This present invention relates to the general field of internal combustion engines and more particularly to an auxiliary gas feeding means used at the time of starting the larger internal combustion engines and most especially the diesel cycle types.

The starting of internal combustion engines of the larger horse powered types and particularly those used on various industrial machines such as bulldozers, carry alls, cranes and the like has for some time posed a difficult problem. As the bore of an internal combustion engine becomes larger all normal hand cranking means prove to be very difficult or impossible of achievement. Where portable equipment is used further difficulties result from lack of space as well as from the necessity of reducing the weight of the power plant to a minimum. As a result starting devices commonly used in fixed installations are impractical.

In the larger industrial multi-cylinder diesel engines the increased size of the piston areas together with the greatly increased compression ratio results in a starting effort that is tremendous for a very short duration. This requires that the energy supplying source must be one that acts more or less as an accumulator, such as a storage battery, high pressure gas tank, or some of the various impulses starters where momentum of a free turning element is employed, or spring wound devices may be used which are gradually rewound after each starting effort and become available to turn the crank shaft probably one-half to one full revolution as about the maximum available starting effort.

Under these difficult conditions it is very essential that the engine start on the first cylinder that has had an opportunity to compress a full charge of air. In the past various means have been improvised to introduce a high volatile explodable gas which when it first will give an adequate impulse, so that on a two cycle type of diesel all cylinders will have their full compression and thus starting is quite easily effected. However, the use of an explosive gas introduces a marked hazard which has often caused disastrous results. The diesel engines themselves do not explode their fuel but burn it, naturally burning it quickly but with no appreciable shock loading on any of the parts of the engine because of the actual internal combustion of the normal fuel used. However, when haphazard means are employed to introduce an explosive to heavy a charge may often actually build up dangerously high pressures in the engine.

My solution of this problem is generally to provide a holder to which a standard pressurized can of volatile fuel such as ether may be firmly secured in close association with the intake manifold of the engine to be started. Operating means are provided which may be actuated manually or more commonly, remotely by solenoid means so that the operator stationed at the controls of the engine can have complete control of the additive fuel injection device, keeping in mind having all controls so centralized that fullest advantage can be taken of the first turning impulse of the engine. Industrial types of internal combustion engines and especially the diesels normally are provided with an intake manifold which is desirable in that air can be cleaned and introduced into the manifold for distribution to the cylinders. This is in distinction to the larger diesels in which each cylinder in effect is a working identity by itself. The injection device delivers the spray of volatilized fuel into the air of the intake manifold under such high pressure as to insure a quick homogenous mixture. With such an arrangement the engine has full control and each cylinder will have a like amount of additive fuel with the assurance that a dangerously explosive mixture will not be built up.

The principal object of this present invention, therefore, is to provide a convenient and easily controllable device for the injection of a highly volatile fuel into the air supply of a diesel engine at the instant the first rotary movement of the crank shaft is made in starting the diesel.

A further object of this invention is to provide an additive fuel injection device which is very adaptable to various types of engines and has a simplified control means for remotely controlling the valving arrangement of a pressurized can of highly volatile fuel.

A further object of this invention is the provision of means whereby all the cylinders of an internal combustion engine will be given a highly volatile fuel additive in substantially equal proportion.

A further object of this invention is to provide a starting assistance by having a pressurized can of highly volatile fuel in place adjacent the manifold of the engine which may be selectively engaged or not by the operator as the local needs indicate whether the additive is needed or not.

A further object is to provide a means for conserving the volatile fuel additive by directing it into the intake manifold of an engine to be started.

Further objects, advantages and capabilities will be apparent from the disclosure in the drawings or may be comprehended or are inherent in the device.

In the drawings:

FIGURE 1 is a side elevation of a typical diesel engine as applied to industrial equipment showing the same complete with its cooling radiator and with my device shown in place thereon.

FIGURE 2 is a typical cross-sectional view taken transversely of FIGURE 1 and through one of the cylinders showing the distributing manifold and the point of discharge of my additive fuel device into this manifold.

FIGURE 3 is fragmentary horizontal view showing the manifold portion of FIGURE 2 and showing the location of my additive controlling and injecting device.

FIGURE 4 is a side elevation, partly in section, showing a preferred arrangement of my high volatile fuel injection device and the control means therefor.

FIGURE 5 is an elevation of the showing of FIGURE 4 with the device rotated 90 degrees to show the supporting means employed and the ease with which a new pressure can many be introduced.

Referring to the drawings, throughout which like reference characters indicate like parts, the numeral 10 designates generally an internal combustion engine having a
3 manifold communicating with the various cylinders of the engine. For illustrative purposes only I have illustrated a two cycle engine exclusively. In this form of engine an impeller type blower 12 is employed to build up moderate pressures in the distributing manifolds 14 and 16 which are communicating. This air is used in the scavenging of the gases of the prior cylinder combustion and to provide a new supply of fresh air which is then compressed and, at the proper point of the cycle, the new fuel is sprayed into the compression heated air for the power stroke. In this particular engine, exhaust valving is employed at 18, discharging the products of combustion out through the exhaust manifold 20. In order that my injection device will be in a position to supply the desired amount of highly volatile fuel additive at exactly the right point I prefer to have the discharge opening 22 directed into the manifold, preferably from one end thereof, so that the entire manifold can be enriched by the additive in substantially equal amounts throughout its length. To facilitate the optimum placement of the discharge nozzle 22, the entire device, indicated generally by the reference character 24, is preferably secured directly to the engine block as will be more clearly understood from a study of FIGURES 1, 3 and 4.

