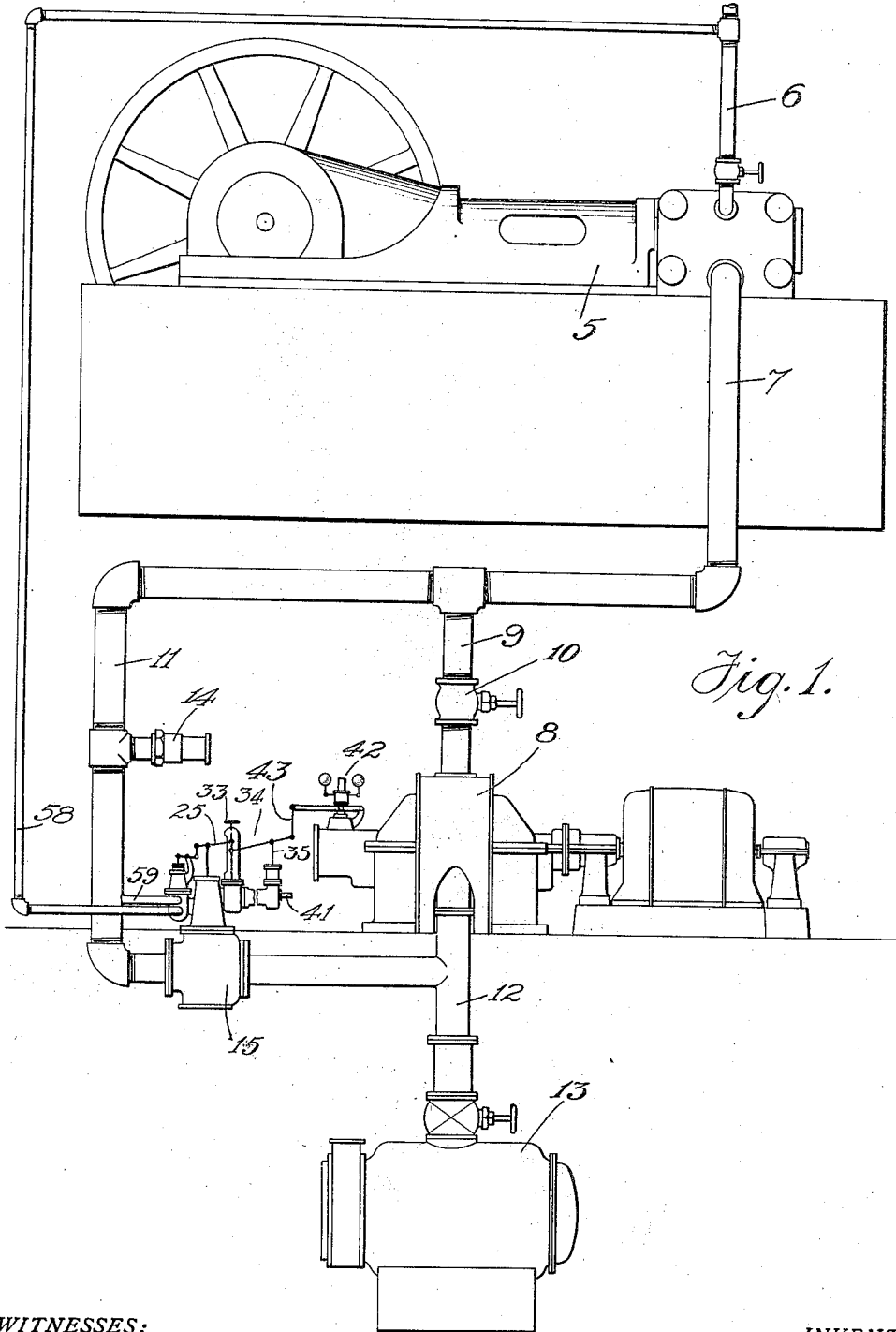


F. HODGKINSON.
FLUID PRESSURE MOTOR.
APPLICATION FILED SEPT. 1, 1909.

1,062,098.

Patented May 20, 1913.

2 SHEETS—SHEET 1.



WITNESSES:

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INVENTOR.

