

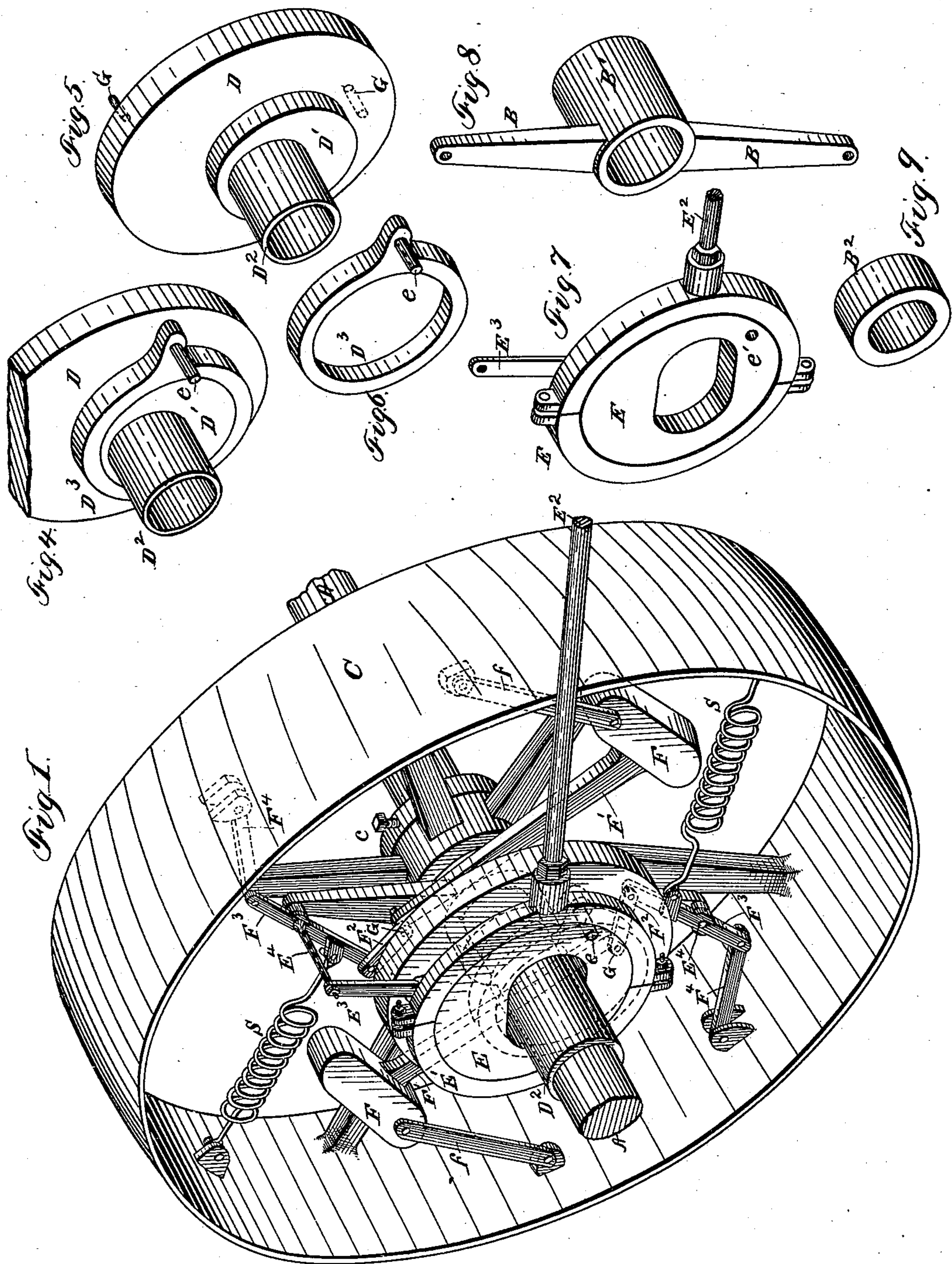
(No Model.)

2 Sheets—Sheet 1.

F. H. BALL.
STEAM ENGINE GOVERNOR.

No. 261,074.

Patented July 11, 1882.



Witnesses
W. R. Edlin.
M. A. Edlin

Inventor
Frank H. Ball.
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(No Model.)

