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(54) **Dual device for the arming of a missile either by means of an electrical signal or by manual mechanical operation.**

(57) The invention is a dual device for effecting the arming of a missile either by means of an electrical signal which operates a motor or by means of a suitable key which is operated manually.

The mechanical device is based principally on the use of a differential the two crown wheels of which are connected respectively to the motor and the mechanism operated by the key. The crown wheels via the pinions independently move the shaft which communicates the movement to the missile actuater.

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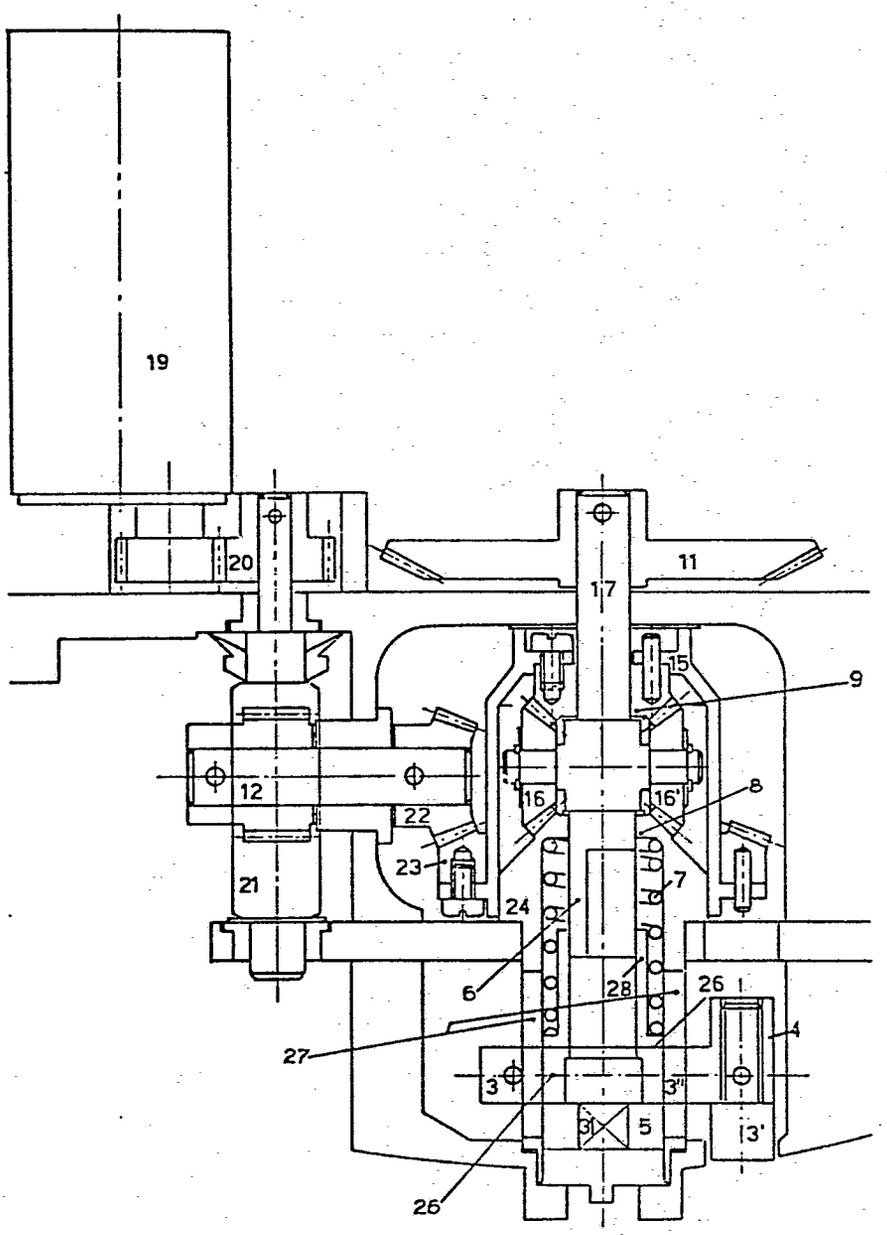

FIG. 1

DUAL DEVICE FOR THE ARMING OF A MISSILE EITHER BY MEANS OF AN ELECTRICAL SIGNAL OR BY MANUAL MECHANICAL OPERATION.

This invention relates to a dual device for the arming of a missile either by means of an electrical signal or by mechanical manual operation.

