C. B. HODGES.

COMPRESSED AIR ENGINE.

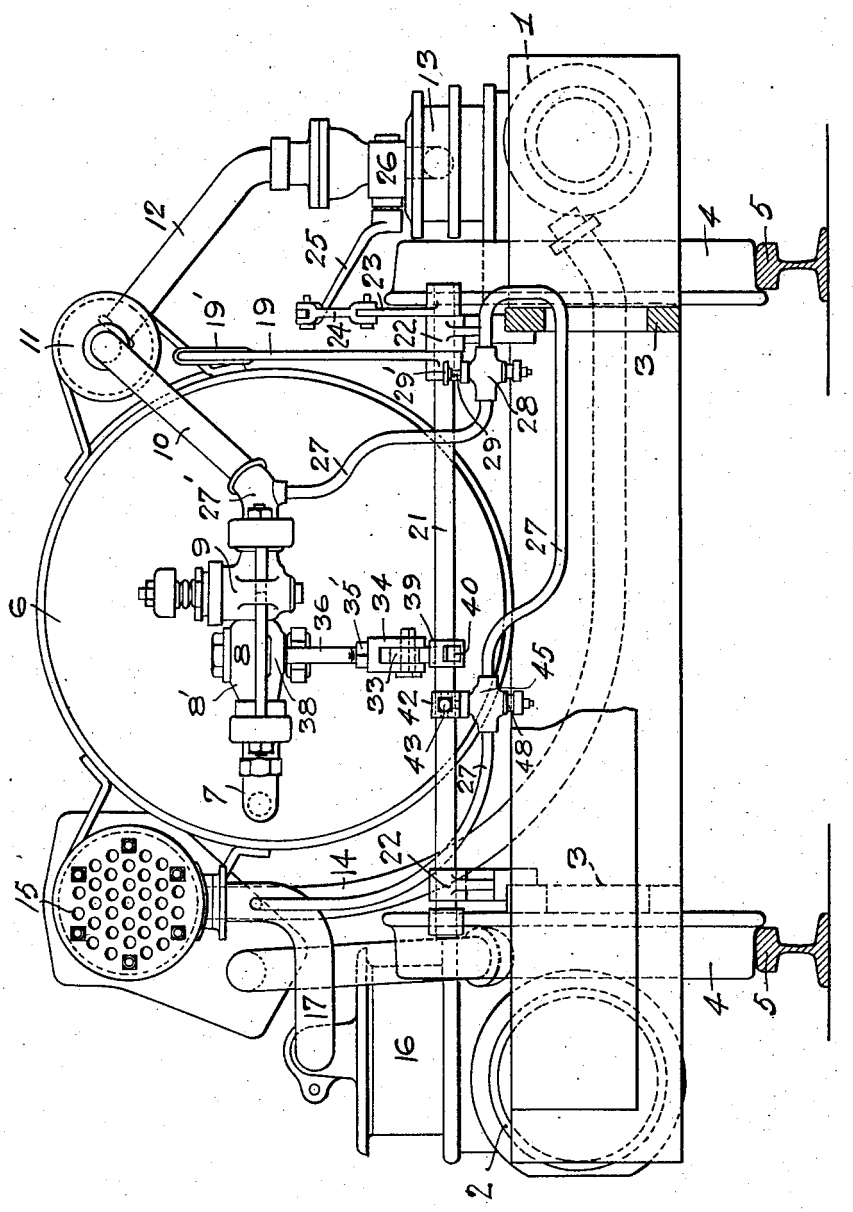
APPLICATION FILED JULY 31, 1911.

1,024,778.

Patented Apr. 30, 1912.

2 SHEETS—SHEET 1.

FIG. 1



WITNESSES.

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2 SHEETS—SHEET 2.

