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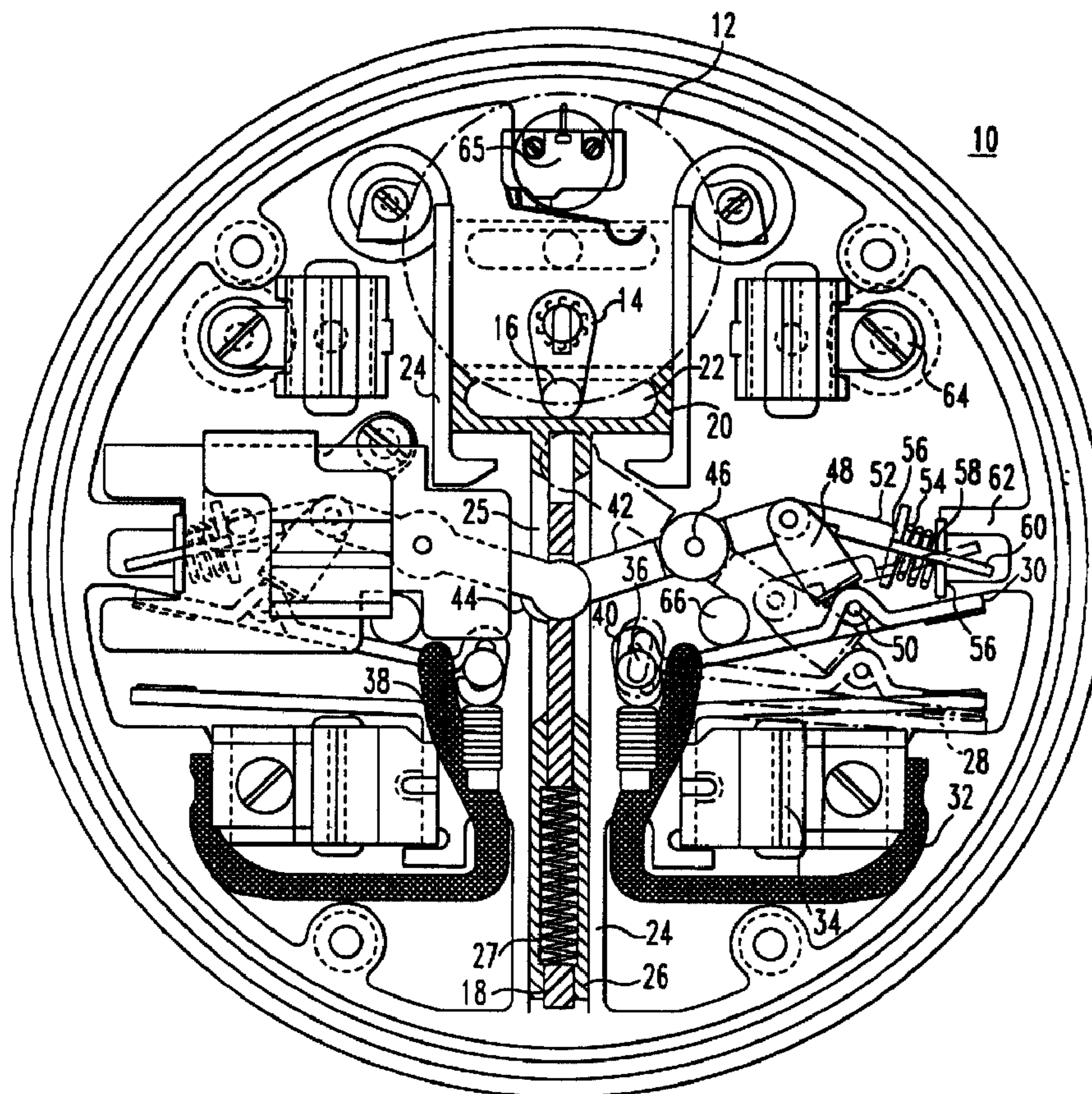
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(54) Title: REMOTELY OPERATED METER DISCONNECT SWITCH



(57) Abrégé/Abstract:

Multiple pairs of stationary and moveable contacts are toggled simultaneously between an open and closed position to disconnect or connect a meter from or to a line power source, by a reciprocating operator driven by low power clock motor. The operator is



(57) **Abrégé(suite)/Abstract(continued):**

connected to the contacts through a series of pivotally coupled toggle links that are spring biased to maintain the contacts in either of two stable states, open or closed. The disconnect switch is housed as a modular unit that is interposed between the meter socket and the meter. The switch is remotely actuated and cycles the motor through a pre-determined number of degrees of rotation sufficient to change the state of the contacts.

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ABSTRACT OF THE DISCLOSURE

Multiple pairs of stationary and moveable contacts are toggled simultaneously between an open and closed position to disconnect or connect a meter from or to a line power source, by a reciprocating operator driven by low power clock motor. The operator is connected to the contacts through a series of pivotally coupled toggle links that are spring biased to maintain the contacts in either of two stable states, open or closed. The disconnect switch is housed as a modular unit that is interposed between the meter socket and the meter. The switch is remotely actuated and cycles the motor through a pre-determined number of degrees of rotation sufficient to change the state of the contacts.

97-MPDA-490

REMOTELY OPERATED METER DISCONNECT SWITCH**BACKGROUND OF THE INVENTION****Field of the Invention**

5 This invention relates generally to disconnect switches for meters and, more particularly, to remotely actuated switches that operate at low power levels.

Background Information

10 There are a number of reasons why it is desirable to disconnect a meter under certain situations. For example, it is desirable to disconnect a meter before the meter is removed from its socket to avoid arcing that could damage the meter electronics. It is also desirable to disconnect power from a meter when servicing the lines into the meter
15 and the corresponding breaker frame. Under certain circumstances, it is also desirable to have the capability to disconnect a meter remotely, such as when electrical service is being discontinued.

20 Typical remotely operated disconnect switches use a form of force generator such as a solenoid or an E-frame magnet commonly used on starters or contactors. These devices require a high level of energy for a short period of time to effectively move electrical contacts to open or close a circuit. The control systems used to power the
25 electronics in a meter are typically solid state devices that have to go to extraordinary means to provide power levels suitable for such solenoids or E-frame magnets.

30 Accordingly, a need exists for an improved disconnect switch that can operate at power levels comparable to those that feed the meter electronics. Furthermore, it is desirable to have such a low power actuated switch that can be operated remotely.

SUMMARY OF THE INVENTION

These and other needs are satisfied by this invention which is directed to a low power motor operated switch which employs a clock motor to reciprocate a shuttle that, in turn, drives a plurality of moveable, electrical contacts between two stable states, open and closed. In one embodiment, the shuttle is slidably and pivotably captured at one end of a crank arm that is fixedly coupled at the other end to and is rotated by the drive shaft of the motor. Rotation of the crank reciprocates the shuttle between fully extended and withdrawn positions. A series of hinged toggle links indirectly connect the shuttle to the contacts and are spring biased in one or the other of the two stable states. The motor is remotely actuated and travels over a selected arc of rotation of the crank to transition the contacts when activated. Thus, the rotation of the crank and the spring bias toggle arrangement provides the mechanical advantage that enables a low power motor to transition the moveable contacts between a closed and open position.

In a preferred arrangement, the connection between the shuttle and the toggle links is spring biased at critical points along the shuttle's path of travel to assist the transition of the contacts from one toggle state to the other. Desirably the connection between the shuttle and the toggle links is accomplished through an internal slide that moves within a channel in the shuttle along the axis of movement of the shuttle. The ends of the toggle links are captured within a portion of the slide. Force is preferably imparted from the shuttle to the slide through an activation spring that is captured by both the slide and the shuttle. Additionally, in the preferred arrangement, the shuttle is connected to the crank in a manner that enables it to reciprocate collinear with a fixed axis, to impart the maximum force available to transition the toggle links. This movement of the shuttle to the extremes of its travel compresses the drive spring and applies the necessary force to the slide, and through the slide to the toggle links, to transition the contacts.

