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(54) **Switch.**

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Description

The present invention relates to a switch, particularly to a switch with a circuit arrangement for controlling the speed and for adjusting the direction of rotation of an electric motor, in particular for electric power tools, with a switch housing containing the circuit arrangement, on which switch housing a trigger element is mounted which can be moved backwards and forwards between an off-position away from the switch housing and an on-position close to the switch housing, in which switch housing there is a stop-element which can be moved in the direction of the backward-and-forward movement of the trigger element between a position for maximum speed and a position for minimum speed, which limits the movement of the trigger element in the on-position and which when adjusted for maximum speed in the setting for clockwise rotation of the electric motor lies with the inner end which faces the switch housing against a stop-face of the switch housing, as well as with a reducing pin mounted on the switch housing, which can be moved perpendicular to the movement of the trigger element between a position for anti-clockwise rotation and a position for clockwise rotation, which pin is situated, when in the position for clockwise rotation, outside the travel path of the inner end of the stop element and in its anti-clockwise rotation position serves as a stop to shorten the distance of travel of the trigger element compared with its distance of travel in the position for clockwise movement.

A switch of this type is the subject of an earlier design which is not part of the prior art. In this switch the travel of the trigger element in the setting for clockwise rotation is greater than in the setting for anti-clockwise rotation, so that the speed in clockwise rotation is greater than in the anti-clockwise direction. This is frequently important, inter alia, in the case of electric power tools, because the electric motors used are frequently wound such that they produce less radio disturbance in clockwise rotation than in anti-clockwise rotation. The lower maximum speed in anti-clockwise rotation due to the shorter travel of the trigger element means that in this operating state the radio interference is no higher than in the clockwise rotation which has a higher maximum speed.

In the designed switch, in order to reduce the maximum anti-clockwise rotation speed, a reducing pin is moved so that it is situated between the inner end face of the stop element and the surface of the switch housing which serves as a stop in the clockwise rotation position. As a result, the distance of travel of the trigger element at every position of the stop element in the anti-clockwise rotation position is reduced by the size of the reducing pin, in the direction of the backward-and-forward movement of the trigger element, compared with that in the clockwise-rotation position, i.e. in the anti-clockwise rotation position the inner end of the stop element comes to rest earlier on the reducing pin, which limits the travel by the width of the reducing pin extending in the direction of the backward-and-forward movement of the trigger element, than it does in the clockwise-rotation position in which the reducing pin is located outside the travel path of the stop element and the movement is limited by the inner end of the stop element coming to rest on the surface of the switch housing.

The designed switch operates very satisfactorily in the clockwise rotation setting and also in the anti-clockwise setting when the stop element is positioned for a relatively high speed. When the latter is the case, the trigger element can be moved a certain distance towards the switch element and thus the desired speed can be adjusted. Difficulties occur, however, when a low speed, particularly the minimum possible speed, is to be set with this switch in the anti-clockwise position. In this setting, when the trigger element is in the off-position, the inner end of the stop element is very close to the reducing pin, so that only an extremely short distance of travel is available for the displacement of the trigger element, which is not sufficient to permit controlled adjustment of the speed to the desired minimum value.

This problem cannot be eliminated by increasing the distance of the inner end of the stop element when in the position for minimum speed in anti-clockwise rotation, because this then increases the minimum speed adjustable in clockwise rotation, and thus the range of speeds that can be fixed by engagement of the adjustable stop element is reduced.

The object of the invention is to improve a switch so that the minimum speed can be controlled and can be set consistently by the displacement of the trigger element even in the anti-clockwise rotation position.

To achieve this object, a switch of the type mentioned in the introduction is constructed according to the invention such that a fixed anti-clockwise rotation stop is provided on the trigger element, the inner stop-face of which, when the stop element is positioned for minimum speed, is distanced further from the switch housing than the inner face of the stop element, and that the reducing pin in the anti-clockwise position lies in the travel path of the anti-clockwise rotation stop, and that, at least in the setting for maximum speed, the trigger movement in the direction of the on-position is limited by the inner end of the anti-clockwise rotation stop coming to rest on the reducing pin. The anti-clockwise rotation stop is preferably located here above the inner section of the stop element.

In the case of the switch according to the invention, therefore, the control of the speed and in particular the limitation of the speed setting using the stop element when in the clockwise-rotation position of the reducing pin is carried out in the same manner as in the switch described above, which is not part of the

prior art.

