April 2, 1935. G. TREMOLADA 1,996,312

TORQUE OPERATED MECHANISM

Original Filed Oct. 10, 1932 4 Sheets-Sheet 1

Fig. 1.

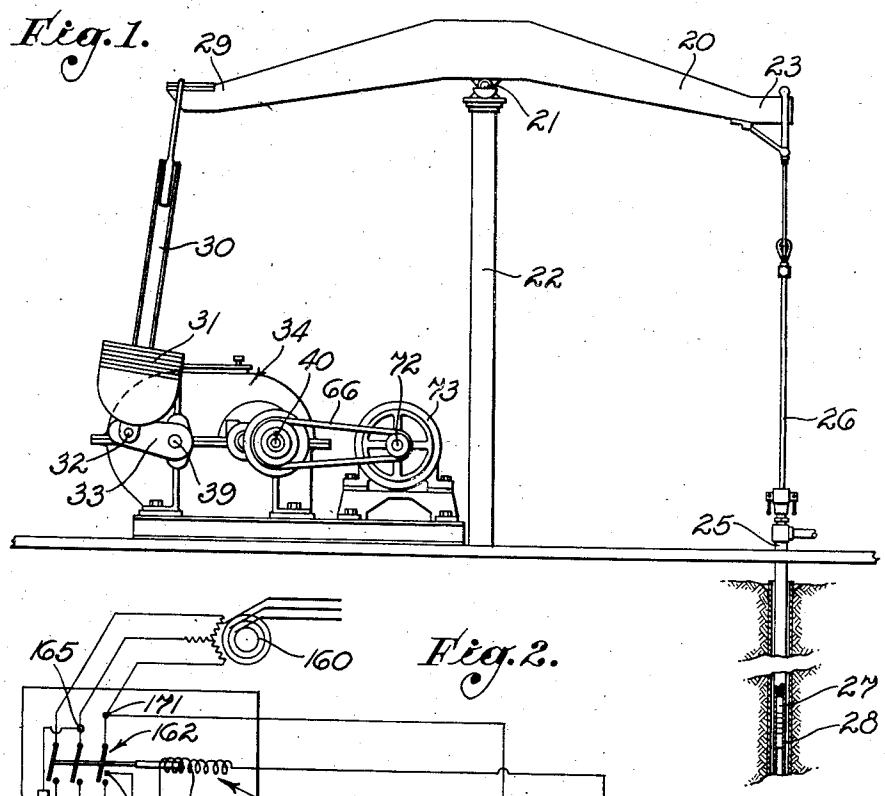
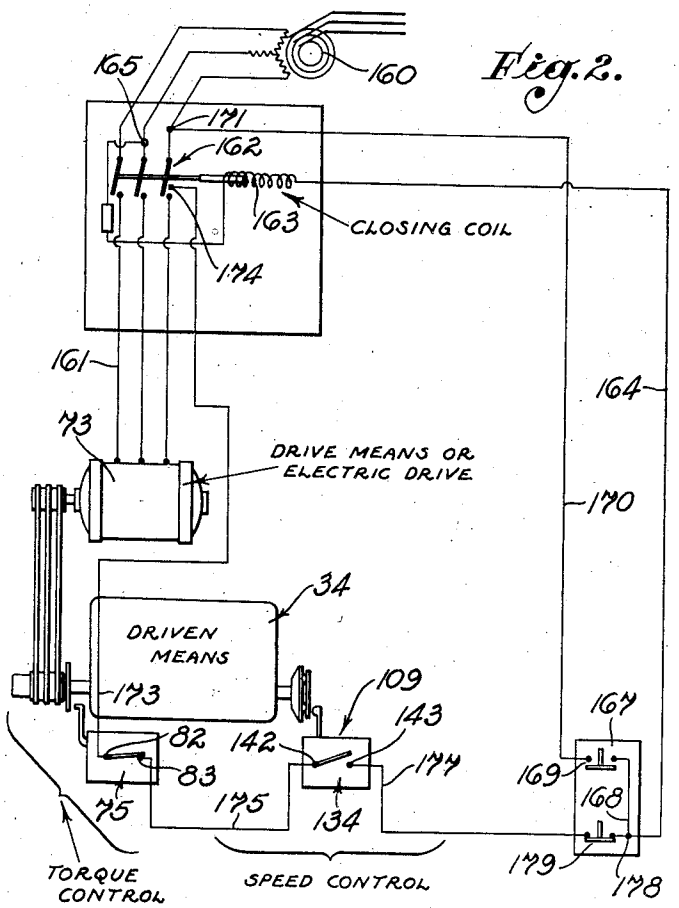


Fig. 2.



INVENTOR:
Guglielmo Tremolada,
BY
Fred A. Davis
ATTORNEY.

