

May 14, 1940.

R. C. SMITH

2,200,781

STARTING APPARATUS

Filed Aug. 4, 1937

4 Sheets-Sheet 1

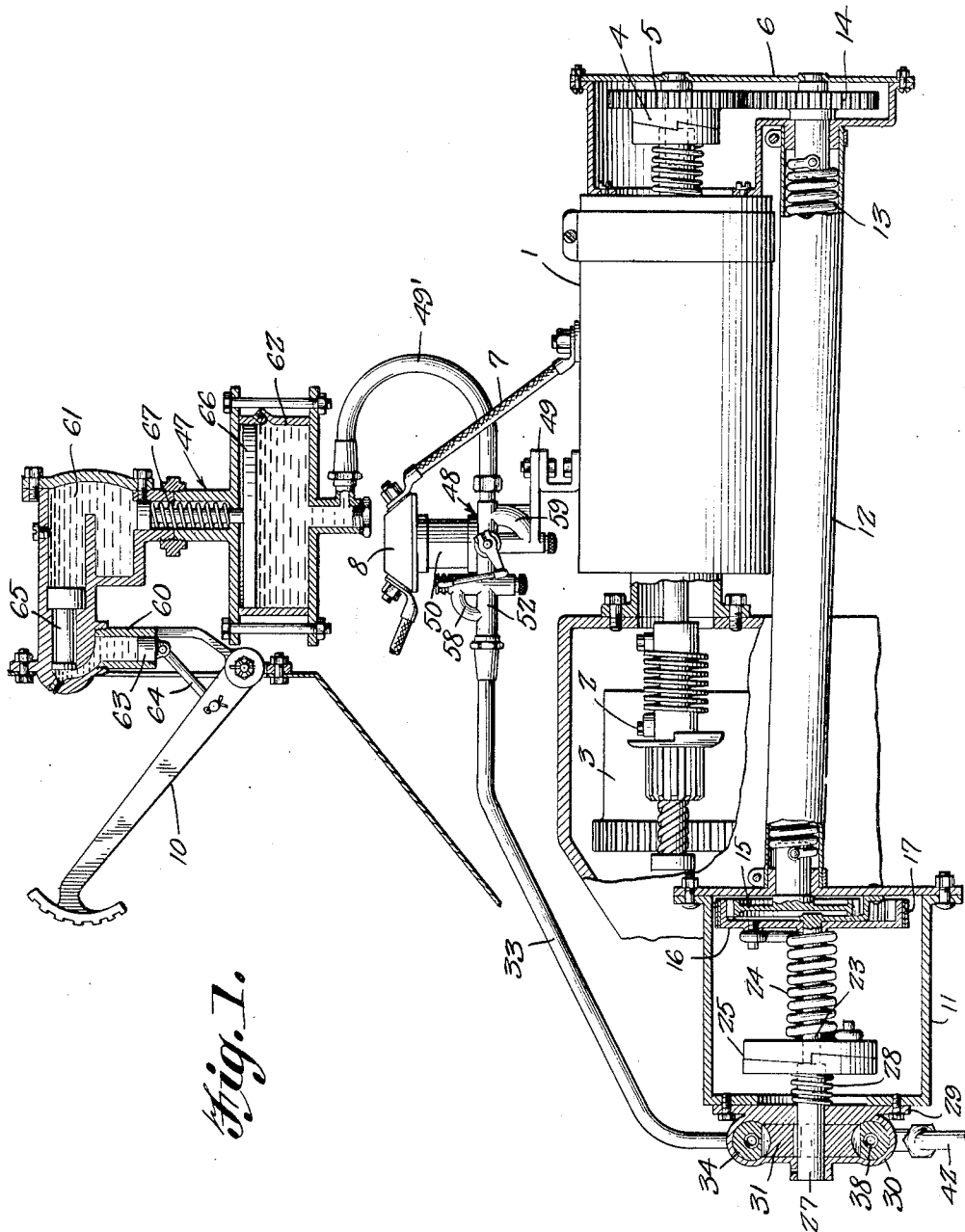


Fig. 1.

