

April 25, 1961

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2,981,056

APPARATUS FOR STARTING INTERNAL COMBUSTION ENGINES

Filed March 7, 1958

2 Sheets-Sheet 2

FIG. 5.

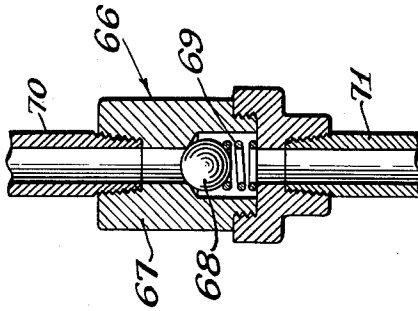


FIG. 4.

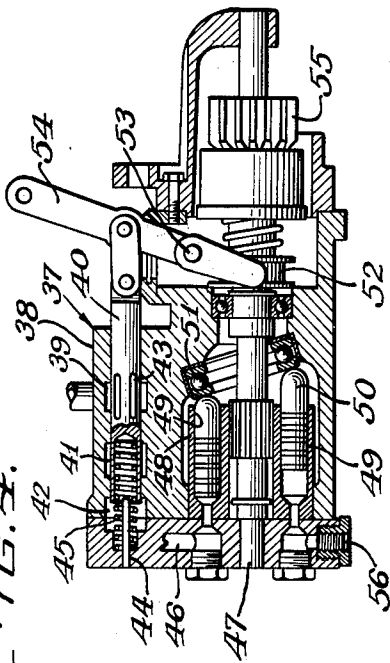
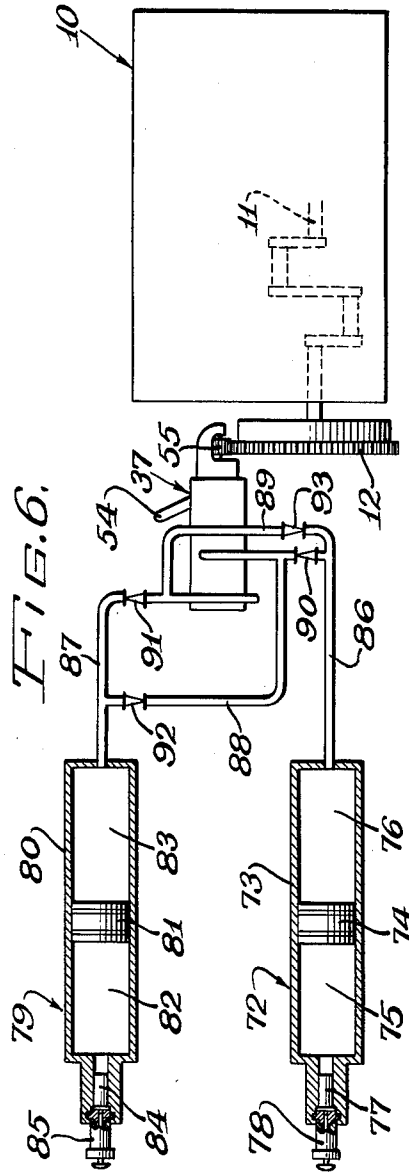


FIG. 6.



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APPARATUS FOR STARTING INTERNAL COMBUSTION ENGINES

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Filed Mar. 7, 1958, Ser. No. 719,868

4 Claims. (Cl. 60—17)

This invention relates to apparatus for starting internal combustion engines.

An object of the invention is to provide apparatus for starting an internal combustion engine wherein fluid pressure does not have to be retained in the apparatus when the apparatus is out of use.

Another object of the invention is to provide apparatus for starting an internal combustion engine having an efficiency far greater than the present cartridge type system.

Another object of the invention is to provide an apparatus for starting an internal combustion engine which is closed so that the apparatus will not fill up with foreign matter.

Another object of the invention is to provide an apparatus for starting an internal combustion engine which eliminates the need for a hand pump.

Another object of the invention is to provide apparatus for starting an internal combustion engine which eliminates the need for an engine driven pump.

A further object of the invention is to provide apparatus for starting an internal combustion engine wherein the operation of the apparatus is not affected by temperature.