In the anti-clockwise rotation position, however, the maximum speed adjusted is limited by means of the anti-clockwise rotation stop, which is fixed on the trigger such that its position cannot be altered and in anti-clockwise rotation comes to rest on the reducing pin before the inner end of the stop-element which is set to maximum speed can touch the surface of the switch housing which serves as a stop in clockwise rotation. In contrast, for very low speeds, including the minimum speed, even in anti-clockwise rotation the inner end of the stop element is used to limit this speed. The inner end, however, does not come to rest on the reducing pin, but rests on the surface of the switch housing, as is also the case in clockwise rotation, because the stop element in this setting is moved so far in the direction of the switch housing that the inner end of the stop element comes to rest on the switch housing, before the inner end of the anti-clockwise stop can touch the reducing pin. Consequently, at the minimum speed in anti-clockwise rotation, the way the clockwise rotation control functions is maintained and thus a sufficiently large distance of travel for the trigger element is also available in anti-clockwise rotation for controlling the motor between standstill and minimum speed.

However, the maximum anti-clockwise rotation speed is determined by the co-operation of the anti-clockwise rotation stop and the reducing pin, such that the inner end of the anti-clockwise stop is closer to the inner end of the reducing pin than the inner end of the stop element is to the stop face provided on the switch housing for the stop element, i.e. the inner end of the story element is in a position which corresponds to the position for maximum speed in clockwise rotation, but does not reduce this greatest possible speed for anti-clockwise rotation. The latter takes place through the fixed position of the inner end of the anti-clockwise stop which, as mentioned above, comes to rest earlier on the reducing pin than the inner end of the stop element on the surface of the switch housing.

It should be mentioned that 'minimum speed' and 'maximum speed' refer to speeds determined by the limitation of the movement of the trigger element. In operation, therefore, speeds also occur which are lower than the "minimum speed', namely those which are produced at the beginning of the displacement movement of the trigger element. If there should be a provision for locking the trigger element, the corresponding locking position determines the 'minimum speed' and the 'maximum speed'.

In order that the present invention be better understood, a preferred embodiment will now be described in more detail by way of example with reference to the accompanying drawings in which:-

Figure 1 shows a switch, partly in elevation and partly broken open and in section, in the setting for maximum speed in clockwise rotation;

Figure 2 shows the switch of Figure 1 in the setting for minimum speed in clockwise rotation;

Figure 3 shows the switch in a representation corresponding to Figures 1 and 2, in the setting for maximum speed in anti-clockwise rotation;

Figure 4 shows the switch of Figures 1 to 3 in a setting for minimum speed in anti-clockwise direction;

Figure 5 shows a detail drawing of the upper end of the reducing pin and the outer end of the adjusting lever for switching the direction of rotation in the clockwise-rotation position, and

Figure 6 shows a drawing corresponding to Figure 5 of the reducing pin and the adjusting lever in the position for anti-clockwise rotation.

The switch shown has a switch housing 2, in which a conventional electronic circuit and contact arrangements are situated, with which an electric motor can be driven at different speeds both in the anti-clockwise and clockwise directions. On the switch housing 2, a trigger element 3 is seated which can be moved against the pressure of a spring towards the switch housing (to the right in the Figures), on which trigger element a pusher rod 8 is attached which extends towards the switch housing (i.e. to the right in the Figures) and to the inner end of which sliding contacts are attached, in a manner not shown, for co-operation with the circuit elements provided in the interior of the switch housing which contacts move together with pusher rod 8 when the trigger element 3 is displaced. In the trigger element 3, a stop element with an inner pin-shaped section 4 and an outer rotary knob 5 is positioned in a through-hole with an interior thread, such that on rotation of the rotary knob 5 the operator can screw this stop element as required into the trigger element 3 and in this way can bring the inner end 6 of the section 4 of the stop element 4, 5 as close as required to the stop-face 7 formed by the switch housing 2.

