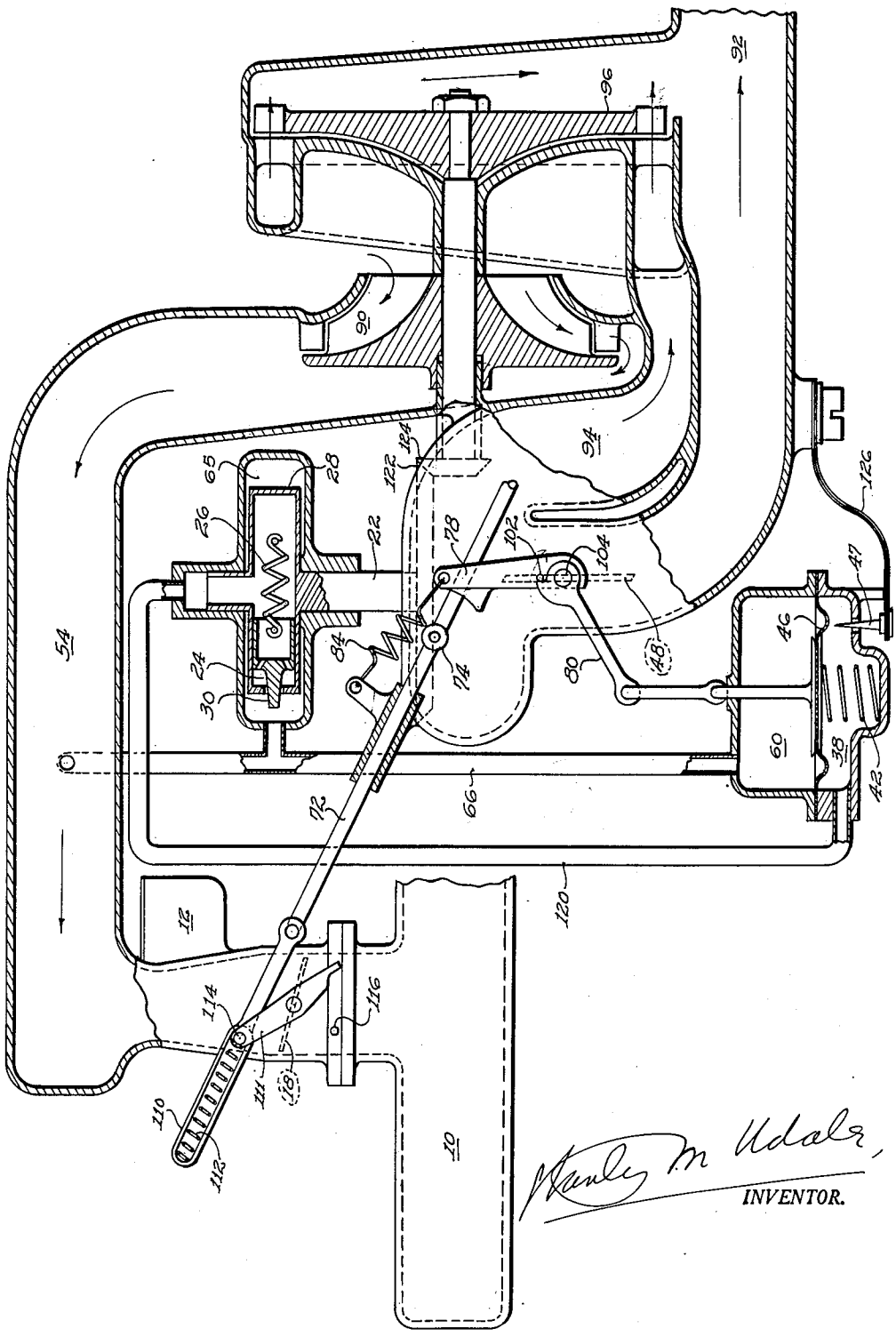
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EXHAUST DRIVEN SUPERCHARGER CONTROL

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EXHAUST DRIVEN SUPERCHARGER CONTROL

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The object of this invention is to control a supercharger installed on a truck having an ordinary commercial (Otto) cycle internal combustion engine so that the supercharger is most effective at the lower speeds.