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TORQUE OPERATED MECHANISM

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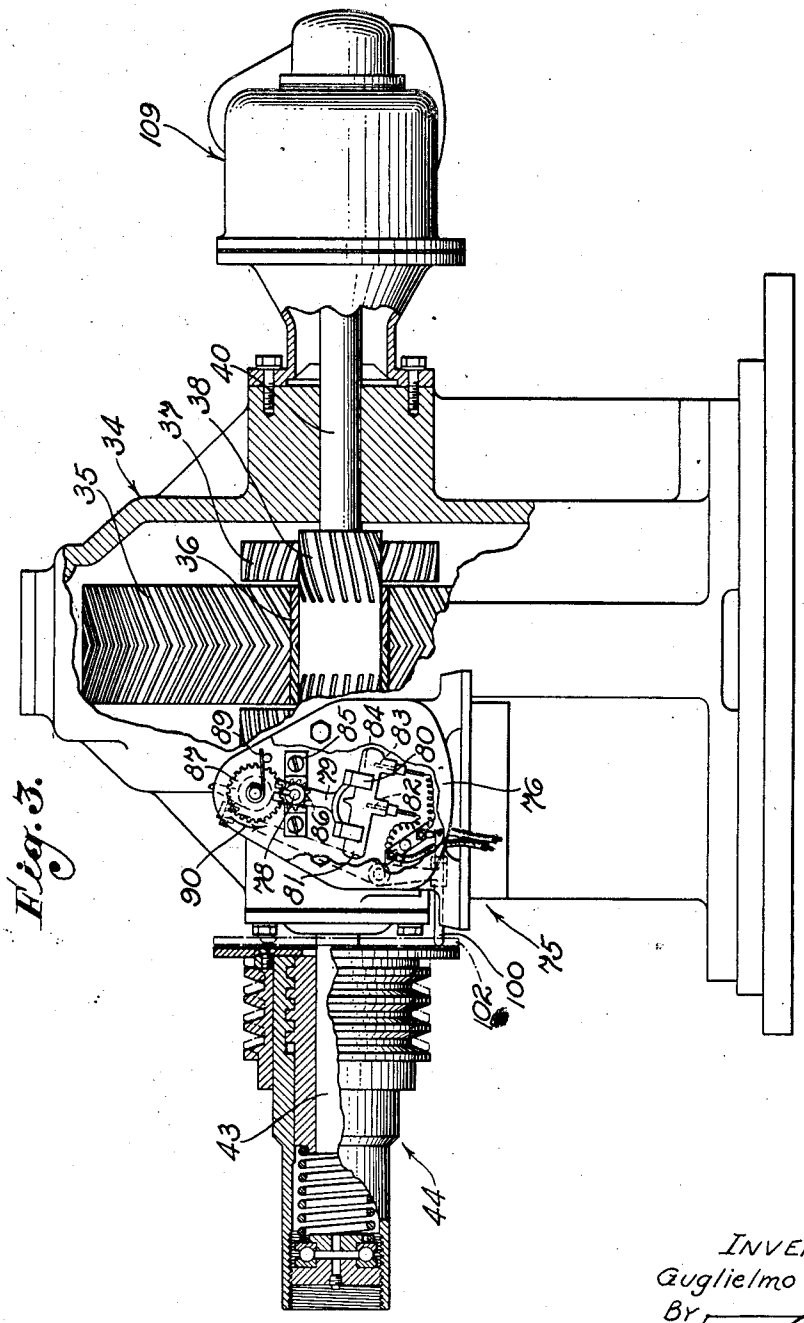


Fig. 3.

INVENTOR:
Guglielmo Tremolada,
BY
Fad N Hanis
ATTORNEY.

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TORQUE OPERATED MECHANISM

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Fig. 4.

