Aug. 13, 1957 H. HOGEMAN 2,802,452

HYDRAULIC STARTER

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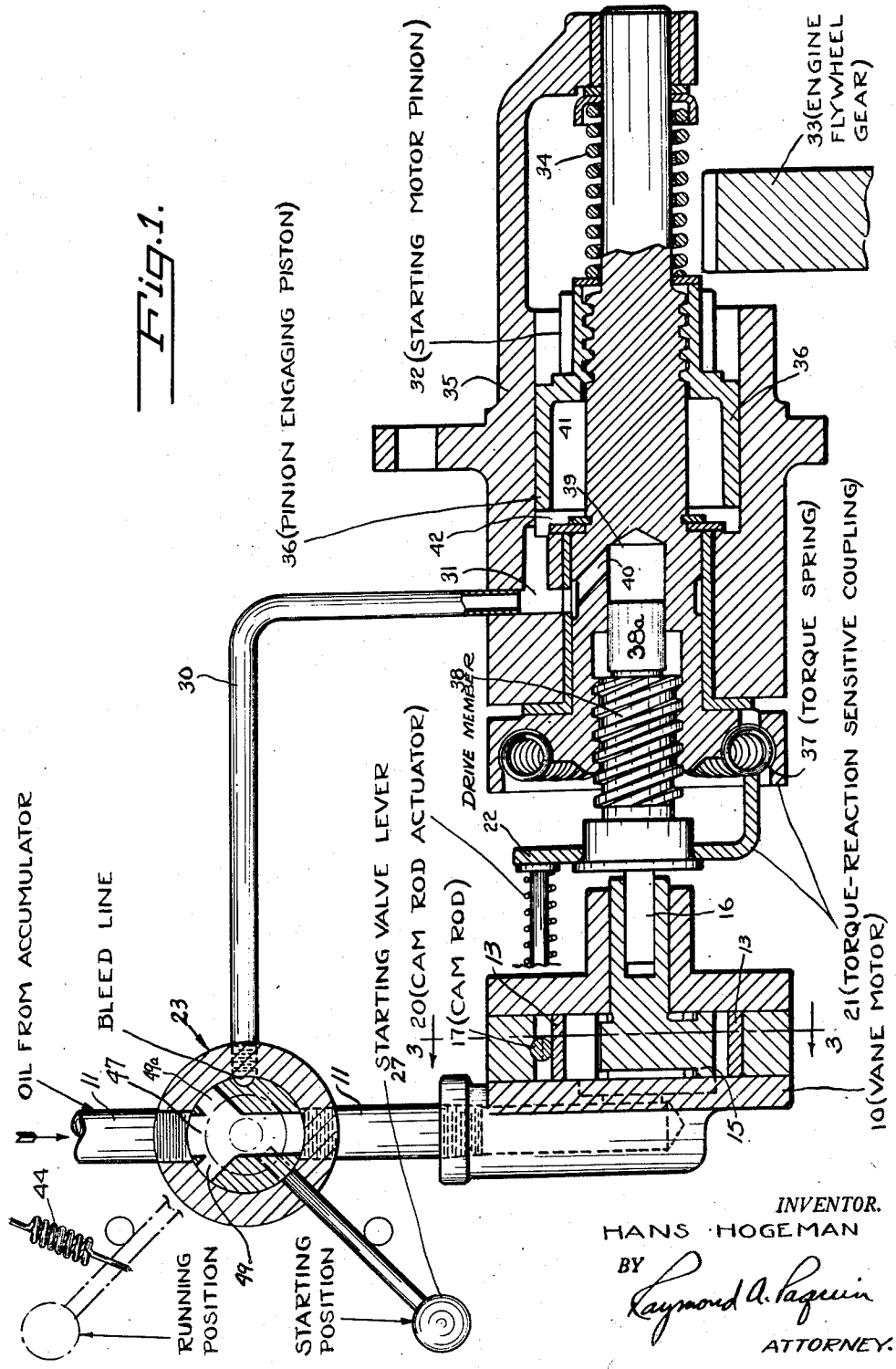
Fig. 1.