The foregoing and other objects of the invention will be apparent from the construction and arrangement illustrated in the accompanying drawings wherein:

Figure 1 is a schematic view of one form of apparatus for starting an internal combustion engine,

Figure 2 is an enlarged fragmentary view of the accumulator shown in Figure 1 illustrating the firing mechanism,

Figure 3 is a view taken on the line 3—3 of Figure 2,

Figure 4 is a longitudinal cross section through the fluid motor,

Figure 5 is a longitudinal cross section through the check valve shown in Figure 1, and

Figure 6 is a schematic view of a second form of the apparatus for starting an internal combustion engine.

In the past one way of starting an internal combustion engine has been by the use of a hydraulic apparatus. In this apparatus a gas charged accumulator turned a hydraulic motor to crank the engine. To recharge the accumulator it is necessary to have a hand driven pump or engine driven pump with a reservoir for the oil after it flows through the hydraulic motor and the oil is pumped from the reservoir back into the accumulator to recharge the accumulator. Another way of starting an internal combustion engine has been by the use of an electrical apparatus. In this apparatus an electric starting motor is energized by a storage battery and the storage battery has to be recharged through the engine generator on the engine that is to be started. Storage batteries are not very efficient at low temperatures. A third way of starting an internal combustion engine has been by the use of an air starting apparatus. In this apparatus a compressed air tank sends compressed air to an air cranking motor which cranks the engine to start it. This

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apparatus requires an engine driven pump to build up pressure in the compressed air tank. A large compressed air tank is required and an air cranking motor is very inefficient.

The invention proposes an apparatus for starting an internal combustion engine. The apparatus is comprised of an accumulator including a cylinder and a free piston in the cylinder dividing the cylinder into a pair of chambers. A cartridge is disposed in one chamber of the accumulator and a firing mechanism is provided to fire the cartridge. A fluid motor is provided and is geared to the flywheel of the internal combustion engine to be started and the inlet of the fluid motor is in communication with the other chamber of the accumulator. A container is provided and is in communication with the outlet of the fluid motor. When the cartridge is fired the expanding gases move the piston causing the fluid in said other chamber of the accumulator to flow into the inlet of the fluid motor through the fluid motor to crank the internal combustion engine resulting in the starting of the engine. The fluid then flows out the outlet of the fluid motor into the container. One advantage of this invention is that fluid pressure does not have to be retained in the apparatus when the apparatus is out of use. Another advantage is that the efficiency of this apparatus is far greater than that of the present cartridge type system. Another advantage is that a closed apparatus is provided so that the fluid in the fluid chamber of the accumulator and the container will not become contaminated with foreign matter. Another advantage is that the system for hand pumping required in present hydraulic apparatus for starting internal combustion engines is eliminated. Another advantage is that applicants' apparatus eliminates the need for an engine driven pump. Another advantage is that the operation of applicants apparatus is not affected by temperature.

In the drawings, 10 generally designates an internal combustion engine having a crankshaft 11 and a flywheel 12 fixed on the crankshaft. The first form of apparatus for starting the internal combustion engine 10 is shown in Figure 1 and will now be described. An accumulator 13 is provided and includes a cylinder 14 and a free piston 15 disposed in the cylinder dividing the interior of the cylinder into a pair of chambers 16 and 17. A cartridge 18 is disposed in the chamber 16 adjacent one end of the cylinder 13 and a firing mechanism 19 is mounted on said one end of the cylinder. The firing mechanism 19 will now be described. The cylinder 13 has a bore or an opening 20 in said one end thereof and a plurality of slots 21 are provided in the cylinder and extend outwardly from the wall of the opening. The cylinder 13 has a circular space 22 therein which merges with the slots 21. A part 23 has an end piece 24 threaded in its inner end and the end piece has a plurality of lugs 24a projecting outwardly therefrom with the number of lugs being equal to the number of slots 21. A cap 25 is threaded on the other end of the part 23. The part 24 is provided with a hole 25a therethrough and a firing pin 26 is disposed in the hole and projects into a recess 27 extending inwardly from the inner end of the part 23 and a head 28 is made integral with the firing pin and a coil spring 29 disposed in recess 27 urges the firing pin away from the cartridge 18. The part 23 has a recess 30 therein extending inwardly from its outer end with a wall 31 separating recess 27 from recess 30. A handle 32 has a shank 34 and a collar 35 is made integral with the shank, and a head 35a is made integral with the shank. The firing mechanism 19 is disposed against the rim 36 of the cartridge 18. When it is desired to insert the firing mechanism 19 in the cylinder 14 of accumulator 13 the lugs 24a are moved through slots 21 in the cylinder into the space 22 and then the firing mechanism is rotated

