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DEVICE FOR AUTOMATICALLY REGULATING AIR COMPRESSORS

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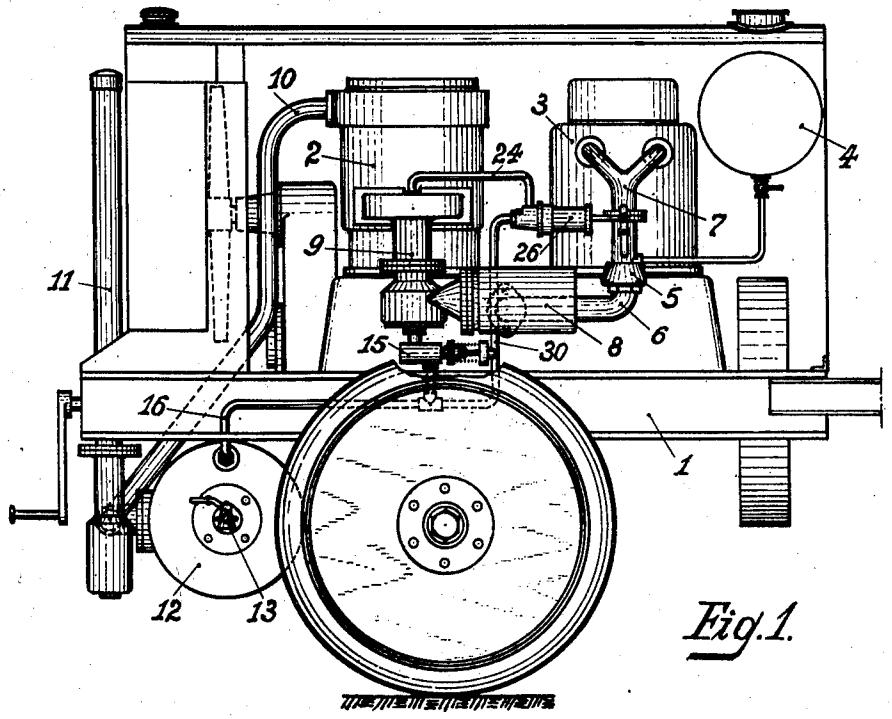


Fig. 1.

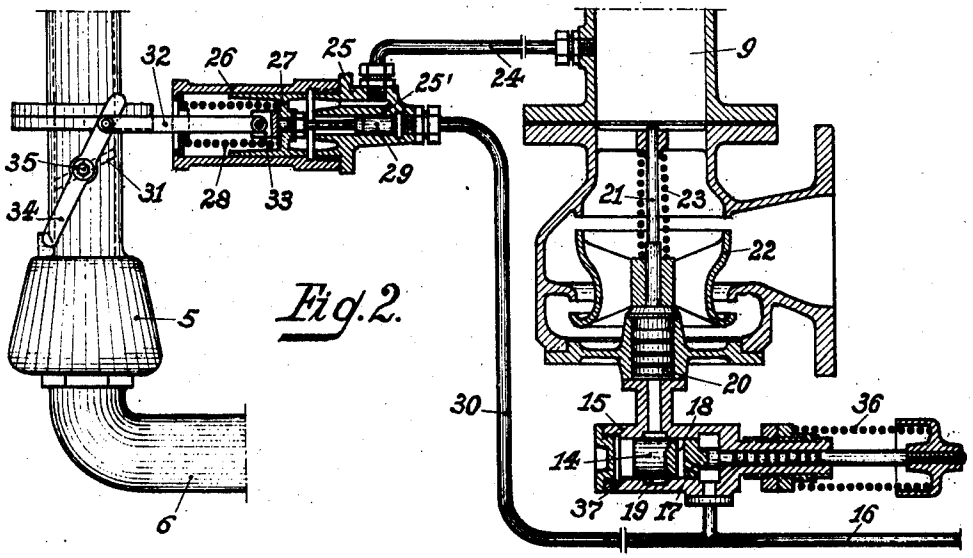


Fig. 2.