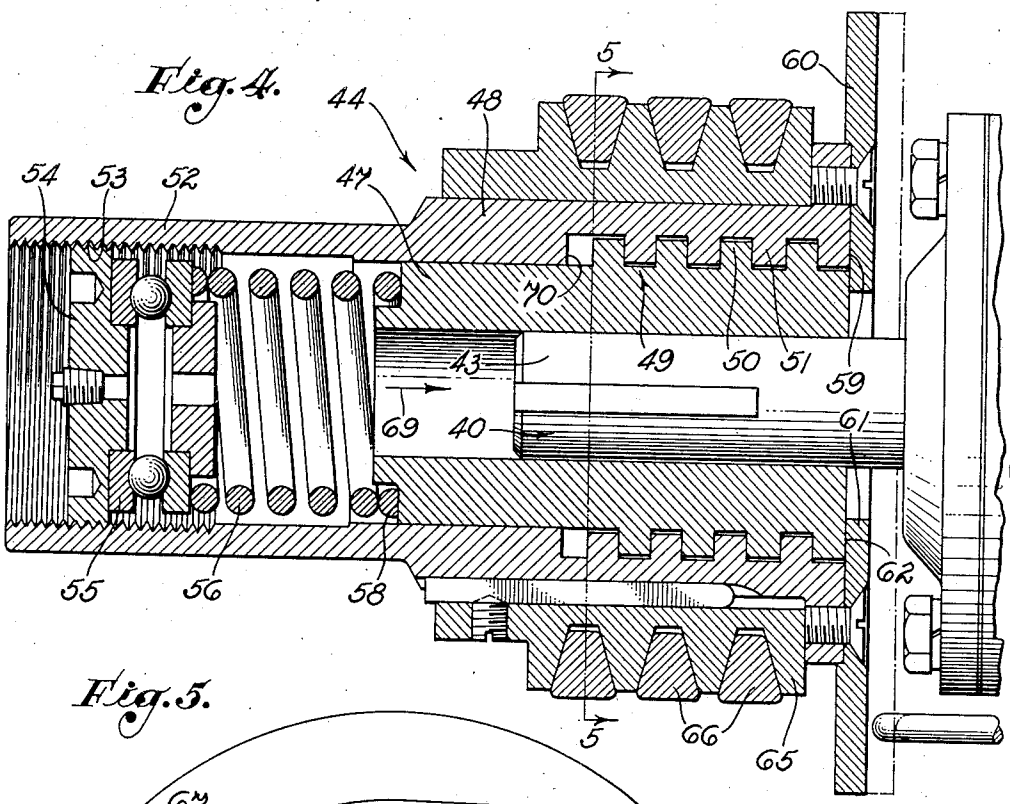
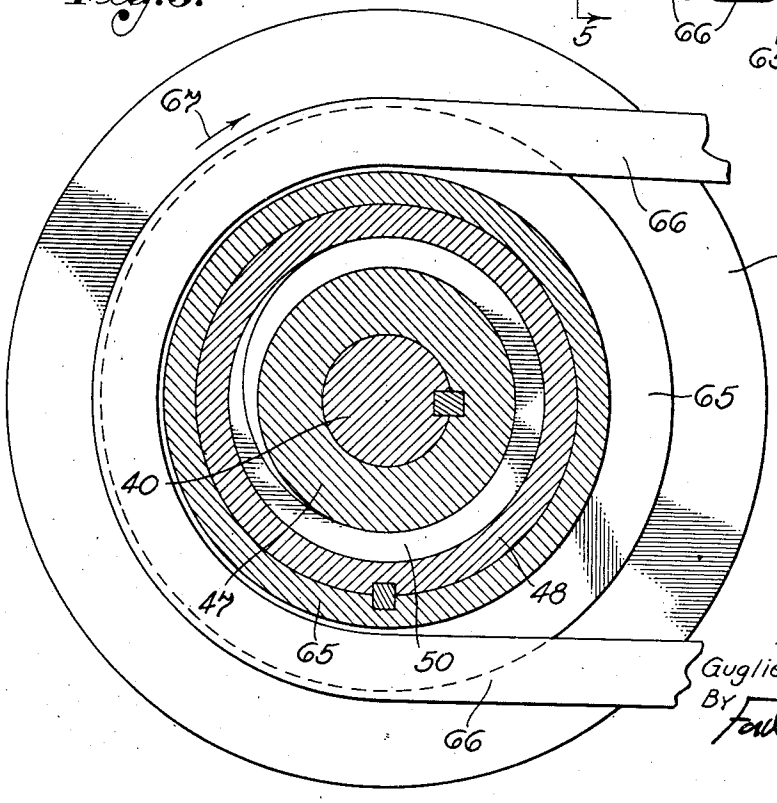


Fig. 5.



INVENTOR:
Guglielmo Tremolada,
BY
Fred W. Davis
ATTORNEY.