Particularly the subject of the patent is a safety device Which allows the actuator which arms the missile to be operated either by manually rotating a key or by the operation of an electric motor once the device has been prepared for this by the predetermined extraction of the key.

It is obvious that the operation of the device for arming a missile must be effected in conditions of absolute security and confidence so as to avoid, with absolute certainty, the arming of the missile as a result of mistaken manoeuvres, accidental knocks or by any casual and undesired events.

In particular it must be impossible to operate the said actuator by means of an electrical signal if the missile has not been previously predisposed to receive this signal. It must also be impossible to operate the actuator mechanically, by an accidental manoeuvre, whenever the missile has been predisposed to receive an electrical arming signal. Therefore the object of this invention is the realization of a device for the arming of a missile which in the inhibited position is protected with absolute guarantee from undesired operation of the actuator either due to events of a mechanical nature (knocks, vibrations, etc.) or as a result of spurious electrical signals.

It is a further object of this invention to realize a device for the arming of a missile, which once predisposed for operation by an electrical signal is protected from undesired and accidental manual manoeuvres.

A further object is the realization of a device for the arming of a missile which once the arming by mechanical means has been determined cannot be disarmed electrically.

These objects, and others which will become clear in the course of the description, are obtained by means of the device which is the subject of this patent.

The presence of a differential gear allows all the mechanical coupling elements to be always connected and therefore in case of blockage of the two possible command inputs renders

the whole system rigidly blocked particularly due to the presence of a worm drive coupling which causes the unidirectional passage of the command signal from the motor to the actuator and not vice versa.

The invention will now be described with reference to the figures :

Figure 1. Shows the device assembly;

Figure 2. Shows sections of particulars of the coupling between the two shafts;

Figure 3. Shows a plan of the missile arming hole;

Figure 4. Shows a section of the arming key;

Figure 5. The spacer to be inserted for disarming the missile

The essential element which identifies and distinguishes this invention is constituted by the use which is made of a differentical gear whose functioning will now be described with specific reference to figure 1.

It is constituted by : a first crown wheel (9) rigidly connected to the case (15); a second crown wheel (8) which is extended in the hollow shaft (24); two pinions (16) and (16') whose hubs are keyed onto the shaft (17) which is rotated by the rotation of the said axes.

Therefore the two possible inlets for motion are :

a) the rotation of the case (15). This rotation transmitted to the crown wheel (9) when it finds the crown wheel(8)blocked transmits the movement of the above-mentioned rotation

to the pinions (16) and (16') and therefore to their axes setting in motion the shaft (17) that may be considered as the motion output.

b) the rotation of the hollow shaft (24). This rotation which is transmitted to the crown wheel(8) when the other crown wheel is blocked also sets in motion the output shaft (7) via the movement of the pinions.

Thus it may be seen from the figures that the rotation of the shaft (17), produced as seen by the input motion at either of the two inputs, via the Bevel Gear (11) which forms part of it and which engages the Gear (10) via the rod (13) operates the actuator (14) which arms or disarms the missile (not shown in the figure).

The mechanism constituted by the gears(11) and (10) and by the rod (13) that operates the actuator (14) is of conventional design, it may be substituted by other mechanisms and does not form a specific subject of the patent.

From the operational point of view of the invention the rotation of the shaft (17) is considered, as already stated, as the output motion of the device.

The input movement by means of an electrical signal occurs as follows : an electric motor (19) via the reduction drive (20) causes the worm drive (21) to rotate and this communicates the motion to the Gear (12).

This in its turn causes the movement of the Bevel Gear (22) keyed on to the same axis, and this is enmeshed with the Gear (23) rigidly fixed to the case (15).

The operation of the motor (19) via the reduction drive (20), the worm drive (21) and Gear (12) and Bevel Gear (22) with the Gear (23) causes the rotation of the case (15) which,as previously seen, is one of the two possible inputs of motion to set in motion the shaft (17) and with it the actuator (14).

It should be noted that the transmission of the movement in the reverse direction i.e. from the case (15) to the motor (19) is impossible due to the worm drive (21) and Gear (12) which have a mechanical efficiency less than 0,5, so that the case (15) is either set in rotation by the action of the motor (19) or it is blocked.

To examine the mode of operation of the other possible input of motion which allows the arming of the missile manually it is necessary to look carefully at the mechanical parts connected to crown wheel (8).

This crown wheel is extended outwards into the hollow shaft(24) from which it receives motion in the manner described below.

The said hollow shaft houses the sleeve (5) that can run longitudinally.