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DEVICE FOR AUTOMATICALLY REGULATING AIR COMPRESSORS

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When employing internal combustion engines for driving air compressors, regulating devices are employed by means of which at the moment the predetermined maximum pressure in the air receiver is exceeded, not only the efficiency of the driving motor is reduced but also the air compressor is unloaded. Regulating devices of this kind mostly act in such a manner that they set a regulating-piston in motion as soon as the maximum pressure is exceeded. This piston admits compressed air to a valve, which causes the throttle-valve of the carburettor to assume its closing-position, and at the same time to operate another valve, which causes the unloading of the compressor, which for instance may be accomplished by throttling a valve arranged in the suction-pipe of the compressor. This method has, however, the disadvantage that the valve which causes the unloading of the compressor on the one hand, and the valve which controls the fuel supply of the engine on the other hand, are influenced independently of each other, for which reason it is possible that while the engine is at full throttle the compressor is running idly, so that the engine, being without load, races.

My present invention provides a regulating device, which is particularly adapted for travelling compressor-plants now so extensively used in the construction of streets and roads and in observance of a simple and novel method assures a reliable regulation of the engine and of the air compressor, in as much as the adjusting-piston that controls the fuel supply of the engine is actively influenced by the vacuum created in the suction-pipe of the air compressor while the latter is regulated by the closing of its suction-pipe by the unloader. The influence of this vacuum on said adjusting-piston is secured by a regulating-piston of the unloader at the moment the maximum pressure of the compressed air contained in the air receiver is exceeded. Said regulating-piston is connected with the air receiver and shifted by the pressure extant therein to close a stop-valve arranged in the suction-pipe of the air compressor. As a result of this action a more or less perfect vacuum is created in the suction-pipe of the air compressor, which vacuum is communicated to a regulating cylinder which operates the throttle-valve of the carburettor—or is transmitted to any other organ intended to regulate the fuel supply—to unload said adjusting-piston in such a manner that the throttle-valve of the carburettor arranged in the supply conduit of the engine is thrown into its end-position, to make the engine run idly.

The adjusting-piston, which controls the fuel supply of the engine, is simultaneously connected by a second pipe to the compressed air receiver to enable the throttle-valve of the carburetor to adjust its position automatically to the air pressure which at the time being may exist in the air receiver and thus accommodate itself to the power required by the air compressor.

In the accompanying drawing my invention is represented by way of example as applied to a travelling compressor-plant, wherein:

Figure 1 is a diagrammatical elevation of the travelling compressor-plant, which plainly indicates the arrangement of the principal elements of my novel regulating-device, and

Figure 2 represents the principal elements of said regulating-device in section on a larger scale and arranged to distinctly show their mutual cooperation at a glance.

The travelling compressor-plant, to which my invention here is shown to be applied, chiefly consists of the two-wheeled carriage 1 upon which the compressor 2 and the internal combustion engine 3 are suitably arranged. The compressor as well as the internal combustion engine are here indicated as provided with two cylinders each, but they might be just as well of the one-cylinder type, as far as my regulating-device is concerned, since it will operate with the same results in both instances. Liquid fuel is stored up in the cylindrical vessel 4 from whence it is led to the carburetor 5 and after it has been mixed herein in due proportion with air admitted by the air pipe 6 the resulting mixture is introduced by the fuel con-

duit 7 into the combustion engine 3. The power of the latter may be transmitted in any suitable manner to a crank-shaft (not shown), which in turn drives the pistons of said compressor 2. The air admitted to the latter is drawn through an air filter 8 and then introduced by the suction-pipe 9 into the compressor 2, from which the highly heated compressed air is led by the mutual discharge-pipe 10 into the air-cooler 11 to be finally introduced in a cooled state into the air receiver 12, from which the compressed air is led by a flexible hose 13, or the like, to the tools employed for the work at hand.