BY

Francis Hodgkinson
Jas. D. Brown
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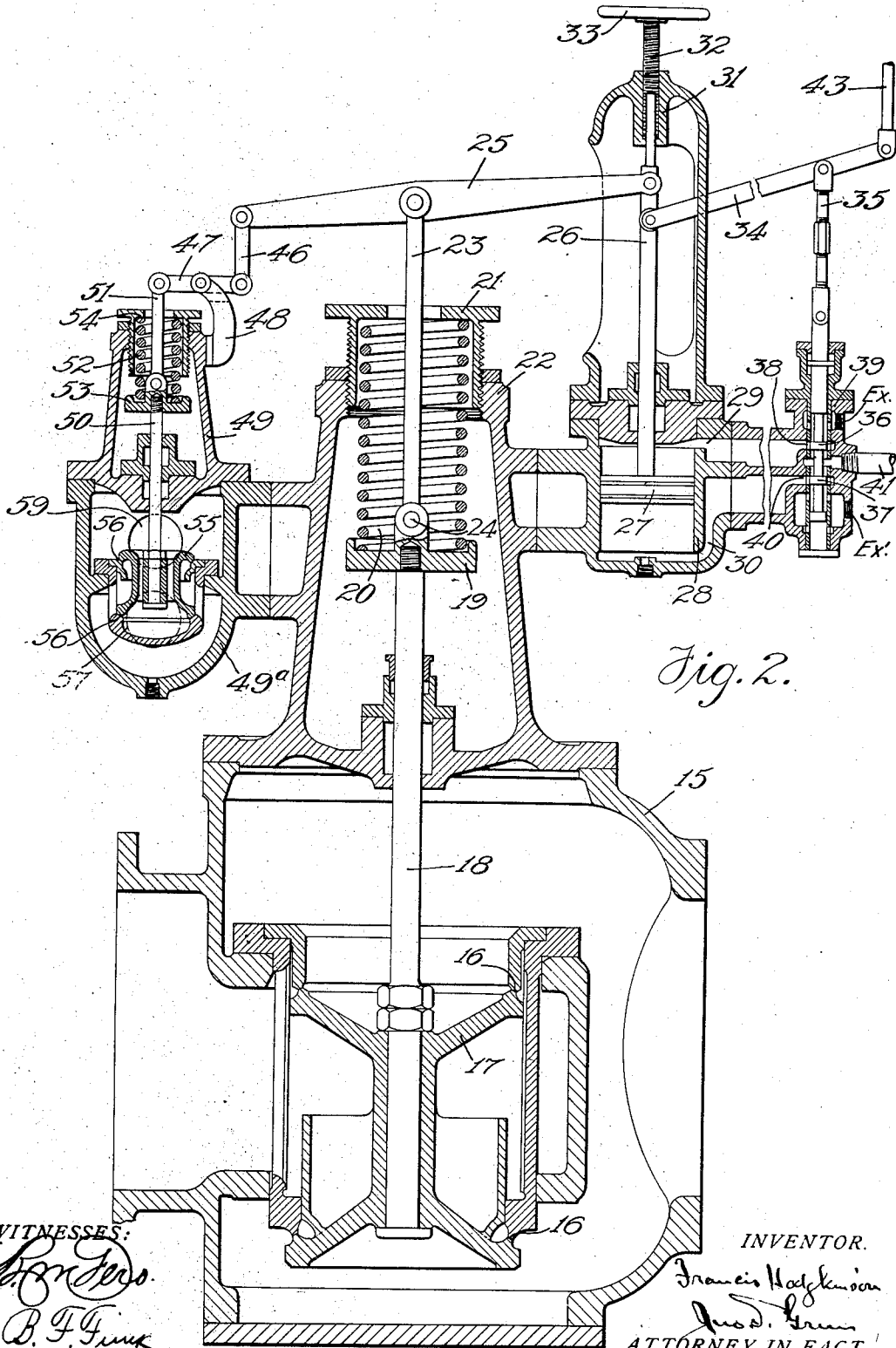


Fig. 2.

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FRANCIS HODGKINSON, OF EDGEWOOD PARK, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

FLUID-PRESSURE MOTOR.

1,062,098.

Specification of Letters Patent.

