable **7** entrains in its movement the end **22a** of the spring **22** whilst the other end **22b** remains held by the pin **24** in the arm **19**.

On release of the pedal lever, the pressure on the shoe **28** is relieved and the shoe is pulled by its spring **31** clear of the track **29** allowing the arm **19** to follow up the training structure under the torsion of the spring **22** applied through the end **22b** against the pin **24**. This also returns the pedal lever to the vertical position.

The arm **19** is now ready for the shoe **28** to take a fresh purchase against the track **29** and thus provide a new fixed point for further training under the next thrust on the pedal lever. Each stroke of the pedal lever can be as short or as long, within its limits, as the gunner desires.

If the thrust on the pedal lever is light, as in tracking a target, the training structure will have a dead-beat motion with and proportional to forward pedal movement.

If however a heavier thrust is made on the pedal lever, as in slowing, the training structure will gain momentum and at the end of the forward stroke of the pedal lever, when the load on the pedal has been taken by the stop **15**, the pressure of the shoe against the track will relax sufficiently to allow the arm **19** to move with the training structure so long as the latter coasts—or free-wheels—under the impetus of the thrust on the pedal lever.

The initial relaxation of the pressure of the shoe against the track is due to transfer of pedal load to the stop **15** and the eventual degree of relaxation is determined by the balance of the pull-off spring **31** against the follow-up effort of the spring **22**, the latter acting, through the arm **19** and the pin **18**, on the cam lever **17** about the rear end of the connecting rod **16** as a fulcrum fixed by the pedal level being held forward. It can be arranged that any resultant pressure of the shoe against the track, while the pedal lever is held forward, is so slight as not to affect rotation of the mounting.

The arm **19** will not recover its original angular position relatively to the turntable until the pedal lever is released to allow the spring **22** to bring the pin **24** into alignment with the pin **23**, but this can of course be done during the coasting period to be ready for another thrust on the pedal lever.

It will be remembered that the mechanism is duplicated, for the two directions of training. Both pedal levers may be thrust simultaneously to engage their shoes and fix the two arms against the track. From this position, differential movement of the gunner's feet, equal and opposite with the two pedal levers within the limits of the stops, produces directly a corresponding movement of the training structure as though the pedals were on the ends of a rudder bar.

Either pedal lever can be applied as a brake, to check slewing of the mounting resulting from thrust on the other pedal lever, the braking lever holding its shoe fast against the track and being forced back against the thrust of the gunner's foot until the training structure has turned sufficiently for the abutment **25** on the turntable **7** to encounter the boss **26** on the arm **19** whereupon the shoe is dragged round the track as a friction brake. This friction braking would only be required to arrest a fast traverse of the mounting. Moderate-speed slewing can be opposed and stopped by thrust of the gunner's foot.

The training mechanism of the present invention provides the gunner, or the operator of any similar directional mounting, with the facility to train his mounting instinctively and with the same fineness of control as, and even greater strength than, he would have with his feet directly on the base or ground.

The above description and the drawing referred to, illustrate one practical embodiment of the invention but modifications could of course be made.

For example, the opposed faces of the shoe **28** and track **29** being simple friction surfaces, they have, in the absence of slip, an infinite capacity for interengagement throughout the training circle. With some loss in infinite fineness of angular position, the interengagement of these faces could be made positive, such as by the provision of very fine axial serrations to avoid the possibility of slip although this would complicate the braking action. However, by so proportioning the leverages of the pedal lever and cam lever it can be ensured that the friction torque of the shoe on the track is always greater than the torque available to turn the mounting so that slip is avoided, even with the relatively low coefficient of friction for opposed plain metal surfaces subject to intermittent lubrication. Consequently plain or metal or metal-faced shoes are preferred.

Another possible modification is that the transmission of pedal pressure to the shoe could be hydraulic instead

of mechanical, means being provided relieving the hydraulic pressure to release the shoe for coasting of the mounting when the pedal has been thrust against its stop.

What I claim is:

1. A directional mounting which comprises, in combination, a base, a training structure support rotatable on said base about a training axis perpendicular to said base, a circular track fast on said base and coaxial with said training axis, a pair of pedal levers pivoted on said support and adapted to be thrust respectively by the feet of an operator seated on said support, a pair of arms angularly movable about said training axis relatively to both said base and said support, said arms extending separately from said training axis radially towards said track, spring-loading means urging each of said arms respectively to a given angular position relatively to said support, a shoe on each said arm and movable relatively to said arm so as to engage against and disengage from said track, and means connecting one of said pedal levers to one of said shoes and the other of said pedal levers to the other of said shoes, said connecting means being arranged to transmit thrust from the respective pedal lever to the respective shoe to engage said shoe against said track and thereby provide a fixed point purchase for movement of said pedal lever to rotate said support on said base.

2. A directional mounting according to claim 1, in which each said shoe is pivoted on the respective arm and the means connecting the respective pedal lever to said shoe comprises, a cam lever pivoted on the same arm as said shoe and bearing on said shoe to move said shoe against said track and a connecting rod universally jointed at one end thereof to said cam lever and at the other end thereof to the respective pedal lever.

3. A directional mounting according to claim 2, in which a pull-off spring is provided between each said shoe and the respective arm to urge said shoe away from said track and against said cam lever.

4. A directional mounting according to claim 1, in which each said pedal lever is pivoted on said support about an axis parallel to the plane of said base and abutments are provided on said support, said abutments limiting angular movement of each said pedal lever to an arc of movement substantially equal on either side of a position in which said respective pedal lever is substantially perpendicular to said base.

5. A directional mounting according to claim 1, in which said spring-loading means comprises a pair of helical torsion springs located coaxially about said training axis, each said spring having its ends crossed one over the other and projecting substantially radially from said training axis, and, for each of said springs, a pair of anchor pins engaged by the crossed ends of the respective spring, one pin of each pair being fast on said support and the other pin of said pair being fast with the respective arm.

6. In a directional mounting comprising a base, a training structure support rotatable on said base and pedal means for an operator on said support to rotate said support on said base; a circular track fast on said base and axially perpendicular to said base, purchase means operative between said pedal means and said circular track to provide a purchase for said pedal means against said track, and comprising a pair of arms angularly movable about the axis of said track relatively to both said base and said support, said arms extending separately and radially towards said track, spring-loading means urging each of said arms to a given angular position relatively to said support, and a shoe on each of said arms, said shoe being directed towards said track and pivoted on the respective arm to engage against said track under thrust from said pedal means and means interconnecting said pedal means and said shoes.

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