In the upper part of the switch housing 2 a reducing pin 11 is mounted which can be moved to and fro perpendicular to the direction of the possible displacement movement of the trigger element 3, and therefore vertically in the Figures, on which a spring 16, which is attached to a pin 15 on the switch housing 2, acts with a force directed upwards in the Figures. The upper end of the reducing pin 11 is chamfered (Figures 5 and 6), and, in the position for clockwise rotation, this pin projects above an upper face of the switch housing 2 (Figure 5). On this face is the inner section of the adjusting lever 13, which is mounted rotatably on the switch housing 2, so that the operator can pivot it by moving the handle 14 between a position for clockwise rotation and a position for anti-clockwise rotation. The adjusting lever 13 effects a switchover in a usual manner, not shown, e.g. by rotation of the armature by means of a di-polar revers-

ing switch, through which the direction of rotation of the electric motor is switched between clockwise and anti-clockwise.

In the position for clockwise rotation (Figure 5) the inner end of the adjusting lever 13 is out of engagement with the reducing pin 11. As a result this is pushed upwards by the force of the spring 16 so that its lower end is in the position as shown in Figures 1 and 2. If the adjusting lever 13 is shifted into the position for anti-clockwise rotation, then the inner end of the adjusting lever slides over the sloping face 12 on the upper end of the reducing pin 11 and pushes this downwards against the force of the spring 16 into the position in Figures 3 and 4.

On the pusher rod 8, an oblong anti-clockwise stop 9 is provided, which can, for example, be constructed in one piece with the pusher rod 8, and the lower face of which is adjacent to the upper face of the inner section 4 of the stop element 4,5. Here the inner section 4 of the stop-element 4,5, the anti-clockwise stop 9 and the reducing pin 11 lie somewhat higher, relative to the planes of projection in Figures 1 to 4, than the pusher rod 8, so that these are situated behind the reducing pin 11 and behind the inner section 4 of the stop element 4,5 and can be moved, unimpeded by this, together with the trigger element 3.

As already mentioned, the direction of rotation of the electric motor to be controlled by the switch depends on the position of the adjusting lever 13. The speed of the electric motor is determined by the position of the trigger element 3 with regard to the switch housing. In the positions in Figures 1 to 4, the trigger element 3 is situated in the off-position at the greatest distance from the switch housing 2. If the trigger element 3 is moved out of this position towards the switch housing 2 against the spring pressure, i.e. to the right in the Figures, the electric motor is energised, and the further the trigger element 3 is displaced in this direction, the more its speed increases.

In the switch position for clockwise rotation shown in Figures 1 and 2, the trigger element 3 can be moved into the switch housing 2 to the point at which the inner end 6 of the stop element 4,5 lies against the stop face 7 of the switch housing 2. One can see that in the position shown in Figure 1 the stop element 4,5 is screwed further out of the trigger element 3 than in the position shown in Figure 2. In the arrangement of Figure 1 the stop element 4,5 is in the maximum screwed out position, so that there is a maximum distance of travel for the trigger element 3 and thus a maximum speed can be achieved. In the position of Figure 2, the stop element 4,5 is screwed as far as possible into the trigger element 3, i.e. the inner end 6 of the stop element 4,5 is situated when the trigger element 3 is in the off-position appreciably less distant from the stop-face 7 of the switch housing 2 than in the position in Figure 1. As a result the travel of the trigger element 3 is shortened and in this position it is possible to set the minimum speed of the electric motor.

It should be mentioned that in the embodiments in Figures 1 and 2, the lower end of the reducing pin 11 lies above the inner section 4 of the trigger element 4,5 and also above the anti-clockwise rotation stop 9, so that the distances of travel of the trigger element 3 with the pusher rod 8 and stop element 4,5 are not impaired by the reducing pin 11.

As already mentioned, the maximum anti-clockwise rotation speed of the electric motor is clearly lower than the maximum clockwise rotation speed, in order, inter alia, to keep the radio interference, which is more marked in anti-clockwise rotation, below the pre-set limits.

If the adjusting lever 13 is moved into the position for anti-clockwise rotation, a downward movement takes place of the reducing pin 11 against the force of the spring 16, as described above, so that the lower end of the reducing pin 11 remains above the inner section 4 of the stop element 4,5 but lies at the level of the anti-clockwise rotation stop 9, as can be seen in figures 3 and 4.