In another embodiment, a remote indication is provided when the contacts have made the transition. When the contacts are in the closed position, added spring bias is applied to improve electrical conduction. Desirably, the motor is operable at wattage levels comparable to those that power the meter electronics. In this way, a low current drive mechanism is able to transition the contacts and maintain good electrical continuity during meter operation.

BRIEF DESCRIPTION OF THE DRAWINGS

A full understanding of the invention can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

Figure 1 is a top view of the motor operated meter switch of this invention, partially in section;

Figures 2A through I are schematic top views of the shuttle, slide and contactor of this invention, which illustrate the movement of the toggle linkage as the shuttle is reciprocated by the clock motor; and

Figures 3A and 3B, respectively, show schematic views of the slide and shuttle of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention takes advantage of a low energy clock motor and mechanical leverage of a bi-stable toggle arrangement to provide a low power, remotely operated disconnect switch for an electrical meter. The low power drive is provided by a clock motor 12 having a rotating armature that turns a crank 14, as shown in Figure 1. At a point spaced from the crank's connection to the armature, the rotating crank supports a post 16, which is slidably captured within a horizontal slot 22 in the upper portion of a shuttle 20. The shuttle 20 is slidably supported at its upper end along its path of travel by the guide walls 24. The extended length of the shuttle 20 below the slot 22, includes an internal channel that houses the moveable slide 18. As the crank 14 rotates, the post 16 forces the shuttle 20 and slide 18 to move up and down within guide walls 24 as the post 16 moves back and forth within the shuttle slot 22. The channel within the shuttle 20 also includes a slide

spring retainer 26 which captures an activation spring 27. The activation spring 27 is also captured within a corresponding, defined region 23 of the slide 18, which can be better appreciated by reference to Figures 2A-I and 3B. As the shuttle 20 is driven downward, the activation spring 27 is compressed between the upper end of the retaining section 26 of the interior channel of the shuttle 20 and the lower surface of the spring retaining section 23 of the slide 18, as can be appreciated from Figure 2G. Similarly, as the shuttle 20 is driven upward, as in Figure 2A, the activation spring 27 is compressed between the lower end of the shuttle 20 spring containment area 26 and the upper portion of the spring containment section 23 of the slide 18. The purpose the activation spring 27 serves will be described more fully hereafter.

The motor operated switch 10 is provided with two sets of moveable contacts; each having a stationary contact 28 and a moveable contact 30. The moveable contact 30 is provided with an elongated aperture 40 at its hinged end which is captured by a pivot pin 36 with an enlarged head. The slidable hinge 40 is an oblong opening that is biased by a recessed spring 38 that urges the moveable contact arm 30 into engagement when the contacts are closed, to assure good electrical conduction. In its open position, the moveable contact rests against a stop 66. A flexible lead 32 electrically connects the moveable contact to a female plug 34 that is designed to mate with a corresponding male component on the meter assembly. A solid connection is made between the stationary contact 28 and a male component, not shown, on the reverse side of the motor driven switch 10. The male component associated with the stationary contact is designed to mate with a corresponding female socket on the base that is connected to the power line.

An operating arm 42 extends through an opening in the walls of the shuttle 20 and is slidably captured at one end 44 within a slot in the slide 18. The operating arm 42 is also connected through a central pivot 46 to the base of the motor operated switch 10. The other end of the operating arm 42 is pivotably connected to a lower toggle

link 48 which is pivotally connected at its other end 50 to the moveable contact 30. A toggle lever 52 is rotatably connected at one end to the juncture of the operating arm 42 and the lower toggle link 48. The other end 60 of the toggle lever 52 is slidably connected to an anchor 58 which captures a spring 54 between plates 56 and 58. The right hand spring capture plate 58 is held in position by a base mold feature 62. The operating arm 42, lower toggle link 48, toggle lever 52 and spring 54 form a toggle assembly having two stable states, which either places the contacts 30 and 28 in a closed or open position as will be appreciated more fully hereafter. It should also be appreciated that the other contact assembly is a mirror image of that just described.

A switch 65 is positioned over the upper portion of the shuttle 20 and is activated when the crank turns to its upward position bringing the upper surface of shuttle 20 in position to trip the lever arm of switch 65 to provide a remote indication that the motor driven switch is in the closed position. The motor is activated remotely by a latching relay which causes the shuttle to move until it hits a limit switch positioned at or just passed the point in the shuttle's 20 travel that causes the contacts to transition. Similarly, a second latching relay is activated to energize the motor 12 to move the shuttle until it hits a second limit switch positioned at the point of the cycle where the contacts again transition. Limit switch 65 can serve one of the limit switch functions. Though not shown, a similar circuit arrangement can be found in United States Patent No. 5,905,239 entitled "Motor Operator With Burn-Out Protection" (Docket No. 97-PDC-433). Alternatively, a timed on cycle can be used in place of the limit switches. The motor driven switch 10 is fastened to the meter base terminals containing the power line connection, by the electrical connectors 64. The meter, in turn, is fastened to the housing of the motor driven switch 10. Thus, the motor driven switch 10 forms a plug-in option. Each of the modules, meter, switch and base, also has a mating outwardly protruding lip at the

module interfaces that are captured within a stainless steel channel ring that extends around the circumference of each mating lip pair and is locked in position with a seal to secure the modules in place.

5 Figure 2A through 2I illustrate in 30_ increments the transitioning of the moveable contact 30 as the crank 14 rotates through a 360_ cycle. Reference characters are provided in Figure 2A that correspond to the reference characters illustrated in Figure 1 for convenience, though
10 it should be appreciated that the same reference characters apply to the corresponding individual elements illustrated in Figures 2B through Figure 2I. Figure 3 provides another view of the slide 18 and shuttle 20 illustrating the opening 25 through which the operating arms 42 extend. Figure 3B
15 provides a better view of the extended end of the slide 18 and its spring retaining region 23 and slot 19 through which the operating arms 42 extend. As can be appreciated by reference to Figures 2A-I, the spring 27 reaches its maximum compressed state just prior to the transition of the
20 contacts and assists in forcing that transition.

 Accordingly, the low power clock motor of this invention uses the mechanical advantage provided by internal reduction gears to toggle the contacts 28 and 30 between open and closed positions in an application where the speed
25 of the transitioning of the contacts is not critical. This is achieved with an assembly that is relatively inexpensive to manufacture.

 While specific embodiments of the invention have been described in detail, it will be appreciated by those
30 skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the
35 invention which is to be given the full breadth of the claims appended and any and all equivalence thereof.

What is claimed is:

1. A meter having a solid state component and which comprises a disconnect switch comprising a moveable contact and a low power motor for positioning said moveable contact to a first position which connects a power line to said meter or to a second position which disconnects said power line from said meter, the motor operating at a current level having an order of magnitude substantially the same as that energizing said solid state component, said disconnect switch being a modular option adapted to be plugged in between an input of said meter for said power line and said power line.
2. The meter of claim 1, wherein the meter is connected to the power line by a plurality of separate, moveable contacts, the motor moving said contacts substantially simultaneously.
3. The meter of claim 1, wherein the first and second positions of the moveable contact represent two stable, discrete states.
4. The meter of claim 1, wherein the motor comprises:
 - a clock motor having a rotatable shaft;
 - a crank fixedly connected at a first location thereon to said shaft;
 - a shuttle-operating member slidably connected at a second location on said crank, said first location being spaced from said second location to enable said shuttle to reciprocate on rotation of said shaft; and
 - a bi-stable toggle link having one end connected to the moveable contact and another end in force communication with said shuttle, reciprocation of said shuttle causing said toggle link to transition between two stable states thereby creating a mechanical leverage or advantage which causes said moveable contact to transition between its first and second positions.

