

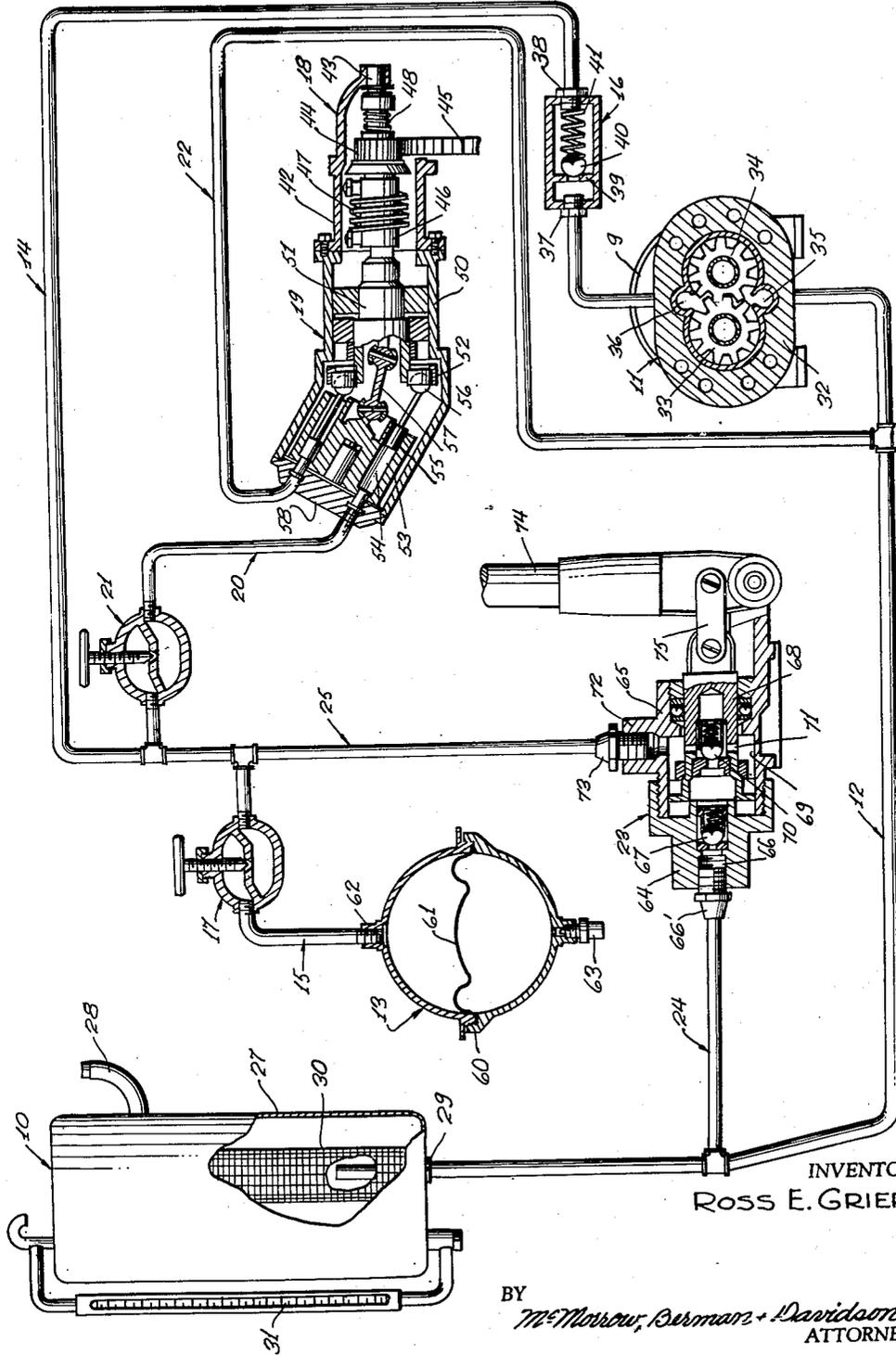
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HYDRAULIC STARTING SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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## HYDRAULIC STARTING SYSTEM FOR INTERNAL-COMBUSTION ENGINES

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1 Claim. (Cl. 60-51)

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This invention relates to starting systems for internal combustion engines, and more particularly to a hydraulic system including a fluid pressure accumulator.