If the operator has put the stop element 4,5 into the minimum speed position when in this anti-clockwise rotation position (Figure 4), then the inner end 6 of the stop element 4,5 is the same distance from the stop face 7 of the switch housing as it is in the minimum speed position in clockwise rotation (Figure 2). In this position, moreover, when the trigger element 3 is not moved, the inner end 10 of the anti-clockwise rotation stop 9 is further away from the side of the reducing pin facing it than the inner end 6 of the stop element 4,5 is from the stop face 7 of the switch housing 2. The trigger element 3 can thus be moved, when in this position, in the same way as when in the corresponding position for clockwise rotation, until the inner end 6 of the stop element 4,5 hits the stop face 7 of the switch housing 2, in order to energise the electric motor corresponding to the minimum speed determined by this position, and the distance of travel available enables the electric motor to be brought up to this minimum speed in a controlled manner.

In the position of the stop element for maximum speed (Figure 3) the inner end 6 of the stop element 4,5 is displaced so far from the stop face 7 of the switch housing 2 and therefore to the left in Figure 3 that the distance between the inner end 6 and the stop face 7 is distinctly greater than the distance between the inner end 10 of the anti-clockwise stop 9 and the side of the reducing pin 11 which faces it. If therefore the trigger element 3 moves, when in this position, against the spring pressure in the direction of the switch housing 2, the inner end 10 of the anti-clockwise stop 9 comes to rest on the lower end region of the reducing pin 11 which prevents the further movement of the trigger element 3, and with the inner end 6 of the stop element 4,5 still at a distance from

the stop face 7 of the switch housing 2, i.e. the maximum speed attainable is reduced compared with the maximum speed attainable in clockwise rotation.

Claims

1. Switch with a circuit arrangement for controlling the speed and for adjusting the direction of rotation of an electric motor, in particular for electric power tools, with a switch housing (2) containing the circuit arrangement, on which a trigger element (3,8) is mounted which can be moved backwards and forwards between an off-position away from the switch housing (2) and an on-position close to the switch-housing (2), in which there is a stop-element (4,5) which can be moved in the direction of the backward-and-forward movement of the trigger element (3,8) between a position for maximum speed and a position for minimum speed, which limits the movement of the trigger element (3,8) into the on-position and which when adjusted for maximum speed in the setting for clockwise rotation of the electric motor lies with the inner end which faces the switch housing (2) against a stop-face (7) of the switch housing (2), as well as with a reducing pin (11) mounted on the switch housing (2), which pin can be moved perpendicular to the movement of the trigger element (3,8) between a position for anti-clockwise rotation and a position for clockwise rotation, which pin is situated, when in the position for clockwise rotation, outside the travel path of the inner end (6) of the stop element (4,5) and in its anti-clockwise rotation position serves as a stop to shorten the distance of travel of the trigger element (3,8) compared with its distance of travel in the position for forward movement, characterised in that on the trigger element (3,8) a fixed anti-clockwise stop (9) is provided, the inner stop-face (10) of which, when the stop element (4,5) is in the position for minimum speed, is distanced further away from the stop-face (7) of the switch housing (2) than the inner face (6) of the stop-element (4,5), and that the reducing pin (11) in the anti-clockwise position lies in the travel path of the anti-clockwise stop (9), and, at least in the setting for maximum speed, the trigger movement (3,8) in the direction of the on-position is limited by the inner end (10) of the anti-clockwise stop (9) coming to rest on the reducing pin (11).

2. Switch according to claim 1, wherein the anti-clockwise stop (9) is provided above the inner section (4) of the stop element (4,5).

3. Switch according to claim 1 or 2, wherein the anti-clockwise stop (9) is constructed in one piece with the adjacent part (8) of the trigger element (3,8).