5. The meter of claim 4, wherein an operating member of the motor moves along a linear path.

6. The meter of claim 5, wherein the motor includes:
a crank arm fixedly connected at one end to the shaft,
a post attached on said crank arm at a location spaced from said end connected to said shaft,
the operating member having an upper portion with a slot, oriented substantially perpendicularly to the axis of movement of said operating member, that slidably captures the post, and
a guide for guiding said operating member along the linear path as said shaft rotates.

7. The meter of claim 6, wherein the operating member defines an inner hollow channel along its axis of movement and within said channel a spring-confining region including:

an elongated sliding member, having a spring-support portion, slidably received within said channel and having a portion thereof in force communication with the toggle link, and

an activation spring surrounding and captured within said spring-support region and retained in position within said spring-confining region of said channel.

8. The meter of claim 4, comprising means for deactivating the motor after the moveable contact transitions between its first and second positions.

9. The meter of claim 8, wherein the motor deactivating means is a timing circuit.

10. The meter of claim 8, wherein the motor deactivating means senses a predetermined degree of rotation of the crank at or after a point the

moveable contact transitions between its first and second positions and turns off the motor after the transition.

11. The meter of claim 1, wherein a spring serves to urge the moveable contact against a second stationary contact when said moveable contact is in a position to connect the power line to the meter.

12. The meter of claim 1, wherein the switch is operated remotely.

13. A modular disconnect switch for connecting or disconnecting a power line to a meter having a solid state component, said switch comprising a moveable contact and a lower power motor for positioning said moveable contact to a first position which connects a power source to said meter or to second position which disconnects said power source from said meter, said motor operating at a power level having an order of magnitude of substantially the same order as that of a power level used to energize said solid state component of said meter and said disconnect switch being adapted to be plugged in between an input of said meter for said power line and said power line.

14. The switch of claim 13, wherein the motor and the moveable contact are seated and supported within a housing having a base one side of which is fashioned to interface with a meter socket while at its other side said housing is fashioned to interface with said meter thereby enabling said switch to be directly plugged into said socket and said meter directly plugged into said switch.

15. The switch of claim 14, comprising means for anchoring said switch to the meter socket.

97-mPDA-490

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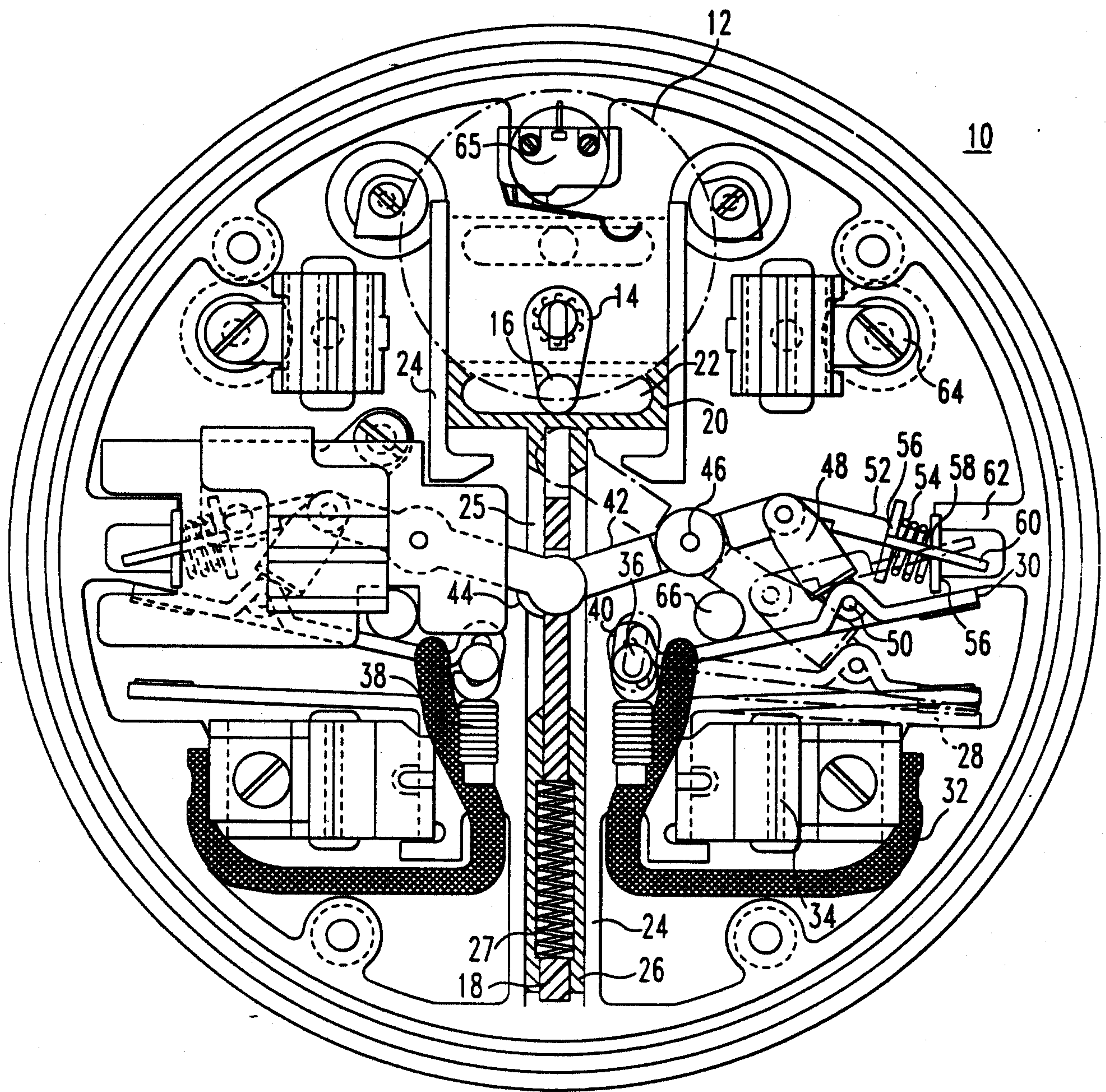