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TORQUE OPERATED MECHANISM

Original Filed Oct. 10, 1932 4 Sheets-Sheet 4

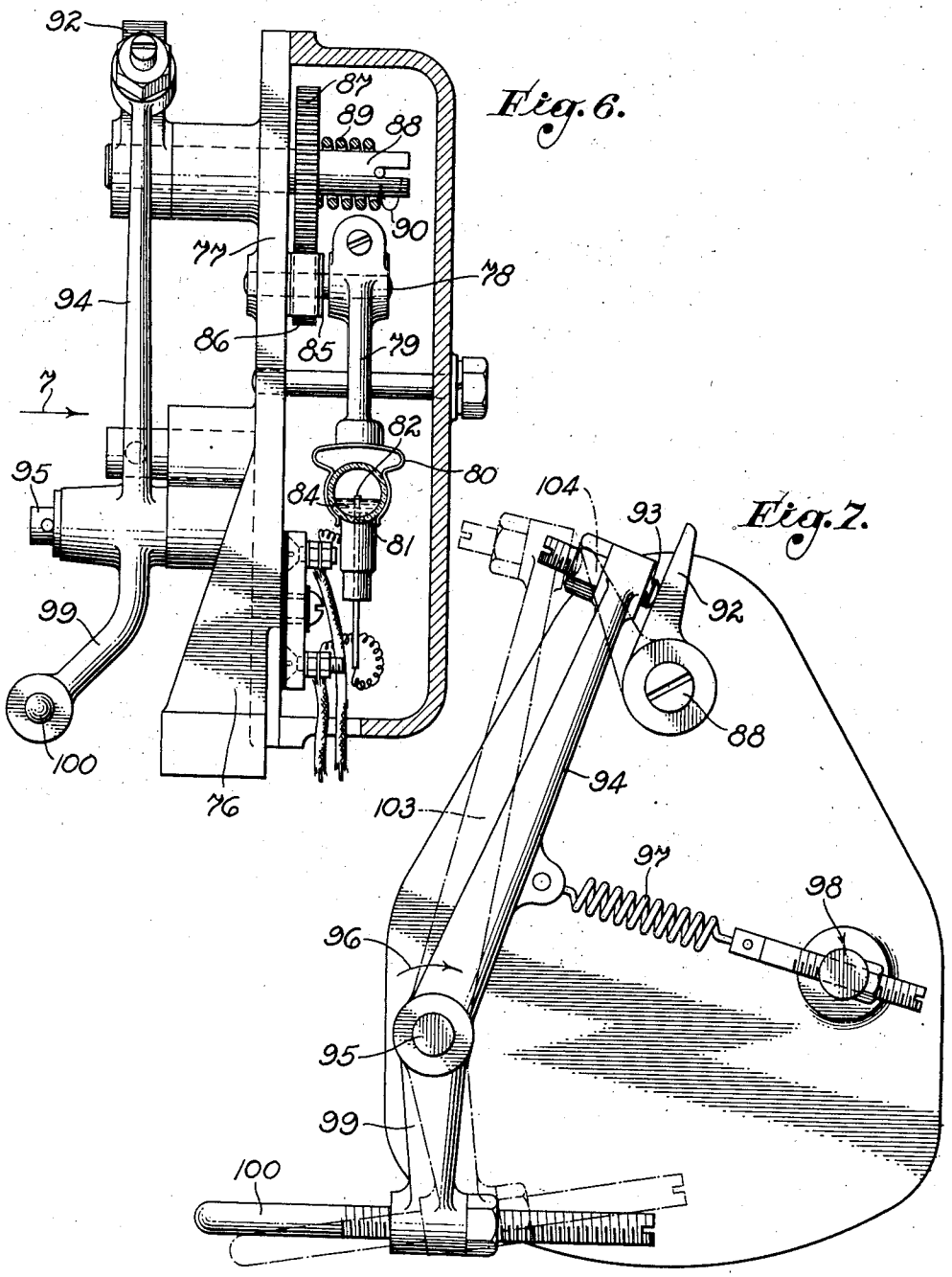


Fig. 6.

Fig. 7.

INVENTOR:
Guglielmo Tremolada,
BY Fad A. Lamia

ATTORNEY.

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1,996,312

UNITED STATES PATENT OFFICE

1,996,312

TORQUE OPERATED MECHANISM

Guglielmo Tremolada, Los Angeles, Calif., assignor to Emsco Derrick & Equipment Company, Los Angeles, Calif., a corporation of California

Original application October 10, 1932, Serial No. 637,106. Divided and this application September 23, 1933, Serial No. 690,751

12 Claims. (Cl. 192—150)

This invention relates to a torque-operating mechanism and this application is a division of my copending application entitled "Control mechanism," Serial No. 637,106, filed October 10, 1932.

The present invention is a torque-operated mechanism or torque-control mechanism which is disclosed in my copending application referred to above as a part of the combination disclosed and claimed therein. The invention which constitutes the subject-matter of this present application is adapted for use in various other combinations and on various other apparatus, and it is therefore my desire to obtain patent protection on the features of construction and principle of operation of this separate invention. For the purpose of illustration, I shall show my invention as being utilized in the combination disclosed in my copending application referred to above. It should be understood, however, that by so illustrating my invention I do not wish to be limited to the particular combination, but desire my protection to extend to any use of my invention.

It is an object of this invention to provide a torque-operated mechanism which is actuated when a certain predetermined torque is transmitted from a drive means to a driven means.

It is a further object of my invention to provide a torque-actuated mechanism in which a switch or other control mechanism may be actuated when the torque transmitted from a drive means to a driven means reaches a certain value.

A still further object of my invention is to provide a torque-operated mechanism in which a positive driving connection may be established through the device. As pointed out in my copending application referred to above, during the starting of an electric motor the starting torque is in excess of the normal operating torque. If the torque-operated mechanism is designed to perform its function when the normal operating torque is exceeded, then it would be impossible to put the device into operation because it requires a starting torque in excess of the operating torque. In my invention I provide a means whereby the torque-operated mechanism may provide a positive driving connection which is very useful during starting conditions.

A still further object of my invention is to provide a novel combination of torque-responsive means and switch or other control device, which combination operates to deenergize the drive means of the combination when a predetermined torque is exceeded.

It is a still further object of my invention to provide a torque-operated mechanism which is adapted to transmit torque from a drive means to a driven means and in which, when the torque increases above a certain amount, a part of the torque-operated mechanism will move relative to another part thereof. In the preferred form of my invention when this movement occurs, the switch is opened in order to deenergize the drive means, thus shutting down the apparatus.

