No. 781,590. PATENTED JAN. 31, 1905.

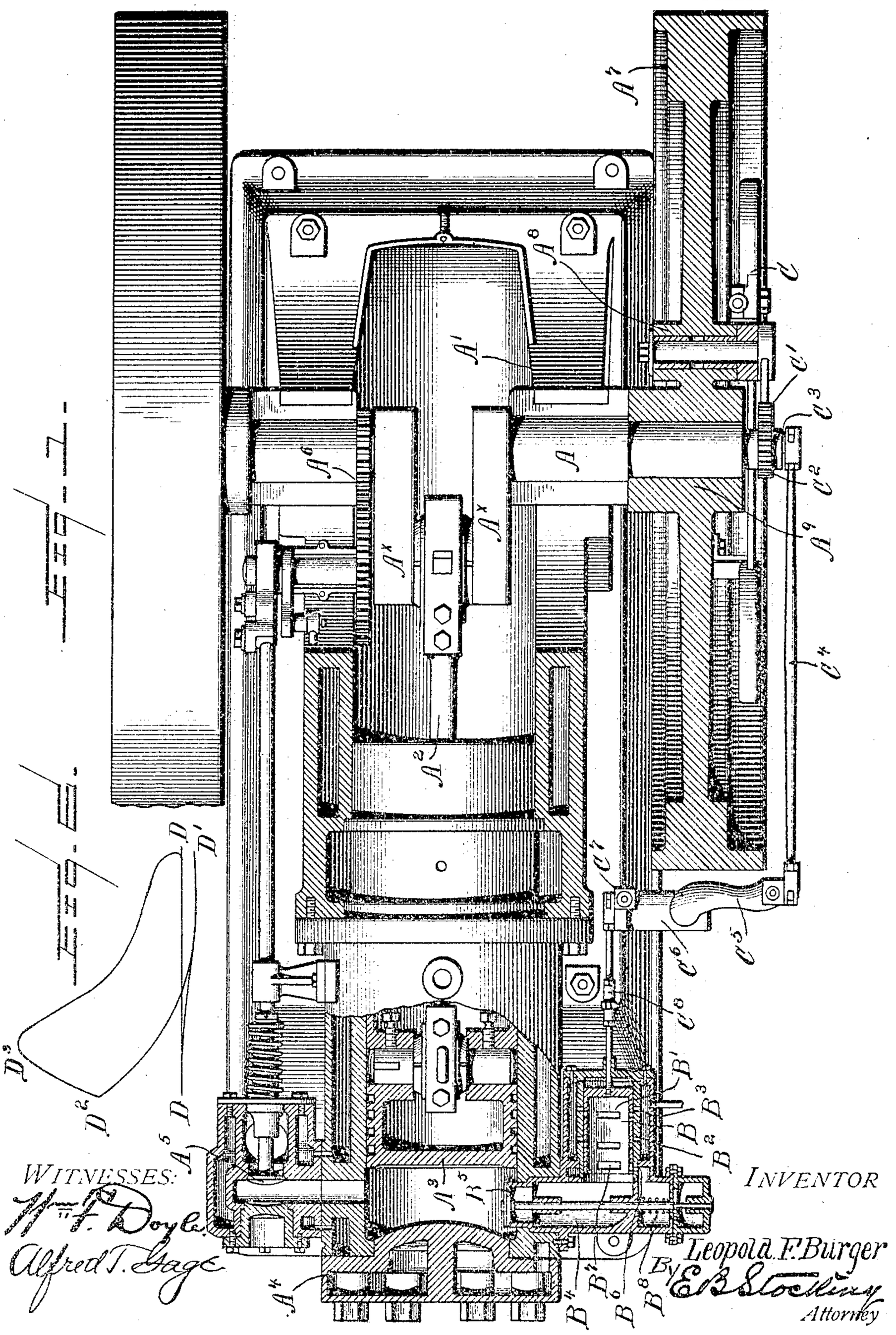
L. F. BURGER.

GOVERNING MECHANISM.

