July 13, 1954 R. E. DISHMAN 2,683,779

SAFETY CONTROL MECHANISM SWITCH

Filed Feb. 10, 1950 6 Sheets-Sheet 1

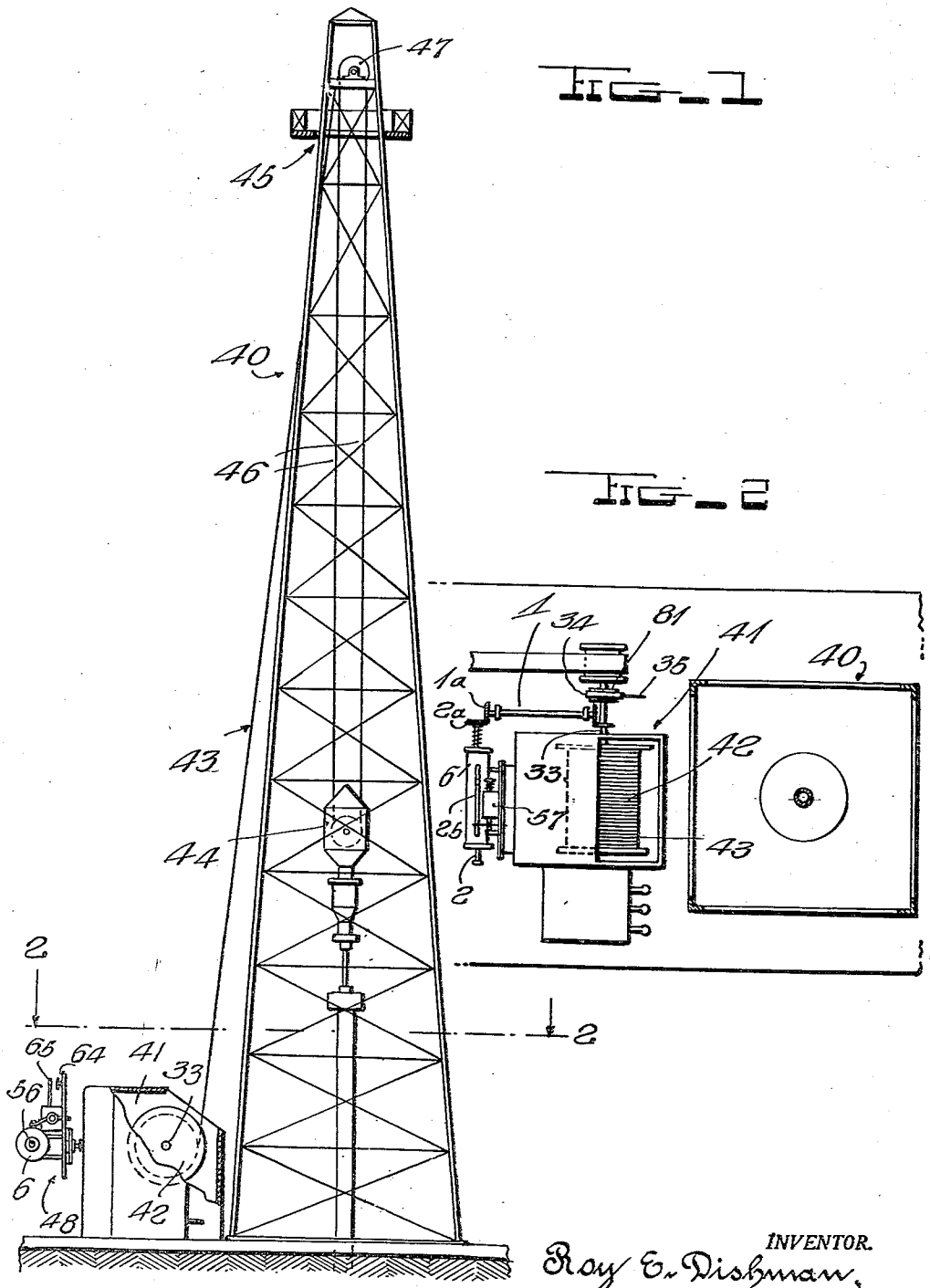



FIG. 1



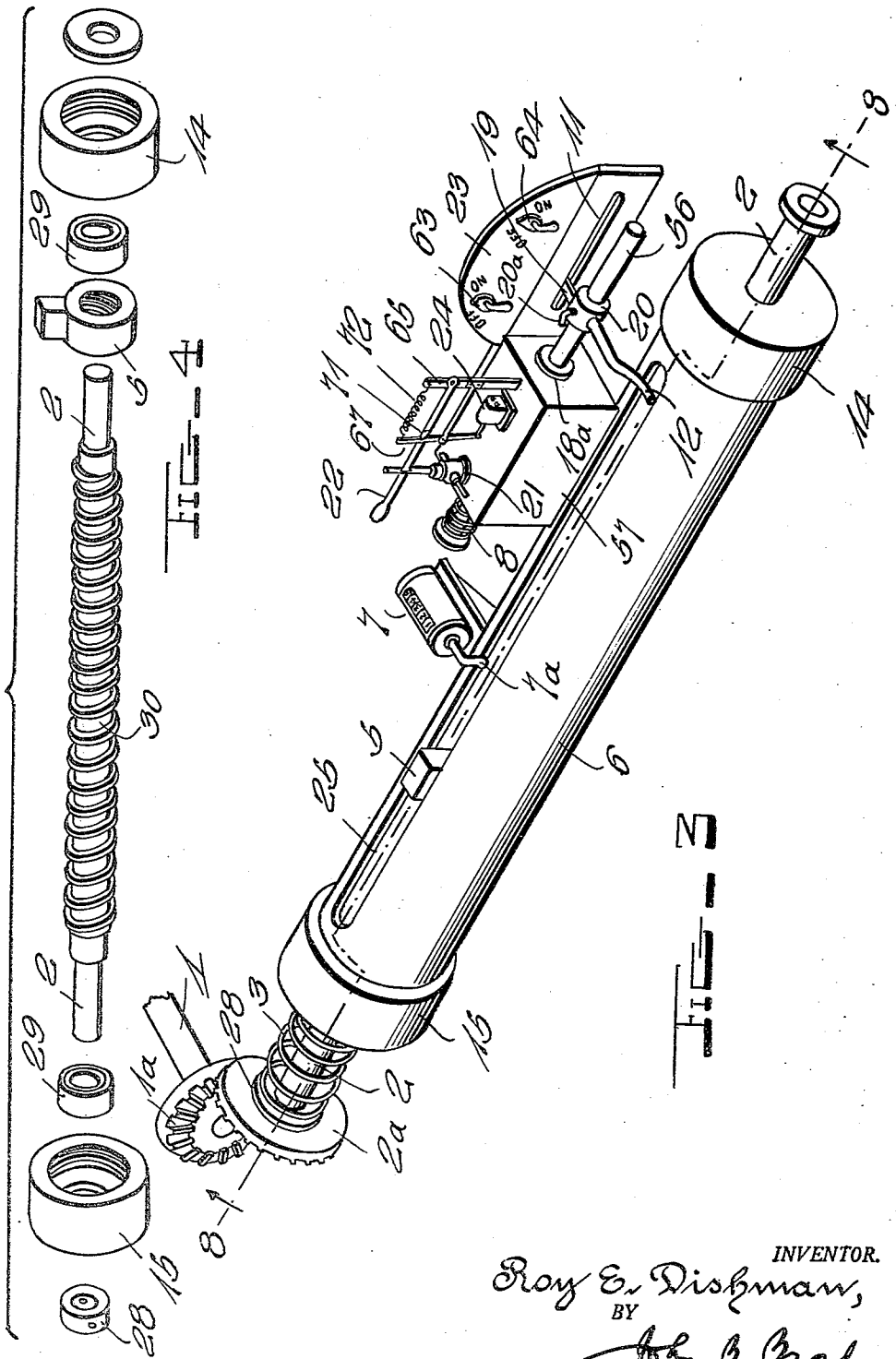

FIG. 2