Specifically the object is (*a*) to limit the speed of a gas turbine driven supercharger, and (*b*) to limit the operation of a gas turbine driven supercharger so that it only operates when needed and operates most effectively when most needed.

A final object is to reduce the governed speed of the gas turbine in hot weather and to limit the time during which the gas turbine operates at its maximum speed in hot weather.

The drawing shows diagrammatically the preferred form of my invention.

In the figure, 10 is the inlet manifold, 54 is the air entrance passage leading to 12 which is an ordinary carburetor attached thereto. 18 is the usual throttle controlled by a manually operated rod 72 connected to a slotted link 110. This link contains a spring 112. A pin 114 is mounted on the throttle lever 111. Pin 114 is held to the right hand end of the slot in link 110 except when the throttle 18 is wide open. Throttle stop 116 limits the opening movement of the throttle 18.

The throttle control rod 72 carries a pin 74 projecting from it. This pin 74 engages with a lever 78, loosely mounted on a shaft 104. Lever 78 carries a pin 102 which engages with a lever 80 which is fastened to the shaft 104. Lever 80 is also joined to a connecting rod which in turn is joined to diaphragm 46.

Chamber 60, above diaphragm 46, is connected through a pipe 66 with the stationary governor chamber 65 and also with the air entrance passage 54. Chamber 38 is below the diaphragm 46 and is connected through the pipe 120 to the inside of the rotating element 20 of the governor.

A centrifugally controlled weight 24 carries a needle valve 30 and is retained by a tension spring 26. The shaft 22 is driven by a bevel wheel 122 which is driven by a small bevel wheel 124 which is driven by a gas turbine 96 which drives a supercharger 90.

An exhaust throttle 48, when open, diverts the flow of exhaust from the exhaust passage 94 away from the gas turbine 96 and out through the main exhaust pipe 92. The throttle 48, when opened, allows about 90% of the exhaust gas to escape through passage 92, the 10% which flows through 94 rotates wheel 96 and blower 90 without appreciably raising the pressure in the inlet passage 54. When the exhaust throttle 48 is

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closed the exhaust flows through the exhaust passage 94 and turbine 96.

A thermostat 126 controls a tapered needle valve 47 which regulates the pressure in the chamber 38. A spring 42 closes the throttle 48 which is opened by the spring 84 connected to the lever 78.

Operation

When the engine is first started the thermostat 126 adjusts the needle 47 so as to restrict the chamber 38 from communicating with the atmosphere. When the engine is started the thermostat 126 is cold and raises the needle valve 47 and closes the passage connecting the chamber 38 with the atmosphere. After the throttle 18 is first opened wide the stop 74 engages with lever 78 and the continued movement of the rod 72 moves the lever 78 and stretches the spring 84 and takes the load off the pin 102. The throttle 48 is then closed by the spring 42 and remains closed as the speed of the engine increases. The exhaust gases then rotate the gas turbine 96 and the supercharger 90 which pushes air into the inlet passage 54 in a well known manner.

The speed of the rotating elements of the governor 22—24—26—28 increases and the governor controlled valve 30 moves so as to restrict the connection between the pipe 120 and the inside of the stationary governor casing 65 and the pipe 66. The pressure in chamber 38 falls, anl eventually falls to the pressure of the atmosphere and the throttle 48 opens under the influence of the pressure in pipe 66 in the chamber 60.

The amount of the movement of the throttle valve 48 and its timing are determined by the relative shape and position of the two valves 30 and 47. The hotter the engine the more the valve 47 is open and the lower is the speed at which the movement of the valve 30 is effective to start to close the exhaust throttle 48. The hotter the atmosphere and the longer the engine has been running the more the valve 47 opens and the quicker the exhaust throttle 48 opens, hence the sooner the exhaust pressure is allowed to escape through the passage 92 the less is the amount of supercharge and the lower is the governed speed.

The danger of burning the gas turbine 96 is less as the throttle 48 moves away from its closed position towards its wide open position which is the position shown on the drawing.

The thermostat 126 is also responsive to the air blowing over the engine by the cooling fan of the radiator. Hence the thermostat is re-

sponsive to the circumambient temperature under the hood covering the engine.