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May 14, 1940.

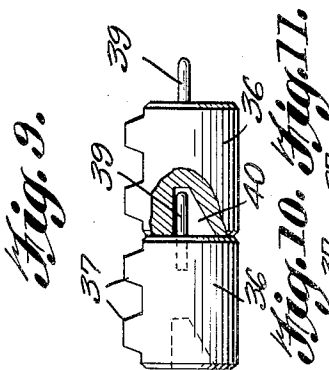
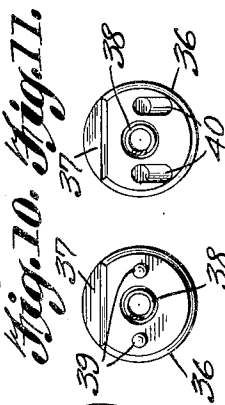
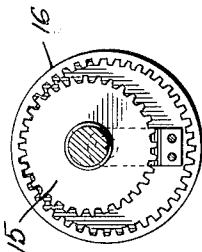
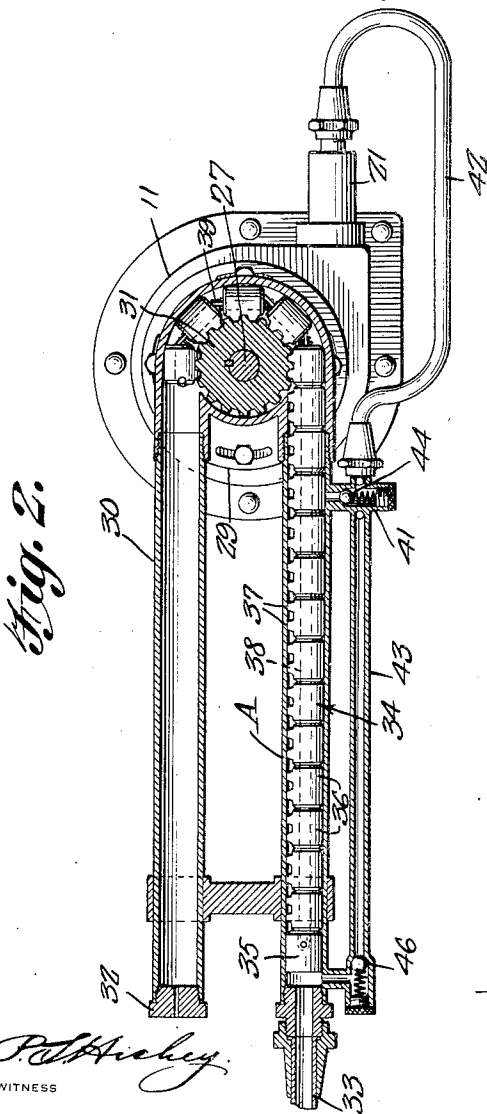
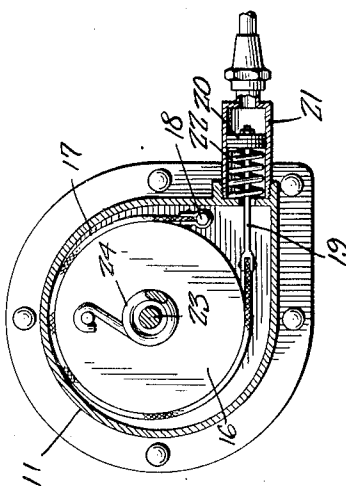
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STARTING APPARATUS