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SAFETY CONTROL MECHANISM SWITCH

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SAFETY CONTROL MECHANISM SWITCH

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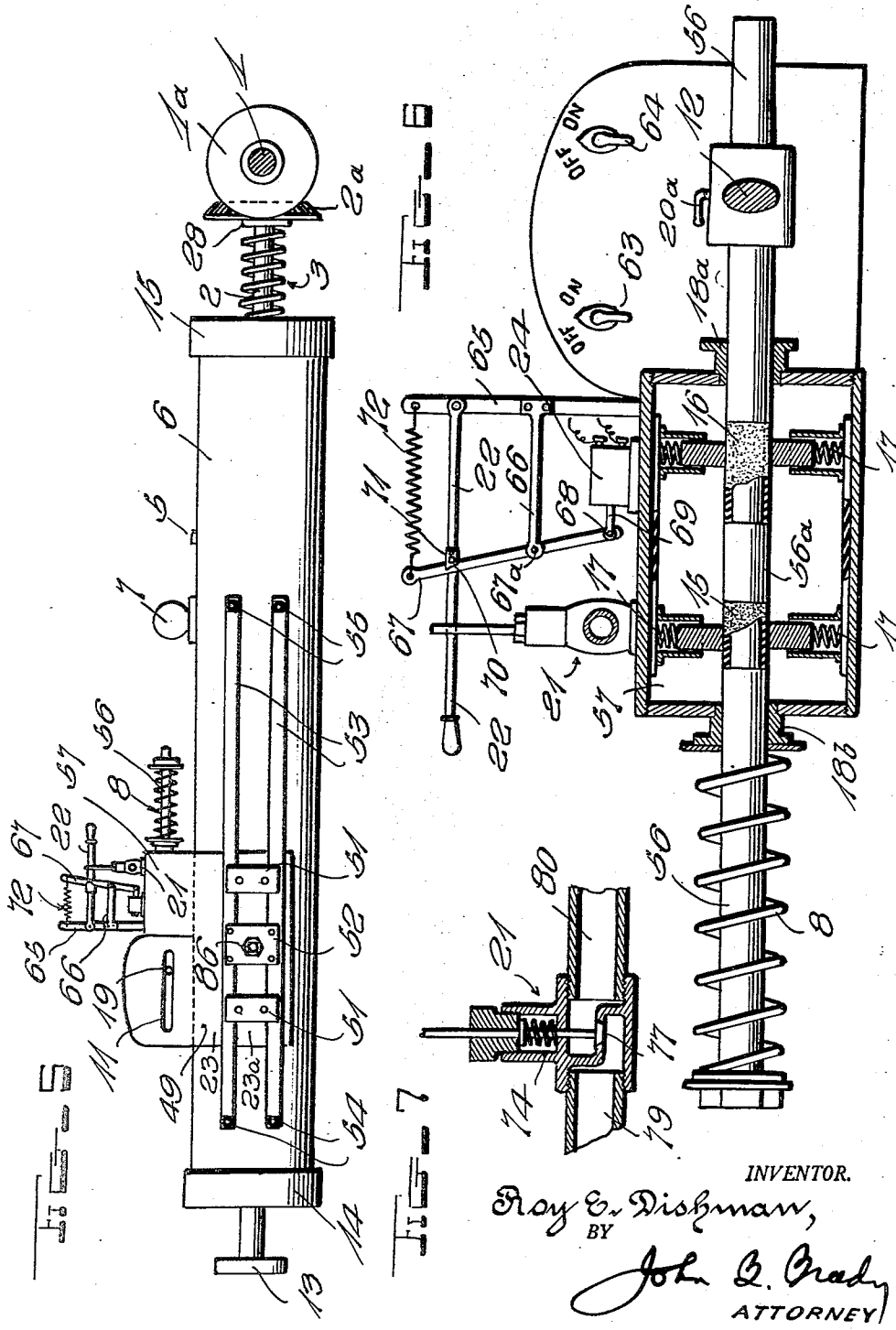