FIG. 1

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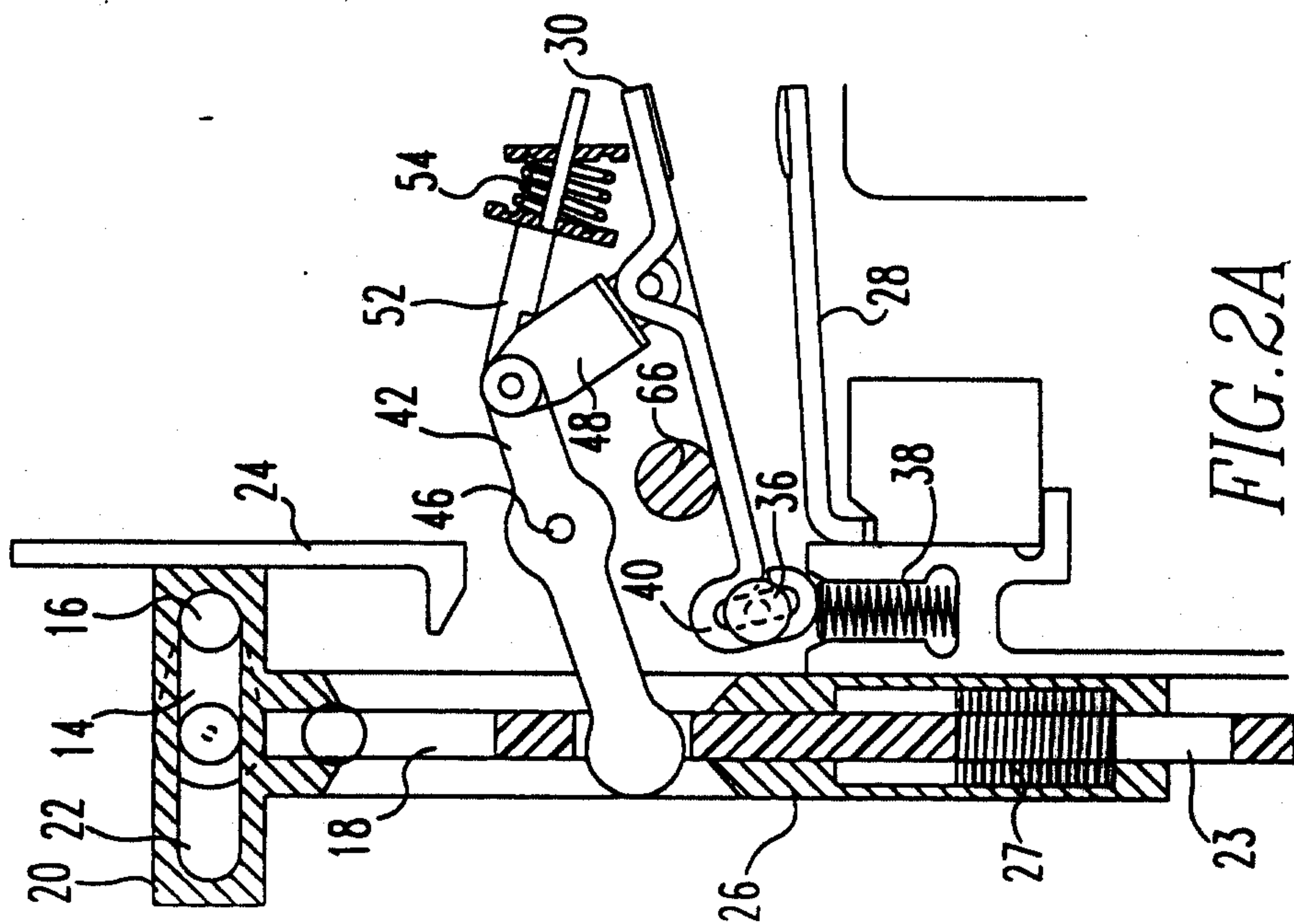