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clockwise as shown in Figures 2 and 3 on cam surfaces on wall 22a so that the firing mechanism fits tightly against the cartridge 18 and fits tightly in the cylinder. When it is desired to remove the firing mechanism 19 from the cylinder 14 of the accumulator 13 the firing mechanism is turned counterclockwise as shown in Figures 2 and 3 until lugs 24 are in registry with slots 21 and then the firing mechanism is pulled out of the cylinder. The chamber 17 of accumulator 13 contains a fluid such as oil.

A fluid motor 37 is comprised of a housing 38 and an oil inlet 39 and a tubular member 40 is slidably mounted in the housing and an enlarged space 41 is located adjacent the inlet and another enlarged space 42 is located next to enlarged space 41. The tubular member 40 is provided with circumferentially spaced slots 43 and a pin 44 is tightly fitted in a hole in the housing 38 and a coil spring 45 is disposed on the pin and engages a shoulder inside the tubular member to urge the tubular member outwardly of the housing. A passage 46 leads from space 42. A shaft 47 is rotatably mounted in the housing 38 and a collar 48 is splined on the shaft and has a plurality of chambers 49 therein and a piston 50 is disposed in each chamber. A bearing 51 is disposed at an angle from the vertical and is fixed in a cutout in the housing. A collar 52 is fixed on the shaft 47 and a shaft 53 is fixed in the housing 38 and a handle 54 is pivoted on shaft 53 and pivotally connected to the tubular member 40 and is also pivotally connected to the collar 52. A spur gear 55 is fixed on shaft 47. The coil spring 45 normally keeps the handle 54 in the position shown in Figure 4 and upon movement of the handle in a counterclockwise direction as shown in said figure the shaft 47 is moved to the right to bring the spur gear 55 into meshing engagement with the flywheel 12 of the internal combustion engine 10. The housing 38 has an outlet 56. When lever 54 is moved to the left as shown in Figure 4 slots 43 provide communication between inlet 39 and space 41 and fluid flows through the inlet into the space 41 and then flows into space 42 into passage 46. The fluid flows from passage 46 into the chamber 49 and the piston will seek a position in which it can move out of the collar 48 and it will go along the bearing 51 and move farther out of the collar and therefore cause rotation of the collar and the shaft 47. When the piston 50 has moved to the lowermost position in Figure 4 the fluid will flow out the outlet 56 and this movement of the pistons will continue so that collar 48 and shaft 47 will continue to rotate.

A conduit 57 is in communication with the chamber 17 of accumulator 13 and is also in communication with the inlet 39 of fluid motor 37. A fluid return means 58 includes a cylinder 59 and a free piston 60 disposed in the interior of the cylinder dividing the cylinder into a pair of chambers 61 and 62. A resilient means in the form of a coil spring 63 is disposed in the chamber 61 and has one end bearing against one end of the cylinder and has its other end engaging the free piston 60 and urging the piston toward the other end of the cylinder. A conduit 64 is in communication with the outlet 56 of the fluid motor 37 and is also in communication with the chamber 62 of the fluid return means 58. A conduit 65 is in communication with conduits 64 and 57 and a check valve 66 is disposed in conduit 65 and is comprised of a housing 67 and a ball 68 and a coil spring 69 urging the ball against an interior shoulder of the housing 67. The conduit 65 is formed in two sections 70 and 71 connected to the housing 67 of the check valve. From Figure 5 it will be seen that oil can flow from conduit 70 to conduit 71 but cannot flow from conduit 71 to conduit 70.