This sleeve in its upper part (28) is of reduced diameter with respect to the internal diameter of the said hollow shaft (24) so that it leaves a circular space for housing the helical

spring (7) which performs its thrust action between the upper wall of the inside of the said hollow shaft(24) and the upper zone of the part of the sleeve (5) which is not of reduced diameter.

In this way the sleeve (5) is forced outwards by the said spring.

Referring again the figure 1 we see that the sleeve (5) contains a hole (26) through which the axis (3'') of a piston (3) passes. The function of this piston will now be described.

There is also a double slit (27) in the hollow shaft (24) corresponding to the hole which allows the longitudinal movement of the said axis(3'')of the piston (3) solidly with the sleeve (5).

In the lower end of the said sleeve (5) there is a housing of square section for the insertion of the operating key.

The upper part of reduced external diameter (28) of sleeve (5) is hollowed internally and has a projection (90) in the form of a sector of a circle having an aperture equal to an angle of about 60 degrees.

Inside of this as may be seen from figure 1 and the plan in figure 2 the shaft (6) is inserted, this shaft being the lower extension of the shaft (17) solid with the shaft of the pinions (16) and (16') as may be seen.

The said shaft (6) possesses a longitudinal channel (91) obtained by the removal of a circular sector having an aperture equal to an angle β which is 50 degrees more than the angle α

referred to above and thus about 110 degrees.

Referring then to figure 2 it will be seen that when the shaft 6 is inserted in the internal cavity of the upper part (28) of the sleeve (5), the said sleeve can freely rotate through 50 degrees (difference between the angle β and the angle α) in the anticlockwise direction while it is engaged with the shaft 6 for rotation in the clockwise direction.

Figure 3 shows the plan of the entrance hole (29) for the key which as will be seen is provided with an entrance slot, which allows the passage of a pin (32), with which the key is furnished, only when the key itself assumes fixed angular positions in its seat. In the figure it is possible also to see the seat (30A) in which the pin can rest when the key is rotated 90 degrees with respect to its input position. In this position the key can rest when the key is rotated 90 degrees with respect to its input position. In this position the key cannot be rotated or be removed as will now be described.

The piston (3) carries a cylindrical head 3' keyed onto the axis 3''. As soon as the piston, which, as seen previously rotates in a piece with the sleeve (5) and with the hollow shaft (24), assumes a fixed angular position (i.e. that shown in figure 1) the said cylindrical head 3' engages with its lower part in a seat (4) and with its upper part in a seat (4') according to the position along the vertical that the piston assumes when it follows the movement of sleeve (5) within the hollow shaft (24).

Now with reference to figure 4 we see a drawing of the device manual operating key for arming the missile.
It consists of a cylindrical body (40) provided at its upper end with a handle (46) for ease of handling during the operation of rotating the key.
At the other end the key terminates in a square-shaped point (33) suitable for insertion in the square seat (31) of the sleeve (5).
Above the said square-shaped point (33) there is a cylindrical part (41) provided with a pin (32) for insertion in the slots (30) and (31), already described, with which the key entrance hole is provided.
The said cylindrical part terminates in a ledge (43) which will be mentioned later.
Inside the said key is inserted the pin (44) which can move within it both in rotating and longitudinal directions coming out from the square-shaped point (33).
The longitudinal movements of the pin result from its being rotated by the grip with which it is provided and it comes out from the handle (46) by means of the thread(47)with which the pin and a zone within the seat of the key are provided.
The operation of the manual arming part of the device will now be illustrated in the light of the above description.
In the safe position the key is inserted with its square-

shaped point (33) within the square-section seat (31) at the lower part of the sleeve (5). The pin (32) of the key will be at 90 degrees with respect to the output slot (30) of its entrance hole and housed in the seat (30 A) and therefore pushed down via the sleeve (5) by the spring (7), so that it cannot come out.

In this position (sleeve (5) pushed right down to the bottom) the lower part of the head (3') of the piston (3) is inserted in seat (4).

The piston is thus blocked and in its turn prevents the rotation of the hollow shaft (24) and therefore of the crown wheel (8).

At the same time the sleeve (5), in its turn blocked by the piston (3) due to its internal cavity being engaged with the shaft (6), prevents any rotation of this in an anti-clockwise direction.

Crown wheel (8) thus being blocked and the pinion being prevented in the motion of rotation, crown wheel (9) will also be blocked and the operation of the device will not be possible not even by means of the electric motor.

The whole device is therefore in the safety position.