With normal operation, that is when the turbine revolves below its governed speed, the valve 30 is drawn to the right by its tension spring 26. When this happens the valve 30 opens and the restrictions shown in the valve 30, to the right of the tapered end, become the controlling restrictions between the two pipes 66 and 120. During this normal low speed operation the thermostat 126, when cold, raises the valve 47 high enough so that the pressure in chamber 38 builds up through these two restrictions in valve 30 to be almost equal to the pressure in chamber 60. The compression spring 42 then acts to rotate the valve 48 clockwise whenever, after the throttle 18 has been opened, the continued movement of the control rod 72 (stretching the spring 84) calls for more power. When, as a result of the above operation, the valve 48 approaches its closed position more and more of the exhaust gases are forced through the turbine wheel 96 which drives the blower 90 so as to build up pressure on both sides of the wall 46 and in the inlet manifold 10.

If the engine is permitted to run for any long period of time the exhaust passages 92 and 94 become red hot especially in hot weather and heat is radiated over element 126.

The thermostatic element 126 then opens the valve 47 and thus the pressure in chamber 38 is allowed to escape to the atmosphere. The pressures on both sides of the moving wall 46 then become unbalanced and the moving wall descends compressing the compression spring 42. The escape valve 48 is thus turned counterclockwise by the lever 80 towards its wide open position (the position in which it is shown).

If the speed of the turbine continues to rise to exceed a critical speed before the valve 48 is opened wide by the thermostat 126, the valve 30 restricts the connection between the passages 66 and 120. This is the equivalent of opening the valve 47 in response to an increase in temperature. In that event any compression pressure higher than that balanced by spring 42 will tend to open the valve 48 at any temperature. The net result of the temperature responsive valve 47 and the turbine speed responsive valve 30 is that the valve 48 opens at a lower temperature when the speed of the turbine is high and at higher temperatures when the speed of the turbine is below its governed (critical) speed.

The engine is thus protected against being overloaded for too long a period of time at its maximum torque in hot weather and the turbine is protected in all weathers against being run at dangerous speeds.

Under any specific conditions the thermostatically controlled valve 47 tends to hold the temperature of the exhaust passages 92 constant because after the valve 48 opens nearly all the exhaust flows past the point at which the bimetal 126 is supported but less air enters the engine manifold 10. Hence the immediate effect is an increase in temperature of the element 126 and the final result is a reduction in temperature so that eventually the exhaust escape valve 48 is held in an intermediate position by the thermostatically controlled valve 47 depending on the temperature of the air surrounding the bimetal element 126 and on the period of time the engine has been run at maximum power with throttle 18 wide open. The result is that after the supercharger goes into operation it operates only at speeds modified by the operating temperature and it is protected against prolonged running developing its maximum air delivery and resulting in excessive heat conditions.

What I claim is:

1. A control for a truck engine having an exhaust driven turbine, a supercharger for said engine driven by said turbine, a throttle controlled air and fuel entrance to said engine, manually and automatically controlled means for said turbine comprising a centrifugal governor driven by the gas turbine, an exhaust pipe leading to the turbine, an escape valve therein responsive to the centrifugal governor so as to open at high speed to render the gas turbine less effective by permitting the exhaust gases to escape without rotating the gas turbine, manual control means for opening the throttle including an overtravel beyond the point of wide open throttle, yieldable means for holding the escape valve open, manually controlled means for neutralizing the said yieldable means after the throttle valve has been opened during the said overtravel portion of the manual control means, an additional control for the escape valve responsive to temperature including a thermostat mounted adjacent the exhaust pipe, servo-mechanism connected to said escape valve for opening and closing said valve, a servo-valve therefor controlled by said thermostat and adapted at temperatures beyond a predetermined temperature to cause the escape valve to open.

2. A control for an internal combustion engine having an exhaust turbine and having a supercharger driven by said turbine, and in which there is an exhaust pipe leading to said turbine, an escape passage for said exhaust, a valve in said escape passage, a yieldable means connected to said valve so as to ultimately close said valve, temperature responsive means exposed to the heat radiated by said exhaust pipe including a themostat mounted adjacent the exhaust pipe, servo-mechanism operatively connected to said escape valve, a servo-valve therefor controlled by said thermostat and adapted at temperatures higher than a predetermined temperature to cause the escape valve to open.