The operation of the invention shown in Figures 1 to 5 inclusive is as follows: The firing mechanism 19 is removed from the accumulator 13. Then a cartridge 18 is inserted in the cylinder 14 through the opening 20 and

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then the firing mechanism is inserted in the opening in the cylinder. Then the lever 54 on fluid motor 37 is moved counterclockwise as shown in Figure 4 to engage spur gear 55 with the flywheel 12 of internal combustion engine 10. Next, the operator pushes the handle 32 inwardly against the pressure of springs 34a and 29 causing the firing pin 26 to engage the cartridge 18 resulting in the explosion of the cartridge. When the cartridge 18 explodes the expanding gases cause the piston 15 to move the oil out of chamber 17 into conduit 57 into the inlet 39 of the fluid motor 37 through the fluid motor to cause fast cranking of the internal combustion engine 10 resulting in starting of the internal combustion engine and then lever 54 of motor 37 is moved clockwise to disengage the gear 55 with the flywheel 12. The oil then flows out the outlet 56 of the fluid motor 37 through conduit 64 into chamber 62 of the fluid return means 58. The firing mechanism 19 and cartridge 18 are then removed from cylinder 14 so that chamber 16 of accumulator 13 is open to the atmosphere. The coil spring 63 then pushes piston 60 toward conduit 64 to move the oil out of chamber 62 into conduit 64 and then into conduit 65 past the check valve 66 into conduit 57 and then into chamber 17 of accumulator 13. The firing mechanism 19 is then reinserted in the end of the cylinder 14.

The second form of the invention is shown in Figure 6. An accumulator 72 includes a cylinder 73 and a free piston 74 is disposed in the cylinder dividing the interior of the cylinder into chambers 75 and 76. A cartridge 77 is disposed in cylinder 73 and a firing mechanism 78 is mounted in the end of the cylinder. An accumulator 79 includes a cylinder 80 and a free piston 81 disposed in the cylinder dividing the interior of the cylinder into chambers 82 and 83. A cartridge 84 is disposed in the cylinder 80 and a firing mechanism 85 is mounted in the end of the cylinder. The firing mechanisms 78 and 85 and the construction of the ends of cylinders 73 and 80 in which the cartridges 77 and 84 are mounted are identical with the firing mechanism 19 and the construction of the cylinder 14 as shown in Figure 2. The chambers 76 and 83 of accumulators 72 and 79 contain oil. A conduit 86 is in communication with chamber 76 and is also in communication with the inlet 39 of fluid motor 37. A conduit 87 is in communication with the outlet 56 of the fluid motor 37 and is also in communication with the chamber 83 of accumulator 79. A conduit 88 is in communication with the conduit 87 and is also in communication with the conduit 86. A conduit 89 is in communication with the conduit 87 and is also in communication with the conduit 86. A check valve 90 is disposed in conduit 86 and a check valve 91 is disposed in conduit 87 and a check valve 92 is disposed in conduit 88 and a check valve 93 is disposed in conduit 89. The check valves 90, 91, 92 and 93 are identical to the check valve shown in Figure 5. The operation of this form of the invention is as follows: If it is desired to fire the cartridge 77 in accumulator 72 the firing mechanism 85 and cartridge 84 on accumulator 79 are removed so that chamber 82 is open to the atmosphere. Then the lever 54 on fluid motor 37 is moved to engage spur gear 55 with the flywheel 12 of the internal combustion engine 10. Then the cartridge 77 in accumulator 72 is exploded by actuating the firing mechanism 78 causing the expanding gases to move the piston 74 pushing the oil out of chamber 76 into conduit 86 through the check valve 90 into the inlet 39 of fluid motor 37 through the fluid motor to fast crank the internal combustion engine 10 resulting in the starting of the engine. The oil then flows out the outlet 56 of the fluid motor 37 into conduit 87 through the check valve 91 into the chamber 83 of accumulator 79. The check valve 92 prevents oil from flowing from conduit 86 through conduit 88 and bypassing the fluid motor 37 when cartridge 77 in accumulator

72 is fired. The check valve 93 prevents oil from flowing from conduit 86 through conduit 89 and bypassing the fluid motor 37 when cartridge 77 in accumulator 72 is fired. The next time it is desired to start the internal combustion engine 10 the firing mechanism 78 on accumulator 72 is removed so that chamber 75 is open to the atmosphere and lever 54 on fluid motor 37 is actuated to cause spur gear 55 to engage flywheel 12 of the engine and the firing mechanism 85 is actuated to fire cartridge 84. When the cartridge 84 is fired the expanding gases move the piston 81 to push oil out of chamber 83 into conduit 87 and into conduit 88 through the check valve 92 and into the inlet 39 of the fluid motor 37 through the fluid motor to fast crank the internal combustion engine 10. The oil flows out the outlet 56 of the fluid motor 37 into the conduit 89 and through the check valve 93 into the conduit 86 and then into the chamber 76 of accumulator 72. The check valve 91 prevents oil from flowing from conduit 87 into conduit 89 and bypassing the fluid motor 37 when cartridge 84 in accumulator 79 is fired. The check valve 90 prevents oil from flowing from conduit 88 directly into conduit 86 and bypassing the fluid motor 37 when the cartridge 84 in accumulator 79 is fired.