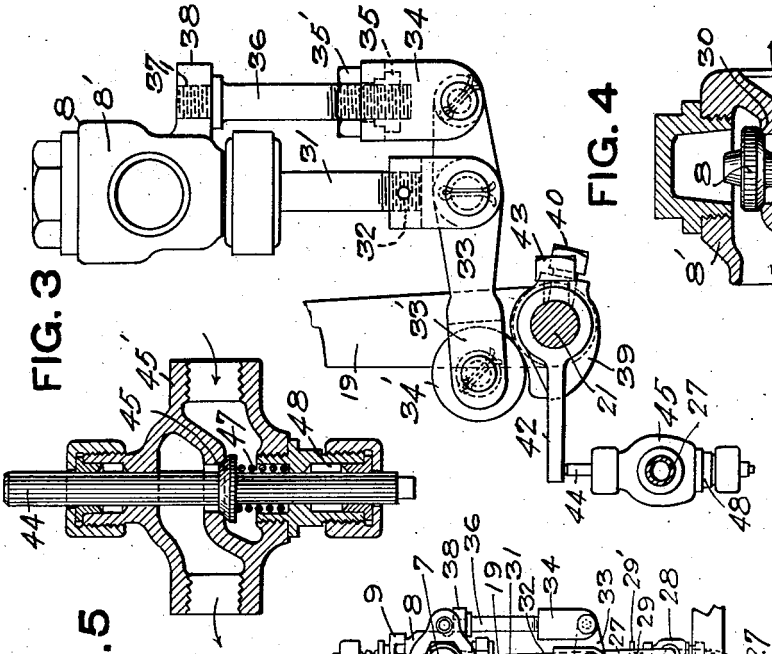

FIG. 3

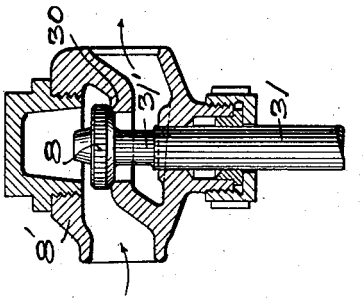

FIG. 4

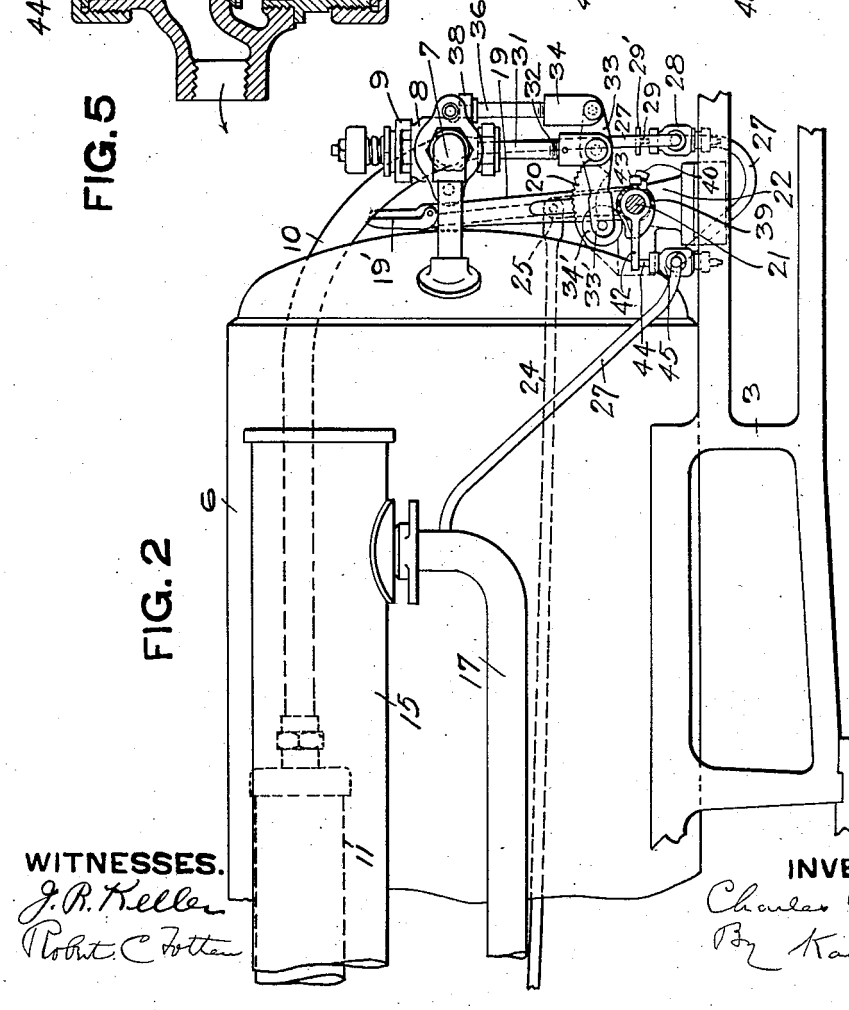

FIG. 5

FIG. 2

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UNITED STATES PATENT OFFICE.

CHARLES B. HODGES, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO H. K. PORTER CO., OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

COMPRESSED-AIR ENGINE.

1,024,778. Specification of Letters Patent. **Patented Apr. 30, 1912.**

Application filed July 31, 1911. Serial No. 641,506.

To all whom it may concern:

Be it known that I, CHARLES B. HODGES, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Compressed-Air Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to compressed air engines, and more particularly to those of the type applied to the running of locomotives. Its object is to improve in certain particulars on a previously known type of compressed air engines, so as to render it more nearly fool proof and with a more simple and durable construction than has hitherto been employed.

In this type of engine a reducing valve is usually employed to reduce the pressure of the air from the main reservoir, so that it enters the initial cylinder at a substantially uniform reduced pressure. However, when the operation of the engine is stopped, the reducing valve, owing to the necessary nature of its construction, does not entirely interrupt the passage of air, so that the pressure of air would pile up in the connection to the cylinder, or in the secondary reservoir interposed ahead of the same unless some means is employed to cut it off. The means employed, as described below, is preferably a stop valve interposed in the connection between the main reservoir and the reducing valve and which may be closed when the throttle valve is closed. As, however, it is desirable where more than one cylinder is employed to admit air in starting to the low pressure or secondary cylinder, I provide a by-pass around the high pressure cylinder, to the interheater or directly to the