APPLICATION FILED DEC. 19, 1903.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

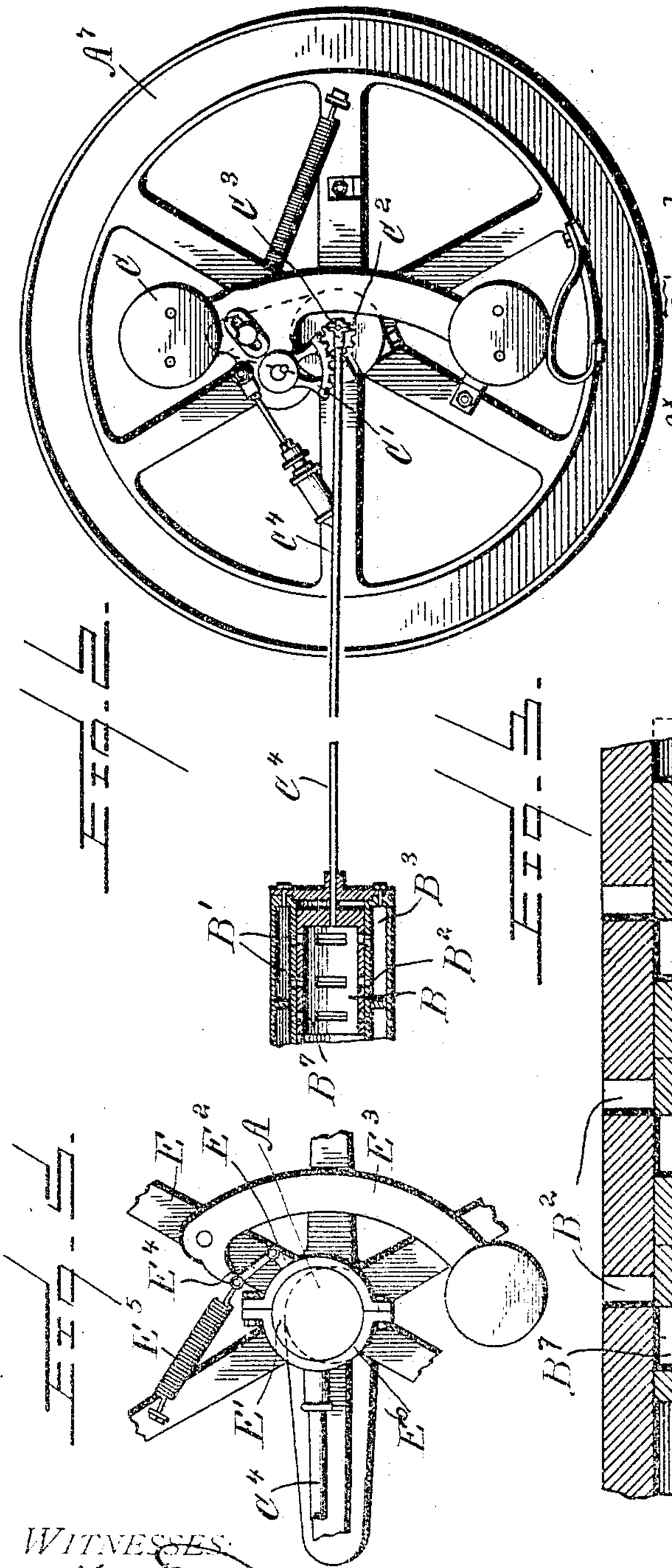

FIG. 1.