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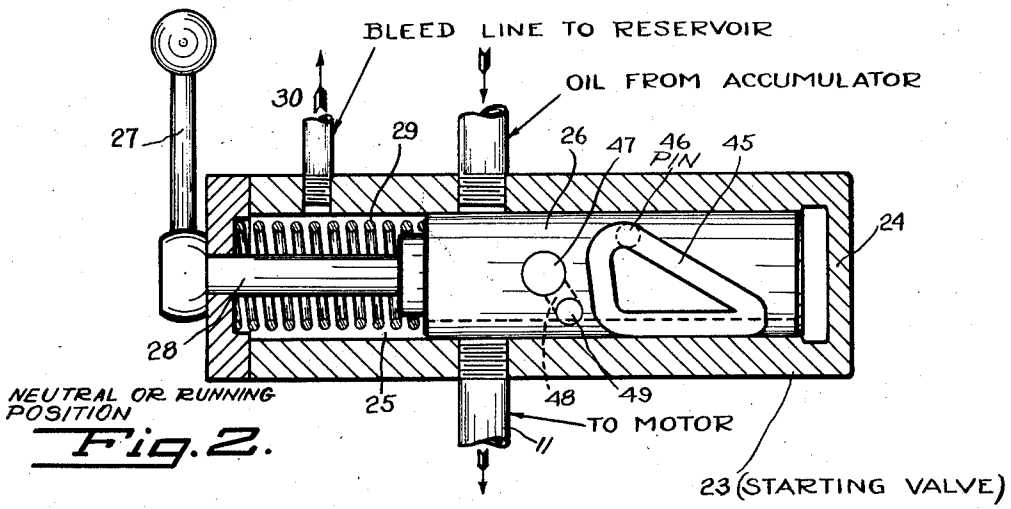

Fig. 2.

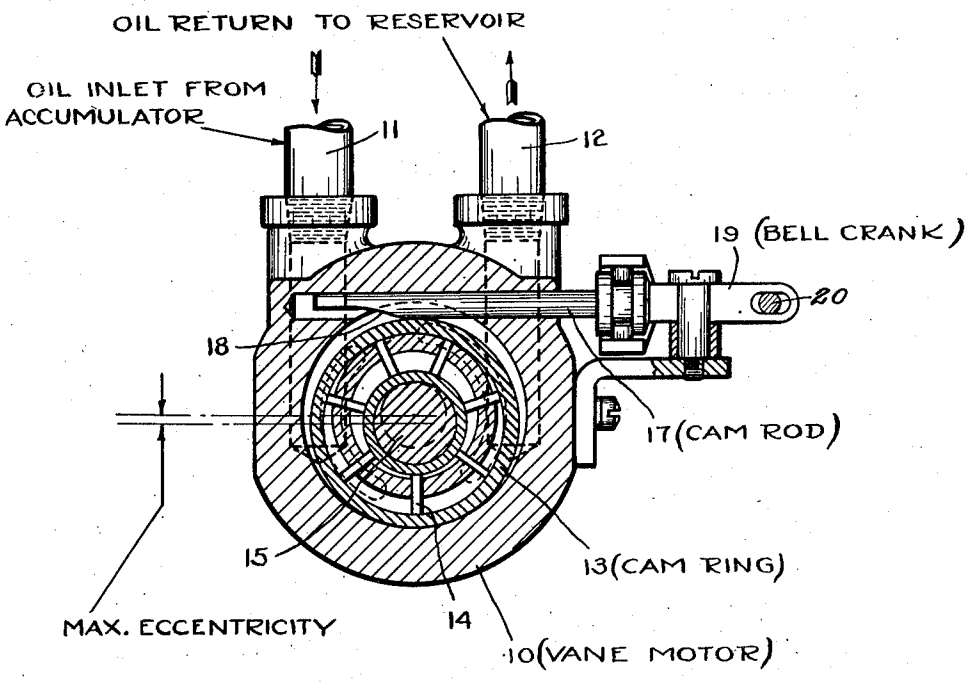

Fig. 3.

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HYDRAULIC STARTER

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6 Claims. (Cl. 121—37)

This invention relates to hydraulic motors and engine starters embodying such motors and has particular reference to a control for a variable displacement hydraulic motor adapted to be operatively connected to a load with the torque requirement of the motor being automatically controlled in relation to the torque requirements of the load, and also to an engine starter which embodies such a hydraulic motor and control as a power source and wherein the displacement of the motor is directly proportional to the torque required therefrom.