low-pressure cylinder. This by-pass is necessarily controlled by a valve. If, however, the use of this valve is abused so that it is opened during the normal operation of the engine or locomotive, the parts are subjected to great strain owing to the excess pressure in the low pressure cylinder, and serious injury results.

The particular object of my present invention therefore is to provide an improved construction of mechanism by which the by-pass above described is automatically closed when the throttle valve is open to admit air to the primary or high pressure cylinder.

The said invention contemplates, generally stated, the combination with a high and a low pressure cylinder, an air reservoir and a connection between the same and the high pressure cylinder provided with a throttle valve and a valve or valves controlling said connection ahead of the same, such as the stop valve below described, of a by-pass communicating with said connection beyond such valve and ahead of the throttle valve and leading to the low pressure cylinder, a valve controlling said by-pass, and preferably also a manually operated valve also controlling the by-pass, and mechanism such as a throttle lever controlling the throttle valve and arranged to directly open the by-pass controlling valve when the throttle valve is closed. The said mechanism consists preferably, with a normally closed valve in the by-pass, in a finger or cam carried by a shaft actuated by the throttle lever, the reservoir connection controlling valve stem being preferably operated by a cam carried by the same shaft.

In the accompanying drawings, Figure 1 is an end elevation of a locomotive engine illustrating my invention. Fig. 2 is a partial side view of the same. Fig. 3 is a detail side view partly in vertical section on a larger scale illustrating the operation of the by-pass controlling valve and the mechanism actuating the same directly. Fig. 4 is a detail vertical section through the stop valve; and Fig. 5 is a like section through the by-pass controlling valve.