FIG. 5

FIG. 6

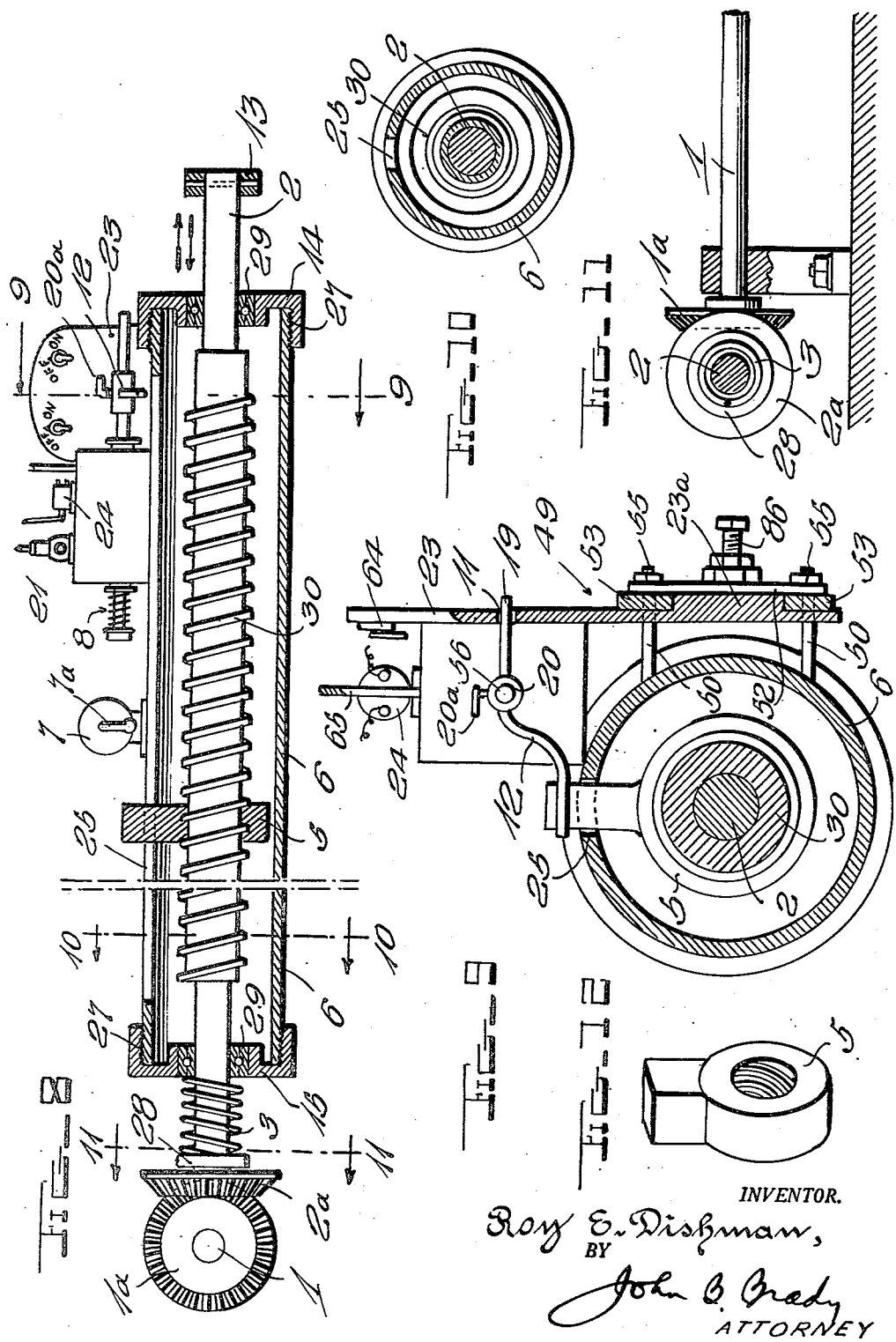
FIG. 7

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SAFETY CONTROL MECHANISM SWITCH

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SAFETY CONTROL MECHANISM SWITCH