It is another object of my invention to provide a means for adjusting the amount of torque which may be transmitted through my invention without causing an actuation thereof.

It is a still further object of my invention to provide a device of the character described in which the movable member when it moves a certain distance establishes a positive driving engagement between the members of my invention, thus causing the drive means to positively drive the driven means through the torque-operated mechanism of my invention.

A still further object of my invention is to provide a device in which the various parts thereof may be enclosed and provided with ample lubrication.

Other objects of my invention and the advantages thereof will be pointed out in the course of the ensuing description of the details of a preferred form of my invention:

Referring to the drawings:

Fig. 1 is a diagram illustrating an oil pumping mechanism on which my invention is employed.

Fig. 2 is a diagram illustrating the mechanism disclosed in Fig. 1 which operates the oil pumping apparatus.

Fig. 3 is an elevational view partly sectioned showing a reduction unit of the mechanism shown in Fig. 1 on which is installed a torque-operated mechanism which incorporates the features of my invention.

Fig. 4 is an enlarged fragmentary section through the torque-operated mechanism of my invention.

Fig. 5 is a section taken on the line 5—5 of Fig. 4.

Fig. 6 is a sectional view taken through a torque switch which forms a part of the combination of this invention and which is used in conjunction with the mechanism shown in Figs. 4 and 5.

Fig. 7 is an elevational view of the torque switch taken as indicated by the arrow 7 of Fig. 6.

In order that the features and advantages of my invention may be clearly and fully understood, I have disclosed my present invention as applied to an oil pumping apparatus such as is shown in my copending application referred to heretofore. It should be understood, however, that the complete apparatus is disclosed solely for illustrative purposes and not for the purpose of limiting my invention to the combination which I have chosen to illustrate the features and advantages of my invention. For a more complete explanation of the entire pumping apparatus, reference should be had to my copending application referred to above.

Referring to the drawings, the numeral 20 represents a standard type of walking beam which is pivotally mounted at 21 on the upper end of a Samson post 22. The end 23 of the walking beam 20 projects over the upper end of a well having a pump tubing 25 mounted therein. Extending from the end 23 of the walking beam 20 is a string of sucker rods 26 which extends downwardly through the pump tubing 25 and is connected at its lower end to a reciprocable plunger 27 which operates in a pump barrel 28. An oscillation of the walking beam 20 causes the pump plunger 27 to reciprocate and to raise oil to the surface of the ground through the pump tubing 25. The end 29 of the walking beam 20 is connected to the upper end of a pitman 30, which pitman 30 according to common practice may include a counterweight 31. The lower end of the pitman 30 is pivotally secured by a pivot pin 32 to a walking beam crank 33. A rotation of the walking beam crank 33 produces a reciprocation of the walking beam 20 with the result that the pumping mechanism previously described will raise oil to the surface of the ground.

The walking beam crank 33 is connected to and forms a part of a reduction gear unit 34 which may be of any standard design. This reduction gear unit 34 may be broadly referred to as a driven means and by use of this term, I intend to mean any apparatus which is driven by a drive means in order to accomplish a useful purpose. Since my invention is not limited to the oil-producing industry nor to any particular type of driven means, the term is of broad significance. The driven means or reduction gear unit 34, as shown in Fig. 3, includes a series of reduction gears 35, 36, 37, and 38 whereby the shaft 39, on which the walking beam crank 33 is mounted, is driven from the shaft 40 shown in Fig. 3.

The shaft 40 extends outwardly from the housing of the driven means 34 and an end 43 thereof has secured thereto a torque-responsive means or torque-operated mechanism 44 which constitutes an essential part of the present invention. Referring now to Figs. 4 and 5, I will describe the details of construction of the torque-operated mechanism of my invention.

Rigidly secured on the end 43 of the shaft 40 is an inner sleeve 47 which constitutes a driven member or driven element of the torque-operated mechanism. Surrounding this inner sleeve 47 is an outer sleeve or body 48 which constitutes a drive means or drive element of the torque-operated mechanism. This body 48 surrounds and is journaled on the inner sleeve 47. Cooperating between the parts 47 and 48 is a cam means or interconnecting means generally designated by the numeral 49 through which the body 48 drives the inner sleeve 47, and by means of which a certain relative movement between the parts is accomplished under certain conditions as will be pointed out in the course of this description. In the form of my invention disclosed herein this cam means is provided in the form of square threads 50 which extend outwardly from the inner sleeve 47 and are in interengagement with square threads 51 formed on and extended inwardly from the inner part of the body 48, the square threads 50 fitting in helical channels provided between the square threads 51 and the square threads 51 fitting between helical channels provided between the square threads 50. Formed as a part of the body 48 is a cylindrical projection 52 which projects outwardly but concentrically beyond the inner sleeve 47 and which is internally threaded at 53. Threadedly advanced into the end of this extension 52 is a shoulder in the form of an adjustment member or adjustment nut 54, which by rotation may be adjusted into different positions in the threaded extension 52. This nut 54 constitutes but one form of adjustable shoulder member which may be employed in my invention. Placed within this nut 54 is a bearing 55 which is engaged by the outer end of a compression spring 56. The inner end of the compression spring 56 engages and presses against an outer end face 58 of the inner sleeve 47. The purpose of the spring 56 is to retain the parts in the position disclosed in Fig. 4 and to resist relative movement between the parts. Secured to the inner face 59 of the body 48 is an engaging means in the form of a friction plate 60. This friction plate 60 has an inner annular portion 61 which projects inwardly a sufficient distance to engage an inner face 62 of the sleeve 47 in order to act as a stop against which the spring 58 pulls the annular portion 62 of the friction plate 60. This part 61 and the face 62 constitute a stop means of the invention, and it should be understood that any equivalent type of stop means disassociated from the friction plate 60 may be employed if desired. Rigidly secured to the body 48 is a means whereby the outer sleeve 48 may be rotated. This means is provided in this form of my invention as a driven pulley 65 around which a belt means 66 is extended for driving the torque-operated mechanism or torque-responsive mechanism in the direction indicated bp the arrow 67 of Fig. 5. It should be clearly understood that this drive means is only one of a number of drive means which may be employed. In this particular type of apparatus a belt drive means is provided. It should be understood that the equivalent of a belt drive means would be a shaft drive means or a gear drive means or any other mechanism by which the torque-operated mechanism could be caused to rotate.