A principal object of the invention is to provide means for automatically controlling the displacement of a variable displacement hydraulic motor whereby the displacement of said motor will be in accordance with load requirements.

Another object of the invention is to provide a new and improved hydraulic starter for internal combustion engines wherein the starting motor produces the necessary torque required during the starting of the engine and wherein the torque provided at other times is reduced to a minimum.

Another object is to provide a hydraulic starter of the type set forth wherein the motor is self-regulating.

Another object is to provide a hydraulic starter employing a variable displacement motor as the power source thereof and wherein maximum torque will be provided during the actual starting of the engine and minimum torque provided at other times and wherein such motor will be self-regulating.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details of construction and arrangement of parts shown and described as the preferred form has been given by way of illustration only.

Referring to the drawings:

Fig. 1 is a diagrammatic view, partly in section, of a hydraulic starter embodying the invention;

Fig. 2 is a sectional view through the control valve arrangement; and

Fig. 3 is a sectional view through the motor and taken on line 3—3 of Fig. 1, looking in the direction of the arrows.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout, the apparatus shown in Fig. 1 comprises the variable displacement motor **10** which is shown in the form of a vane motor which has an inlet **11** from a hydraulic fluid accumulator and an outlet or return **12** to a fluid reservoir.

The motor **10** is of the vane type, as stated, having the cam ring **13** within which is positioned the vanes **14** and drive shaft **15** which is keyed at **16** to the starter drive mechanism.

The cam ring **13** of vane motor **10** is controlled by cam rod **17** which extends into the housing of the vane motor and has the cam portion **18** adjustably engaging cam

ring **13** for controlling the displacement of cam ring **13** and thereby controlling the power output of the motor.

Cam rod **17** is connected through the bell-crank **19** to cam rod actuator **20** which is connected to the torque-reaction sensitive coupling **21** at **22**.

Interposed in the oil or fluid inlet line **11** from the accumulator is a starting valve **23** which comprises a housing **24** having a bore or chamber **25** in which is positioned a valve member **26** which is connected to starting valve lever **27** through valve stem or shaft **28**. Valve **26** is retained in operative position by valve spring **29** in chamber **25**.

Bleed line **30** communicates with chamber **25** and the oil or fluid reservoir **31**.

Starting mechanism is shown in Fig. 1, and includes the starting motor pinion **32** adapted to engage the engine fly-wheel gear **33** when the pinion is advanced by the hydraulic starting motor against spring **34**.

In the inside of a starter housing **35** is a piston **36** engaging pinion **32** or integral therewith, as shown, and adapted to function as hereinafter described. The torque-reaction sensitive coupling **21** is provided with the torque spring **37** and in coupling **21** is also threaded the drive portion **38** which is keyed to vane motor **10** at **16**, as previously described. Drive member **38** is adapted to be driven during the cranking cycle by the vane motor **10** and returned in the opposite direction by high pressure fluid in chamber **39** which high pressure acts on piston **38***a* which passes into said chamber through port **40** from reservoir **31** which communicates with chamber **41** in pinion engaging piston **36** through port **42**.

The displacement of the vane motor **10** is directly proportional to the torque required to crank the engine. As previously described, vane motor **10** has the adjustable eccentric cam ring **13**, the eccentricity of which is changed by means of cam rod **17** which is actuated by a torque-reaction sensitive coupling.

The vane motor **10** is driven by high pressure oil from an accumulator through starting valve **23**. When the starting valve lever **27** is pulled out against spring **29** and turned from running position as shown in Fig. 2 into the starting position, port **47** is aligned with the line from the accumulator to the motor as shown in Fig. 1 and high pressure oil from the accumulator is introduced momentarily to the torque coupling **21** and the pinion engaging piston **36** through the line from the accumulator and ports **49** and **49***a*, line **30**, reservoir **31**, and ports **40** and **42**. This operation sets the cam ring **13** at maximum eccentricity and engages the starting motor pinion **32** with the engine flywheel gear **33**, allowing cranking of the engine immediately when the starting valve **23** reaches starting position. In this starting position, the coupling shaft **38***a* and pinion engaging piston **36** are relieved of high pressure oil through a bleed line back to the reservoir as hereinafter described. The coupling shaft and engaging piston are now held in this position during the cranking cycle by the torque required to crank the engine. As the engine starts, and its cranking torque is reduced, the torque sensitive coupling starts returning the coupling shaft **38***a* into its chamber **39** by means of a torque spring.