It is among the objects of the invention to provide an improved engine starting hydraulic system which includes a hydraulic engine starting motor, a motor driven pump for building up hydraulic pressure to operate the motor, a pressure fluid accumulator and a hand pump for supplying motor operating fluid under pressure in the event of failure or exhaustion of the pressure fluid accumulator or failure of the pump driving motor, which system is simple in arrangement and capable of utilizing components already available without material modification of such components or of the engine structure, and which is economical to manufacture and install, easy to operate, and positive and highly effective in operation.

Other objects and advantages will become apparent from a consideration of the following description and the appended claim in conjunction with the accompanying drawing, wherein the single figure is a diagrammatic illustration of a hydraulic engine starting system illustrative of the invention, certain parts being broken away and shown in cross section to better illustrate the construction thereof.

With continued reference to the drawing, the system comprises, in general, a fluid tank or reservoir 10, a motor driven hydraulic pump 11, a conduit 12 connecting the reservoir 10 to the inlet side of the pump 11, a pressure fluid accumulator 13, conduits 14 and 15 connecting the outlet side of the pump 11 to the accumulator 13, a check valve 16 in the conduit 14 precluding return flow of fluid from the accumulator to the pump, a manually operated valve 17 in the conduit 15 for shutting off the accumulator to prevent flow of fluid thereto or leakage of fluid therefrom, an engine starting gear 18, a hydraulic motor 19 drivingly connected to the engine starting gear, a conduit 20 leading from the conduit 14 to the inlet side of the motor 19, a manually controlled valve 21 in the conduit 20 for precluding, when closed, leakage of hydraulic fluid from the accumulator through the motor, a conduit 22 connecting the outlet side of the motor 19 to the conduit 12 and through this line back to the reservoir 10, a hand operated pump 23, a conduit 24 connecting the conduit 12 and through it the reservoir 10 to the inlet side of the pump 11, and a conduit 24 connecting the outlet side of the pump 23

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to the conduits 15 and 14, so that fluid under pressure can be supplied from the pump 23 to the accumulator 13 or directly to the motor 19 independently of the pump 11.

The reservoir 10 may conveniently comprise an elongated, cylindrical tank 27 vertically disposed and having a filler spout 28 near its upper end, and a fitting 29 in its bottom wall for connection of the conduit 12 to the tank. A screen or filter 30 receives the end of the conduit 12 within the tank 27 and a liquid level gauge 31 is secured at its respectively opposite ends to the bottom and top of the tank and is disposed alongside the tank exteriorly thereof.

The motor driven pump 11 is a conventional gear pump of well known construction having an elongated housing 32 and two intermeshing gears 33 and 34 journaled in the housing, one of these gears being driven by an electric motor 9 which may be energized from a storage battery. The pump 11, has in the housing 32, an inlet port 35 to which the adjacent end of the conduit 12 is connected, and an outlet port 36 to which the adjacent end of the conduit 14 is connected.

The check valve 16 comprises an elongated hollow housing having, at its opposite ends, fittings 37 and 38 by means of which the corresponding ends of the conduit 14 are connected to the housing, a valve seat 39, a valve ball 40 and a compression spring 41 resiliently urging the ball into seating relationship with the seat 39.

The starter gear 18 is an old and well known construction including a housing 42 attachable to the flywheel housing of an internal combustion engine, a shaft 43 journaled in the housing, a gear 44 rotatably mounted on this shaft and movable into and out of mesh with the toothed flywheel 45 of the engine, a collar 46 secured on the shaft and a drive spring 47 connecting the collar to the gear 44. The shaft is externally screw threaded, as indicated at 48, and the gear 44 is internally screw threaded, so that when the shaft 43 is rotated the gear will be moved into mesh with the flywheel 45, and when the flywheel rotates faster than the gear 44 this gear will be moved out of mesh with the flywheel gear.