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4 Sheets-Sheet 2



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STARTING APPARATUS

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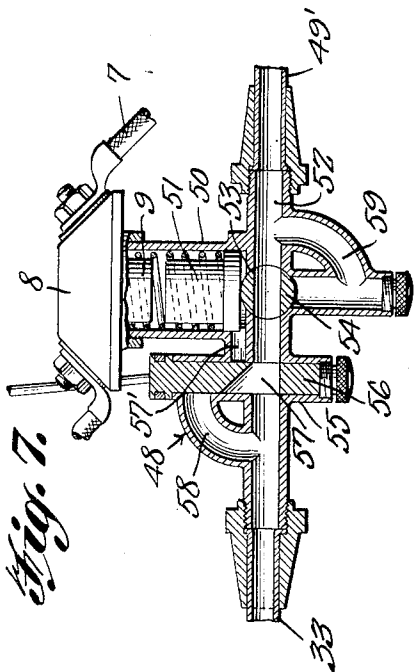


Fig. 7.

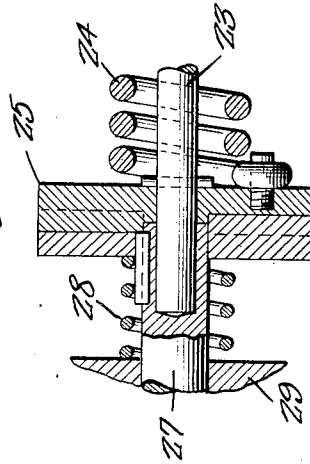


Fig. 8.

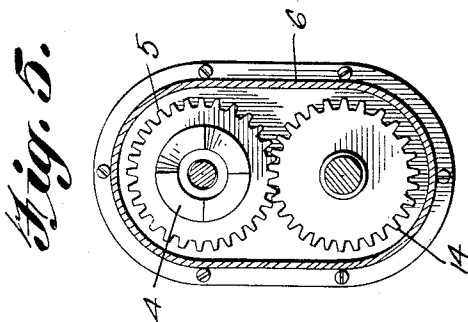
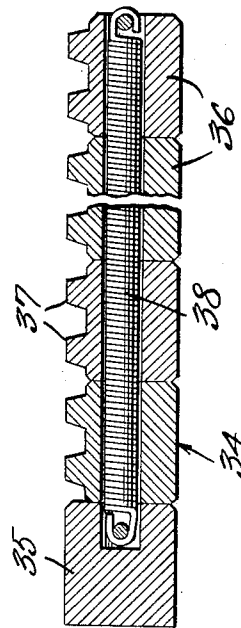


Fig. 5.

Fig. 6.