A preferred form of mounting my device is shown in FIGURES 4 and 5 in which it will be noted that a collar or cap is provided at 30 and this collar is supported in turn by the discharge pipe 32 which is secured preferably by being threaded into the block of the engine 10 so that the discharge opening 22 will be directed into the end of the manifold 14 as is probably best illustrated in FIGURE 3. The cap or cover 30 provides a rest or abutment for the spring biasing means 34 so that when the enlarged portion 39 of piston valve 38 is depressed to release the volatile fuel of storage pressure can 40, the discharge will be directed out through pipe 32 and orifice 22 into manifold 14 as will be further noted later. Cover 30 also provides a support means for a pivot supporting bracket 42 or for a solenoid 44 where the same is used. Pivotally supported on pivot 46 is an operating lever 48, which in some cases may be manually operated to depress plunger 50 against spring 34 when operated by the upward thrust of core 52 of the solenoid 44. To facilitate replacement of can 40 I provide the U-shaped stirrup arrangement 54 illustrated in FIGURE 5 with the upper ends 56 preferably pivotally secured as by detents 55 secured to cap 30. At its lower end stirrup 54 provides a support for the pressure screw 58 which screw in turn engages the concave bottom of can 40 and forces it up into snug engagement with collar 30 and sealing means 36 insuring that the actual discharge opening 60 from the can assembly piston portions 38 and 39 will be alignment with pipe 32 and its discharge end 22. The replacement of can 40 when it is exhausted or at any other time is accomplished by using ring 64 for unscrewing the pressure stud 58 so that the bottom of the can may be moved to one side, thus withdrawing the mount of the can 62 from its shallow engagement with cap 30.

In use there may be a slight difference in timing due to the responsiveness of the starting means for the engine but normally it is considered adequate to energize solenoid 44 and thus release a charge into the manifold 14 that, from prior trials, has been found to be adequate, this occurring at the same time that the engine starting means is energized. This is an optimum arrangement in that the turbulence of the relatively high pressure of the pressurized can 40 gives a thorough or homogenous mixture of the air in manifold 14 and the highly volatile additive fuel from can 40. Consequently a normal starting cycle is for each cylinder to take in its normal amount of air and fuel additive from manifold 14 and compress it. The normal fuel charge is sprayed into the cylinder, or as happens in some cycles of diesels, the fuel is deposited in a cup or retaining device within the cylinder. The additive fuel, having a much higher flash point than the normal fuel used in the engine, ignites preferably as a high speed combustion cycle and has the effect of increasing the amount of heat in the cylinder as well as the pressure. This air pressure will blow off any fireball of that cylinder the first time it comes up into firing position. Normally, any one cylinder that fires with a full pressure stroke will give enough inertia to start the revolving mass of the engine in motion sufficiently to insure a continuous functioning of the normal fuel supply means and to carry the engine in functioning in its normal or expected manner. Through use these devices are found to offer an almost certain method of starting diesel engines and certain of the gas engines under conditions where normally the usual starting equipment cannot be depended upon to start the engines.

Because of the difficulties generally encountered in starting these engines and to prevent slowing down the sequence of operations which might easily nullify the work effort of a large crew it has often been observed that in many instances diesel engines are allowed to run for hours unused just so that the equipment they operate will be immediately available if required. With my device this needless waste can be virtually eliminated.

It is believed that it will be clearly apparent from the above description and the disclosure in the drawings that the invention comprehends a novel construction of gas starting means for diesel engines.

Having thus described my invention, I claim:

1. A gas starting means for diesel type engines, comprising: a gas pressure can positioned to discharge its contents into the intake manifold of a diesel engine; a threaded discharge pipe for engaging said intake manifold; a collar fixedly secured to said discharge pipe; a U-shaped stirrup pivotally secured to said collar; a pressure stud and corresponding screw means at the bottom of said stirrup to force and hold said gas pressure can in engagement with said collar; a depressible valve supported on said collar to operate and engage the discharge valve of said pressure can and remotely controlled means for selectively operating said depressible valve; said discharge valve of said pressure can having the discharge opening thereof aligned with said discharge pipe for direct injection of the contents of said can into said intake manifold.

2. A gas starting means for diesel engines, comprising: a gas pressure can positioned to discharge its contents into the intake manifold of a diesel engine; a threaded short and straight discharge pipe for engaging said intake manifold; a cap fixedly secured to said discharge pipe for receiving the mounting of said pressure can; a U-shaped stirrup pivoting secured to said cap; an adjustable pressure stud at the bottom of said stirrup to force said pressure can into engagement with said cap; a depressible piston supported on said cap to operate and engage the discharge valve of said pressure can and means for selectively operating said depressible piston, said discharge valve of said pressure can having the discharge opening thereof aligned with said discharge pipe for direct injection of the contents of said can into said intake manifold.

3. A gas starting means for diesel engines, comprising: a gas pressure can positioned to discharge its contents into the intake manifold of a diesel engine; a threaded short, straight length of discharge pipe for engaging said intake manifold; a cap fixedly secured to said discharge pipe for receiving the amount of said pressure can; a U-shaped stirrup pivotally secured to said cap; an adjustable pressure stud at the bottom of said stirrup to force said pressure can into engagement with said cap; a spring biased depressible piston supported on said cap to operate and engage the discharge valve of said pressure can and means for selectively operating said depressible piston, said discharge valve of said can having a discharge opening
aligned so as to direct the contents of said can directly into said intake manifold.

4. The subject matter of claim 3 in which a solenoid is remotely controlled to provide the means for selectively operating said depressible valve.

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