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FIG. 13

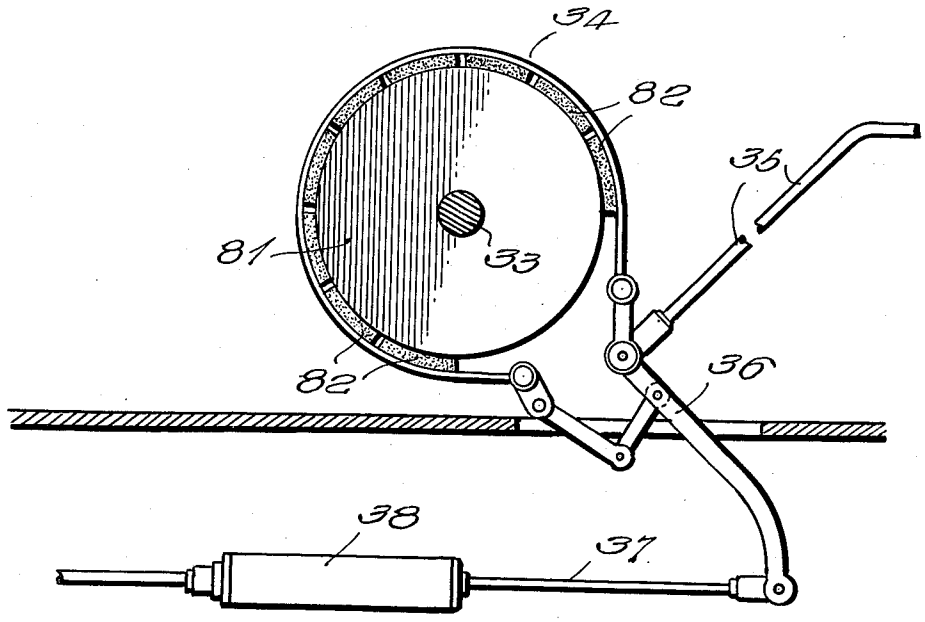
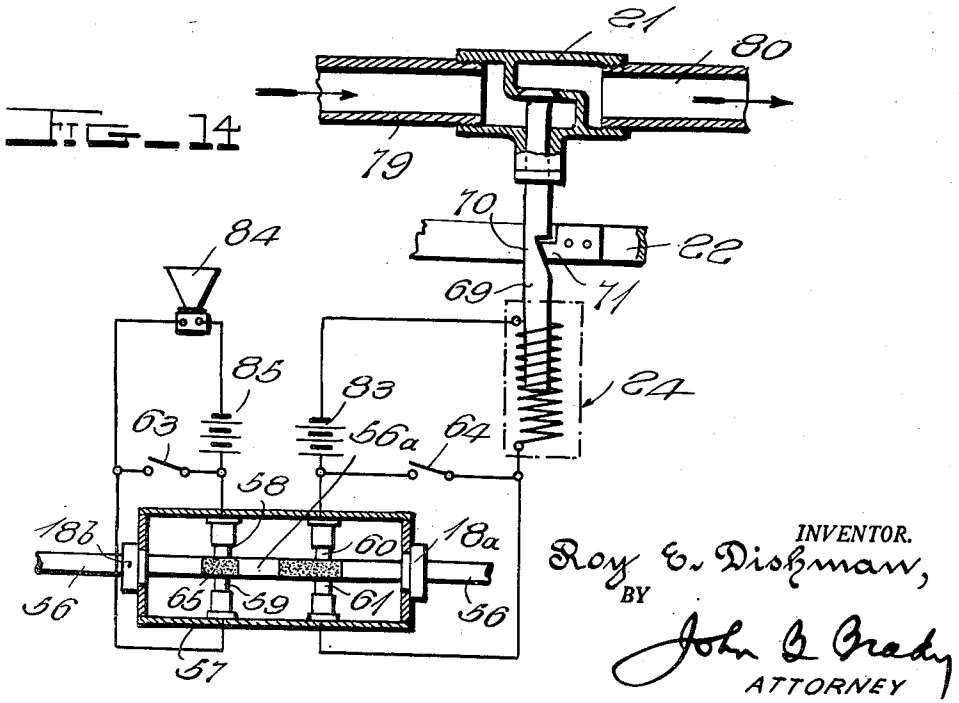



FIG. 14




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FIG. 15

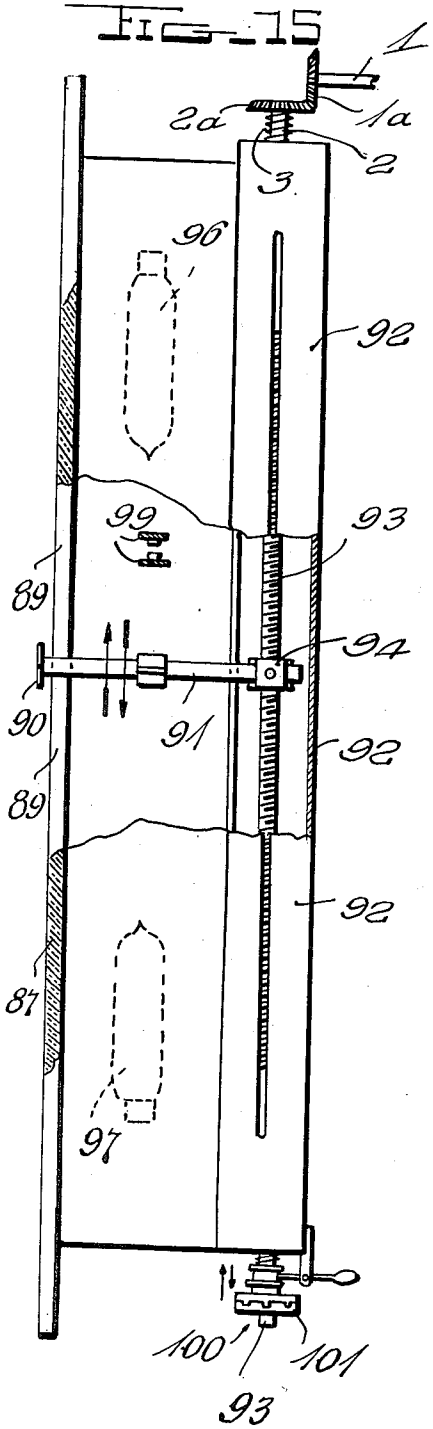
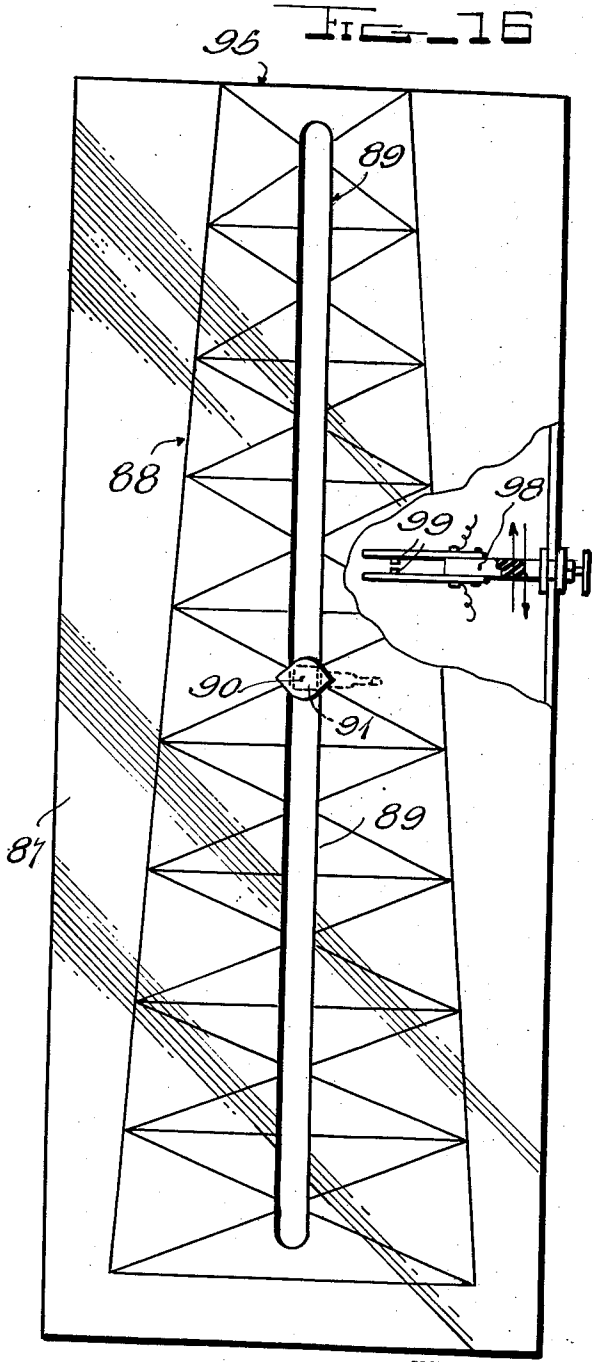