3. A control as claimed in claim 2 in which the means to counteract the effect of said yieldable means comprises a chamber, a movable wall dividing said chamber into two chambers and connected to said escape valve in said escape passage from said exhaust pipe, a first passage connecting one of said two chambers to the atmosphere, a valve in said first passage connected to said temperature responsive means so as to be opened by said temperature responsive means with high temperature, a second passage connecting said chamber to the supercharger pressure, a restriction in said second passage, a third passage connecting the chamber on the other side of the movable wall to the unrestricted effect of the supercharger pressure, the movable wall being so connected to the escape valve that the supercharger pressure tends to open the escape valve when the temperature responsive valve is opened with increasing temperature by overcoming the yieldable means which tend to close the escape valve with decreasing temperature.

4. A manual and pressure responsive control means for an internal combustion engine including an exhaust driven turbine, a supercharger for said engine driven by said turbine, means for limiting the pressure derived from said exhaust turbine driven supercharger associated with said

internal combustion engine comprising a chamber at the pressure generated at the outlet from said supercharger, an escape passage forming a bypass around said exhaust turbine, an escape valve in said escape passage, yieldable means connected to said escape valve so as to close said valve, an air chamber, a movable wall forming one wall of said chamber and connected to said escape valve, a passage connecting this chamber with the chamber at said supercharger pressure, a restricted passage admitting atmospheric pressure to act on the other side of said movable wall which wall is so connected to the escape valve that the valve is moved towards its open position in response to any excessive rise in supercharger pressure, throttling means for the air and fuel supply to said internal combustion engine, manually operated means for controlling the throttling means including an overtravel beyond the point of wide open throttle, a loose lever mounted on said escape valve, said manually operated means during said overtravel being adapted to engage said loose lever to permit the escape valve to respond to said movable wall, said loose lever being adapted to engage said escape valve whenever the manually operated means are moved to the position in which the throttle restricts the flow of fuel and air.

5. Temperature and pressure responsive control means for limiting the power developed by an internal combustion engine having an exhaust turbine and a supercharger driven by said exhaust turbine, an exhaust escape passage comprising an escape valve therein, yieldable means connected to said escape valve and tending to close said valve, an air chamber, a movable wall forming one wall of said chamber and connected to said escape valve, a passage connecting this chamber with the supercharger pressure, a restricted passage admitting atmospheric pressure to act on the other side of said movable wall, which wall is so connected to the escape valve that the valve is moved towards its open position in response to any excessive rise in supercharger pressure, temperature responsive means located so as to be subjected to the heat radiated from the exhaust connections of the exhaust turbine, a valve controlled by said temperature responsive means admitting atmospheric air to act on the other side of said movable wall.

6. Temperature and pressure responsive means for limiting the power developed by an internal combustion engine having an exhaust outlet, an exhaust driven turbine therein, a supercharger for said engine driven by said turbine, an exhaust escape passage, an escape valve therein, a movable wall connected to said valve, a first chamber located on one side of said movable wall, a second chamber located on the other side of said movable wall, an open first passage connecting the first chamber to the chamber at supercharger pressure, a second passage connecting the second chamber to the atmosphere, a third passage connecting the second chamber to the supercharger pressure, a restriction in said third passage, a centrifugal governor driven by said gas turbine, a governor valve controlled thereby adapted to further restrict the admission of supercharged air when the speed of the supercharger exceeds a predetermined value to the third passage leading to the second chamber to modify the effect of the opening leading to the atmosphere, a valve in said second passage leading from said second chamber to the atmosphere, temperature responsive means adapted to move said valve to the open position at high temperatures radiated from the exhaust pipe and thereby establish a lower pressure in said second chamber and thus permit the movable wall to move in response to a lower supercharger pressure and to open the exhaust so as to allow the exhaust gases to escape at substantially lower turbine speed than would be the case at lower temperatures, yieldable means engaging with said movable wall so as to close the said exhaust valve when the pressures on both sides of said movable wall are equal.

7. A device as claimed in claim 6 in which there are yieldable means for holding the exhaust valve open, manually controlled means for neutralizing the said yieldable means after the carburetor throttle has been opened.

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