Patented May 20, 1913.

Application filed September 1, 1909. Serial No. 515,554.

To all whom it may concern:

Be it known that I, FRANCIS HODGKINSON, a subject of the King of Great Britain and Ireland, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have made a new and useful Invention in Fluid-Pressure Motors, of which the following is a specification.

This invention relates to fluid pressure motors and particularly to means for admitting fluid pressure (hereafter termed steam) from a high pressure motor to a low pressure motor.

One of the objects of the invention is to provide means whereby a governor or speed responsive device will control the admission of steam into the casing of the low pressure motor.

Another object of the invention is to provide means whereby the low pressure motor will receive fluid from the low pressure supply until such time as the load upon the motor becomes great enough to demand augmentation of the normal fluid pressure supply when additional fluid pressure will be provided from a high pressure source.

The invention is herein illustrated as being applied to a low pressure turbine which receives its motive fluid from the exhaust of a high pressure engine.

The valve mechanism which is illustrative of one embodiment of my invention is so arranged that at the time the load on the turbine is light a valve will be opened so as to by-pass a large quantity of steam from the exhaust of the engine to the condenser whereby the engine will get the benefit of exhausting at low pressure. When the load on the engine is light and heavy on the turbine, live steam will be automatically fed into the exhaust of the engine and into the turbine to enable the turbine to carry a heavy load. The valve mechanism is illustrated as being controlled by a speed responsive governor on the turbine which operates a relay to impart the desired opening and closing movements to the by-pass valve which admits the steam into the condenser and also the valve which admits high pressure steam into the exhaust of the engine and then into the turbine.

In the drawings, Figure 1 is a diagrammatic view of a high pressure engine and

a low pressure turbine having suitable connections for conveying steam from one to the other and provided with a valve mechanism constructed in accordance with my invention; and, Fig. 2 is an enlarged sectional view through the several valve casings and the casing of the relay.

Referring now to the drawings by numerals of reference, 5 designates a fluid pressure motor herein shown as a reciprocating engine to which steam may be supplied from boiler pressure through the inlet pipe 6.

7 is an exhaust pipe for the engine 5 and through which exhaust steam may be supplied into the turbine 8 through the branch pipe 9. In the branch pipe 9 is a valve which will be referred to hereinafter.

11 is a by-pass pipe communicating with exhaust 7 and with the pipe 12 leading into the condenser 13. The pipe 12 also constitutes an exhaust passage for the turbine 8. In the by-pass 11 is a relief valve 14.

15 designates a valve casing in the bypass piping 11 and it is provided with a valve seat 16 in which is a balanced valve 17 of suitable construction. The valve 17 is provided with a stem 18 on one end of which is a seat 19 for one end of an expansion spring 20, the other end of which abuts against a seat 21 adjustably connected to a support 22 on the valve casing 15. A link is pivoted at 24 to the stem 18 and is secured to a lever 25, one end of which is connected to a piston rod 26 on one end of which is a piston 27. The piston 27 is movable in a cylinder 28 having ports 29 and 30 at its respective ends. These ports alternately become inlet and exhaust ports according to the direction of movement to be imparted to the piston 27. The piston rod 26 extends through a bush 31 above the cylinder 28 and in which is a threaded stem 32 of the hand wheel 33. The piston rod 26 is also connected to a lever 34 which is pivotally secured to a valve stem 35 of a relay device. The valve stem 35 is provided with collars 36 and 37 which form valves in the relay device. The valve 36 is adapted to close the port 38 in the casing 39 of the relay device and the valve 37 is adapted to close a port 40 in the relay device, said ports being supplied from some suitable

source as for example an oil reservoir through the port 41.