FIG. 16




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# UNITED STATES PATENT OFFICE

2,683,779

## SAFETY CONTROL MECHANISM SWITCH

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Application February 10, 1950, Serial No. 143,566

2 Claims. (Cl. 200—47)

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My invention relates broadly to oil and gas well equipment, and more particularly to indicator, alarm and safety control mechanism for drilling rigs used in the petroleum industry.

One of the objects of my invention is to provide a construction of indicator for drilling rigs which represents in similitude the movement of the traveling blocks vertically through the drilling derrick for informing the draw-works operator on the ground of the approach of the traveling blocks with respect to the crown block in the derrick.

Another object of my invention is to provide a construction of visual indicator, electric alarm controller, and valve control mechanism for use in connection with the operation of oil and gas well derricks for indicating the approach of the traveling blocks of the derrick with respect to the crown block, sounding an alarm as the traveling blocks approach the ground block and/or actuating control mechanism for shutting down the draw-works under conditions of dangerous approach of the traveling blocks with respect to the crown block.

Another object of my invention is to provide an arrangement of indicator by which the draw-works operator of an oil and/or gas well derrick is visually informed at all times of the relative movement of the traveling blocks of the derrick with respect to the crown block of the derrick.

A still further object of my invention is to provide a construction of safety control mechanism for the traveling blocks of oil and/or gas well drilling rigs which is adjustable in accordance with the path of movement of the traveling blocks of the drilling rig for effecting, at a selectively adjustable time, the shutting down of the draw-works under conditions where the traveling blocks may approach a predetermined limit.

Still another object of my invention is to provide a composite electrical circuit and valve operating mechanism controllable in timed relation to the movement of the traveling blocks of a derrick for controlling an electrical circuit closure and/or a valve actuator as the traveling blocks of the derrick move to a predetermined limit for preventing over-travel of the traveling blocks and movement of the blocks into an obstruction with the incident damage and injury which may result from such over-travel.

Still another object of my invention is to provide a precision type screw mechanism adjustable over a wide range of movement for reproducing in similitude the path of travel of the traveling blocks of an oil and/or gas well drilling

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rig and controlling by such simulated movement a countermechanism and electrical circuit and fluid valve control means for recording the travel of the traveling blocks and effecting a warning as the traveling blocks dangerously approach the crown block and automatically cutting off the movement of the traveling blocks under conditions of over-travel thereof, for eliminating danger which might result from collision of the traveling blocks with the crown block.

Other and further objects of my invention reside in the adjustable screw mechanism for an indicator and electrical circuit and valve control mechanism for the draw-works of oil and gas well drilling machinery, as set forth more fully in the specification hereinafter following by reference to the accompanying drawings, in which:

Figure 1 is a schematic view showing the application of the indicator, alarm and safety control mechanism to a drilling rig in accordance with my invention; Fig. 2 is a schematic horizontal sectional view taken substantially on line 2—2 of Fig. 1; Fig. 3 is a perspective view of the control mechanism of my invention; Fig. 4 shows the operating parts of the control mechanism illustrated in Fig. 3 in juxtaposed relation; Fig. 5 is a rear elevational view of the control mechanism shown in Fig. 3; Fig. 6 is an elevational view of the electrical switching mechanism which is operated by the control mechanism illustrated in Fig. 3, certain of the parts being broken away and illustrated in section; Fig. 7 is a fragmentary sectional view through the control valve which is operated by the mechanism illustrated in Fig. 6; Fig. 8 is a longitudinal sectional view through the control mechanism of my invention and showing the assembled relation thereof with the switching and valve operating mechanism of Figs. 6 and 7; Fig. 9 is a vertical sectional view taken substantially on line 9—9 of Fig. 8, the view being taken on an enlarged scale to more clearly show the coaction of the parts; Fig. 10 is a vertical sectional view taken substantially on line 10—10 of Fig. 8; Fig. 11 is a fragmentary view of the gearing associated with the control mechanism, the view being taken substantially on line 11—11 of Fig. 8; Fig. 12 is a perspective view of the travelling nut employed in the control mechanism of my invention; Fig. 13 is a schematic view of the brake control mechanism employed in the system of my invention; Fig. 14 is a schematic diagrammatic view showing the electrical circuit for the alarm and the valve operating mechanism employed in the system of my invention; Fig. 15 is a vertical sectional view of the control mech-

anism of my invention associated with an indicator including a replica of the derrick with which the control mechanism of my invention is associated and Fig. 16 is an elevational view of the indicator shown in Fig. 15.