Applicants' apparatus has the advantages that fluid pressure does not have to be retained in the apparatus when the apparatus is out of use. In an oil and gas accumulator oil flows from the accumulator and flows through the hydraulic motor to the reservoir so that pressure in the accumulator is lost or greatly reduced. The efficiency of applicants' apparatus is however far greater than the present cartridge type systems. In the present cartridge type system the cartridge explosion drives the gas motor which cranks the engine. The disadvantage of the cartridge type system is the inherent inefficiency of the gas motor. Applicants' invention provides a closed apparatus so that oil in the oil chamber of the accumulator or in the oil chamber of the fluid return means or in the oil chamber of the second accumulator will not fill up with foreign matter. Most hydraulic apparatuses used in the past have a reservoir which is open to the atmosphere letting foreign matter in the apparatus causing wear in the cranking motor or if moisture gets into the reservoir and forms water and freezes the conduits will become stopped up causing the apparatus to become inoperative. In applicants' apparatus the system for hand pumping required in present hydraulic apparatuses for starting internal combustion engines is eliminated. With a hand pump pressure in the accumulator is built up and if the engine fails to start after the first cranking the accumulator must be recharged by the hand pump which takes about one half hour before the second starting attempt can be made. In applicants' apparatus a hand pump never needs to be used. Applicants' apparatus also eliminates the need for an engine driven pump. The operation of applicants' apparatus is not affected by temperature. When hand pumping is done at a low temperature the oil is viscous and pumping is difficult. In some hydraulic apparatuses a light oil is used for extremely low temperatures so the oil can be hand pumped. At higher temperatures a heavier oil is used because with light oil the hand pump or engine driven or other type pump becomes inefficient. Therefore two different weights of oil must be used for widely varying temperatures. In accumulators having nitrogen gas and oil separated by a free piston the gas pressure varies with temperature. With applicants' apparatus the cartridges can be stored away from the apparatus so that unauthorized persons cannot start the engine. The advantage of the form of the invention shown in Figure 6 over the form of the invention shown in Figures 1 to 5 inclusive is that one does not have to wait for the oil chamber of either accumulator in Figure 6 to fill up after firing one cartridge where the engine fails to start on the first cranking. In the form of the invention shown

in Figures 1 to 5 inclusive the coil spring in the fluid return means is slow to force oil back in the oil chamber of the accumulator when the oil is cold.

What is claimed is:

1. Apparatus for starting an internal combustion engine having a crankshaft, the apparatus comprising a pair of accumulators and each of the accumulators including a cylinder and a free piston in the cylinder dividing the cylinder into a pair of chambers and a cartridge disposed in one chamber adjacent one end of the cylinder and a firing mechanism mounted on said one end of the cylinder and the other chamber containing a fluid, a fluid motor having an inlet and an outlet and having a shaft operatively connected to the crankshaft of the engine, the other chamber of one accumulator being in communication with the inlet of the fluid motor and the outlet of the fluid motor being in communication with the other chamber of the other accumulator and said other chamber of said other accumulator being in communication with the inlet of the fluid motor and the outlet of the fluid motor being in communication with said other chamber of said one accumulator, and one way check valve means between the other chamber of each accumulator and the motor directing the fluid to the motor and then to each of the other chambers, the cartridge in said one accumulator being fired causing the piston to move fluid out of said other chamber into the inlet of the fluid motor through the fluid motor to crank the engine and out the outlet of the fluid motor into said other chamber of said other accumulator with the cartridge and the firing mechanism removed that said one chamber of said other accumulator is open to the atmosphere and the next time the engine is started the cartridge and the firing mechanism in said other accumulator being again disposed in said one chamber and fired so that its piston moves fluid out of said other chamber into the inlet of the fluid motor and through the fluid motor to crank the engine and out the outlet of the fluid motor into said other chamber of said one accumulator with the firing mechanism removed that said one chamber of said one accumulator is open to the atmosphere.
2. Apparatus for starting an internal combustion engine having a crankshaft, the apparatus comprising a pair of accumulators and each of the accumulators including a cylinder and a free piston in the cylinder dividing the cylinder into a pair of chambers and a cartridge disposed in one of the pair of chambers adjacent one end of the cylinder and a firing mechanism mounted on said one end of the cylinder and the other of the pair of chambers containing a fluid, a fluid motor having an inlet and an outlet and having a shaft operatively connected to the crankshaft of the engine, a first conduit in communication with said other of the pair of chambers of one of the pair of accumulators and the inlet of the fluid motor, a second conduit in communication with the outlet of the fluid motor and said other of the chambers of the other of the pair of accumulators, a third conduit in communication with the second conduit and the first conduit, a fourth conduit in communication with the second conduit and the first conduit, a first check valve disposed in the first conduit between the third conduit and said one of the pair of accumulators preventing flow of fluid from the third conduit into the said one pair of accumulators, a second check valve in the second conduit between the fourth conduit and said other of the pair of accumulators preventing flow from said other of the pair of accumulators into the outlet of the fluid motor and the fourth conduit, a third check valve disposed in the third conduit and preventing flow of fluid from said one of the pair of accumulators through the third conduit, and a fourth check valve disposed in the fourth conduit and preventing flow of fluid from the first conduit into the fourth conduit, the cartridge in said one of the pair of accumulators being fired causing the piston to move fluid out of said other of the pair of chambers