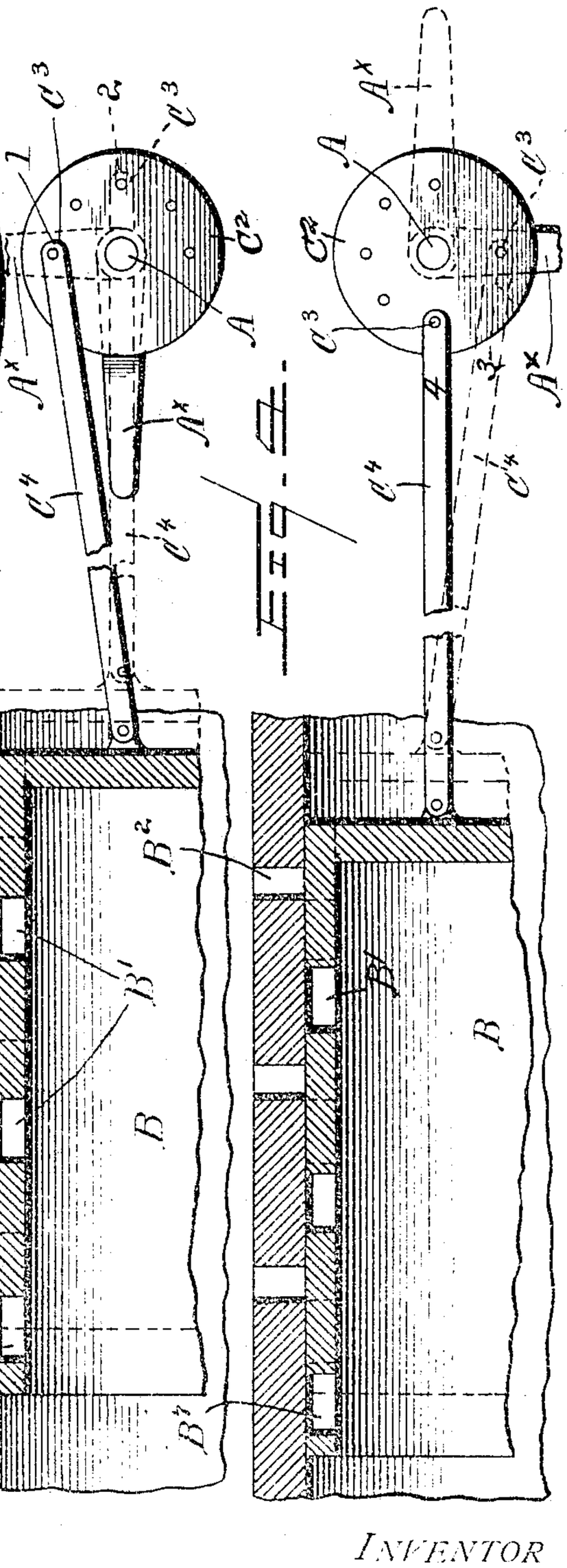

FIG. 2.

FIG. 3.

FIG. 4.

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UNITED STATES PATENT OFFICE.

LEOPOLD FERDINAND BURGER, OF ANDERSON, INDIANA, ASSIGNOR TO WOOLLEY FOUNDRY AND MACHINE WORKS, OF ANDERSON, INDIANA.

GOVERNING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 781,590, dated January 31, 1905.

Application filed December 19, 1903. Serial No. 185,880.

To all whom it may concern:

Be it known that I, LEOPOLD FERDINAND BURGER, a citizen of the United States, residing at Anderson, in the county of Madison, State of Indiana, have invented certain new and useful Improvements in Governing Mechanism, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a governing mechanism, and particularly to a valve-governing device applicable to governor-controlled engines.

The invention has for an object to provide an improved connection between the governing-valve and crank-shaft of the engine whereby the valve will be quickly and positively closed during the period of greatest speed in the rotation of the shaft and retained fully open during the necessary period to charge the cylinder, whereby the "wire-drawing" effect frequently produced in governing-valves is entirely avoided.

A further object of the invention is to provide a novel construction and arrangement of governing-valve and governor-controlled connector extending to the crank-shaft of the engine, whereby a four-cycle explosive-engine may be most effectually controlled relative to the load which it carries, so as to produce a card showing the minimum of resistance and lost friction or energy below the atmosphere-line, thus reducing the cost of fuel and producing a closer regulation of the engine.

Other and further objects and advantages of the invention will be hereinafter set forth and the novel features thereof defined by the appended claims.

In the drawings, Figure 1 is a horizontal section of a gas-engine having the invention applied thereto, parts being shown in elevation. Fig. 2 is an elevation of a balance-wheel having the crank-shaft thereof connected to a sectionally-illustrated governing-valve. Fig. 3 is a diagrammatic view, in full and dotted lines, of positions of the governing-valve relative to the rotation of the crank-shaft. Fig. 4 is a similar view showing further positions thereof. Fig. 5 is a detail elevation of a modified form of governor connection, and Fig. 6 is a card taken from an engine controlled by a valve mechanism of this character.