The oil is preferably under pressure and when entering through the port 41 may pass through the port 38 into the port 29 or through the port 40 into the port 30 so as to enter the cylinder 28 and move the piston 27 in the desired direction. Both ports 40 and 38 are opened at the same time or closed at the same time so that when the oil is entering through one of the said ports it will be exhausting through the other so as to facilitate the movement of the piston 27. The lever 34 is connected to a suitable speed responsive device as for example a speed governor 42 through a link 43. The lever 25 is connected to a link 46 which in turn engages a lever 47, fulcrumed on a bracket 48 secured to a valve casing 49 through which high pressure steam may be admitted to the turbine when the low pressure steam from the exhaust of the engine 5 is insufficient for the turbine 8. The lever 47 is connected to a piston rod 50 by a link 51 and surrounding the link 51 is an expansion spring 52, the expansive force of which is greater than that of the spring 20. The spring 52 has one end abutting against a disk 53 and the other end against an adjustable seat 54 carried by part of the valve casing 49^a. At the end of the stem 50 is a valve 55 adapted to be seated upon seat 56 in the casing 49^a and said inlet port is in communication with a source of high-pressure steam, as for example the boiler, through a pipe 58. The outlet port 59 for the valve casing 49 communicates with the by-pass pipe 11 or may be led to a high pressure element contained within the turbine casing.

In the operation of the device as illustrated, it will be assumed that all the parts are at rest. Before starting the engine 5 hand wheel 33 will be turned so as to depress the piston 27 and cause the valve 17 to be unseated. Thus the exhaust steam from the engine 5 will be permitted to pass through the by-pass casing 15 direct to the condenser 13. After the engine 5 is under way, the valve 10 may be slightly opened to warm up the turbine preparatory to starting it. Upon a further opening movement of the valve 10 the steam may be admitted into the turbine 8, but will be incapable of operating the turbine inasmuch as there can be substantially no difference of pressure between the piping 9 and 12 because the lever 17 is in its wide open position. When the hand wheel 33 is manipulated to take off pressure from the rod 26 the valve mechanism will become automatic and the valves will be controlled wholly by the speed responsive device 42. By reference to the drawings it will be seen that when the turbine 8 is rotating at a low

speed the end of the lever 34 to which the link 43 is connected will be displaced so as to cause the valve 37 to uncover the port 40 and admit oil under pressure from the pipe 41 into the cylinder 28 through the port 30.

Inasmuch as the turbine is at rest, the speed responsive device is in a position corresponding to the low speed position and the valve stem 35 and the valve parts 36 and 37 are in their lowest position and admitting oil to the cylinder below the piston 27 and exhausting oil from above the piston 27. The oil pressure therefore tends to raise the piston 27, which is unable to rise because of the position of the hand wheel 33 and the stem 32. In order to start the turbine the hand wheel 33 may be turned to release the piston 27 and to permit it to rise a desired amount, causing a partial closing of the valve 17. The turbine will commence revolving when the valve 17 is closed a sufficient amount to cause a great enough difference in pressure between the pipes 9 and 12 to bring this about. The hand wheel 33 may be further raised until the turbine is up to speed when it may be entirely released; the valve mechanism will then become automatic and the valve will be controlled wholly by the speed responsive device 42.

By referring to the drawing it will be seen that without the hand wheel 33 and with the turbine at rest, and the valves 36 and 37 in their lowest position, that as soon as the oil pressure is established the piston 27 will rise, closing the valve 17; then if the engine were started with the valve 10 closed there would be no outlet for the exhaust steam except through the escape valve 14. If, on the other hand, the valve 10 were open a full discharge of steam would be admitted into the casing of the turbine 8 and the turbine might be too rapidly speeded up, with the consequent ill effects.

When the turbine is operating at low speed the lever 34 is moved by the governor 42 of the turbine through the agency of the link 43 to such a position that the valves 36 and 37 uncover the respective ports 38 and 40 of the relay device and place them respectively in communication with the ports 41 and an exhaust port of the relay device. This admits oil pressure to a cylinder 28 below the piston 27 and exhausts the oil from above the piston. As the piston rises in response to the oil pressure, it first closes the valve 17 in the by-pass piping 11 and then if a still further movement is imparted in the piston 27 the valve 55 is opened and admits high pressure steam through the piping 58 and 59 to the by-pass piping 11, this steam augments the exhaust steam from the engine 5 and increases the power of the turbine.