FIG. 2A

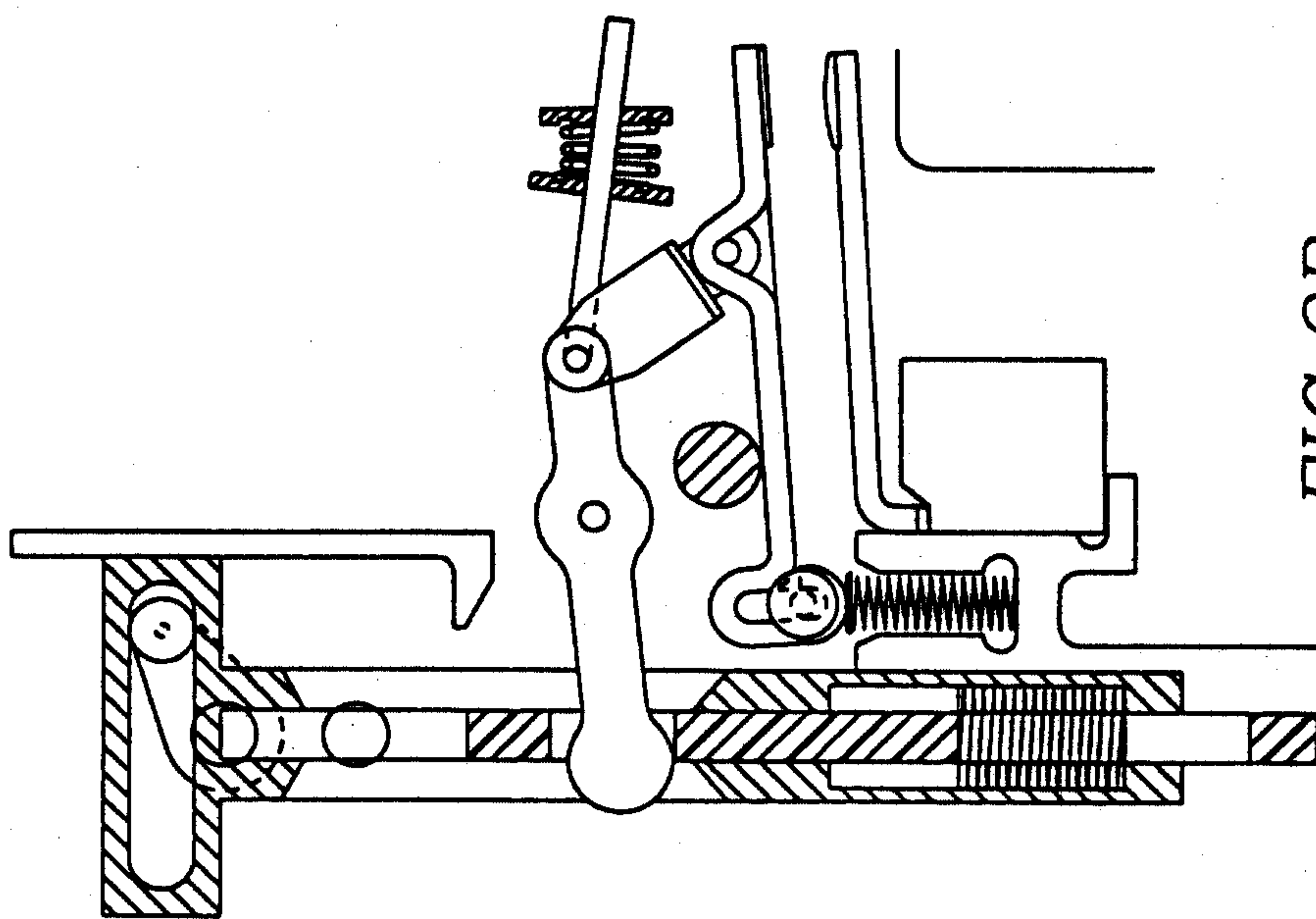


FIG. 2B

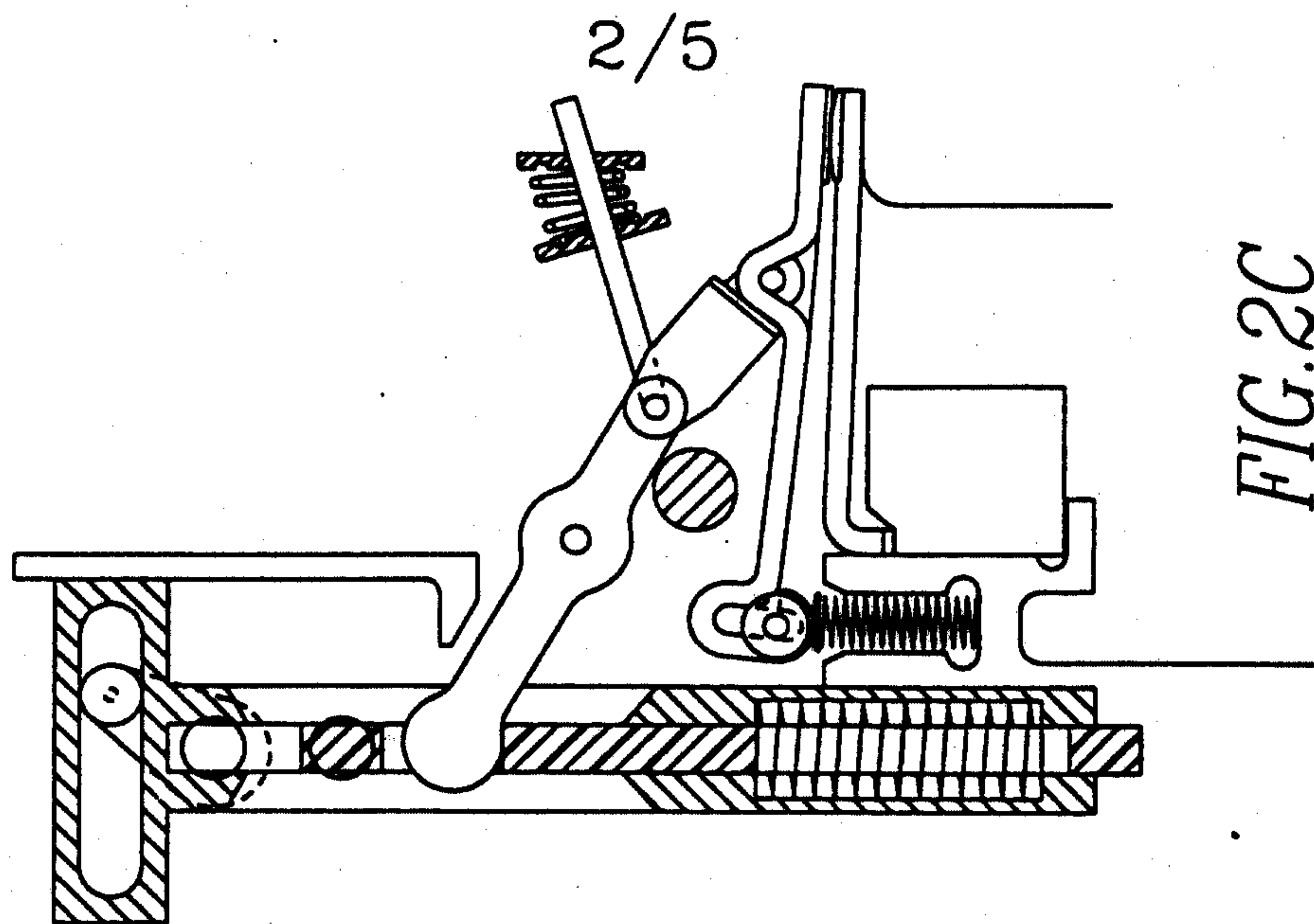