The threads 50 and 51 of the torque-operated mechanism are so formed that a rotation of the body 48 relative to the sleeve 47 in the direction indicated by the arrow 67 will advance the body 48 relative to the sleeve 47 in a direction indicated by the arrow 69 of Fig. 4. However, under normal operating conditions such a movement of these parts does not occur because the spring 56 is so adjusted that it produces a resistive force sufficient to resist relative axial movement between the parts in the direction indicated by the arrow 69. This adjustment is accomplished by the adjustable nut 54 which is so positioned in the extension 52 that a predetermined amount of torque may be transmitted from the body 48 to the sleeve 47 without relative movement between the parts. When the torque required to drive

the body 48 and the driven means exceeds this predetermined value, the body 48 will rotate relative to the sleeve 47 and as a consequence the body 48 will move in a direction indicated by the arrow 69. This axial movement in the direction of the arrow 69 continues until the end of the thread 50 engages a shoulder 70 of the body 48, at which time the body 48 has a positive driving engagement with the sleeve 47. This constitutes the means of my invention for producing a positive driving engagement between the two elements 48 and 47 of the torque-operated mechanism and between the drive and driven means of the combination. In the combination in which my invention is shown herein, under normal operating conditions the apparatus will be shut down before this positive drive is established, but during the starting of the apparatus this positive drive is utilized, as will be pointed out in the course of the following description.

As shown in Fig. 1, the belt means 66 extends over a drive pulley 72 of a drive motor 73. This drive motor 73 represents a drive means of my invention and the term "drive means" is intended to cover any equivalent mechanism.

The torque-operated mechanism or the torque-responsive means is adapted in the form of my invention shown herein to function in conjunction with what I denominate a torque switch 75 which is shown in detail in Figs. 3, 6, and 7. This torque switch includes a housing 76 which is suitably supported such as by being secured to the reduction gear unit 34. Rotatably supported by a supporting wall 77 of this housing 76 is a shaft 78 having an arm or lever 79 secured to the inner end thereof, this lever being preferably adjustable on the shaft 78. The lever 79 depends from the shaft 78 and has at its lower end a plurality of engaging members 80 which are adapted to support a mercury switch 81 or its equivalent. The mercury switch 81 includes a pair of terminals 82 and 83 as shown in Fig. 3, both of which are in contact with a body of mercury 84 when the switch is in closed position, as shown in Fig. 3. Supported by the shaft 78 between the wall 77 and the arm 79 is a small gear 86 which is engaged by a larger gear 87 which is mounted on a shaft 88, the shaft 88 being provided with a spring 89 which tends to rotate same in a direction indicated by the arrow 90 of Fig. 3. This is the direction which will rotate the shaft 88 so that the gears 87 and 86 rotate the shaft 78 in such direction that the arm 79 will support the mercury switch 81 in an open position. The shaft 88 extends outwardly through the wall 77 of the housing 76 and has a short arm or cam member 92 secured to the end thereof, this arm being adapted to be engaged by an adjustable engager 93 which is adjustably secured to the upper end of a lever 94. The lever 94 is pivoted on a shaft 95 and is resiliently urged in a direction indicated by the arrow 96 of Fig. 7 by means of a tension spring 97 which is placed under a desired tension by an adjusting means 98. The spring 97 opposes the spring 89 and is so adjusted that it exerts a force stronger than that exerted by the spring 89, with the result that the switch 81 is supported in a closed position. This lever 94 has a downwardly projecting arm 99 to which an engager 100 is adjustably secured, as shown in Fig. 7.

