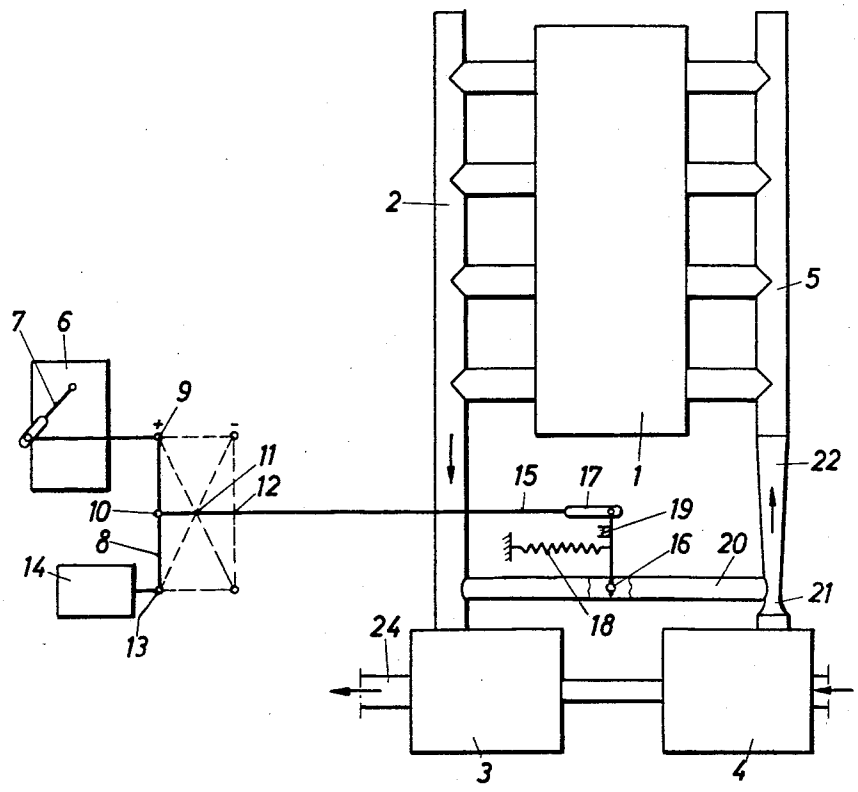
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GAS ENGINES

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GAS ENGINES

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The invention relates to a method of and an apparatus for regulating a gas engine which is supercharged by an exhaust gas turbo-supercharger, the quantity of combustion air being reduced in the partial-load range in order to maintain an at least approximately constant air excess.

When using gases having a relatively narrow ignition range, for example, natural gas or methane, the quantity of combustion air must be reduced simultaneously as the gas quantity or load diminishes, in order that the gas-air mixture arriving at the engine remains ignitable or is burned rapidly and completely so that no unburned gas escapes into the exhaust system. In this way it is possible to obtain a low consumption of fuel even at low loads. Hitherto the reduction in the quantity of air has been effected by throttling the air supply, but this has considerable disadvantages since the working point of the supercharger in the lower load range easily moves into the unstable range of the characteristic.

The object of this invention is to obviate this disadvantage.

According to the present invention an improvement in the method of operation of the engine is obtained by introducing the volume of exhaust gas made to by-pass the exhaust gas turbine into the pressure pipe coming from the supercharger, a local pressure drop being achieved at the point of introduction with the help of a venturi nozzle interposed in the pressure pipe. This arrangement has the advantage that the combustion process in the partial-load range is advantageously influenced, i.e. in the sense of a low fuel consumption (heat consumption) by the increased temperature of the supercharged air and the manifestly ignition-accelerating constituents contained in the exhaust gas. A further advantage of this arrangement resides in the utilisation of unburned portions of combustible gas which may still remain in the exhaust gas. The local pressure drop proposed in this arrangement is necessary since in the case of exhaust gas turbo-supercharging the mean supercharger pressure is higher than the mean exhaust gas counter-pressure, so that without this measure no exhaust gas would enter the pressure pipe. With appropriate construction of the diffuser portion of the venturi nozzle, the pressure energy converted into speed energy in the narrowest part of the nozzle is recovered again for the greater part. The loss which occurs can be generally tolerated since engines with an exhaust gas turbo-supercharger generally operate with a considerable air excess.

In the case of dual fuel engines unfavourable influencing of the operation of the machine by insufficient excess air in diesel working is prevented by conducting at least approximately the entire quantity of exhaust gas to the exhaust gas turbine in the working range in which the engine is supplied with a quantity of disel fuel in excess of the ignition oil quantity.

It is expedient to arrange in the pipe for the quantity of exhaust gas which is made to by-pass the exhaust gas turbine, an exhaust gas regulating member which is operated in such a manner by the control linkage for operating the gas fuel control member that the momentary opening of the gas fuel control member is inversely proportional to the particular opening of the exhaust gas control member at the time, in linear or non-linear dependence thereon.