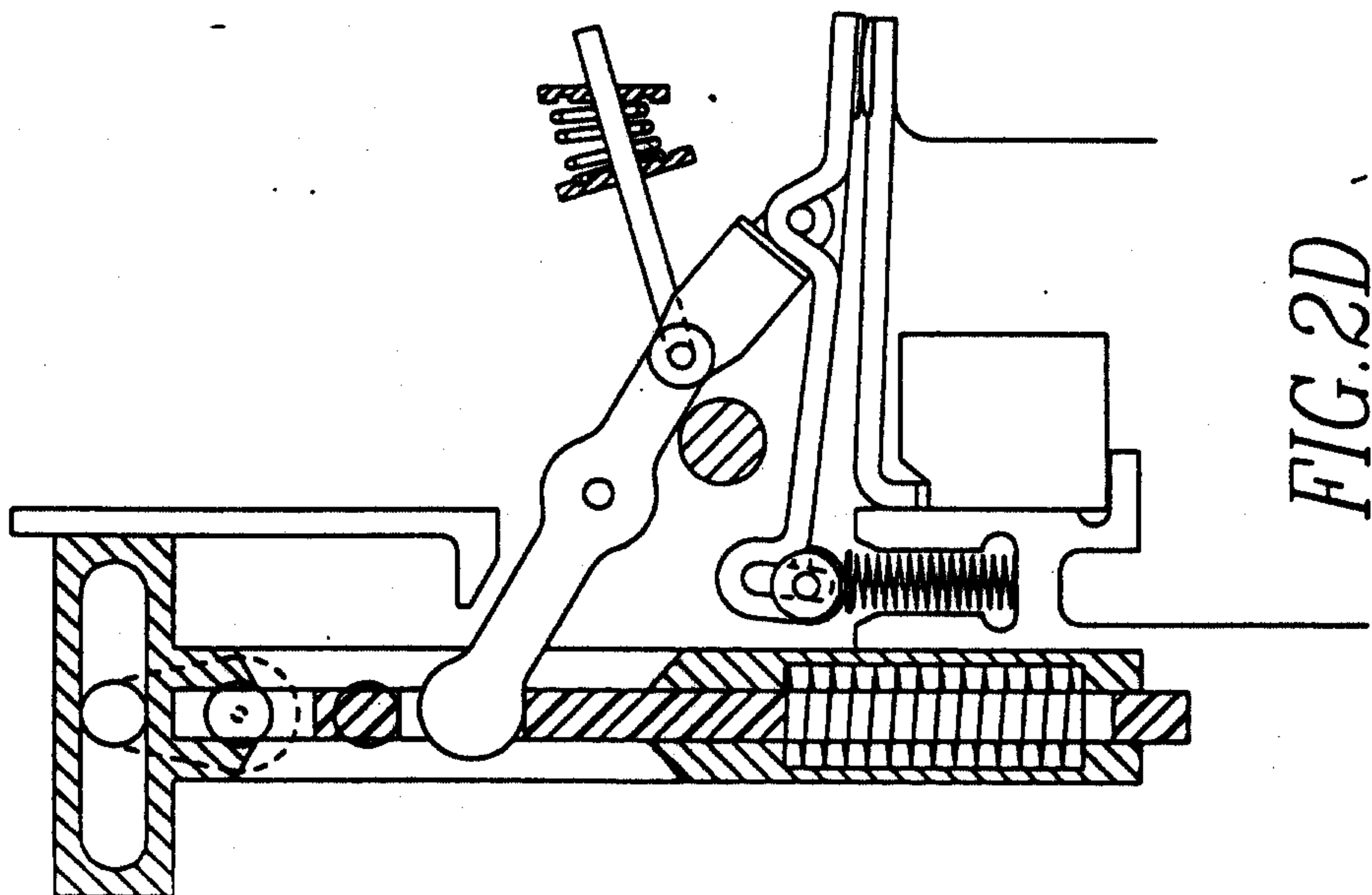
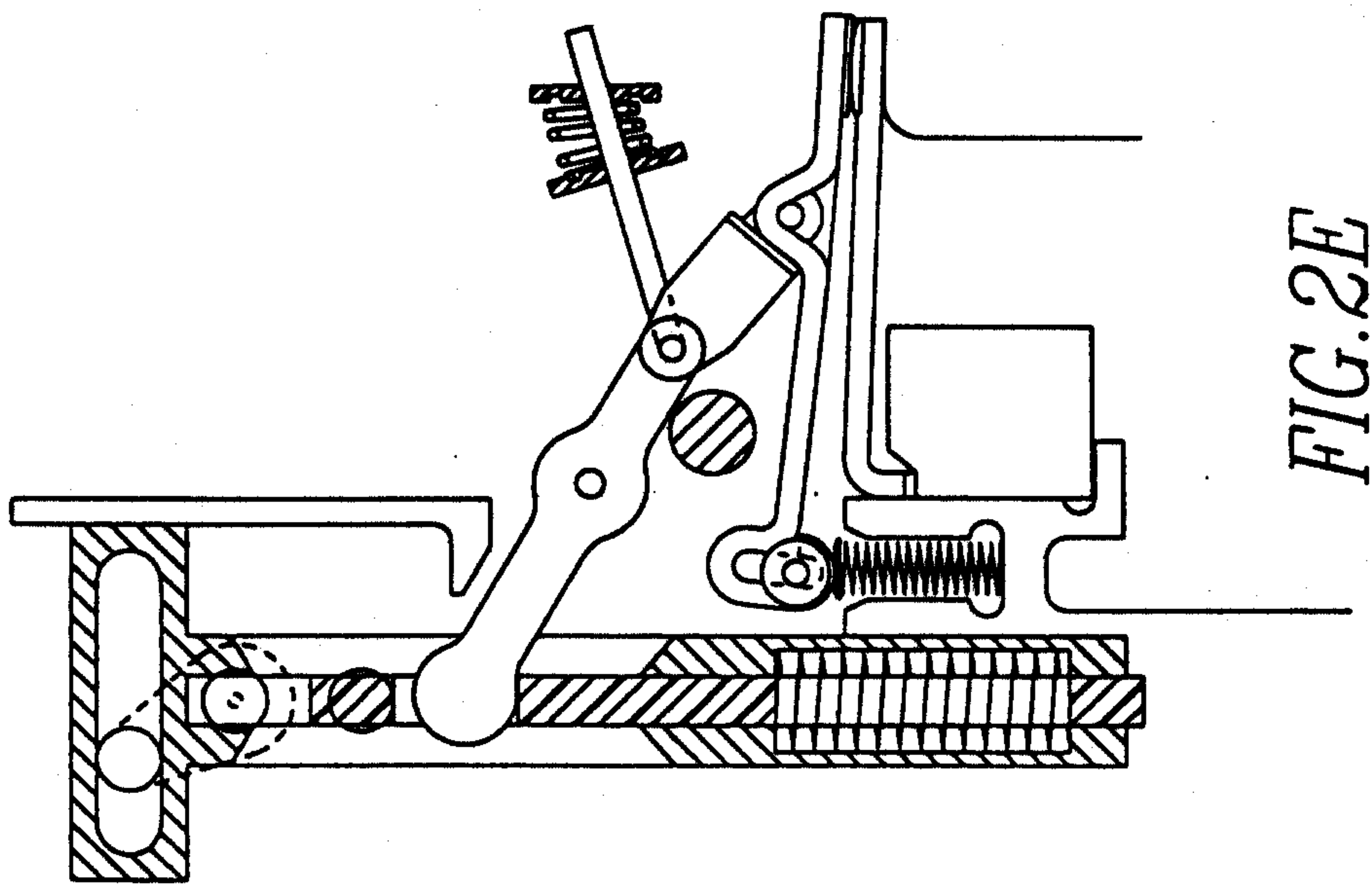
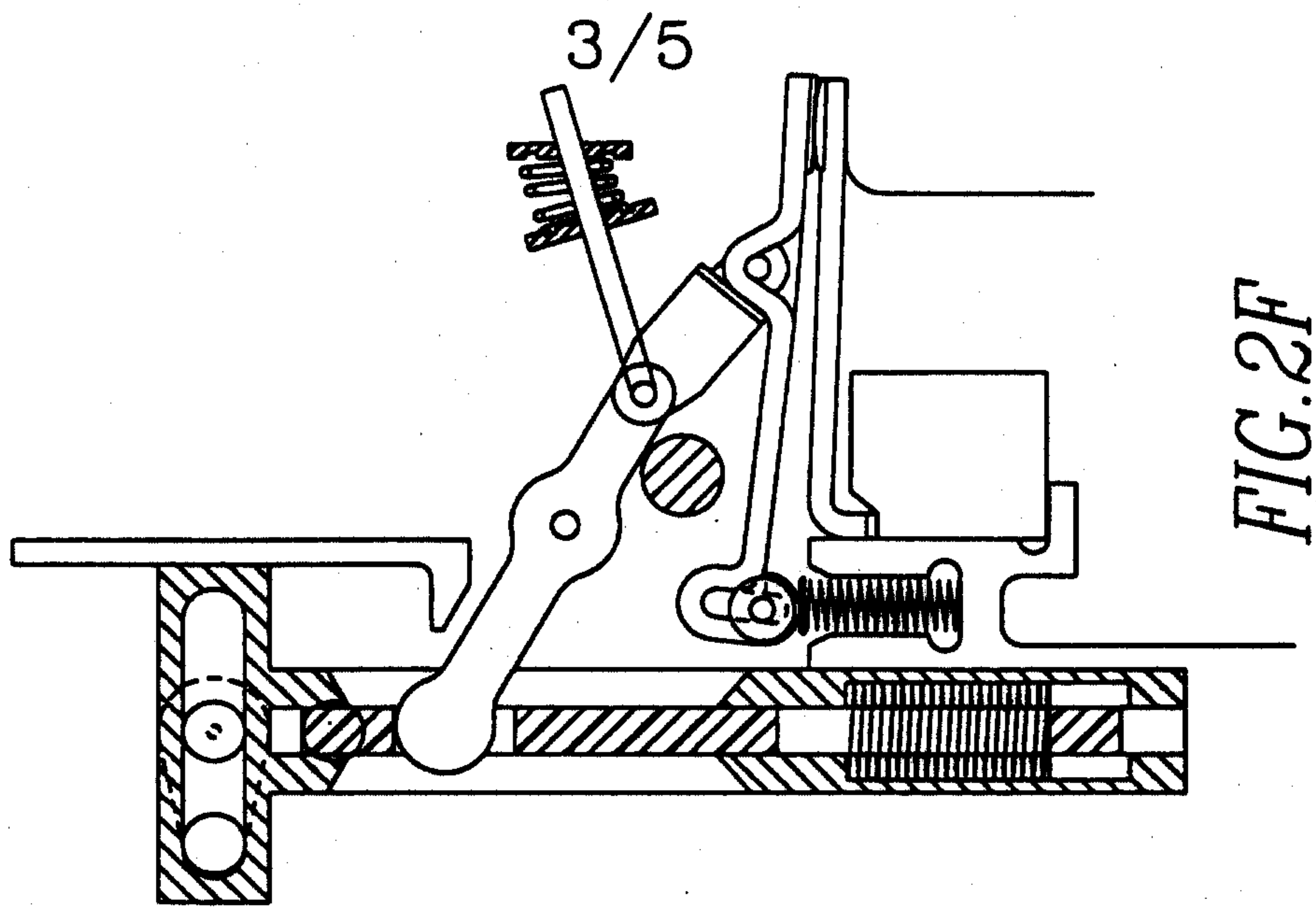