Now, when for one reason or another the predetermined maximum pressure in the air receiver 12 is exceeded, the regulating-piston 14 of the unloader 15 will be pushed to the left by the compressed air introduced by the pipe 16 connected with the air receiver 12. The compressed air hereby enters the ducts 17 and 18 and after the duct 18 has reached the annular channel 19 said air acts upon the face of a piston 20, which preferably forms an integral part of the spindle 21 of the double seated stop-valve 22, which may thus be shut in opposition to the compression-spring 23 to close the suction-pipe 9 of the compressor. The vacuum, which now will be created in the suction-pipe 9 on account of the continued operation of the compressor, is simultaneously communicated by the pipe 24 to the hollow cover 25 of the regulating-cylinder 26 of the regulating means for the fuel supply of the engine, to relieve the right-hand side of the adjusting-piston 27, upon which the compression-spring 28 acts from the opposite side. During the normal operation of the compressor, i. e. when the unloader is inactive, the little loading-plunger 29 arranged in a return-cylinder 25', which forms a part of said cover 25 of the regulating-cylinder 26, is kept in equilibrium by said compression-spring 28 which acts upon the regulating-piston 27 and by the compressed air directed to its free face by the pipe 30, or the like, which likewise communicates with the the air receiver, as shown in Figure 1. It is clear that by the adjustment of the piston 27 the action of the plunger 29 might be replaced by a spring similar to the spring 28 without altering the adjustment in any way. Whenever the end of the cylinder 26 adjacent to said loading-plunger 29 stands under the influence of said vacuum, the compression-spring 28 will be able to push the loading-plunger 29 toward the right, whereby the butterfly-valve 31 will be rotated in a direction favorable to the reduction of the fuel supply of the engine. This throttling action is obtained by means of a rod 32, linked at one end to a cross-head 33 arranged in and connected with the adjusting-piston 27, and at the other end to a double-armed rocking-lever 34 seated on the valve-shaft 35, as plainly shown in Figue 2.

When, however, through the withdrawal of compressed air from the air receiver 12 the pressure in the latter sinks below a permissible point, then the piston 14 of the unloader 15 will be returned to its initial position by means of the adjustable spring 36, as shown in Figure 2, whereby the space beneath the piston 20 will be connected with the atmosphere by way of the annular channel 19 and the duct 37, so that the spring 23 can open again the double seated stop-valve 22. As soon as this valve has its seats freed for a limited distance the suction air will regain admission to the suction-pipe of the air compressor, so that the vacuum contained in said suction-pipe will be destroyed and the loading-plunger 29 will drive the adjusting-piston 27 back into its initial position against the pressure of the spring 28. The motor will now receive again its full fuel supply and will thus be enabled to very quickly regain its normal number of revolutions and this all the more so, since the load on the air compressor is very small at the beginning of this operation. When the valve 22 has been opened again to its full width and the full admission of air has been attained the motor will be in a position to provide all the torque required.

The loading of the plunger 29 from the right can be accomplished either by means of a spring or by compressed air taken from the receiver 12. In the latter case, the advantage is gained that a second reliable regulation of the plant is made possible. This possibility arises from the fact that the pressure exerted in this case by the loading-plunger 29 will always exactly adapt itself to the pressure prevailing at this moment in the air receiver and, in consequence, thereof to the power demanded by the compressor. This is very important, when, for instance, the engine has to be set into motion for the operation of the compressor plant. Since in this case the over-pressure in the air receiver is approximately zero, the adjusting piston 27 will take up its right-hand end position and the butterfly-valve 31 will occupy the position required for the engine when running idly. When now the pressure in the air-receiver increases, the adjusting piston 27 will be pushed to the left in exactly the same ratio and thus open the butterfly-valve 31 to increase the fuel supply to an extent adapted to attain the necessary speed of the engine during a comparatively short space of time.

From the above description it will be seen that the operation of the regulating means of the engine and that of the air compressor are dependent upon each other, because in as much as by the overstepping of the maximum pressure in the air receiver the air compressor will be unloaded and after the vacuum cre-

ated thereby has reached a certain degree, the engine will be throttled in such a manner that an increased fuel supply can not take place before the opening-motion of the stop-valve has set in. The method in keeping with my invention likewise offers the advantage, that the regulating device can be arranged in such a manner as to admit a full fuel supply to the engine when the stop-valve of the air compressor has been opened to a very limited extent only. A further advantage offered by my invention arises from the fact that the regulation of the compressor is accomplished in such a manner, that the engine may very quickly attain its normal number of revolutions under a light load while the stop-valve of the compressor is gradually opened and after it has been fully opened the engine will be enabled to render the full torque then required. In the known devices of this kind the engine will be fully loaded down by the throwing-in of the compressor while still at slow speed and is thus required to render the full torque at once, for which reason the engine must be over-dimensioned, since the torque of an internal combustion engine is considered proportional to the number of its revolutions.

My invention described above may be equally well applied to air or gas compressors driven by internal combustion engines or by engines, in which the fuel is injected into the cylinder.

I claim:—

1. A device for automatically regulating the operation of air compressors driven by internal combustion engines, comprising an unloader having a piston inoperative under the action of the predetermined maximum receiver-pressure; a suction-pipe having a stop-valve therein, said valve being influenced by a weak spring and being responsive when the maximum receiver-pressure is exceeded to close the suction-pipe; a fuel-supply conduit for the engine and a throttling-element arranged in said conduit; a control-piston connected with said throttling-element; and tubular means whereby the vacuum resulting from the closing of said stop-valve operates said throttling element to limit the fuel supply to said engine.