Patentansprüche

1. Schalter mit einer Schaltungsanordnung zur Steuerung der Drehzahl und zur Einstellung der Drehrichtung eines Elektromotors, insbesondere für Elektrowerkzeuge, mit einem die Schaltungsanordnung aufnehmenden Schaltergehäuse (2), an dem ein Drückerelement (3,8) gehaltert ist, das zwischen einer Aus-Stellung, die vom Schaltergehäuse (2) entfernt ist, und einer Ein-Stellung, die nahe zum Schaltergehäuse (2) liegt, hin- und herbewegt werden kann, in dem ein Anschlagelement (4,5) vorgesehen ist, das in der Richtung der Hin- und Herbewegung des Drückerelementes (3,8) zwischen einer Stellung für maximale Drehzahl und einer Stellung für minimale Drehzahl bewegt werden kann, das die Bewegung des Drückerelementes (3,8) in die Ein-Stellung begrenzt und das bei Einstellung für maximale Drehzahl in der Einstellung für Rechtslauf des Elektromotors mit dem inneren Ende, das dem Schaltergehäuse (2) zugewandt ist, gegen eine Anschlagfläche (7) des Schaltergehäuses (2) anliegt, sowie mit einem Reduzierstift (11), der am Schaltergehäuse (2) gehaltert ist, wobei der Stift senkrecht zur Bewegung des Drückerelementes (3,8) zwischen einer Stellung für Linkslauf und einer Stellung für Rechtslauf bewegt werden kann, wobei sich der Stift in der Stellung für Rechtslauf außerhalb der Bewegungsbahn des inneren Endes (6) des Anschlagelementes (4,5) befindet und in seiner Linkslauf-Stellung als ein Anschlag zur Verkürzung des Verlagerungshubes des Drückerelementes (3,8) gegenüber seinem Verlagerungshub in der Stellung für Vorwärtsbewegung dient, **dadurch gekennzeichnet**, daß am Drückerelement (3,8) ein unverlagerbarer LinkslaufAnschlag (9) vorgesehen ist, dessen innere Anschlagfläche (10) bei in der Stellung für minimale Drehzahl befindlichem Anschlagelement (4,5) weiter von der Anschlagfläche (7) des Schaltergehäuses (2) entfernt ist als die innere Fläche (6) des Anschlagelementes (4,5), und daß der Reduzierstift (11) in der Linkslauf-Stellung in der Bewegungsbahn des Linkslauf-Anschlags (9) liegt und zumindest in der Einstellung für maximale Drehzahl die Drückerbewegung (3,8) in der Richtung der Ein-Stellung durch das innere Ende (10) des Linkslauf-Anschlags (9) begrenzt wird, das am Reduzierstift (11) zur Anlage kommt.

2. Schalter nach Anspruch 1, wobei der Linkslauf-Anschlag (9) oberhalb des inneren Abschnitts (4)

des Anschlagelementes (4,5) vorgesehen ist.

3. Schalter nach Anspruch 1 oder 2, wobei der LinkslaufAnschlag (9) einstückig mit dem benachbarten Teil (8) des Drückerelementes (3,8) ausgebildet ist.

Revendications

1. Commutateur comprenant un dispositif de circuit pour contrôler la vitesse et pour déterminer le sens de rotation d'un moteur électrique, destiné en particulier à des outils à moteur électrique, ayant un boîtier du commutateur (2) contenant le dispositif de circuit sur lequel est monté un élément de déclenchement (3, 8) qui peut se déplacer vers l'arrière et vers l'avant entre une position d'arrêt éloignée du boîtier du commutateur (2) et une position de marche proche du boîtier du commutateur (2), dans lequel se trouve un élément d'arrêt (4,5) qui peut être déplacé dans le sens du mouvement d'arrière en avant de l'élément de déclenchement (3, 8) entre une position pour la vitesse maximale et une position pour la vitesse minimale, qui limite le mouvement de l'élément de déclenchement (3, 8) dans la position de marche et dont l'extrémité interne faisant face au boîtier du commutateur (2), lorsqu'il est ajusté pour une vitesse maximale dans le réglage pour la rotation en sens horaire du moteur électrique, repose contre une face d'arrêt (7) du boîtier du commutateur (2), ainsi qu'une broche de réduction (11) montée sur le boîtier du commutateur (2), laquelle broche peut être déplacée perpendiculairement au mouvement de l'élément de déclenchement (3, 8) entre une position pour la rotation en sens anti-horaire et une position pour la rotation en sens horaire, laquelle broche est située, lorsqu'elle se trouve dans la position pour la rotation en sens horaire, à l'extérieur du parcours de l'extrémité interne (6) de l'élément d'arrêt (4, 5) et, dans la position pour la rotation en sens anti-horaire, sert d'arrêt pour raccourcir la course de l'élément de déclenchement (3, 8) par rapport à sa distance de déplacement dans la position pour le mouvement horaire, caractérisé en ce que l'élément de déclenchement (3, 8) est pourvu d'un arrêt en sens anti-horaire fixe (9), dont la face d'arrêt interne (10), lorsque l'élément d'arrêt (4, 5) se trouve dans la position pour la vitesse minimale, est plus éloignée de la face d'arrêt (7) du boîtier du commutateur (2) que de la face interne (6) de l'élément d'arrêt (4, 5), et en ce que la broche de réduction (11), dans la position anti-horaire, se situe sur le parcours de l'arrêt en sens anti-horaire (9), et, du moins dans le réglage pour la vitesse maximale, en ce que le mouvement de déclenchement (3, 8) dans le sens de la position de marche est limité par le fait que l'extrémité interne (10) de l'arrêt anti-horaire (9) vient reposer sur la broche de réduction (11).