For a better understanding of the invention and to show how the same may be carried into effect reference will now be made to the accompanying drawings, in which the single figure is a diagrammatic representation of a diesel-gas engine.

Referring to the drawing the exhaust gases of a dual fuel engine 1 are conducted through an exhaust gas manifold 2 to an exhaust gas turbine 3. Combustion air is supplied to the engine 1 through a supercharger 4 which is coupled to the turbine 3, the combustion air being supplied through a pressure pipe 5 to the individual cylinders of the engine 1. The dual fuel engine 1 is regulated by a governor 6 having an output lever 7 to which one end 9 of a two-armed lever 8 is pivotally connected. A control linkage (not shown) of a diesel oil injection pump (not shown) is pivotally connected to the centre point 10 of the lever 8 in such manner that the pump is only adjusted to an injection quantity in excess of the ignition oil quantity when the point 10 is situated between the illustrated position and the position designated as 11. The gas fuel control linkage (not shown) is pivotally connected to the point 10 in such manner that this gas fuel control linkage opens the gas fuel regulating member (also not shown) when the point 10 is situated between the positions designated as 11 and 12. Pivotably mounted at the other end 13 of the lever 8 is a change-over switch 14 which is controlled by the pressure of the source of gas fuel and which switch displaces the end 13 of the lever 8 into the position designated "diesel" in FIGURE 1 in the event that the gas fuel pressure is deficient and into the position designated "gas" when the gas fuel pressure is normal. If the gas fuel pressure is slightly lower than normal, the end 13 assumes a position between the two designated positions. The end 9 of the lever 8 can take up the position designated $+=$ "full torque" and that designated $-=$ "idling torque" and can also assume positions between the positions $+$ and $-$. A rod 15 is pivotally connected to the midpoint 10 of the lever 8, the rod 15 adjusting an exhaust gas control member 16. A slot 17 in the rod 15 ensures that the member 16 is only adjusted when the point 10 is situated between the positions 11 and 12. tension spring 18 and a stop 19 ensure that the exhaust gas control member 16 is situated in the illustrated completely, or almost completely closed position when the engine 1 is in the diesel working state. An exhaust gas branch pipe 20 enters the pipe 5 at the narrowest point 21 of a venturi nozzle 22 in the pipe 5. The entire control linkage is so constructed that the gas fuel control member is fully opened when the midpoint 10 of the lever 8 is in the position 11, the exhaust gas control member 16 being completely or almost completely closed. When the midpoint 10 is in the position 12 the gas fuel control member is only opened sufficiently far to allow the quantity of gas fuel required for idling to flow to the engine, the exhaust gas control member 16 being open so that the exhaust gas turbine 3 receives only a part of the full quantity of exhaust gases. The remainder of the exhaust gases are delivered through the branch pipe 20 back into the pressure pipe 5. In the position 12 of the point 10 and in the intermediate positions of the control linkage, the opening cross-sections of the gas fuel control member and exhaust gas fuel control valve 16 are inversely proportional to one another. The ratio of the variations of the openings of the two control members relatively to one another can be linear or non-linear.

I claim:

1. In combination, a gas engine, an exhaust gas turbine, a first duct for feeding exhaust gases of said engine to said exhaust gas turbine to drive the latter, a super-

charger driven by said turbine, a second duct for feeding supercharging air from said supercharger to said engine, a venturi nozzle in said second duct having a throat, a third duct joining said throat to said first duct, a governor for controlling the admission rate of gas fuel to said engine and responsive to the speed of said engine to vary said gas fuel admission rate in inverse relation to the speed of the engine, and means in said third duct for controlling the flow of exhaust gases from said first duct to said throat, said means being operatively connected with said governor so as to cause said exhaust gas flow to increase as the admission rate of gas fuel is reduced.

2. The combination as claimed in claim 1, wherein said means comprises valve means in the third duct for controlling flow of exhaust gases through said third duct, and wherein the combination further includes a member for controlling flow of gas fuel to the engine, and a linkage connecting said valve means to the controlling member for progressively opening the valve means as the supply of gas fuel is reduced.

3. In combination, a gas engine, an exhaust turbine, a first duct for feeding exhaust gases of said engine from said engine to said turbine, a supercharger driven by said turbine, a second duct for feeding supercharging air from

said supercharger to said engine, a venturi nozzle in said second duct having a throat, a third duct joining said throat to said first duct, gas fuel control means operatively connected with said engine and controlling the gas fuel flow to said engine, means in said third duct for controlling the flow of exhaust gases from said first duct to said throat, said gas fuel control means and said exhaust gas control means being operatively interconnected to increase said exhaust flow as said gas fuel flow decreases.

4. The combination as claimed in claim 3, wherein the engine is a supercharged dual fuel engine, and wherein in the working range in which the engine is supplied with a quantity of diesel oil exceeding the ignition oil quantity, at least approximately the full quantity of exhaust gas is fed to the turbine.

5. The combination as claimed in claim 3, wherein said means is constituted by valve means, the opening of the gas fuel control valve means being inversely proportional to the opening of the exhaust gas control valve means.

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