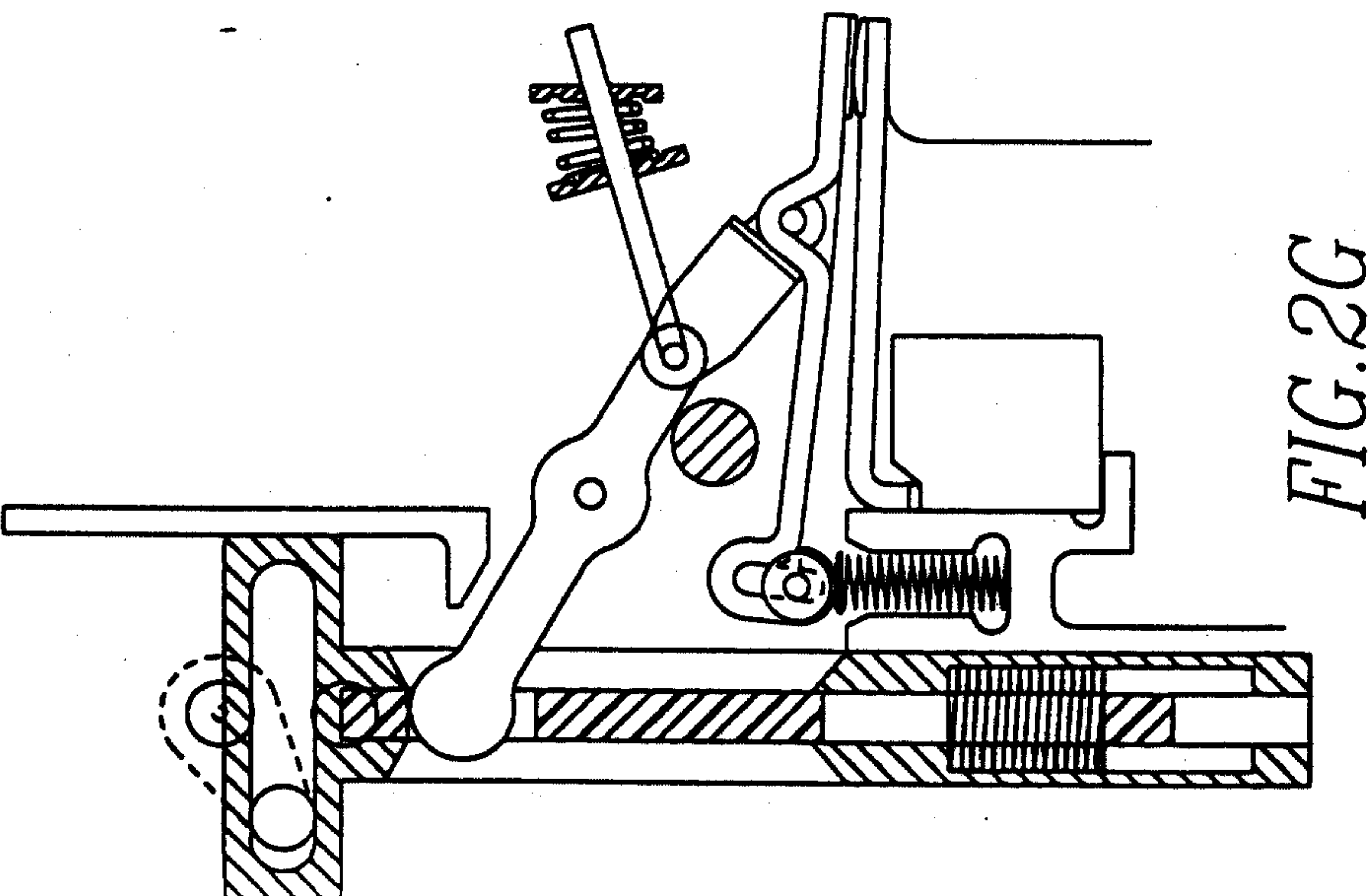
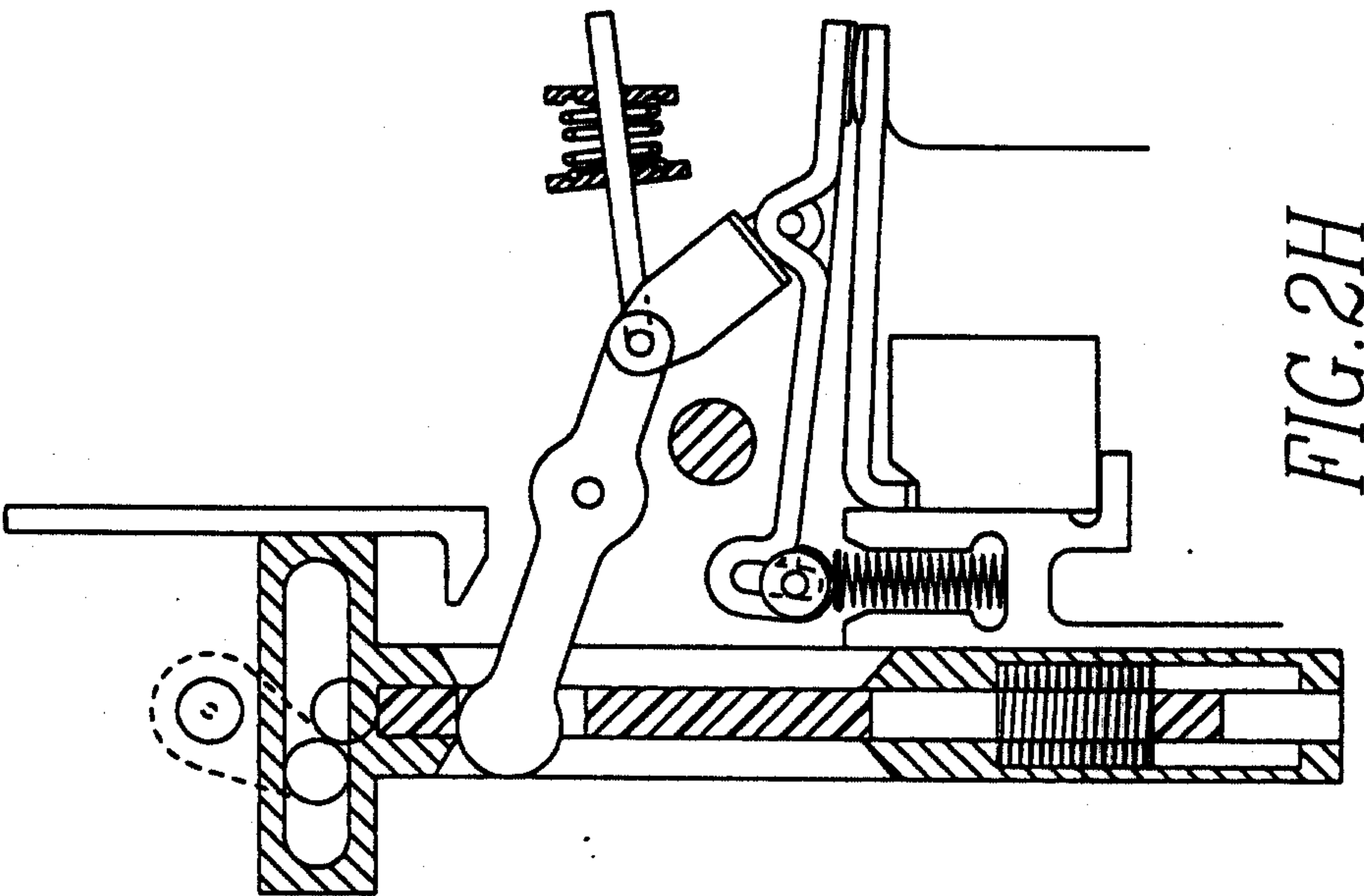
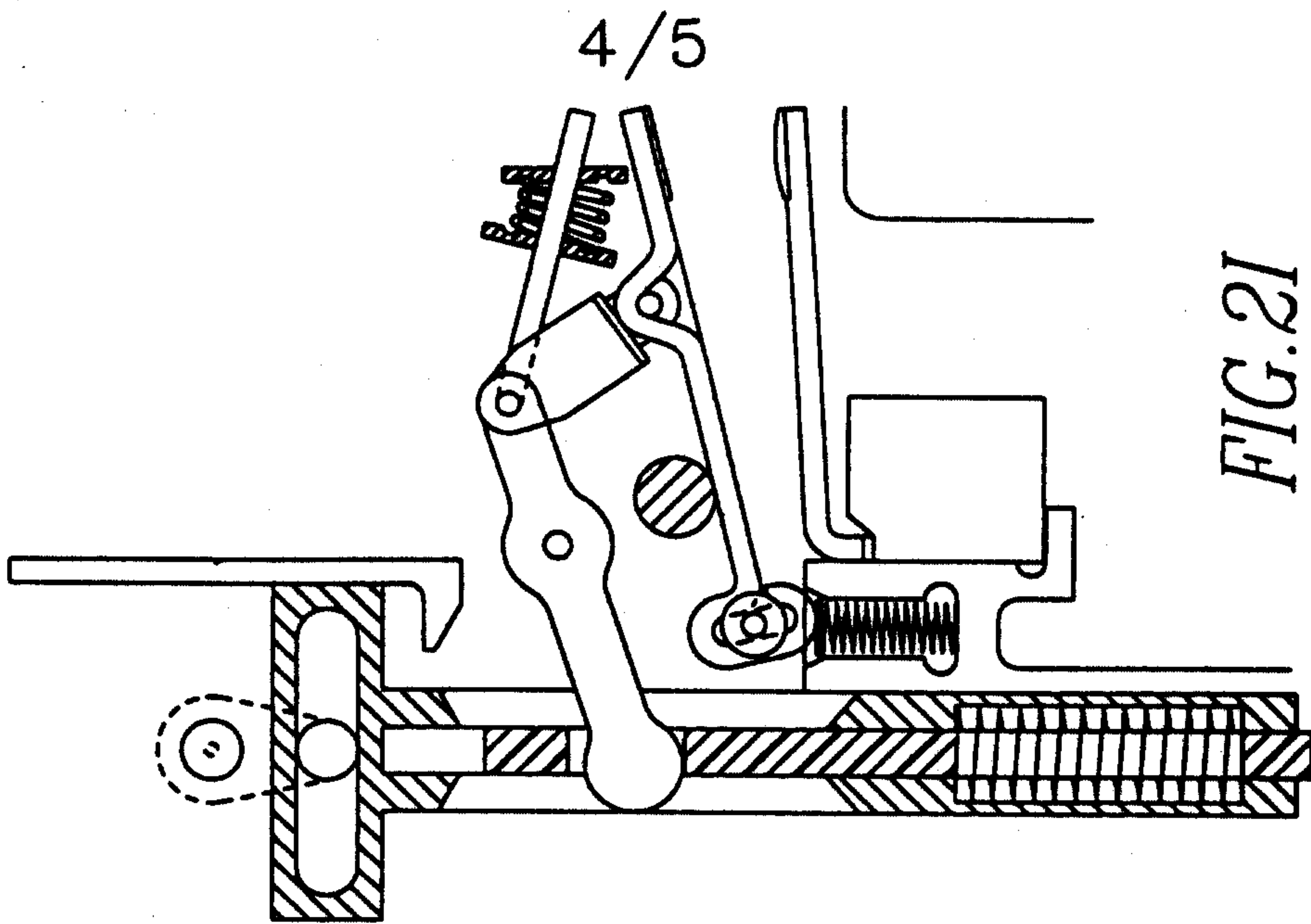