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STARTING APPARATUS

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4 Sheets-Sheet 4

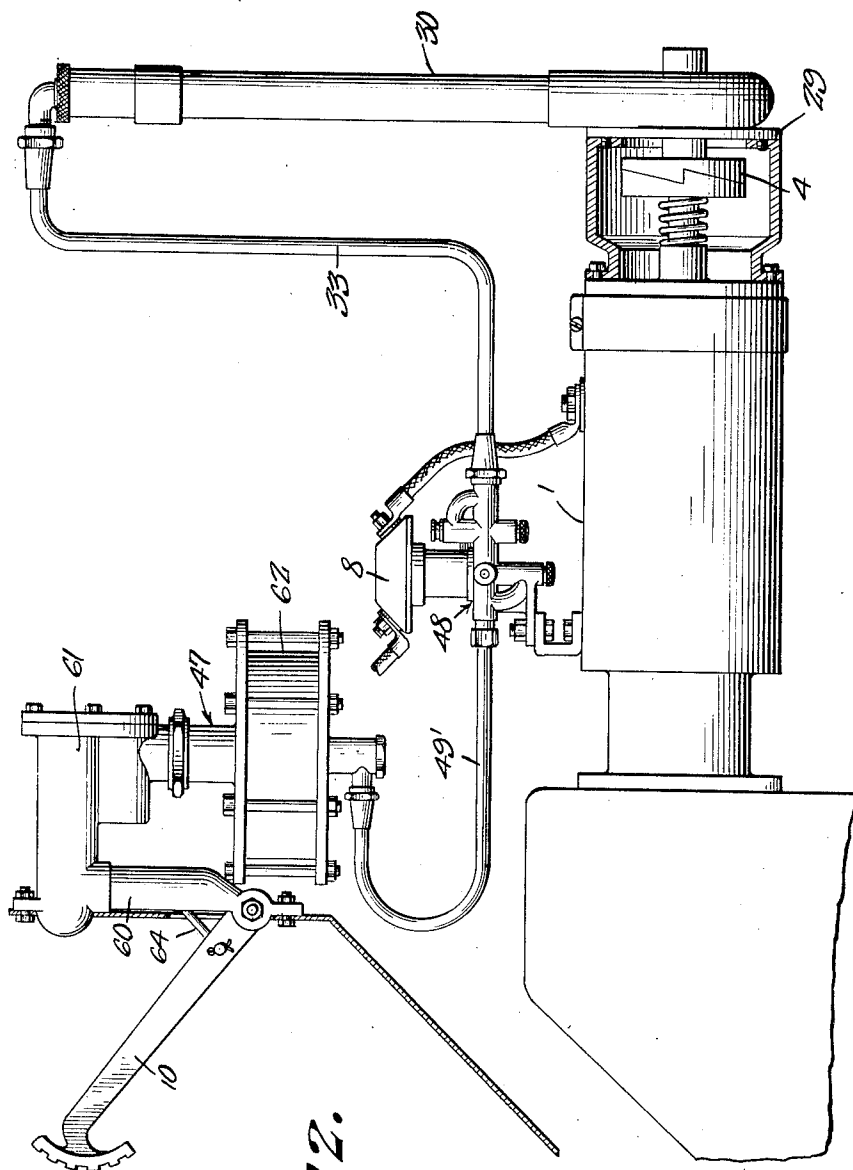


Fig. 12.

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2,200,781

STARTING APPARATUS

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Application August 4, 1937, Serial No. 157,422

9 Claims. (Cl. 185—11)

This invention relates to a starting apparatus for internal combustion engines or other similar devices and has for the primary object the provision of a manually actuated hydraulic device to operate in conjunction with a conventional type of electric starter of an engine so that the latter may be started or cranked by said device should the electrical source become weak and fail to actuate the electrical starter or said device may be made to operate with the electrical starter for aiding the latter in starting or cranking the engine, this sometimes being desirable in cold weather wherein the engine is made difficult to start or crank.

With these and other objects in view, this invention consists in certain novel features of construction, combination and arrangement of parts to be hereinafter more fully described and claimed.

For a complete understanding of my invention, reference is to be had to the following description and accompanying drawings, in which

Figure 1 is a vertical sectional view illustrating a starting apparatus constructed in accordance with my invention and showing the same connected with a conventional type of electrical starter of an engine.

Figure 2 is a fragmentary transverse sectional view illustrating a fluid actuated rack.

Figure 3 is a transverse sectional view illustrating a fluid actuated brake.

Figure 4 is a transverse sectional view illustrating gearing wherein one of the gears is of internal type and also forming a brake drum.

Figure 5 is a transverse sectional view showing a friction clutch and gearing connecting this invention onto an electric starter.

Figure 6 is a fragmentary sectional view showing detail construction of a flexible rack bar.

Figure 7 is a vertical sectional view illustrating a fluid actuated switch.

Figure 8 is a fragmentary vertical sectional view showing a frictional clutch employed for tensioning or winding a drive spring.

Figure 9 is a fragmentary side elevation, partly in section, showing several elements of the flexible rack bar and the connection between said elements.

Figure 10 is an end view illustrating one of the elements showing dowel pins.

Figure 11 is an end view showing the opposite end of said element from that shown in Figure 10.

Figure 12 is a side elevation partly in section showing a modified form of my invention.