If one wishes to arm the missile by means of the key it is necessary to proceed as follows: the key is pushed towards the inside until it causes the ledge (43)to come in contact with external wall of the key entrance hole.

In this way the key frees the pin (32) from the seat (30A) and pushing the sleeve (5) upwards by means of the shoulder (45) causes the head of the piston (3') to come out of the seat (4).

The shaft (6) and the hollow part (28) of the sleeve (5) remain engaged as described above.

The key is now free to rotate and therefore it is made to rotate 90 degrees anticlockwise.

Now reference should be made to figures 1 and 2. When the sleeve (28) rotates anticlockwise the crown wheel(8) is set in rotation and since the crown wheel(9) is blocked the pinions(16) and (16') are set in motion and therefore also the shaft (17) and its extension (6). In particular it is necessary to remember that the rotation of the crown wheel (8) through a certain angle causes the rotation of the shaft (17) through half of that angle.

Now referring to figure 2 it will be observed that initially the sleeve (28) is able to rotate anticlockwise through an angle of about 50 degrees. When this rotation has been completed from what has been said above the shaft (6) will have completed a rotation equal to half angle β (25 degrees) allowing the sleeve (28) to rotate further so little by little it can rotate upto 90 degrees.

The corresponding rotation of shaft (6) (and 17), as we already know, causes the arming of the missile. When the ro

tation is completed and the arming is effected the pin (32) is coincident with the through slit (30) and therefore the key can be extracted.

The head of the piston (3') which will have rotated through 90 degrees with respect to the starting position when it was inserted in the seat (4) will be housed in another seat (not shown in the figure) which, unlike seat (4) which is not provided with a bottom and therefore communicates with the outside, is however provided with a ledge on which the said head of the piston (3') rests so blocking the descent of sleeve (5) down to the bottom.

The missile is thus now armed and the key extracted.

As already stated the seat (4) in which the piston is housed in the disarmed position of the missile communicates with the outside allowing the bottom of the head of the piston (3') to be seen and therefore providing away of knowing if the missile is disarmed (piston visible) or armed (piston not visible).

The operation of extracting the key from the missile without arming it, so that the missile is predisposed for arming electrically will now be described.

This starts from the safety position with the key inserted as already seen.

Referring to figure 1 it will be seen how in this position there is a space between the ledge (43) of the key

and the wall of the key entrance hole.

A spacer (49) shown in figure 5 is inserted in this space. It is provided with a channel in which the cylindrical part of the key (41) is placed.

By rotating the sleeve (50), as already described the pin is caused to advance and begins to come out from the head of the key (33).

This movement causes a thrust on the body of the piston and therefore on the sleeve (5) which begin to rise together progressively freeing the head (3') from the seat (4).

When the said head is freed it should be noted that the square-shaped point of the key (33) is not yet disengaged from the square seat (31) of the sleeve so that the latter cannot rotate.

Meanwhile the progressive advance of the sleeve upwards causes the head of the piston (3') to be engaged with seat (4') in line with seat (4) so that when the engagement between the square-shaped point of the key (33) and the square seat of the sleeve (31) ceases the latter is still prevented from rotating by the engagement now ensured between the head of the piston and the seat (4').

The spacer (49) is now removed and the key is pressed upwards in order to free the pin (32) from seat (30).

The key is now rotated 90 degrees and this movement does not cause the arming of the missile since the sleeve (5)

cannot rotate because it is disengaged from the key and blocked by the piston (3') which is in seat (4').

The 90 degrees movement in a clockwise direction brings the pin (32) into coincidence with the slot (30 A) and so the key can be extracted.

The extraction of the key results in the lowering of the sleeve (5) again which, not now being restricted by the insertion of pin (32) in seat (30) or by the edge of the head of the piston (3') in seat (4) which as stated is without a bottom, leads to a complete disengagement between the shaft (6) and the internal part of sleeve (5).

Shaft (6) and therefore shaft (17) are thus now free to rotate and a command coming from the motor (19) will cause the arming of the missile as seen previously.

Finally we must consider a further cause of intervention. The missile could have been armed as already shown electrically, and it becomes necessary to disarm it, but this cannot be effected due to a fault on the motor or its control circuits.

It will be necessary to proceed to manual disarming, which, however, cannot be executed normally since the key cannot push the sleeve (5) upwards because the projection (90) with which the part (28) of the sleeve is provided internally coincides with the full part (91) of the shaft (6) (see figure 2).