Like letters of reference refer to like parts in the several figures of the drawings.

This invention is adapted for application with any desired form of engine, but is here shown in connection with a four-cycle engine, such as disclosed in my prior patent, No. 725,669, April 21, 1903. Referring to this illustration, the letter A designates a crank-shaft having bearings in an engine-frame A′ in the usual manner and connected by a piston-rod A^2 with a piston A^3, disposed within a cylinder A^4 of an engine. This cylinder is provided with an exhaust-valve A^5, connected therewith and controlled by means of a geared connection A^6, carried upon the crank-shaft A. The cylinder is also in communication with a governing-valve B, which in the present instance is shown as a cylindrical structure having a series of ports B′ coöperating with ports B^2 of less area than the ports B′ and located in the casing having an air-chamber B^3 therein. This casing communicates with an intake-chamber B^4, having at its upper end an inwardly-opening check-valve B^5, while the lower portion of the intake-chamber adjacent to the valve B is provided with a gas-port B^6, adapted to coöperate with a port B^7 upon the inner end of the valve, the gas being admitted thereto from the chamber B^8 below the port in the intake-chamber.

Secured to the crank-shaft A is a balance or fly wheel A^7, having a bearing A^8 disposed eccentrically to the hub A^9 thereof. This bearing has journaled therein any suitable form of governor mechanism C and means for communicating motion therefrom to the governing-valve B. In the structure illustrated the governor-weights are provided adjacent to their axis with a segmental gear C′, adapted to mesh with the pinion C^2, which is rotatably mounted upon the outer end of the crank-shaft A and provided eccentrically to the center of said shaft with a wrist-pin C^3, from which the connecting-rod C^4 extends to a rock-arm C^5, carried by a rock-sleeve C^6,

which sleeve upon the opposite end is provided with an arm C^7, from which a connecting-link C^8 extends to the governing-valve B.

As is well known in this class of engines, the crank-shaft A is at its lowest speed of movement as it passes over the opposite dead-centers when the piston-rod and crank-arm $A^\times$ are in the same plane, while its greatest speed of movement is in the travel of the crank-arm from one of these centers to the other. As illustrating this the diagrams in Figs. 3 and 4 have been provided, in which the crank-arm $A^\times$ upon the crank-shaft A is shown in different positions by full and dotted lines and the valve correspondingly shifted. Referring to Fig. 3, it will be seen that the crank-arm is there in position shown in Fig. 1, with the valve about to open or the port thereof brought into alinement with the port in the casing. This opening occurs during the travel of the crank-arm from the position shown in full lines to that shown in dotted lines, shifting the valve to the full-open position by a quick movement incident to the travel of the crank-arm between its dead-centers. The valve connection C^4 thus travels from the full-line position 1 to the dotted-line position 2, where the valve is opened to its fullest extent. Referring to Fig. 4, it will be seen that the crank-arm shown by dotted lines has traveled to the opposite dead-center away from the cylinder and during such travel has brought the connector to the position 3 (shown by dotted lines) by a quick movement in approaching this dead-center, the movement from positions 2 to 3 being the closing movement of the valve. The continued travel of the crank-arm to its full-line position in Fig. 4 retains the valve in a closed position in the passage of the connector from position 3 to position 4, while the continued movement of the crank-arm back to its original position carries the connector to the position 1, where the valve is again ready to open. A series of connecting-points are shown in these diagrams, and it is obvious that the position of the connector may be altered from that of a right angle to the crank-arm, as here shown, in accordance with the load upon the engine and the consequent necessity for opening the valve to a different extent. It will be seen from the foregoing that the valve is completely closed during a portion of the travel of the crank-shaft and is open during the quickest movement of valve connection, so as to prevent a loss of energy and resistance due to the wire-drawing effect incident to a valve which closes very slowly or which is never fully closed in the operation of the engine. By this construction and arrangement it will be seen that less power, and consequently less fuel, is required, while a greater amount of work may be accomplished, as the governing-valve only admits to the cylinder sufficient gas and air for the requirements of the load. For instance, during rotation one-half the ports of the governing-valve are wide open at the beginning of the introduction-stroke and remain wide open until the piston has traveled one-half of its stroke, then closed, while the piston travels on vacuum the rest of the stroke. This vacuum created in the cylinder is not lost, but allows the atmospheric pressure to bring the piston back until it reaches a point where the vacuum is begun to be created. As demonstrating more clearly the operation, reference is made to the indicator-card shown in Fig. 6, wherein the atmosphere-line is designated as D D and the introduction-stroke from D to D′, which travels over the line D D for a portion of its length, then leaves the line at the point of cut-off and drops to the end of the stroke. The line from D′ to D^2 retraces the former line to near the point of cut-off and then proceeding above the atmosphere-line designates the compressing, which continues to rise until nearing the end of the stroke at the point D^2, where the ignition takes place and then the explosion. The line from this point ascends to D^3, indicating the point of explosion, and then falls back to the atmosphere-line at D, which is the point of exhaust and which is traversed back to the starting-point, thus producing a card as shown in Fig. 6.