During the time that the piston 27 is

moving up to close the valve 17 the link 47 will act as a fulcrum for the lever 25 because the valve 55 is seated due to the expansive force of the spring 52 and because the expansive force of the spring 52 exceeds that of the spring 20. If the exhaust steam from the engine 5 is insufficient to drive the turbine 8 (on account of the load on the turbine) the port 40 of the relay will continue to be opened after the valve 17 is seated. As oil continues to flow into the cylinder 28 the piston 27 will continue to move in an upward direction after the valve 17 is seated. The fulcrum for the lever 25 being then transferred from the link 46 to the link 23 and through the medium of the links 46 and 51 and the lever 47, the spring 52 will be overcome and the valve 55 will be unseated so as to admit high pressure steam to the valve casing 49 and into the by-pass 11 (it being understood at this time the ports in the valve casing 15 are closed) and the high pressure steam will pass into the turbine through a pipe 9 to augment the supply from the exhaust of the engine 5. When the turbine has speeded up to the proper speed the speed responsive device 42 will cause the valves 36 and 37 to close the ports 38 and 40 so that the live steam will continue to flow into the turbine and the turbine will have the benefit both of the exhaust steam from the engine 5 and high pressure steam from a suitable source, as for example boiler pressure. If the load on the turbine becomes light it will not require so much steam; therefore the speed responsive device will raise the stem 35 so as to uncover the port 38 and admit oil into the cylinder 28, through the port 29. The initial downward movement of the piston 27 will permit the valve 55 to close so that the turbine will be driven from the exhaust of the engine 5. If however, the load becomes very light oil will continue to flow into the cylinder 28 through the port 29 and the valve 17 will be closed and if the whole amount of exhaust steam is insufficient to drive the turbine, the valve 55 will again be opened and live steam admitted thereto.

When it is desired to shut the turbine down without interfering with the operation of the engine 5, the hand wheel 33 may be screwed down, thus opening the valve 17 regardless of the oil pressure in the cylinder 28; the exhaust from the engine will then pass direct to the condenser, the turbine will come to rest and the valve 10 may be closed if desired.

What I claim is:

1. In combination with a high pressure engine, a low pressure turbine having its inlet connected to the exhaust of said engine, a by-pass leading from the exhaust of said high pressure engine to the exhaust of said

turbine, automatic mechanism for controlling the effective area of said by-pass in accordance with the load on said turbine, an augmenting source of fluid supply adapted to communicate with the turbine, and automatic mechanism for effecting communication between the augmenting source of fluid supply and the turbine when the by-pass is closed.

2. In combination with an exhaust steam supply, a turbine designed to operate on steam from said supply and to exhaust to a lower pressure, a connection for leading steam from said supply to a point where the pressure is substantially the same as the exhaust pressure of said turbine, means responsive to the speed variations of said turbine for automatically shunting all or a portion of the steam from said supply around said turbine, a source of high pressure steam, and automatic means for admitting high pressure steam into the turbine or closing communication between the source of high pressure steam in the turbine in accordance with the load on said turbine.

3. In combination with an exhaust steam supply, an engine designed to operate on steam from said supply, a speed responsive agent connected to said engine, means controlled by said agent for shunting all or a portion of the steam from said supply around said engine, said means being effective to cause all of the steam to be fed into said engine, a source of high pressure steam adapted to communicate with said engine and means controlled by the speed responsive agent to admit steam from the high pressure source to said engine.

4. In a fluid pressure motor, two sources of supply, valves for controlling the delivery from said sources of supply, actuating means connected to said valves and having variable fulcrums, and means for actuating said last named means.

5. In a fluid pressure motor, two sources of supply, valves for said sources of supply, springs for normally closing said valves, the spring for one of said valves being stronger than the spring for the other valve, a lever connected to said valves, and means for actuating said lever.

6. In a fluid pressure motor, a high pressure valve and a low pressure valve, the high pressure valve having connections with the low pressure valve, springs for normally closing said valves, the spring on the high pressure being stronger than the spring on the low pressure valve, and means including the connections for unseating said valves.

7. In combination with a high pressure valve and a low pressure valve of a relay for operating said valves including a piston and means for actuating it, a lever mechanism connected to said valves and springs

for normally maintaining said valves seated, one of said springs being stronger than the other.