In the said drawings the primary or high pressure engine cylinder 1 and secondary or low pressure engine cylinder 2 are each mounted in the frame 3 of the locomotive shown, which is provided with suitable wheels 4 carried on the rails 5. The main air reservoir 6 is also mounted on the frame 3 in a suitable manner and is provided with an elbow 7 which leads into the stop valve 8 and through the same and the reducing valve 9 to the connecting pipe 10 leading to the secondary or auxiliary reservoir 11. The connecting pipe 12 leads from the said reservoir 11 to the valve chest 13 of the cylinder 1. The exhaust pipe 14 leads from the exhaust of the high pressure cylinder 1 to the interheater 15; and the pipe 17 connects the interheater with the valve chest 16 of the low pressure cylinder 2.

The throttle lever 19, which is preferably

provided with the latch handle 19′ and segment rack 20, is mounted on a shaft 21 journaled in the bearings 22 attached to the frame 3. The arm 23 is attached to the same shaft 21 and is pivotally connected to the rod 24 extending longitudinally of the reservoir 6 and pivoted to the valve stem arm 25, which controls the throttle valve 26. It will be noticed that the throttle valve 26 is interposed in the pipe 12 just ahead of the valve chest 13. The by-pass 27 is tapped off from the pipe connection 10, 12 between the said throttle valve 26 and the reducing valve 9, being illustrated as joined to an elbow 27′ near the reducing valve. The said by-pass 27 leads to the low pressure cylinder 2, being shown as entering the pipe 16 connecting the same with the interheater 15. The by-pass pipe 27 is provided with the spring pressure valve 28 having a stem 29 and treadle portion 29′ by which said valve is opened by the port, it being so constructed as to remain normally closed in a manner well understood in the art.

The stop valve 8 is provided with a casing 8′ and a seat 30 for the valve head proper 8, being illustrated as downwardly closing. It has the downwardly extending stem 31 which is provided at its lower end with a screw head 32 to which is pivoted the valve lever 33. The valve stem 31 has preferably a reduced portion 31′ within the casing 8′. The effective area of the upper pressure face of the valve 8, above the valve seat 30, is therefore much greater than the effective area of its opposite pressure face, the difference being substantially equivalent to the horizontal cross-section of the portion 31′ of the valve stem 31, when the valve is open. There is therefore, during normal operation, a force tending to close this valve equal to the pressure per square inch in the reservoir 6 times the cross-sectional area of the valve stem portion 31′. When the valve is closed, however, owing to the decrease of pressure per square inch beyond the valve 8, the difference in total pressures on the opposite faces of the valve 8, is greatly increased; so that a very great force is necessary to raise the valve 8 from its seat 30. The said valve stem 31 is controlled through the lever 33 which is fulcrumed to the adjustable bracket head 34 secured by the sleeve-nut 35 and lock-nut 35′ to the bracket rod 36 illustrated as attached by the thread 37 to the lug 38 on the valve casing 8′. The said lever 33 is preferably provided near the end of its arm 33′ with the antifriction roller 34 against which the cam 39 plays. The said cam 39 is fixed to the shaft 21, as by the screw bolt 40, and is arranged to raise the lever 33 at a progressively increasing rate so as to gradually open the valve 8, as pointed out more fully in another application of even date herewith, Serial No. 641,526, filed by Daniel R. Murphy. The said cam and lever mechanism for operating the stop valve 8 form thus no part of my present invention, although I have embodied the same in my improved combination to be more specifically described and claimed. Also carried on the rod or shaft 21 is the trigger or finger 42, which is fastened to the said shaft in any desired manner as by the screw bolt 43, and is arranged to engage the stem 44 of the valve 45, the casing 45′ of which is threaded into the by-pass connection 27. The said stem 44 and valve head proper 45 are normally held in closed position by the spring 47, the stem 44 extending downwardly preferably through the stuffing box 48 so that the parts are conveniently accessible for adjustment or repair.