Valve **23** has the port **47** between spaced ports **49** and **49***a* and also has the track or cam slot **45** in which rides the pin **46** which controls the movement of the valve and assures the feeding of oil through line **30** for starting and for bleeding when running.

As the shaft returns, it moves the cam ring from maximum eccentricity, that is, the position of greatest torque to zero eccentricity which is the position of least torque through its connection to the cam rod actuator **20**, bell-crank **19** and cam rod **17**. At the same time, the starting motor pinion **32** becomes disengaged by decreased torque

and is returned to its running position (as shown in Fig. 1) by means of compression spring **34**. As the engine starts, the operating or starting valve lever **27** is released and is returned to its running position (shown in Fig. 2) by a return spring **44**. This action closes off high pressure oil to vane motor **10** and the hydraulic starter is ready for the next start.

When lever **27** is moved from neutral or running position, as shown in dotted lines in Fig. 1, to starting position as shown in full lines in Fig. 1, the line from the accumulator is connected for an instant with line **30** by means of ports **49** and **49***a*. During this instant, port **49** is aligned with the line from the accumulator and port **49***a* is aligned with line **30** and during this instant, fluid passes through line **30** to chamber **31** from which it passes through port **42** to chamber **41** and acts upon piston **36** to force pinion **32** into engagement with gear **33** against the force of spring **34**.

When lever **27** reaches starting position, the line from the accumulator is in communication with line **11** and fluid passes to the vane motor **10** and spring **37** through bell crank **19** and cam rod **17** positions cam ring **13** for maximum displacement thereby giving maximum torque of the vane motor which is coupled to the starting drive shaft **15** and drives said shaft and thereby causes starting motor pinion **32** to rotate and crank the engine.

When the torque required to crank the engine is reduced, the torque spring **37** adjusts the position of cam ring **13** to a position of less displacement through bell crank **19** and cam rod **17**. This may occur after the first cranking motion which requires the greatest torque, as well as when the engine starts. This lessens the supply of high pressure fluid from the accumulator to the vane motor to that required by the torque needed to crank the engine.

After the engine has started, the lever **27** is moved from starting position to running position which shuts off the supply of fluid through line **11** to the vane motor and releases the fluid pressure in chamber **41** back through line **30** to the bleed line and allows spring **34** to move the pinion out of engagement with the engine flywheel gear **33**.

In Fig. 2 the starting valve **23** and lever **27** are shown in neutral or running position.

From the above it will be seen that vane motor **10** is controlled so as to provide power only when needed and, therefore, the torque employed to turn the engine is reduced to that required which eliminates waste of power.

From the foregoing it will be seen that I have provided simple, efficient and economical means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion.

2. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion, and hydraulic means for urging said pinion into operative position.

3. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connected said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion, and hydraulic means for urging said pinion into operative position, a hydraulically actuated piston operatively connected to said pinion and means whereby hydraulic force on said piston will actuate said pinion into operative position.

4. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion, said means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor comprising cam means and means for actuating said cam means.

5. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion, said torque sensitive coupling comprising resilient means so arranged that the resiliency of said resilient means is a function of the torque applied on said pinion.

6. In a device of the character described, a variable displacement hydraulic motor, means for varying the displacement of said motor, a pinion operatively connected to said motor, said means for varying the displacement of said motor including a torque sensitive coupling between said motor and said pinion, the load on the pinion actuating said torque sensitive coupling and means operatively connecting said torque sensitive coupling to said means for varying the displacement of said motor according to the actuation of said torque sensitive coupling by said load on said pinion, said torque sensitive coupling comprising a wound spring so arranged that the tension of said spring is a function of the torque applied on said pinion.

References Cited in the file of this patent

UNITED STATES PATENTS

1,077,884	Kinney	Nov. 4, 1913
2,161,439	Thoma	June 6, 1939
2,199,081	Perin	Apr. 30, 1940
2,370,526	Doran	Feb. 27, 1945
2,653,577	Jenny	Sept. 29, 1953
2,666,293	Vigneau	Jan. 19, 1954
2,674,093	Slomer	Apr. 6, 1954