Mishaps which cause enormous amounts of property damage and fatal injuries to employees occur each year in the petroleum industry due to the driller or the operator allowing the traveling blocks to run into the crown blocks. One major oil company had two men killed and a large drilling contractor sustained $104,000 worth of property damage in such a mishap during 1949. There is a widespread need, therefore, for a device that will prevent these serious accidents.

There have been two devices developed; the first consisting of a photocell device and relays which set off an alarm, and the second consisting of a line that unspools from a spring loaded drum and goes up over the crown block and attaches to the traveling block. Both of these devices are expensive, cumbersome, and have not proved practical and have not been well received by the petroleum industry.

On some wells in the Gulf Coast area, heavy fogs are encountered and it is sometimes impossible for the driller to see more than a few feet up in the derrick. The attachment of my invention alloys the drilling crew to "go in" or "come out" of the hole regardless of fog.

My invention is directed to a simplified construction of indicator alarm control and valve control mechanism which may be readily installed adjacent the operator's position at the draw-works of an oil and/or gas well drilling rig for visually reproducing in similitude the oil well derrick with which the draw-works is associated, and indicating the traveling blocks of the oil or gas well drilling rig and the relative movement thereof with respect to the crown block. The apparatus of my invention includes an electric alarm circuit which is operated to warm the operator of the dangerous approach of the traveling blocks with respect to the crown block of the drilling rig. The mechanism also includes valve control means which are operated automatically for shutting off the power, disengaging the clutch and applying the brake to the draw-works upon continued movement of the traveling blocks, by failure of the operator to respond to the warning signal theretofore sounded upon the approach of the traveling blocks to the crown block.

Referring to the drawings in more detail, Fig. 1 pictorially shows my invention applied to the oil or gas well drilling rig 40, with which there is associated the conventional draw-works 41 having cable winding drum 42 driven through draw-works drum shaft 33 from the conventional draw-works drive mechanism, not shown. The cable winding drum 42 controls the winding and unwinding of the cable 43 for raising and lowering the traveling blocks represented generally at 44 attached to the rig indicated at 45 for controlling raising and lowering of the sections of the well casings or the manipulation of the drill bits. The traveling blocks are controlled by a multiplicity of cables 46 operating over multiple sheaves in the traveling blocks 44 and in the crown block 47.

The attachment of my invention is represented at 48 mounted adjacent the operator's position of the draw-works 41, and includes mechanism shown more particularly in Fig. 3 which is driven from shaft 1, which is gear connected to the draw-works drum shaft 33. The shaft 1 carries a bevel gear 1*a* thereon which meshes with the bevel gear driving shaft represented at 2. I provide a mounting structure for the mechanism operated by bevel gear driving shaft 2, as shown more particularly in Fig. 9 wherein the bracket 49 is adjustably supported with respect to cylindrical housing 6. A pair of rails 53 connect at opposite ends 54 and 55 through bolts 50 with cylindrical housing 6. Plate 52 is attached to the frame of the draw-works 41 through connecting bolt 86 and is fastened to the guide rails 53 on the cylindrical housing 6. A linearly extending track member 23*a* connected with the rear of panel 23 is slidably supported between guide rails 53 associated therewith. Panel 23 is slidably keyed to the rails 53 by plates 51 connected to the rear of track member 23*a*. The cylindrical housing 6 is screw-threaded at opposite ends thereof as represented at 27, for receiving the end cap carrying bearings 4 and 14, which form supporting means for the bearings 29 through which the bevel gear driving shaft 2 extends. Collar 28 is secured in position upon the projecting end of shaft 2 beyond the end cap 4 for generally maintaining shaft 2 in the proper relation to cylindrical housing 6 for presenting bevel gear 2*a* in meshing relation with bevel gear 1*a*. The bevel gear driving shaft 2 carries bevel gear 2*a* on the end thereof which is continuously urged into mesh with the bevel gear 1*a* of the drive shaft 1 by means of the coil spring 3 which continuously exerts a force against the end of the end cap 15 and the rear of the bevel gear 2*a*. The bevel gear driving shaft 2 may thus be continuously driven so long as coil spring 3 maintains bevel gear 2*a* in mesh with bevel gear 1*a*.

The bevel gear driving shaft 2 is provided with a precision spiral screw designated at 30. This screw may be formed of four Acme threads per inch.

The screw 30 drives a travel nut 5 which is engaged thereby, the traveling nut having a transverse projection thereon extending through a slot 25 in cylindrical housing 6, as shown more particularly in Fig. 3. The projection of the traveling nut 5 encounters in the course of its linear travel the angularly shiftable arm 7*a* of the counter mechanism 7. Counter mechanism 7 is a step by step device where arm 7*a* in its movement counterclockwise effects the shifting of one digit successively, but does not effect movement of a digit on the return stroke of the mechanism as arm 7*a* moves in a clockwise direction. An arm indicated at 12 attached to the shaft 56 also projects in the path of the traveling nut 5 and when engaged thereby shifts the shaft 56 against the action of coil spring 8 which normally holds shaft 56 with its controlling electrical contacts thereon in an off position. The traveling nut 5 when contacting the arm 12 tends to shift arm 12 and shaft 56 linearly, for moving the electrical contacts carried thereby in corresponding manner.

In an installation where shaft 2 is 36" long and on the rig on which it is installed, the hoisting drum shaft makes 90 revolutions in carrying the blocks from the lowest position up to the point where the alarm is set to go off. This means that traveling nut 5 travels axially 22½" for this particular rig, which I would say is a typical medium depth drilling rig. On other rigs, this travel may only be about 18 inches while on others the travel may be about 30 inches in

raising the blocks from the floor up to the derrickman's position.

The electrical contacts associated with shaft 56 are carried by housing 57 and are formed by spring pressed sets of contacts 58 and 59 and spring pressed sets of contacts 60 and 61 arranged in insulated relation one with respect to the other and adapted to be bridged by sections of insulation material 15 and 16 on shaft 56 under all normal positions of the shaft 56. The spring means which effect the spring pressed operation of the sets of contacts are represented at 17. Intermediate the insulated sections 15 and 16 I provide a conductive section of the shaft indicated at 56a.