FIG. 2C

97-mPDA-490



97-mPDA-490



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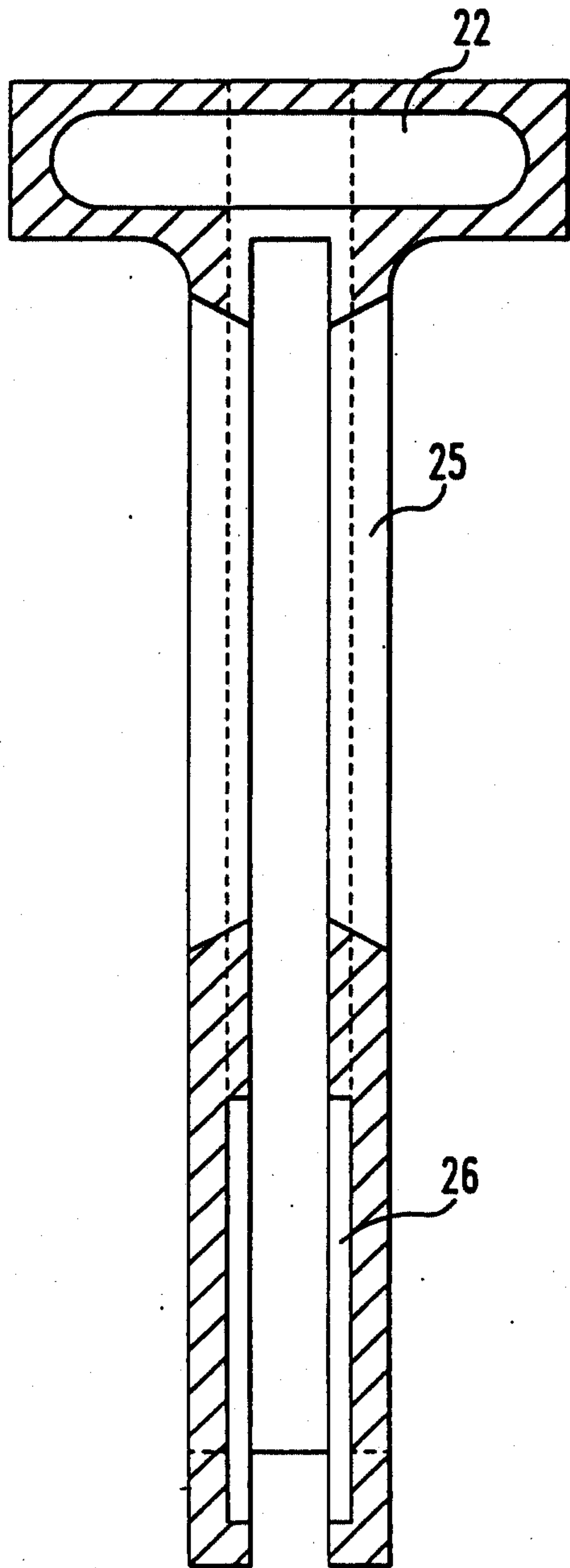


FIG. 3A

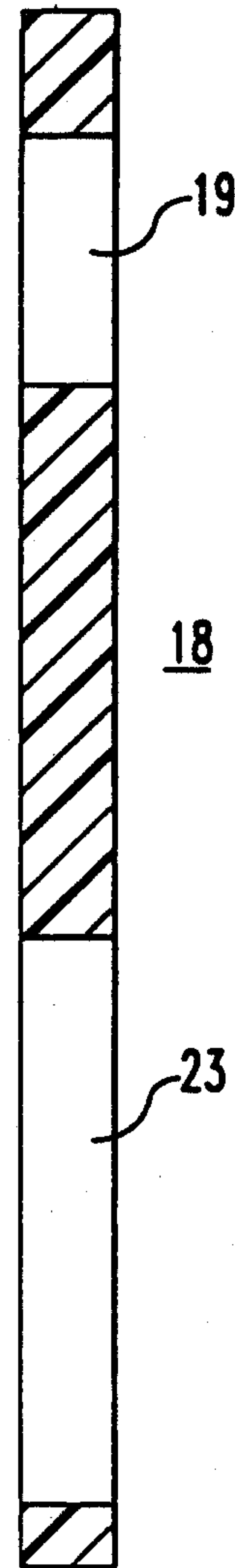


FIG. 3B