2. A device for automatically regulating the operation of air compressors driven by internal combustion engines, comprising an unloader having a piston, said piston being inoperative under the action of the predetermined maximum receiver-pressure; a suction-pipe having a stop valve therein, said valve being influenced by a weak spring and being responsive when the maximum receiver-pressure is exceeded to close the suction-pipe; means for regulating the fuel supply to said engine, comprising a fuel-supply conduit; an adjusting cylinder; a control-piston arranged in said cylinder, including means for linking the cylinder and said throttling element; and a tubular connection between said suction-pipe and said cylinder whereby the influence of the vacuum is communicated to said control-piston to operate said throttling element for limiting the fuel-supply to said engine.

3. A device for automatically regulating the operation of air compressors driven by internal combustion engines; comprising an unloader having a piston inoperative under the predetermined maximum receiver-pressure; means operative with said piston whereby the latter is adapted for movement when said maximum receiver-pressure is exceeded; a suction-pipe in the compressor and stop-valve therein; a second piston carried by the stop-valve; channel means in said first piston whereby the raised receiver-pressure is communicated to the second piston to operate the stop-valve; means for regulating the fuel supply to the engine comprising a fuel supply conduit and a butterfly valve seated in said conduit; an adjusting cylinder; a control-piston arranged in said adjusting cylinder; a rod linking said control-piston to said butterfly valve; elastic means operative with said control-piston to maintain the same normally in equilibrium; and a tubular connection between said suction pipe and said adjusting cylinder to cause the control-piston to become operative under the influence of vacuum to actuate the throttling element for limiting the fuel supply to the engine.

4. A device for automatically regulating the operation of air compressors driven by internal combustion engines, comprising an unloader and associated piston, said piston including spring means to render the same inoperative under the predetermined maximum receiver-pressure; means operative with said piston whereby the same is moved when said maximum receiver-pressure is exceeded; a suction-pipe on the compressor and a stop-valve in said pipe; a second piston carried by the stop-valve; channel ducts in said first piston whereby the raised receiver-pressure is communicated to said second piston to close said valve whereby vacuum is created in said suction-pipe; means for regulating the fuel supply to the engine, comprising a fuel-supply conduit and a butterfly valve seated in said conduit; an adjusting cylinder; a control piston arranged in said adjusting cylinder; a rod linking said control piston to said butterfly-valve; a spring located in said cylinder to press against one face of said control-piston; a plunger always standing under receiver-pressure acting on the other face of said control-piston to maintain the latter normally in equilibrium; tubular means connecting said suction-pipe with the interior of said adjusting cylinder, whereby the face of the control piston adjacent to said plunger is subjected to the influence of a vacuum; said con-

trol piston being actuated by the spring pressure against its opposite face to operate said butterfly-valve for limiting the fuel supply to the engine.

5. A device for automatically regulating the operation of air compressors driven by internal combustion engines, comprising an unloader having a piston, said piston including adjustable spring means to render it inoperative under the predetermined maximum receiver-pressure; means operative with said piston whereby it is made movable when said maximum receiver-pressure is exceeded; a suction-pipe on the compressor and a stop-valve in said pipe responsive to raised receiver-pressure to cause a vacuum to be created in said suction-pipe; means for regulating the fuel-supply to said internal combustion engine, comprising a fuel-supply conduit and a butterfly-valve arranged in the said conduit; said valve being provided with a rocking-lever; an adjusting-cylinder open at one end; a control-piston arranged in said adjusting-cylinder; a pressure spring arranged in the open end of said cylinder and bearing against the adjacent face of said control-piston; a rod linking said control-piston to the rocking-lever of said butterfly-valve; a plunger constantly held under receiver-pressure bearing against the other face of said control-piston to keep the latter normally in equilibrium; and a tubular connection between said suction-pipe and the closed end of said adjusting-cylinder, whereby the reduction in pressure on the closed cylinder end enables the spring pressing against the outer face of said control-piston to rotate said rocking-lever, thus actuating said butterfly-valve for diminishing the fuel-supply to said combustion engine.

In testimony whereof, I affix my signature.

GERHARD ROTHMANN.