In the application of the invention herein illustrated the same is applied to a four-cycle engine, wherein under the first cycle the charge is turned into the cylinder with the valve wide open, as shown in Fig. 2, and with valve-pin in position 2 of Fig. 3, when in the continued rotation of the crank-shaft a quick cut-off is effected with valve-pin in position 3 of Fig. 4, while the remaining portion of this cycle is run under vacuum, as before described. The valve-pin is set at an angle to the crank-pin, so that when the latter is at its slowest travel the former is at its quickest or highest point of travel. The return stroke of the piston under the second cycle comprises a charge which is assisted by the atmospheric pressure, the supply or governing valve being at this time closed, as in position 4 of Fig. 4, and continuing closed until the initial position 1 of the valve-pin in Fig. 3 is reached. The next outward stroke of the piston constituting the third cycle occurs during the explosive action of the charge, and although the valve is open at this time it does not affect the condition within the cylinder, owing to the closure of the intake-valve by the pressure in the cylinder. Under the fourth cycle the valve remains closed, and the returning stroke of the piston to the position shown in Fig. 1 clears or exhausts the cylinder through the usual exhaust-port. After the closing of this port the operation is repeated. It will therefore be seen that the full-open port occurs during the charging period, while a quick opening

and closing of the port is effected, and the disposition of the governor controlling the point of attachment for the connection between the valve and the crank-shaft shifts this point relative to the axis of said shaft under changes of load, so that a longer opening may be maintained for an increase of load than in the case of a decrease of load and the valve closed in each case during the movement of the valve-pin from one dead-center to the other or at the time when the greatest speed of travel is acquired by said pin.

The governor construction shown in Figs. 1 and 2 for controlling the point of attachment between the connector for the valve and the crank-shaft is a preferred construction; but other forms may be used—for instance, as shown in the modification in Fig. 5, where the balance-wheel E is mounted upon the crank-shaft A and provided with an eccentric E', rotatably mounted upon the end of the shaft and adapted to be shifted by means of the arm E^2, connected to the pivotally-mounted governor-weight E^3 by means of the link E^4 and operating against the tension of the spring E^5. Motion is communicated to the connector-rod C^4 by means of the strap E^6, surrounding the eccentric. The outward movement of the governor-weight rotates the eccentric upon the end of the crank-shaft, and thus transmits motion to the valve-rod through the eccentric-sleeve.

It will be obvious that changes may be made in the details of construction and configuration of the invention and that the same is applicable to all classes of engines and in connection with various constructions of governing mechanism and valves without departing from the spirit thereof as defined by the appended claims.

Having described my invention and set forth its merits, what I claim, and desire to secure by Letters Patent, is—

1. In a governor mechanism, a crank-shaft, a valve-case and valve having ports of differing sizes, and a connection between the valve and crank-shaft constructed and arranged to open and close the valve intermediate of the opposite extremes of travel thereof.

2. In a governor mechanism, a crank-shaft, a valve-case and valve having respective ports of differing sizes, a connection between the valve and crank-shaft constructed and arranged to open and close the valve intermediate of the opposite extremes of travel thereof, and a governor mechanism operatively connected to advance or retard the operation of said valve connection in its relation to the crank-shaft.