Referring in detail to the drawings, the numeral 1 indicates a conventional type of electrical starter employed on internal combustion engines and which includes a Bendix drive 2 for connecting and disconnecting the electric motor of the electrical starter with the fly wheel 3 of the engine. To adapt my invention to the electric starter the armature shaft of the electric motor has secured thereon a ratchet type clutch 4 including a gear 5 located within a housing 6 mounted on the electric motor. The electrical leads for the electric motor are indicated by the character 7 and have connected therein a switch 8 of the push button type, the button being indicated by the character 9 and illustrated in Figure 7. The electrical leads 7 are connected with the electrical source (not shown). The starter pedal of the electrical starter is indicated by the character 10 and in this instance is not directly connected to the switch 8 but is connected to my invention. The parts described briefly are common in electrical starters now in use and are set forth in this application for the purpose of giving a clear understanding as to how the present invention operates in connection with the electrical starter.

A suitable housing 11 cooperates with the housing 6 in supporting a shaft casing 12 in which is journaled a flexible shaft 13 having secured to one end a gear 14 which meshes with the gear 5 of the ratchet clutch 4. The other end of the shaft 13 has secured thereto a gear 15 which meshes with an internal gear 16. The periphery of the internal gear 16 provides a brake drum and operating in conjunction with the brake drum is a band 17, one end of which is anchored, as shown at 18, and the other end is connected to a stem 19 of a piston 20. The piston operates in a cylinder 21 adapted to receive fluid pressure. The brake band 17 is normally applied to the periphery of the internal gear or the brake drum by a spring 22 acting on the piston 20 to urge the piston in one direction. A pressure is applied to the piston 20 to release the brake 17 and which will be hereinafter more fully described.

A spring driven shaft 23 has the internal gear 16 secured thereon and one end of a drive spring 24 is secured to the internal gear. The spring 24 surrounds the spring shaft 23 and has its other end secured on a ratchet clutch 25 partly supported by the spring driven shaft 23 and by a shaft 27. The friction clutch is splined on the shaft 27 and is engaged by a spring 28 supported by the shaft 27 for maintaining the ratchet clutch 25 in driving condition.

A mounting 29 is detachably and adjustably

mounted on the housing 11 and has an opening to permit the shaft 27 to extend therethrough. A substantially U-shaped hollow guide 30 forms an integral part of the mounting 29 and is cutaway to expose a gear 31 secured on the shaft 27. One end of the guide is partly closed by a vent type plug 32 and the other end of the guide has a fluid pipe 33 connected thereto. The run A of the guide 30 forms a cylinder and received in said cylinder is a flexible rack bar 34 having connected to one end a piston 35 to be acted on by the fluid from the pipe 33. The rack bar 34 being flexible will readily follow the guide 30 and is in mesh with the gear 31. The rack bar 34 is constructed from a plurality of members 36 each of which has teeth 37 formed thereon and each is provided with a bore. Connected to one of the end members 36 of the rack bar is a coil spring 38 which extends through the remaining number of members 36 and is connected to the piston 35. The coil spring acts to maintain the members 36 in proper relation to each other and to permit said members to move relative to each other to follow the guide 30 and pass about the gear 31. The members 36 are further connected by dowel pins 39, each member 36 having the dowel pins connected thereto and they in turn fit within sockets 40 formed in the adjacent member 36. A fitting 41 connects with the run A of the guide 30 and the fitting 41 is connected to the cylinder 21 by a pipe 42. A bypass pipe 43 is connected with the fitting 41 and with the run A of the guide 30 adjacent where said run connects onto the fluid pipe 33. A check valve 44 is located in the fitting 41 and a check valve 45 is located in the bypass pipe 43 adjacent where the latter connects onto the run A of the guide 30. The check valve 44 will let fluid pass from the run A through the pipe 42 to the cylinder 21 for actuating the piston 20 when the fluid has moved the rack bar the limit of its travel in one direction or after the piston 35 of the rack bar has passed the fitting 41. The liquid passing to the cylinder 21 may return to the fluid pipe 33 by way of the bypass pipe 43, the check valve 45 permitting the return of said fluid.