Thus it will be necessary to unscrew the head of the piston (3') which is accessible from the outside.
A suitable key will be inserted, this being practically formed by a simple cylindrical body furnished with a handle, terminating in a square form analogous to the square-shaped point (33) and not furnished with pin (32).
The said key can therefore, enter freely and cause the sleeve (5) to rotate clockwise 90 degrees which will disarm the missile.
Thus the scope of this invention is a dual device for the arming of the missile either by means of an electrical signal or by manual mechanical operation characterised by the fact that it includes a differential element formed by a first crown wheel, a second crown wheel and a pair of coaxial pinions whose hubs are keyed onto the output shaft coaxial with the two said crown wheels, and the extension downwards of the said second crown wheel into the second shaft which is solid with it and is able to transmit the arming or disarming command by means of the mechanism to the arming actuation of the missile and in which the said first crown wheel is solid with the differential case which by means of the unidirectional mechanical devices receives the operational command from an electric motor transmitting it to the said output shaft via the said pinions when the said second crown wheel is blocked and in which the

said second crown wheel, via mechanical coupling elements, can be operated manually by means of a key which sets it in rotation causing the entrainment of the said pinions and therefore the rotation of the said output shaft while the said first crown wheel is blocked. The whole being contained in a body provided with seats for the blockage of positioning elements in predetermined angular positions. In it the unidirectional mechanical devices for the transmission of the electric motor operational command and of the case of the differential are formed by a reduction gear consisting of a pair of enmeshed gears the first of which is solid with the axis of the motorand the second is keyed onto a first shaft on which is also placed a worm drive that operates a gear at one end of a second shaft perpendicular to the said first shaft and which has a bevel gear at the other end enmeshed with another bevel gear which is solid with and drives externally the said case of the differential.
The mechanical coupling elements are formed by a sleeve consisting of two coaxial cylindrical elements of equal internal diameter and of which the upper one has an external diameter less than the other, which is provided with an internal seat towards the bottom of square cross section;
a hollow shaft constituting the extension of the said second crown wheel and of which the internal diameter is equal to the external diameter of the cylindrical element of the said sleeve having the greater diameter; a helical spring of a

diameter such as will fit in the space between the outside surface of the said cylindrical element of the sleeve with lesser external diameter and the internal surface of the said hollow-shaft; a piston formed by a cylindrical body to one side of which a cylindrical head is fixed, the lower part of which being fixed to the upper part by means of screws can be removed; and in which the said upper part of the said sleeve is also hollow inside and is provided with a projection in the form of a circular sector having an aperture equal to an angle α while the said lower part of the sleeve has a hole perpendicular to its axis for the introduction of the said cylindrical body of the said piston which passes along a longitudinal channelling cut in the lower part of the said hollow shaft, and in which the said second extension shaft of the said output shaft possesses a longitudinal channel obtained by the removal of a circular sector having an aperture β greater than the said angle and is inserted within the said hollow of the upper part of the said sleeve and in which the said body is provided with a first cylindrical seat for the housing of the said lower part of the said cylindrical head of the piston and communicating with the outside, a second cylindrical seat of equal diameter placed 90 degrees anticlockwise with respect to the said first seat and provided with a bottom ledge and a third cylindrical seat also of equal diameter

for the housing of the upper part of the said cylindrical head of the piston and placed coaxially with the said first seat and in which also in the said body provided with seats there is a round form of aperture whose centre corresponds to the axis of the said sleeve and which is further provided with two slots separated by 90 degrees for the passage of a pin with which the said key is furnished.

The arming key also consitutes a part of the invention. The said key consists of a cylindrical body provided above with a handle and terminating at the other end with a square shaped point for the insertion in the said square shaped seat of the said sleeve and the cylindrical part situated above the said square-shaped point being also furnished with a pin for insertion in the two said 90 degree slots with which the said round aperture in the said body containing seats is provided, and the said cylindrical part terminating with a shoulder ledge, the said cylindrical body constituting the key being further provided with an axial hole for the housing of a pin inserted in it, which, being provided above with a threaded part which is screwed into a corresponding threaded hole with which the upper part of the said axial hole terminates, can be made to advance or recede longitudinally and therefore protrude more or less from the said lower end of the said key by the manual rotary movement obtained from a handle with which the said pin is

provided in the upper part.

This invention has been described purely for the purpose of illustration taking into account its operational peculiarity, nevertheless modifications can be made to it and innovations in the choice of mechanical parts realising a particular function without going out of the area of protection of the present industrial patent right.