The housing 57 is provided with packing glands 18a and 18b, in each end thereof, through which the shaft 56 is adapted to linearly slide. Coil spring 8 continuously exerts pressure between the flanged end 56b of shaft 56 and the gland 18a for maintaining shaft 56 in a position in which the shaft sections 15 and 16 of insulation material break the continuity of an electrical circuit through the sets of contacts 58—59 and 60—61.

The assembly of the cylinder and the housing 57 will be more clearly understood by reference to Fig. 9 from which it will be seen that rear panel 23 supports the housing 57 and also extends beyond shaft 56 for substantially the entire linear distance to which shaft 56 may be displaced, and forms by reason of horizontally extending slot 11 a guide for arm 19, which extends rearwardly with respect to arm 12 from adjustable sleeve 20 and prevents angular shifting of shaft 56 so that movement thereof is confined in a linear path. Sleeve 20 is adjustable along shaft 56 by means of screw-threaded adjustment, represented at 20a. Thus, shaft 56 is free to be linearly displaced under control of traveling nut 5, but angular movement thereof is resisted.

The panel 23 carries two on and off control switches designated at 63 and 64, which are employed as test switches, as shown more particularly in the circuit diagram of Fig. 14. It will be realized that in an installation of the magnitude of the type involved in my invention, that it is necessary to determine from time to time whether the equipment is in a condition for operation under conditions of alarm and emergency. I accordingly provide switches 63 and 64, which, when manually moved to on position will accomplish the same results which are obtained upon the linear shifting of shaft 56.

The housing 57 provides a support for a quick opening air, hydraulic or steam valve, represented at 21, with which there is associated the trip reset arm 22, pivotally mounted on the standard 65, which is erected on housing 57. The standard 65 includes a horizontally extending fulcrum arm 66, to which is pivotally connected the cross-arm 67, pivoted at 67a. The lower end of cross-arm 67 connects as represented at 68 with the solenoid plunger shown at 69, which is operated by trip coil 24. The upper end of cross-arm 67 is provided with a notch for recess 70 into which latch 71, carried by trip reset arm 22, extends. The coil spring 72 extends between standard 65 and the end of cross-arm 67 and tends to maintain recess 70 of cross-arm 67 into engagement with latch 71 so long as trip reset arm 22 is maintained in a position holding valve actuating rod 69 downwardly in a position closing valve 21. The valve actuating rod 69 is normally maintained in a vertically upward position by the action of coil spring 74 seated in valve housing 76 operating against flange 75 carried by valve actuating rod 73 raising valve 77 away from its coacting valve seat 78. When the trip reset arm 22 is maintained by engagement of the latch 71 with recess 70, the pressure of spring 74 is overcome, and valve 77 is maintained closed against valve seat 78. However, upon energization of solenoid 74, cross-arm 67 is rocked to a position in which trip arm 22 is released with respect to the confining relation of latch 71 and notch 70, so that coil spring 74 operates to raise valve 77, opening air, hydraulic or steam line 79 for supplying through pipe 80 pressure to the actuating cylinder 38. Actuating cylinder 38 operates arm 37 connected with toggle mechanism 36 drawing brake band 34 into tight relation with respect to brake drum 81. The brake shoes 82 carried by brake band 34, grip the surface of brake drum 81, thereby bringing to a halt the movement of draw-works drum shaft 33. The brake drum 81 is secured on the shaft 33 of the draw-works, and constitutes the brake for the draw-works. Thus, valve 21 controls the stoppage of the draw-works. A hand reset lever 35 connects with the toggle mechanism 36 for releasing the brake band 34 with respect to the brake drum 81 when the draw-works are again placed in condition for operation.

The electrical circuit which controls the energization of the solenoid 24 is diagrammatically shown in Fig. 14 and operates the solenoid plunger 69 as heretofore described, which in turn operates the cross-arm 67, as heretofore described, and controls through the coaction of latch 71 and recess 70 the movement of the trip reset arm 22 for correspondingly controlling valve 21 and the flow of pressure from inlet 79 to outlet 80, as schematically illustrated. Solenoid winding 24 is energized from suitable source of potential indicated at 83. The circuit is closed through contacts 60 and 61 bridging the conductive shaft 56 when insulated section 16 thereof is displaced out of position between contacts 60 and 61. As heretofore explained, on and off switch 64 is provided for test purposes so that a local test may be from time to time made, to be sure that the circuit through solenoid 24 is conditioned to prevent over-travel of the traveling blocks 44.

The alarm circuit includes the horn or annunciator 84, connected through source of potential 85 with the set of contacts 58 and 59 bridged by shaft 56. The annunciator is not activated so long as the section of insulation material 15 separates contacts 58 and 59. However, when shaft 56 is shifted linearly to a position in which the conductive shaft 56 bridges contacts 58 and 59, the circuit is included from source of potential 85 through the annunciator or alarm 84, thereby sounding a warning signal to the operator that the traveling blocks 44 are approaching the crown block 47. As heretofore explained, the on and off switch 63, when closed, will effect excitation of the annunciator or alarm 84 for purposes of testing the system. Particular attention is called to the fact that the sections of insulation material 15 and 16 are of unequal length. This assures the excitation of the alarm circuit prior to the excitation of the circuit through solenoid 24. Thus, the operator will be adequately warned to take steps to shut down the draw-works manually upon initial sounding of the alarm. However, as the traveling nut 5 continues to advance under action of screw 30 and the operator has failed to take heed of the warning, insulated section 16 moves out from beneath contacts 60 and 61,

whereby contacts 60 and 61 are shunted by the metallic shaft 56, thereby energizing solenoid 24 and automatically effecting the shut down of the draw-works.

In addition to the braking operation which I have described, I also provide for the disengagement of the clutch in the draw-works simultaneously with the braking operation.