A fluid operating device is indicated in entirety by the numeral 47 and is connected to a valve mechanism 48 by a pipe 49'. The fluid pipe 33 is connected to the valve mechanism 48, the latter being suitably supported by a bracket 49 mounted on the electric starter.

The valve mechanism 48 consists of a casing 50 on which the switch 8 is mounted and receives therein the button 9 of the switch. Also received in the casing 50 is a spring pressed plunger 51 normally urged away from the button 9. Integral with the casing 50 is a pipe 52, one end of which is connected to the pipe 49' and the other end connected to the pipe 33. The pipe 52 is in communication with the casing 50 by a port 53 in the form of a valve seat and operating in the pipe 52 is a rotary valve 54 which can be positioned to direct fluid from the pipe 49' into the casing or can be positioned to direct the fluid through the pipe 52 to the pipe 33. The pipe 52 between the valve 54 and the pipe 33 is provided with a valve casing 55 in which is slidably mounted a plug type valve 56 having a port 57. The port 57 when in one position opens the pipe 52 from the valve 54 to the pipe 33 and in another position connects an outlet port 57' of the casing 50 with a bypass pipe 58. The bypass pipe 58 connects with the pipe 52 between the valve casing 55 and the pipe 33. Connected to the pipe 52 is a bypass pipe 59, one end of which forms a seat for the rotary

valve 54 and the other end is connected to the pipe 52 between the rotary valve and the pipe 49' so that when the valve 54 is in one position fluid may flow through the bypass 59 from the pipe 52 through the port 53 into the casing 50 and act on the plunger 51 to move into engagement with the button 9 and press the same for completing the electric circuit to the starter motor 1. At the same time the valve plug 56 is positioned to connect the outlet port 57' with the bypass pipe 58 so that the fluid pressure may pass on through the pipe 33 for actuating the rack bar 34, or if desired, the fluid pressure may be passed directly into the pipe 33 from the pipe 49' by positioning the valve 54 and valve 56 to open the pipe 52 from end to end. The valves 54 and 56 when thus positioned close the casing 50 to the pipe 52 both at its intake and exhaust ports, the exhaust ports including the bypass port 58 and the outlet port 57'. The rotary valve 54 when in the latter-named position also closes one end of the bypass pipe 59 to the pipe 52.

The fluid operating device includes cylinders 60, 61 and 62. The fluid capacity of the cylinder 62 is greater than the capacity of the cylinders 61 and 60 and the fluid capacity of the cylinder 60 is less than the fluid capacity of the cylinder 61. The cylinders are connected with each other and the cylinder 62 is connected to the pipe 49'. A piston 63 operates in the cylinder 60 and is connected to the starter pedal 10 by a link 64. A double ended piston 65 operates in the connection between the cylinders 60 and 61. A double ended piston 66 operates in the connection between the cylinders 61 and 62. A spring 67 acts on the piston 66 to urge the latter in one direction or in a direction to relieve pressure on the fluid. The pistons 63, 65 and 66 prevent fluid of said cylinders from mixing. The arrangement of the pistons and cylinders as described is for the purpose of progressively building up pressure from the foot pedal 10 to the pipe 49'. When the foot pedal 10 is moved in one direction it displaces fluid in the cylinder 60 which acts on the piston 65. The piston 65 being acted on by the fluid pressure mentioned acts on the fluid in the cylinder 61 which in turn acts on the piston 66 and the latter displaces the fluid into the pipe 49' at an increased pressure over the pressure developed by the piston 63 in the cylinder 60, consequently requiring a minimum amount of manual effort for the actuation of the starter pedal with a maximum amount of fluid pressure developed in the pipe 49'.