3. A governor mechanism for internal-combustion engines comprising a cylinder, a crank-shaft, a valve-case and valve having respective ports of differing sizes, a connection between the valve and crank-shaft constructed and arranged to open and close the valve intermediate of the opposite extremes of travel thereof, and an intake-valve interposed between said ported valve and cylinder.

4. In a governing mechanism, the combination with a cylinder, a crank-shaft carrying a valve connection, a casing and ported valve having coöperating ports of different area, of a connection between the valve and shaft connection to retain the valve in an open position during the movement of the shaft connection from one dead-center to another, and to retain said valve closed during one-half of the travel of said shaft connection, and an intake-valve interposed between said ported valve and the cylinder.

5. In a governing mechanism, the combination with a cylinder, a crank-shaft carrying a valve connection, a casing and ported valve having coöperating ports of different area, of a connection between the valve and shaft connection to retain the valve in an open position during the movement of the shaft connection from one dead-center to another, and to retain said valve closed during one-half of the travel of said shaft connection, an intake-valve interposed between said ported valve and the cylinder, and means for shifting the point of attachment of said valve connection relative to the position of the crank upon said shaft.

6. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a cylindrical ported valve, a casing for said valve having coöperating ports of different capacity from the relative ports in the valve, and a connection between said valve and crank-shaft for opening and closing the valve intermediate of its opposite extremes of travel.

7. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a cylindrical ported valve, a casing for said valve having ports of different capacity from the cooperating ports in the valve, a connection between the valve and valve-pin upon the crank-shaft disposed at an angle to the crank-arm of said shaft for opening and closing the valve intermediate of its opposite extremes of travel, and means for shifting the point of connection with the crank-shaft relative to the crank thereof.

8. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a ported valve, a balance-wheel mounted upon the crank-shaft, a rotatable member mounted upon said shaft having a valve-pin at an angle to the crank-pin, a connection from said valve eccentrically connected to said pin for opening and closing the valve intermediate of its opposite extremes of travel, and means for shifting said pin and connection in advance of the crank upon the shaft.

9. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a ported valve, a balance-wheel mounted upon the crank-shaft, a rotatable member mounted upon

said shaft having a valve-pin at an angle to the crank-pin, a connection from said valve eccentrically connected to said pin, means for shifting said pin and connection in advance of the crank upon the shaft, a pivotally-mounted governor mounted to shift said pin relative to the crank upon said shaft, and an intake-valve disposed between the ported valve and cylinder.

10. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a ported valve, a balance-wheel mounted upon the crank-shaft, a rotatable member mounted upon said shaft having a valve-pin at an angle to the crank-pin, a connection from said valve eccentrically connected to said pin, means for shifting said pin and connection in advance of the crank upon the shaft, a pivotally-mounted governor mounted to shift said pin relative to the crank upon said shaft, an intake-valve disposed between the ported valve and cylinder, a pivoted governor-weight, a segmental gear carried thereby at the axis of the weight, and meshing gearing carried by said rotatable member.

11. In a governing mechanism, the combination with a cylinder and a crank-shaft, of a ported valve having a casing with ports of different capacity from those of the valve to coöperate therewith, a geared rotatable member mounted upon said shaft and having an eccentric valve-pin, a connection between said valve and pin, a pivoted governor-weight, and a segmental gear carried thereby at the axis of the weight and meshing with said rotatable member.

12. In a governing mechanism, the combination with a cylinder, of a crank-shaft, a balance-wheel thereon, rotatable means carried by said shaft, means carried by the balance-wheel for operating said rotatable means, a ported cylindrical valve disposed within a ported casing, a connector eccentrically connected to said rotatable means and to the valve to insure a fixed length of travel thereof and to open and close said valve intermediate of the extremes of said travel.

13. In a governing mechanism, the combination with a cylinder, of a crank-shaft and balance-wheel thereon, rotatable means carried by said shaft, means carried by the balance-wheel for operating said rotatable means, a cylindrical valve disposed within a ported casing and having ports of greater area than the casing, and an eccentric connection with the shiftable means being disposed to open and close the valve intermediate of the opposite extremes of travel thereof.

In testimony whereof I affix my signature in presence of two witnesses.

LEOPOLD FERDINAND BURGER.

Witnesses:

CLAYTON E. CHEESMAN,

JOHN F. CURNS.