The position of the finger 42 on the shaft 21 is so adjusted that when the throttle lever is moved to open the throttle valve 26, the said finger 42 is rotatably raised by the shaft 21 so that the valve 45 is automatically closed by the spring 47 and the action of the compressed air. The by-pass 27 is therefore automatically closed at all times when the throttle valve 26 is open, so that the operator or engineer cannot impair the working of the machine by admitting air from the pipe connection 10 through the by-pass to the low pressure cylinder 2 during its normal operation. It is apparent, however, assuming the machine to be at rest and the throttle valve 26 closed, in which case the stop valve 8 is also closed, that the engineer by opening the valve 29 can admit air from the pipe 10 and auxiliary reservoir 11 to the low pressure cylinder 2. The throttle valve being then opened, an extra pressure of air is obtained in the two cylinders to start the engine. As the valve stem 44 of the valve 45 is covered by the finger 42, it is impossible or at least highly inconvenient to depress the same and open the by-pass 27 subsequently. Consequently during normal running the machine must be operated in its normal fashion, all the air passing in succession through the two cylinders.

What I claim is:

1. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve controlling said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said low-pressure cylinder, a valve controlling said by-pass, a throttle lever, and mechanism directly movable thereby to simultaneously open said throttle valve and close said controlling valve.

2. In compressed air engines, the combi-

nation with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve adapted to close said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said cylinder, a normally operative valve controlling said by-pass, and mechanical means controlling said throttle valve and arranged to directly open said last mentioned valve when the throttle valve is closed, and to insure its closing when the throttle valve is open, substantially as described.

3. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve adapted to close said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said cylinder, a manually operative valve in said by-pass, another valve controlling said by-pass, a throttle lever connected to said throttle valve, and mechanical means closing said first aforementioned valve in said reservoir connection, and opening said last mentioned valve controlling said by-pass when said controlling lever is moved to close said throttle valve, and opening said by-pass connection when said throttle lever is oppositely moved.

4. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve adapted to close said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said cylinder, a throttle lever controlling said throttle valve, a shaft actuated by said lever and provided with a finger, and a valve controlling said by-pass and opened by said finger when the throttle valve is closed.

5. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve adapted to close said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said cylinder, a rotary shaft, a throttle lever carried thereby and controlling said throttle valve, means carried thereby operating said first aforementioned valve, two valves arranged in said by-pass, the first of which is manually operative, and a finger carried by said shaft arranged to open the second of which valves when the throttle valve is closed, and to permit its closing when the throttle valve is open.

6. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve in said connection and another valve adapted to close said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between said valves to said low pressure cylinder, a valve controlling said by-pass, a rotary shaft, a lever actuating the same, and controlling said throttle valve, and means carried by said shaft connected to said last mentioned valve and to said first mentioned valve in said reservoir connection for controlling the same, substantially as described.

7. In compressed air engines, the combination with an air reservoir, a high pressure cylinder, a connection leading from said reservoir thereto, a throttle valve controlling said connection, and another valve controlling said connection ahead of said throttle valve, of a low pressure cylinder, a by-pass leading from said connection between aforesaid valves to said low pressure cylinder, a manually operative valve normally closing said by-pass, another valve controlling said by-pass and provided with a spring normally closing the same, a rotatable shaft, a throttle lever actuating the same, means carried by said shaft for closing aforesaid second mentioned valve controlling said reservoir connection, and a finger carried by said shaft adapted to open said second-mentioned valve controlling said by-pass.

In testimony whereof, I, the said CHARLES B. HODGES have hereunto set my hand.

CHARLES B. HODGES.

Witnesses:
ROBERT C. TOTTEN,
J. R. KELLER.