CLAIMS

1. Dual device for the arming of a missile either by means of an electric signal or by manual mechanical action characterized by the fact that it contains a differential element formed by a first crown wheel, a second crown wheel and a pair of co-axial pinions whose hubs are keyed onto the output shaft coaxial to the said two crown wheels and the extension downwards into the second shaft solid with it which provides a mechanism to transmit the arming and disarming command to the missile arming actuator and in which the said first crown wheel is solid with the case of the differential which by means of undirectional mechanical devices receives the operational command from an electric motor transmitting it to the output shaft by means of the entrainment of the said pinions when the second crown wheel is blocked and in which the said second crown wheel by means of mechanical coupling elements, can be operated manually by a key which rotates it turning the said pinions and therefore rotating the said output shaft while the said first crown wheel remains blocked the whole being contained in a body provided with seats for the blocking of positioning elements in predetermined angular positions.

2. Dual device for the arming and disarming of a missile as in claim 1, in which the said unidirectional mechanical devices for the transmission of the operational command, from the electric motor to the said differential case are formed by a

reduction gear comprising a pair of enmeshed gears of which the first is solid with the motor axis and the second is splined to a first shaft on which is also placed a worm drive which operates a spur gear placed at one end of a second shaft perpendicular to the said first shaft and which carries at the other end a bevel gear enmeshed with another bevel gear which is solid with and drives the said differential case externally.

3. Dual device for the arming and disarming of a missile as in claim 1, characterized by the fact that the said mechanical coupling elements are formed by a sleeve consisting of two coaxial cylindrical elements of equal internal diameter and of which the upper one has a smaller external diameter than the other which is provided with an internal seat of square section at the lower part; a hollow shaft constituting the extension of the said second crown wheel and the internal diameter of which is equal to the external diameter of the cylindrical element of the said sleeve with the larger external diameter; a cylindrical helical spring of a diameter such that it can be housed in the space between the external surface of the said cylindrical element of the sleeve of smaller external diameter and the internal surface of the said hollow shaft; a piston constituted by a cylindrical body at one end of which is fixed a cylindrical head of which the lower part being fixed to the upper part by means of screws can be removed; and in which also the said upper part of the said sleeve is hollow within and provided with a projection of a circular sector form having an aperture equal to an angle α while the said lower part of the sleeve possesses a hole perpendi-

cular to its axis for the introduction of the said cylindrical body of the said piston which passes along a longitudinal channel obtained by the removal of a circular sector having an aperture β greater than the said angle α and is inserted within the said hollow upper part of the said sleeve and in which said body there is a first cylindrical seat for the housing of the said lower part of the said cylindrical head of the piston and communicating with the outside, a second cylindrical seat of equal diameter placed at 90 degrees anticlockwise with respect to the said first seat and provided with a bottom ledge and a third cylindrical seat also of equal diameter for the housing of the upper part of the said cylindrical head of the piston and placed coaxially to the first seat and in which also in the said body provided with seats there is an aperture, for the insertion of the said key, of a round form the centre of which corresponds to the axis of the said sleeve and which is further provided with two slots 90 degrees apart for the passage of a pin with which the said key is furnished.

4. Dual device for the arming and disarming of a missile as in claim 1 characterized by the fact that the said key consists of a cylindrical body provided in the upper part with a handle and terminating at the other end with a square shaped point for insertion in the said square seat of the said sleeve, and also the cylindrical part above the said square-shaped point being fitted with a pin for insertion in the said two slots 90 degrees apart with which the said round aperture in the said body, provided with seats, is provided, and terminating in the cylindrical part

with a shoulder ledge the said cylindrical body constituting the key being further provided with an axial hole for the housing of a pin inserted in it, which, being provided above with a threaded part which is screwed into a corresponding threaded hole with which the upper part of the said axial hole terminates, can be made to advance or recede longitudinally and therefore protrude more or less from the said lower end of the said key by the manual rotary movement obtained from a handle with which the said pin is provided in the upper part.