2. Commutateur selon la Revendication 1, dans lequel l'arrêt en sens anti-horaire (9) est disposé au-dessus de la section interne (4) de l'élément d'arrêt (4, 5).

3. Commutateur selon la Revendication 1 ou 2, dans lequel l'arrêt en sens anti-horaire (9) et la partie adjacente (8) de l'élément de déclenchement (3, 8) sont construits d'une seule pièce.

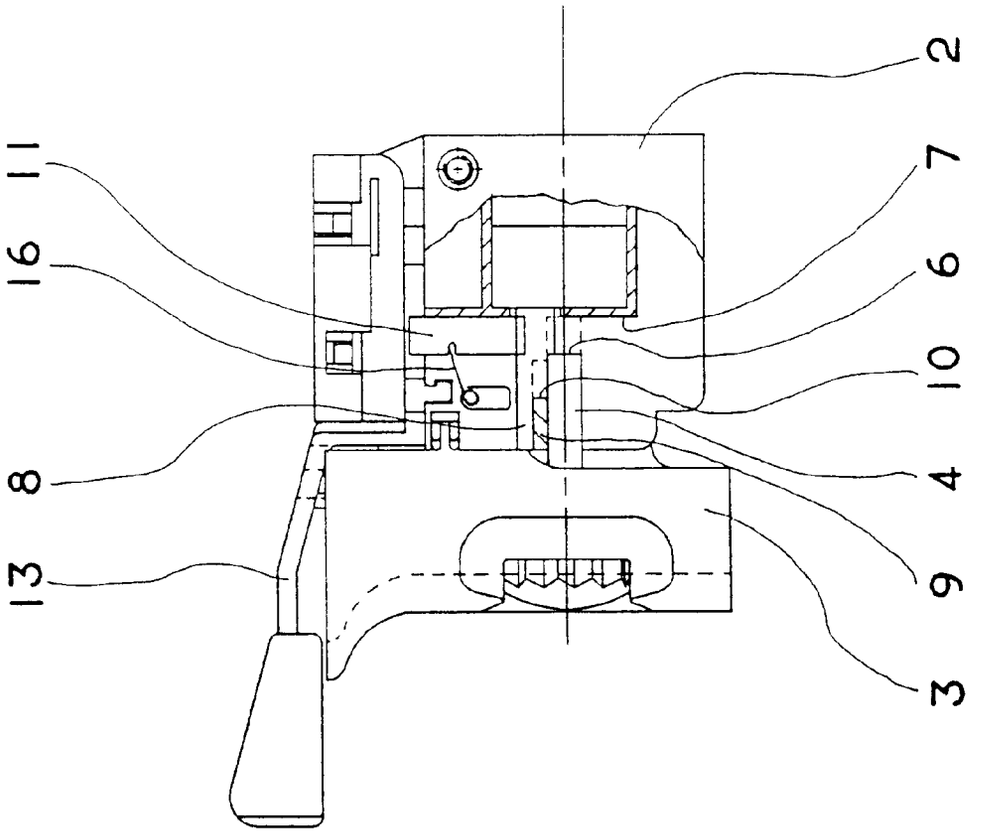

FIG. 2