The purpose of the ratchet clutch 4 is to permit use of the starter 1 without the present invention and the purpose of the ratchet clutch 25 is to permit unwinding of the spring 24 without rotating the shaft 27. When the starter pedal 10 is returned to its normal position, as shown in Figure 1, the fluid is withdrawn from the run A of the guide 30 and the pipe 42 and bypass pipe 43 and also the pistons 66, 65 and 63 are returned to their normal positions, the piston 66 being aided in its return to normal position by the spring 67. Thus it will be seen that when the starter pedal 10 returns to normalcy sufficient pressure is developed by the piston 63 to return the rack bar to its initial position, as shown in Figure 2, the clutch 25 acting to permit the rack bar 34 to return to normal position without rotating the spring shaft 23, the latter at this time being held against rotation by the brake 17 due to the release of fluid pressure in the cylinder 21. Normally, the valves 54 and 56 are positioned, as shown in Figure 7, and should

the electric starter 1 fail to actuate or crank the engine due to a fully discharged battery, the engine may be cranked by the operator pushing the starter pedal in a direction to displace the fluid in the cylinder 60. The displacement of the fluid in the cylinder 60 brings about displacement of the fluid in the cylinder 61, 62, pipe 49' and pipe 33. The displacement of fluid as mentioned develops sufficient pressure to slide the rack bar 34 in the run A of the guide 30 imparting rotation to the gear 31. The gear 31 rotating winds the spring 24 and as the piston 35 of the rack bar 34 passes the fitting 41 fluid pressure then enters the cylinder 21 by way of the pipe 42 and acts on the piston 20 to release the brake band 17. The spring 24 then unwinds and rotates the shaft 13 and the latter being connected to the electric motor which rotates the shaft thereof and through the Bendix 2 imparts rotation to the crank shaft of the engine. Should the engine fail to start on the first cranking the same operation is repeated.

Should the engine be cold and hard to start or crank by the electric starter 1 and it is desired to aid the latter, the valves 54 and 56 are actuated by a suitable control from the instrument board, placing the cylinder 50 in communication with the pipe 52 so that when the fluid pressure is developed by the movement of the foot pedal 10 it will act on the plunger 51 to close the switch 8 and thereby complete the circuit to the electric motor 1 and also the fluid pressure passes on to act on the piston 35 of the rack bar 34. The rack bar 34 being acted on by the fluid pressure rotates the shaft 27 bringing about a winding of the spring 24 and as the spring becomes wound and the piston 35 of the rack bar passes the fitting 41 the fluid pressure acts on the piston 20 and releases the brake so that the spring 24 may unwind and drive the shaft 13 to aid in the rotation of the shaft of the electric motor.

While this invention has been described as operating in conjunction with an electric starter of an engine it is to be understood that this device can be employed for other purposes wherein it is desired to impart an intermittent rotation to some device.

In some instances it may be desirable to omit the spring drive mechanism heretofore described which may be accomplished by connecting the gear 31 onto the ratchet type clutch 4, as shown in Figure 12. My invention thus connected to the electric starter will bring about rotation of the latter by the manual actuation of the hydraulic mechanism.

What is claimed is:

1. In combination with an electric starter motor including a drive mechanism for connecting and disconnecting said motor to an engine and an electric circuit for the motor and having a switch for the control thereof, a mechanical drive, a ratchet mechanism for connecting said mechanical drive to said motor, and a manually actuated hydraulic means for actuating said mechanical drive and including means for the simultaneous actuation of the switch when desiring to electrically operate the motor concurrently with the actuation of the mechanical drive by said hydraulic means.

2. A starting apparatus for engines comprising the combination of a rotatably supported shaft, a ratchet mechanism connecting said shaft to an electric starter motor of an engine, a spring motor connected to said shaft, a brake

for said spring motor, and a manually actuated hydraulic means for winding said spring motor and to simultaneously and automatically actuate the brake to release said spring motor and thereby drive the engine through the electric starter motor.

3. A starting apparatus for engines comprising the combination of a shaft, a ratchet mechanism connecting said shaft to an electric starter motor of an engine, a spring motor connected to said shaft, a brake normally retaining said spring motor against operation to drive said shaft, a hydraulically operated concatenated rack bar geared to said spring motor, and a manually actuated hydraulic means for operating said rack bar to wind the spring motor and then automatically and simultaneously actuate the brake to release said spring motor to drive the engine through the starter motor.