through the first conduit past the first check valve through the fluid motor to crank the engine and through the second conduit past the second check valve into said other of the pair of chambers of said other of the pair of accumulators with the cartridge and firing mechanism removed so that said one of the pair of chambers is open to the atmosphere and the next time the engine is started the cartridge in said other of the pair of accumulators being fired so that its piston moves fluid out of said other of the chambers into the second conduit through the third conduit past the third check valve through the fluid motor through the fourth conduit past the fourth check valve into the first conduit into said other of the pair of chambers of said one of the pair of accumulators with its firing mechanism being removed so that said one of the chambers is open to the atmosphere.

3. The apparatus according to claim 1 and said firing mechanism comprising a tubular member having an inner end and an outer end, a plurality of lugs projecting radially outwardly from said inner end, a firing pin extending through said member and engageable with said cartridge, said one end of said cylinder having a bore for receiving said member, a plurality of radially placed slots within said bore, and a circular space within said cylinder inwardly of said bore, said lugs of said member disengageably receivable within said circular space when registeredly inserted through said slots for engaging said firing pin to fire said cartridge and for disengaging said firing mechanism to permit removal of said cartridge for exposing said one chamber to the atmosphere.

4. Apparatus for starting an internal combustion engine having a crankshaft, the apparatus comprising a pair of accumulators and each of the accumulators including a cylinder and a free piston in the cylinder dividing the cylinder into a pair of chambers and a cartridge disposed in one chamber adjacent one end of the cylinder and a firing mechanism mounted on said one end of the cylinder and the other chamber containing a fluid, a fluid motor having an inlet and an outlet and having a shaft operatively connected to the crankshaft of the engine, the other chamber of one accumulator being in com-

munication with the inlet of the fluid motor and the outlet of the fluid motor being in communication with the other chamber of the other accumulator and said other chamber of said other accumulator being in communication with the inlet of the fluid motor and the outlet of the fluid motor being in communication with said other chamber of said one accumulator, one-way delivery flow means connected between the other chamber of said one accumulator and the motor inlet to accommodate flow from such chamber to the motor inlet, one-way return flow means connected between the chamber of said one accumulator and the motor outlet to accommodate flow from such outlet to such chamber, a second one-way delivery flow means connected between the chamber of the other accumulator and the motor inlet to accommodate flow from such chamber to the motor inlet, a second one-way return flow means connected between the chamber of said other accumulator and the motor outlet to accommodate flow between such outlet and said chamber of said other accumulator, the cartridge in said one accumulator being fired causing the piston to move fluid out of said other chamber into the inlet of the fluid motor through the fluid motor to crank the engine and out the outlet of the fluid motor into said other chamber of said other accumulator and the next time the engine is started the cartridge in said other accumulator being fired so that its piston moves fluid out of said other chamber into the inlet of the fluid motor and through the fluid motor to crank the engine and out the outlet of the fluid motor into said other chamber of said one accumulator.

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