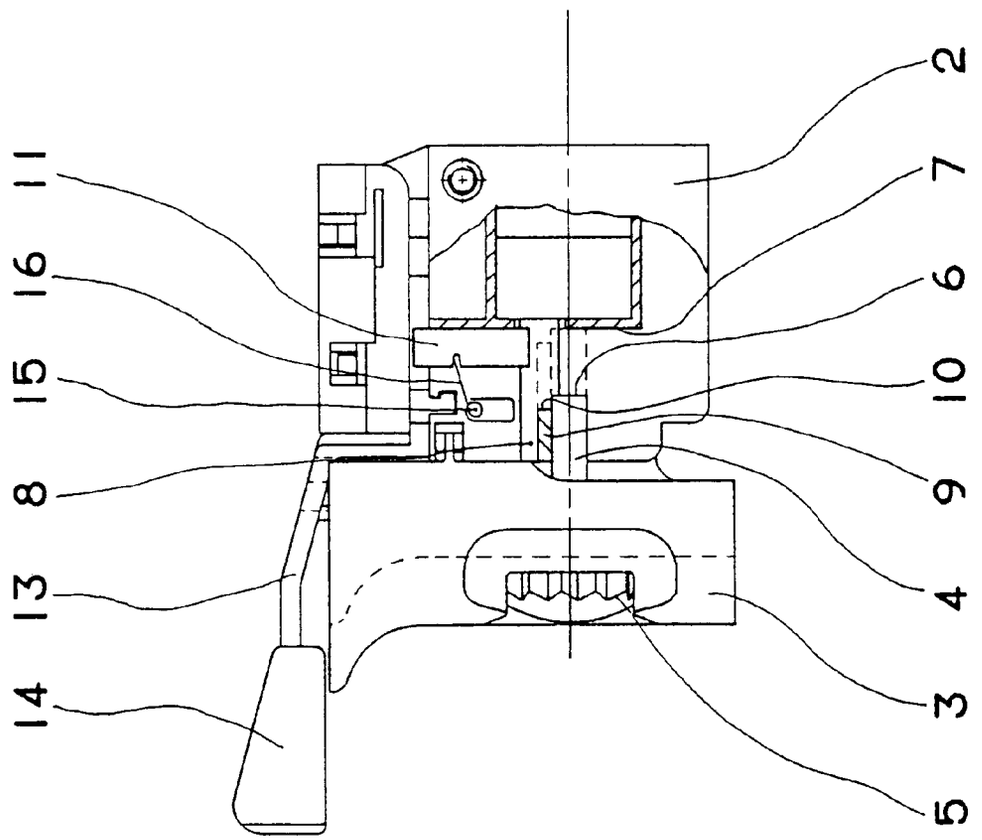

FIG. 1

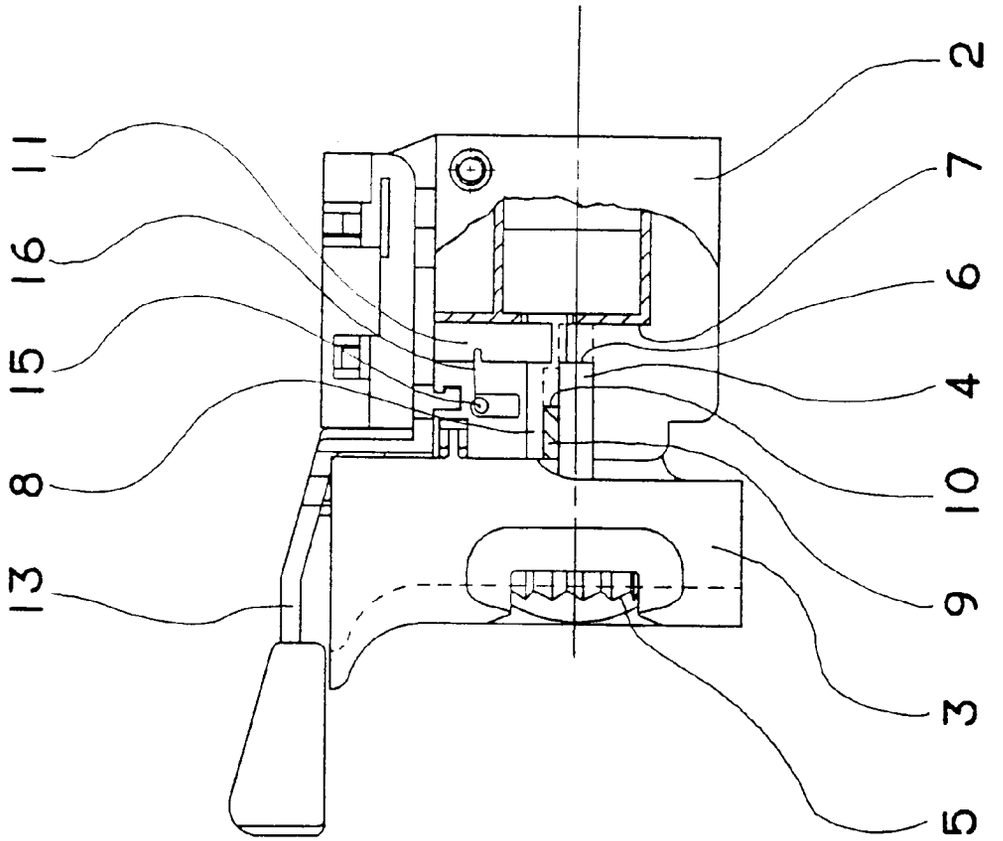

FIG. 4

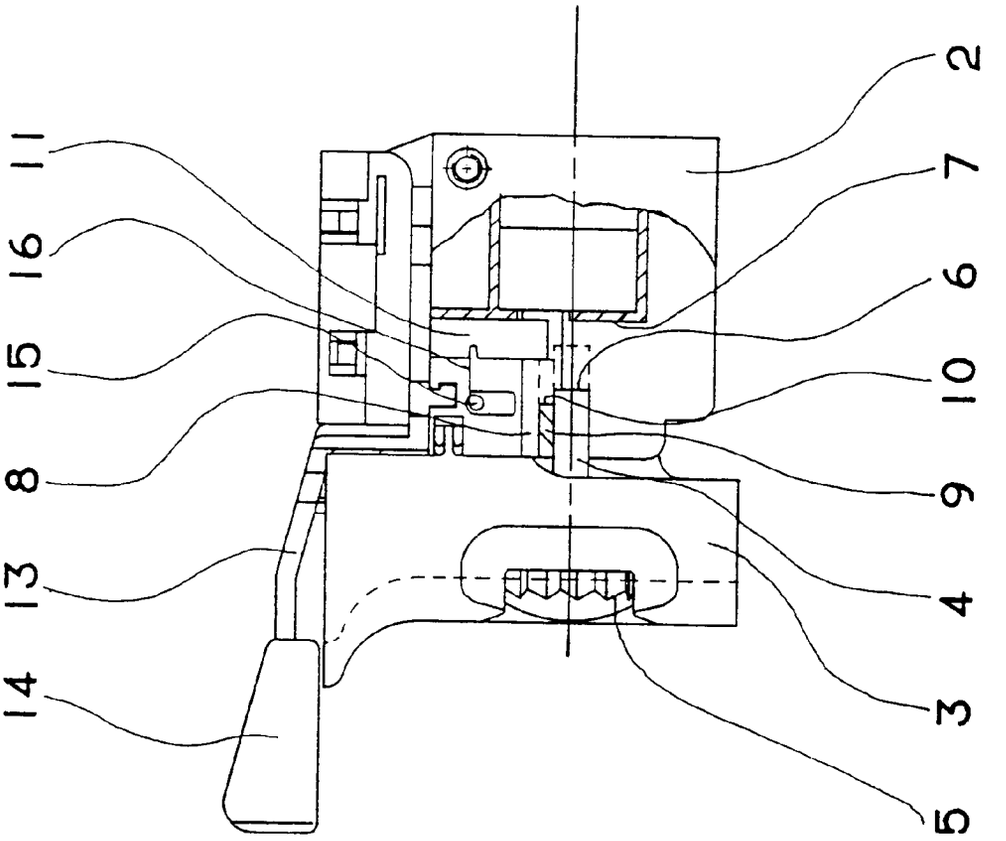

FIG. 3

FIG. 6

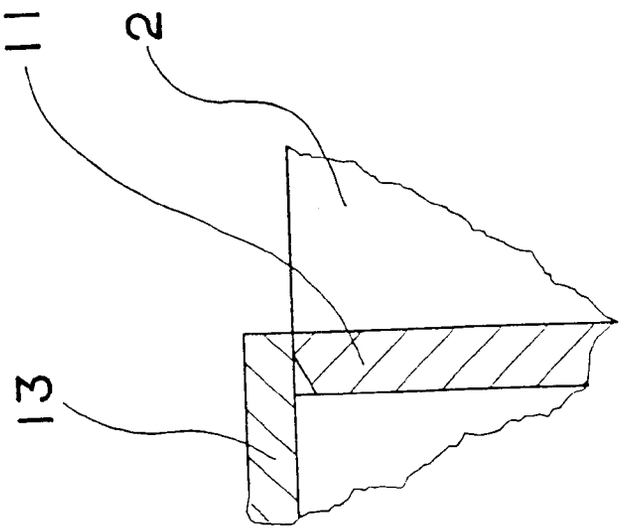

FIG. 5