This engager, as shown in Fig. 3, extends outwardly or leftwardly so that the end thereof rests in a position adjacent the inner face of the friction plate 60. This engager is in such a position that when the friction plate 60 moves in a rightward direction, as indicated by the dotted lines 102 of Fig. 3, it will be engaged and the lever will be swung into a position such as indicated by the broken lines 103 of Fig. 7. When the lever occupies the broken line position, the short arm 92 follows the engager 93 due to the action of the spring 89, with the result that the mercury switch moves into such a position that the body of mercury 84 is removed from contact with the contact 83, and in this manner the torque switch is opened. It will therefore be seen that in the preferred form of my invention disclosed herein, when the torque-operated mechanism is used in conjunction with a torque switch, should the torque required to operate the driven means increase above a predetermined amount, the body 48 will move in a direction indicated by the arrow 69 and the friction plate will be caused to engage the engager 100, thus opening the mercury switch 81 which constitutes a part of the torque switch 75. When the term "torque switch" is used, it is understood that I mean any type of switch operated by the torque-operated mechanism or any other structure which may be used in conjunction with the torque-operated mechanism for deenergizing or stopping the driving action of the drive member on the driven member.

In the apparatus shown, there is provided a speed-responsive means generally indicated by the numeral 109. Since this mechanism does not represent a part of the present invention, the details of construction of this mechanism are not disclosed in this application. Reference should be had to my copending application referred to heretofore if an understanding of the details of construction of the torque-responsive device is desired.

In order that the mode of operation and important advantages accruing from my invention may be understood, I have disclosed in Fig. 2 a schematic view showing the complete system in which my invention is employed. Referring to Fig. 2, the drive means or electric motor 73 is adapted to be connected to an electrical energy source 160 by means of an electric circuit 161 which has included therein a main switch 162 which permits energization of the motor 73 only when the main switch is closed. For the purpose of closing the switch 162 there is provided an electrically operated means including a coil 163 which is connected by a wire 164 to the main circuit 161 above or outside the switch 162, as indicated at 165. The wire 164 extends to a control box 167 and is connected to a wire 168 including a starting switch 169. Extending from the starting switch 169 is a wire 170 which is connected to the main circuit 161 at a point 171. It will be seen that by closing the starting switch 169, the circuit including the wires 164, 168, and 170 is closed. This circuit may be closed independently of the main switch due to the fact that it is connected to the live side of the main circuit above or outside the main switch. The closing of this circuit energizes the closing coil 163, thus closing the switch 162 in order to supply electrical energy to the motor 73. The motor 73 will continue to operate so long as the starting switch 169 is held closed.

The terminal 82 of the torque switch is connected by a wire 173 to a contact 174 which is engaged when the main switch 162 is closed. The terminal 83 of the torque switch 75 is connected by a wire 175 to a terminal 142 of a speed switch 134 which constitutes a part of the speed-responsive means employed in the apparatus. Connect-

ed to a terminal 143 of the speed switch 134 is a wire 177 which is connected at 178 to the wire 164. The wire 177 includes a shut-off switch 179 whereby the circuit including the torque and speed switches may be broken. As clearly explained in my copending application referred to heretofore, the speed-responsive means is so designed that the switch 134 is held open until a certain minimum speed is attained, at which time the speed switch 134 is closed. It will therefore be seen that the apparatus cannot be put into operation without either manually closing the speed switch 134 or providing an auxiliary starting circuit whereby the switch 162 is held closed until normal operating speed and normal operating conditions are reached. Therefore, when it is desired to put the apparatus into operation it is necessary to close the starting switch 169 which closes the starting circuit and energizes the coil 163, thus closing the main switch 162. When normal operating conditions are reached, the speed switch, will by the mechanism fully disclosed in my copending application, be moved into closed position at which time the starting switch 169 may be opened, the coil 163 being thereafter energized through the main operating circuit which includes the torque switch and the speed switch. The operation of the apparatus will then continue until some abnormal condition creates either an excessive torque or an insufficient speed, at which time either the torque switch 75 or the speed switch 134 will be opened and the main switch 162 opened, thus cutting off the supply of electrical energy to the motor. As pointed out heretofore, during the starting of the drive means or electric motor 73, the starting torque which exists is greater than the normal torque required to operate the driven device when normal speed is attained. In view of the fact that the torque-responsive means is adjusted to respond when the normal operating torque is exceeded, the body 48 will, during starting, move in a direction indicated by the arrow 69 until the thread 50 of the sleeve 47 engages the stop 70, thus establishing a positive driving connection between the sleeve 47 and the body 48. Prior to reaching this position of the body 48 and prior to the establishing of a positive drive, the engager 100 of the torque switch will be engaged as pointed out heretofore, thus opening the torque switch. When this occurs, the torque switch 75 will break the circuit to the closing coil 163, thus allowing the main switch 162 to open. It will therefore be seen that unless a separate means of energizing the closing coil 163 is provided, the apparatus could never be put into operation; therefore, the starting circuit is employed until the apparatus is operating under normal torque and normal speed conditions, at which time both the torque switch 75 and the speed switch 134 will be closed. It will be obvious from the description of the operation of the torque-operated mechanism that it is necessary during starting, when there is an excessive torque, to have a positive drive means in order that the driven means may be driven with an excessive torque or with a starting torque during the starting of the apparatus. It will therefore be seen that this feature of my present invention is quite important.