The motor 19 may be a wobble pump of conventional construction having a hollow housing 50, one part of which is angularly disposed relative to the other part, a shaft 51 journaled in the housing and connected at one end to the starter gear shaft 43, a bearing ring 52 carried at the opposite end of the shaft 51, a rotor 53

journalled in the housing with its axis of rotation at an angle to the axis of rotation of the shaft 51, a plurality of cylinders 54 in the rotor 53, pistons 55 reciprocable in the cylinders 54 and connected to bearings 56 carried by the bearing ring 52, a universal coupling 57 between the rotor 53 and the shaft 51 to transmit torque between the rotor and the shaft, and a cap 58 secured to the housing and overlying the end of the rotor 53 remote from the shaft 51, this cap having an inlet and an outlet port therein to which the conduits 20 and 22 are respectively connected.

The hand operated valves 17 and 21 may be of conventional construction and a detailed description thereof is considered unnecessary for the purposes of the present disclosure.

The accumulator 13 comprises a hollow spherical body made in two hemispherical parts threaded together, as indicated at 60, around a diameter of the body, a flexible diaphragm 61 extending transversely of the interior of the body and marginally secured between the two hemispherical halves thereof, a fitting 62 on one of the body halves receiving the adjacent end of the conduit 15, and an inlet check valve 63 carried by the other half of the spherical body for admitting air or a suitable gas under pressure into the space between this half of the body and the diaphragm 61, to provide a resilient cushion for hydraulic fluid contained between the diaphragm and the other hemispherical half of the body.

The manually operated pump 23 is also of well known construction and includes a housing comprising two parts 64 and 65 threaded together in longitudinal alignment, the part 64 having a longitudinal bore therethrough. A fitting 66' is secured in the outer end of the bore 66 of the housing part 64 to receive the adjacent end of the conduit 24, and a check valve 67 is mounted in this bore adjacent the fitting 66'. The housing part 65 is provided with a longitudinally extending bore larger than the bore 66, and a hollow pump plunger 68 is reciprocable in the bore 69 of the housing part 65. This plunger carries a check valve 70 and is provided with ports 71 through which fluid under pressure is forced to a hollow boss 72 on the housing part 65, and a fitting 73 is threaded into the boss 72 to connect the adjacent end of the conduit 25 thereto. The housing part 65 is extended at one side in a direction away from the part 64, and a pump handle 74 is pivotally connected at one end to the outer end of this extension. Suitable links 75 connect the handle to the plunger 68, so that the plunger will be reciprocated in the bore 69 when the handle 74 is rocked back-and-forth.

In the operation of the device, hydraulic fluid is supplied under pressure to the accumulator 13 by the pump 11 when the pump driving motor is put into operation, and this fluid under pressure is stored in the accumulator when the manually operated valve 21 is closed or is applied directly to the fluid motor 19 when the valve 21 is open. In order to place the starter in operation the valve 21 is opened providing a flow of fluid under pressure from the accumulator to the starting motor 19. After the engine has started the valve

21 is again closed. If the fluid under pressure in the accumulator becomes exhausted, either by leakage or by difficult starting of the engine and the pump driving motor also becomes inoperative by failure of its battery or for some other reason, the valve 17 may be closed and the hand operated pump 23 operated to supply fluid under pressure directly to the motor 19 to start the motor. Also, if the pump 11 should become inoperative, fluid pressure can be built up in the accumulator 13 by closing the valve 21 and opening the valve 17 and operating the hand operated pump.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claim rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claim are, therefore, intended to be embraced therein.

What is claimed is:

A hydraulic starting system for an internal combustion engine comprising an engine starting gear, a hydraulic motor drivingly connected to said gear, a motor driven pump, a fluid pressure accumulator, a fluid reservoir, a first conduit connecting said reservoir to the inlet side of said pump, a second conduit connecting the outlet side of said pump to said accumulator, a check valve in said second conduit precluding return flow of fluid from said accumulator to said pump, and a manually operated valve in said second conduit, a third conduit leading from said accumulator to the inlet side of said fluid motor, a manually operated valve in said third conduit, a fourth conduit leading from the outlet side of said fluid motor into said first conduit, a hand operated pump, a fifth conduit connecting the outlet side of said hand operated pump to said accumulator, and a sixth conduit connecting the inlet side of said hand operated pump to said first conduit, said hand operated pump being effective to supply fluid under pressure directly to said motor or to build up fluid pressure in said accumulator and serving as a valve precluding flow of fluid from the outlet of said motor driven pump back to said reservoir, and said check valve precluding flow of fluid from the outlet of said hand operated pump back to said reservoir through said motor driven pump.

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