4. A starting apparatus for engines comprising the combination of a shaft connected to an electric motor of an engine, a spring motor connected to said shaft, a brake automatically retaining the spring motor against operating said shaft, a rack bar guide in the form of a cylinder, a flexible rack bar operating in said guide and forming a piston in the cylinder, a ratchet mechanism connecting said rack bar to said spring motor, and a manually actuated hydraulic means for actuating said rack bar to wind the spring motor and to automatically and simultaneously actuate the brake to release said spring motor for driving the engine through the starter motor.

5. A starting apparatus for engines comprising a shaft connected to an electric starter motor of an engine, a spring motor connected to said shaft, a brake automatically retaining the spring motor against operating said shaft, a rack bar guide including a cylinder, a flexible rack bar operating in said guide and forming a piston in the cylinder, a ratchet mechanism connecting the rack bar to said spring motor, a series of fluid cylinders, pistons operating in certain of said cylinders and affected by the displacement of fluid in the cylinder adjacent thereto, a pipe connecting one of said cylinders to the cylinder of the guide, and a manually actuated piston operating in one of said cylinders.

6. In combination with an electric starter motor, a shaft connected to said motor, a spring motor connected to said shaft, a brake automatically retaining the spring motor against operating said shaft, a rack bar guide including a cylinder, a flexible rack bar operating in said guide and forming a piston in the cylinder, a ratchet mechanism connecting said rack bar to said spring motor, a series of fluid cylinders, pistons operating in certain of said cylinders and affected by the displacement of fluid in the cylinder adjacent thereto, a pipe connecting one of said cylinders to the cylinder of the guide, a manually actuated piston operating in one of said cylinders, and a manually actuated valve mechanism connected in said pipe for operating a switch of a circuit of the starter motor by the fluid pressure when desired.

7. In combination with an electric starter motor, a shaft connected to said motor, a spring motor connected to said shaft, a brake automatically retaining the spring motor against operating said shaft, a rack bar guide including a cylinder, a flexible rack bar operating in said guide and forming a piston in the cylinder, a ratchet mechanism connecting the rack bar to said spring motor, a series of fluid cylinders, pistons operat-

ing in certain of said cylinders and affected by the displacement of fluid in the cylinder adjacent thereto, a pipe connecting one of said cylinders to the cylinder of the guide, a manually actuated piston operating in one of said cylinders, and a manually actuated valve mechanism for operating a switch of an electric circuit of the starter motor and connected in said pipe whereby on the adjustment thereof the fluid pressure will be made to actuate the switch during the actuation of the rack bar by the fluid pressure.

8. In a starting apparatus for internal combustion engines, the combination of a shaft connected to the electric starter motor of an engine, a spring motor connected to said shaft, a hydraulically operated brake band encircling said spring motor to normally hold the same against rotation, gear means connected to the spring motor, a cylindrical rack bar guide receiving the said gear means, a rack bar including concatenated links reciprocally mounted in the said rack bar guide and having teeth adapted to enmesh with the teeth of the said gear means, and a manually actuated hydraulic means for actuating

the said rack bar to wind the spring motor and to automatically and simultaneously release the said brake band to permit the release of the spring motor.

9. In a starting apparatus for internal combustion engines, the combination of a shaft connected to the electric motor of an engine, a spring motor connected to said shaft, gear means connected to the said spring motor, a substantially U-shaped cylindrical member, a rack bar including concatenated links reciprocally mounted within the said cylindrical member and having teeth adapted to enmesh with the said gear means, one end of said rack bar comprising a piston, a manually operated hydraulic means, and pipe means communicating at one end with the said hydraulic means and at the other end thereof with the piston end of the rack bar to permit actuation of the same to wind the spring motor and to automatically and simultaneously release the said hydraulically actuated brake band thereby releasing the spring motor for driving the engine through the said electric starter motor.

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