If at any time during the operation of the system something occurs which increases the torque required to drive the driven means above the normal operating torque and above a predetermined torque, the body 48 will move relative to the sleeve 47, as explained heretofore, and the friction plate 69 will engage the engager 100, thus opening the torque switch 75. When the torque switch 75 is opened, the circuit to the closing coil 163 is deenergized, thus allowing the main switch 162 to open. It will therefore be seen by the use of the device of my invention that the apparatus will be shut down immediately upon the occurrence of transmission of an excessive torque from the drive means to the driven means.

The torque-operated mechanism of my invention is very sensitive to differences of torque and may be rather accurately adjusted to respond to the transmission torque through the device in excess of a predetermined value. Futhermore, the torque-operated mechanism may be readily adjusted to change the torque values at which it is intended to operate. Its simplicity of construction and compactness are of considerable merit, and furthermore the design which enables it to be placed on the end of a shaft is quite important. It is quite easy to remove from a shaft the ordinary pulley or drive means and to substitute therefor the torque-operated mechanism of my invention. It will therefore be seen that this torque-responsive mechanism is more or less a self-contained unit which can easily be installed or removed.

Operating in conjunction with this torque-operated mechanism is the torque switch which includes an important part of the combination of my invention. This torque switch is representative of any type of control device which may be desired in conjunction with the torque-operated mechanism. It should be understood that I do not limit the torque-operated mechanism of my invention to use in conjunction with a torque switch. It may, however, be used in conjunction with some other type of control mechanism. For example, the torque switch may control electrical circuits on other apparatus which may be placed into operation when the torque increases above a certain amount. Instead of a switch the control mechanism used in conjunction with the torque operated mechanism may be some other type of release or control mechanism.

I claim as my invention:

1. In a mechanism of the class described, the combination of: a driven element; a drive element; cam means providing driving engagement between said elements, said cam means causing relatively axial movement between said elements upon relative rotational movement; means for determining the amount of torque which is transmitted through said elements without relative rotational movement; and positive drive means whereby said drive element positively drives said driven element.

2. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; means for resisting relative axial movement between said elements; and stop means for limiting relative movement between said elements.

3. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational

movement between said elements an axial movement is produced; means for resisting relative axial movement between said elements; and stop means for limiting relative movement between said elements in either direction.

4. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; an extension on said drive element; a nut adjustably mounted in said extension; a spring compressed between said nut and said driven element for resisting relative axial movement between said elements; and stop means for limiting relative movement between said elements.

5. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; means for resisting relative axial movement between said elements; and a stop plate secured to said drive element at one end thereof and engageable by said driven element.

6. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; an extension on said drive element; a nut adjustably mounted in said extension; a spring compressed between said nut and said driven element for resisting relative axial movement between said elements; and a stop plate secured to said drive element at one end thereof and engageable by said driven element.

7. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; means for resisting relative axial movement between said elements; a stop plate secured to said drive element at one end thereof and engageable by said driven element; and switch means adapted to be engaged by said stop plate when relative movement between said driven and drive elements takes place.

8. In a mechanism of the class described, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; an extension on said drive element; a nut adjustably mounted in said extension; a spring compressed between said nut and said driven element for resisting relative axial movement between said elements; a stop plate secured to said drive element at one end thereof and engageable by said driven element; and switch means adapted to be engaged by said stop plate when relative movement between said driven and drive elements takes place.

9. In a mechanism of the class describe, the combination of: a driven element; a drive element journalled on said driven element; cam means for providing a driving engagement between said elements whereby upon a rotational movement between said elements an axial movement is produced; means for resisting relative axial movement between said elements; a stop plate secured to said drive element at one end thereof and engageable by said driven element; and control means adapted to be engaged by said stop plate when relative movement between said driven and drive elements takes place.

10. In a mechanism of the class described, the combination of: a driven element; a drive element; means for providing driving engagement between said driven element and said drive element, said means causing a predetermined relative movement between said driven element and said drive element when the torque required to drive said driven element becomes abnormal; and positive drive means whereby said drive element drives said driven element when said predetermined relative movement has occurred.

11. In a mechanism of the class described, the combination of: a driven element; a drive element; means for providing driving engagement between said driven element and said drive element, said means causing a predetermined relative movement between said driven element and said drive element when the torque required to drive said driven element becomes abnormal; positive drive means whereby said drive element drives said driven element when said predetermined relative movement has occurred; and control means operable by one of said elements before said positive drive is established.

12. In a mechanism of the class described, the combination of: a driven element; a drive element; means for providing driving engagement between said driven element and said drive element, said means causing an axial movement between said driven element and said drive element when the torque required to drive said driven element becomes abnormal; and positive drive means whereby said drive element drives said driven element when said predetermined relative movement has occurred.

GUGLIELMO TREMOLADA.