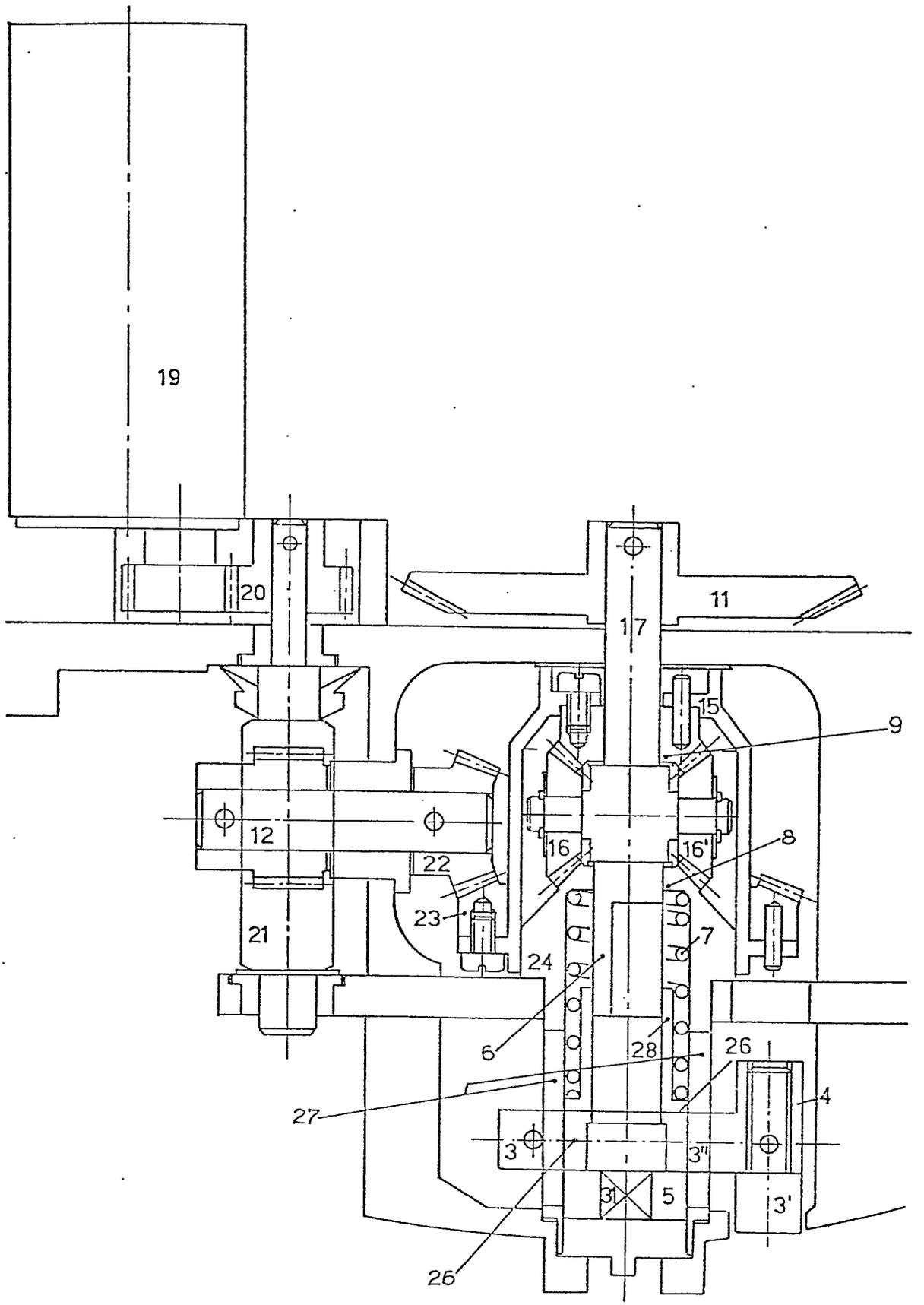

FIG. 1

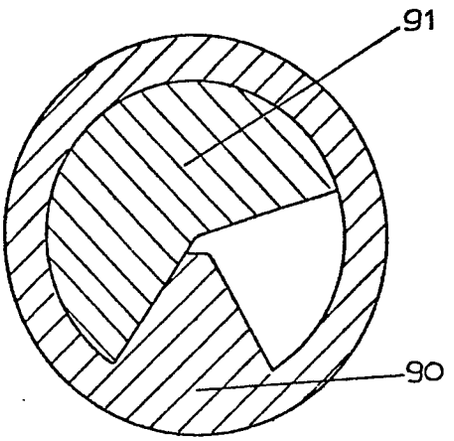

FIG. 2

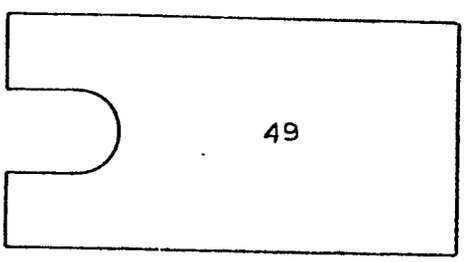