8. The combination with a high pressure engine and a low pressure turbine, a pipe leading from the exhaust of the high pressure motor to the low pressure turbine, a by-pass valve and its connections, a condenser adapted to communicate with the exhaust of the high pressure motor through the by-pass valve connection, a branch pipe leading from the exhaust pipe into the low pressure turbine, a fluid actuated piston for actuating the by-pass valve, and manually controlled means for imparting movement to the piston to temporarily open the by-pass valve to permit exhaust steam from the high pressure motor to pass around the low pressure turbine into the condenser.
9. The combination of a high pressure motor and a low pressure turbine, an exhaust pipe leading from the high pressure motor and having a by-pass pipe leading around the turbine to a condenser, a branch pipe leading from the exhaust pipe into the turbine, a valve in the by-pass pipe, automatic means for actuating said valve and manually controlled means for actuating said valve.
10. A high pressure engine, a low pressure engine, a passage for delivering the exhaust fluid of said high pressure to said low pressure engine, a passage for delivering an auxiliary supply of high pressure fluid to said low pressure engine, a by-pass passage for by-passing exhaust fluid from said high pressure engine around said low pressure engine, a governor controlled valve for controlling the passage of fluid through said by-pass passage and a governor controlled valve for controlling the auxiliary supply of fluid to said low pressure engine.
11. A high pressure engine, a low pressure engine, means for delivering the exhaust fluid from said high pressure engine to said low pressure engine, means for delivering an auxiliary supply of fluid to said low pressure engine, a governor controlled valve for by-passing exhaust fluid from said high pressure engine around said low pressure engine and a governor controlled valve for controlling the auxiliary supply of steam to said low pressure engine.
12. A high pressure engine, a low pressure engine, a condenser communicating with the exhaust of said low pressure engine, a passage for delivering the exhaust fluid from said high pressure engine to said low pressure engine, means for delivering an auxiliary supply of fluid to said low pressure engine, a by-pass passage for delivering the exhaust fluid from said high pressure

engine around said low pressure engine to said condenser, a governor controlled valve for controlling the passage of fluid through said by-pass passage and a governor controlled valve controlling the auxiliary supply of steam to said low pressure engine.

13. A high pressure engine, a low pressure engine, a condenser, means for delivering the exhaust steam from said high pressure engine to said low pressure engine, means for delivering an auxiliary supply of steam to said low pressure engine, a passage for by-passing fluid exhausted from said high pressure engine around said low pressure engine to said condenser, and a valve responsive to the speed of said low pressure engine for controlling the delivery of steam through said by-pass passage.

14. A high pressure engine, a low pressure engine, a condenser communicating with the exhaust of said low pressure engine, means for delivering fluid exhausted from the high pressure engine to said low pressure engine, means for delivering an auxiliary supply of fluid to said low pressure engine, a passage for delivering fluid exhausted from said high pressure engine around said low pressure engine to said condenser, valves for controlling the delivery of steam through said passage and the auxiliary supply to said low pressure engine and speed responsive means for controlling the operation of said valves.

15. The combination of a high pressure engine and a low pressure engine, means for delivering the exhaust from said high pressure engine to said low pressure engine, means for delivering an auxiliary supply of motive fluid to said low pressure engine and means dependent upon the speed of the low pressure engine for by-passing some or all of the exhaust from the high pressure engine around the low pressure engine.

16. The combination of a high pressure engine and a low pressure engine, means for delivering the exhaust from said high pressure engine to said low pressure engine, means for delivering an auxiliary supply of motive fluid to said low pressure engine, a condenser connected to the low pressure engine and means dependent upon the speed of the low pressure engine for by-passing some of the fluid around the low pressure engine to the condenser.

In testimony whereof, I have hereunto subscribed my name this 26th day of August, 1909.

FRANCIS HODGKINSON.

Witnesses:

C. W. MCGHEE,
WM. H. LARIMER.

1,062,098

Correction in Letters Patent No. 1,062,098.

It is hereby certified that in Letters Patent No. 1,062,098, granted May 20, 1913, upon the application of Francis Hodgkinson, of Edgewood Park, Pennsylvania, for an improvement in "Fluid-Pressure Motors," errors appear in the printed specification requiring correction as follows: Page 2, line 98, for the word "valves" read *valve parts*; same page, line 116, for the word "ports" read *port*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of June, A. D., 1913.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.