For derricks of different heights it is necessary that adjustment means be provided for the proper positioning of the traveling nut 5. For this purpose the hand wheel 13 is provided on the end of bevel gear driving shaft 2. The hand wheel 13 may be grasped and manually drawn backwards against the action of spring 3, disengaging bevel gear 2a from bevel gear 1a, after which traveling nut 5 may be shifted to any selected position by manual adjustment of shaft 2.

As heretofore explained in connection with Fig. 9, the entire cylinder 6 may be adjusted in position with respect to the housing 57 and the operating means associated therewith by linear adjustment of cylinder 6. The bracket 49 carried by cylinder 6, as heretofore explained, is linearly adjustable through plates 51 at the rear of the panel 23. The rails 53 are attachable to the draw-works through the stud and lock nut 86 extending from the rear of plate 52.

The operation of the indicator mechanism of my invention may be rendered even more convenient and effective to the operator by the addition of a supplementary indicator mounted in a vertical position, as illustrated in Figs. 15 and 16 and which includes a vertically extending panel 87 of translucent material on which there is displayed the outline of the derrick with which the indicator is to coact, as represented at 88. Through the front of the panel 87 I provide a vertically extending slot 89 coincident with the vertical axis of the representation of the derrick shown at 88. The movable indicator 90 is vertically movable through the slot 89 and is carried by the arm 91 which projects rearwardly into the slotted cylinder 92. Slotted cylinder 92 is mounted in a vertical position and contains the mechanism similar to that described in connection with cylinder 6. A shaft 93, having precision type Acme threads thereon, operates traveler nut 94, which connects with arm 91 and indicator 90 to move indicator 90 up and down the representation of the derrick 88 in similitude. Thus, the relative approach of the traveling block represented by the indicator 90 with respect to the top of the derrick representated pictorially at 95, may be visually observed. To facilitate such observation, electric light bulbs 96 and 97 are arranged behind the indicator screen 87. An arm 98, controlling contacts 99, is arranged in the path of movement of the arm 91, which effects a closing of the contacts 99 when the indicator approaches the end of its upward travel representing the approach of the traveling blocks with respect to the crown block, thereby sending an alarm. The position of contact arm 98 is vertically adjustable with respect to the path of movement of arm 91 for adjusting the position at which the alarm will be effective.

A similar adjustment is provided on the indicator attachment for setting the traveling nut 94. That is, a spring loaded notched clutch 100 is provided, which can be released so that the position of traveling nut 94 may be manually adjusted by revolving hand wheel 101 attached to shaft 93 to allow for the proper location of the contact arm 98 with respect to the path of movement of arm 91.

A shaft leading to clutch 100 may be flexible, or the shaft can be a solid one provided with universal joints or panel gears in order to establish the connection with shaft 2 of the mechanism of my invention heretofore explained.

The indicator attachment is approximately 12" wide and 30" in heighth, and may be installed in a convenient place in front of the driller or operator, so that the operator can see the relative position of the traveling blocks as they approach the crown block at all times.

I have found the mechanism of my invention highly practical in its construction and operation. I realize that changes in detail of my invention may be made, and I desire that it be understood that no limitations upon my invention are intended other than may be imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. Limit control mechanism comprising supporting means, a pair of longitudinally extending fixed rails carried by said supporting means, a cylindrical casing carried by said rails and having a longitudinally extending slot therein opposite said rails, a panel structure, means adjustably mounting said panel structure for limited movement linearly of said rails, an electrical circuit controller mounted on said panel structure and extending longitudinally thereof and including an actuator extending adjacent said cylindrical casing, journalling means carried by each end of said cylindrical casing, a rotatable screw device extending axially of said casing and terminating short of the opposite interior ends thereof, a shaft extending from each end of said rotatable screw device and mounted in said journalling means in each end of said casing, a drive gear disposed adjacent one end of said casing, a gear member carried by one of said shafts and engageable with said drive gear, expansion spring means extending between the end of said casing and said gear member for normally urging said gear member into meshing relation with said gear means, an orientatable manual means carried by the other of said shafts and aligned axially with the aforementioned shaft for manually retracting said gear member out of meshing relation with said drive gear against the action of said expansion spring means and a movable member carried by said rotatable screw device and projecting through the longitudinal slot in said casing into the path of said actuator for operating said actuator, the position of said movable member being selectively adjustable on said rotatable screw device by revolving said rotatable screw device by said orientatable manual means while a longitudinal pull is exerted on said rotatable screw device for maintaining said gear member out of meshing relation with said drive gear.

2. Limit control mechanism comprising a casing having a longitudinally extending slot in one side thereof, journalling means in each end of said casing, a shaft extending longitudinally through said casing and journalled in each end thereof, a rotatable screw carried by said shaft and terminating short of each interior end of said casing, whereby said rotatable screw may be displaced axially through said casing in addition to the rotative movement thereof, an orientatable manual means on the externally projecting end of said shaft at one end of said casing, a bevel

gear carried by the extremity of the other end of said shaft, expansion spring means concentrically disposed over the last mentioned end of said shaft between said bevel gear and the exterior of the last mentioned end of said casing for urging said bevel gear continuously to a projected position, a drive gear normally meshing with said bevel gear in the projected position of said bevel gear under control of said expansion spring means, the orientatable manual means at the first mentioned end of said shaft being operative for retracting said bevel gear out of meshing relation with said drive means against the action of said expansion spring means and operative for selectively revolving said shaft while the bevel gear is maintained out of meshing relation with said drive means, a movable member carried by said rotatable screw and projecting through the slotted side of said casing and an electric circuit controller supported in longitudinally adjustable relation to the slotted side of said casing and disposed in the path of said movable member whereby said movable member establishes an actuating abutment with said electric circuit controller at a predetermined position along the path of travel of said movable member with respect to said screw, the position of said movable member on said screw being selectively settable from the end of said casing by manually revolving said rotatable screw throughout the period that said manual means maintains said bevel gear in retracted position out of meshing relation with said drive means.



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