FIG. 5

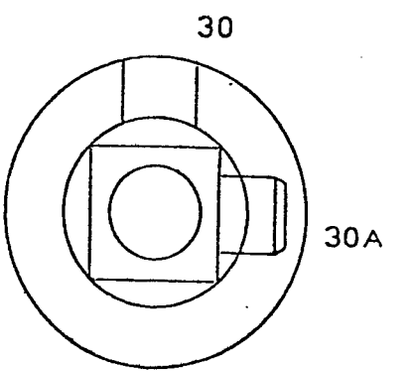

FIG. 3

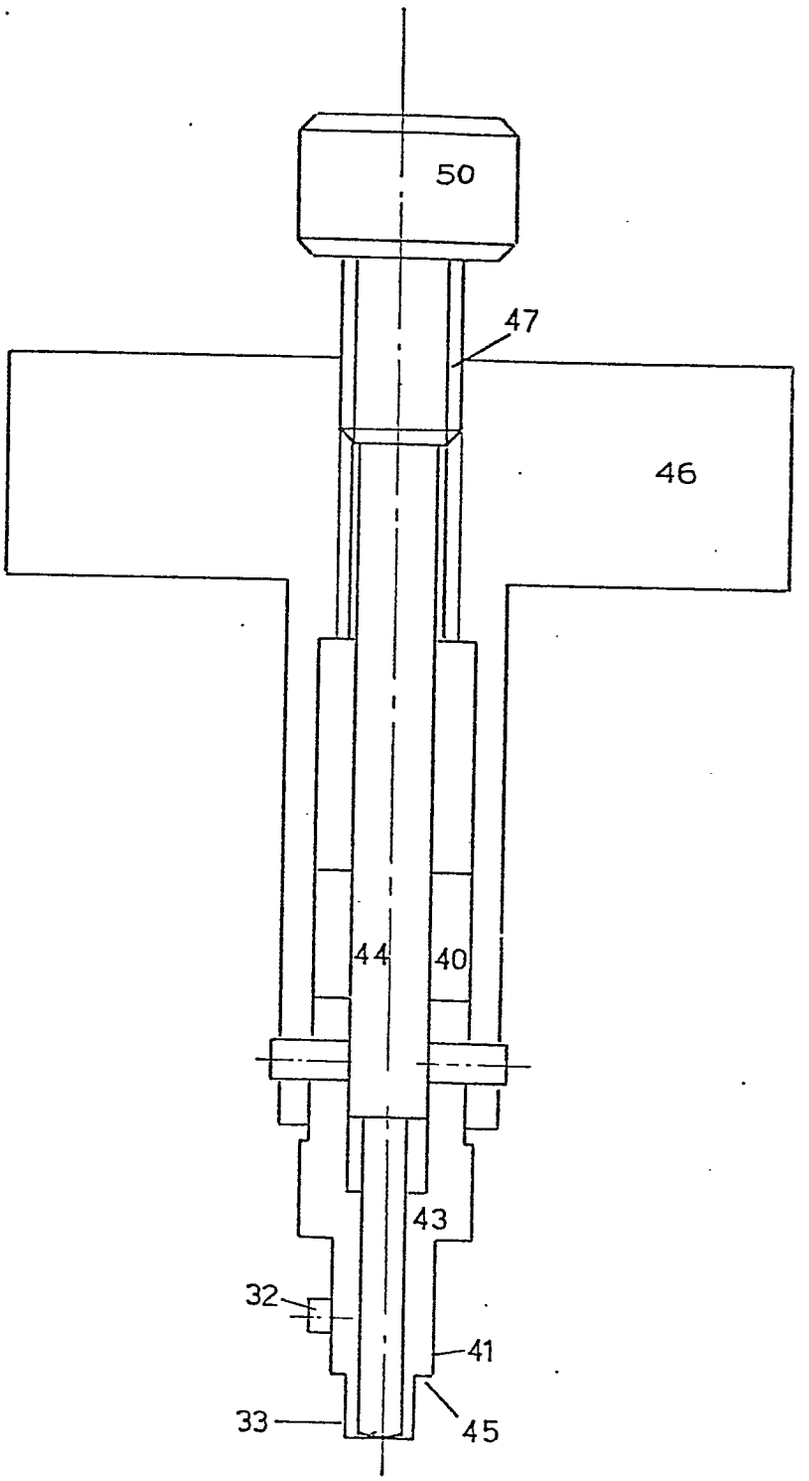

FIG. 4