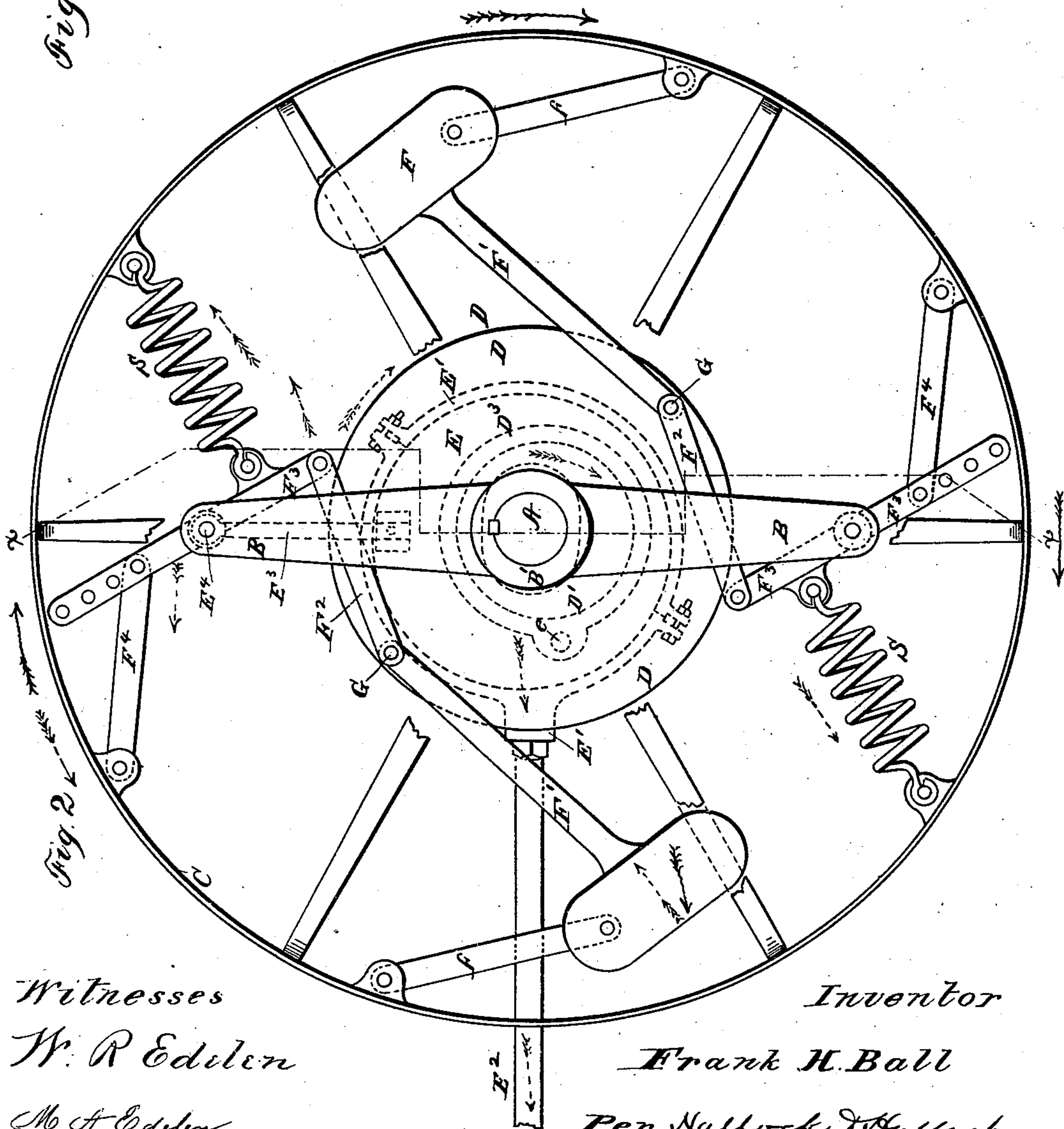
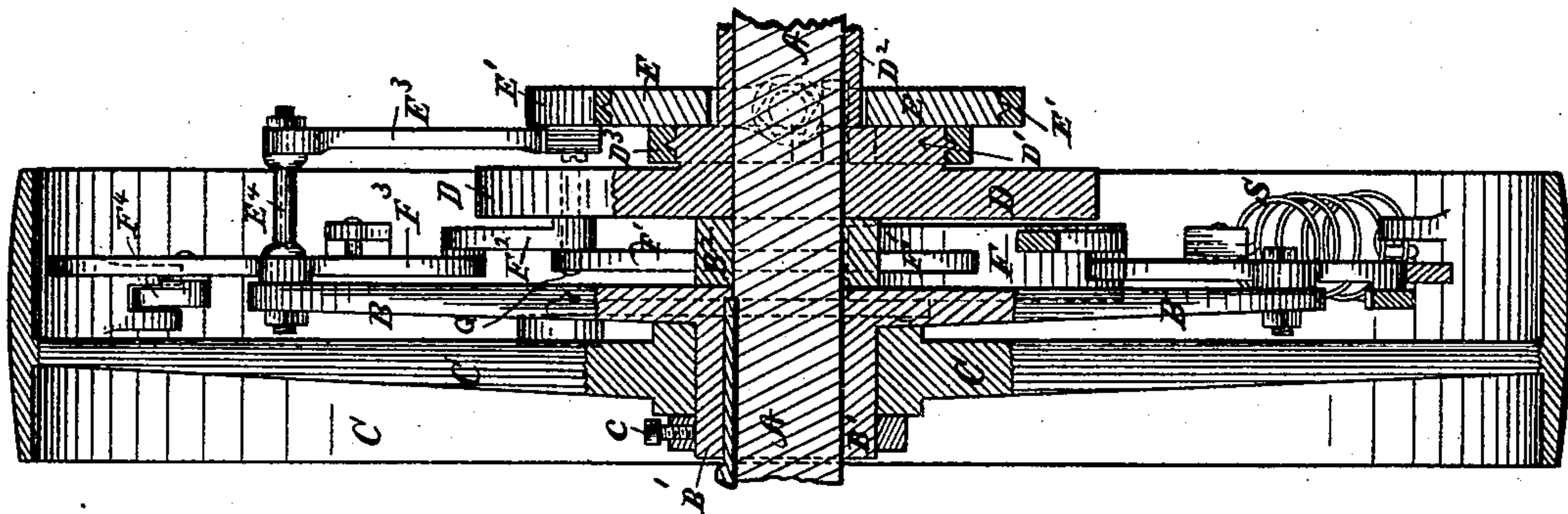
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UNITED STATES PATENT OFFICE.

FRANK H. BALL, OF ERIE, PENNSYLVANIA.

STEAM-ENGINE GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 261,074, dated July 11, 1882.

Application filed April 26, 1882. (No model.)

To all whom it may concern:

Be it known that I, FRANK H. BALL, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Steam-Engine Governors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings and the letters or figures of reference marked thereon.

This invention relates to steam-engine governors; and it consists in certain new and useful improvements therein which will fully and at length appear in the following general description and claims.

All steam-engine governors with which I am acquainted are either operated by the changes in the speed of the engine or by the changes in the load, or the exertion of the engine being made to effect the valve without waiting for a consequent change in the speed. Both of these classes of governors, no matter on what particular plan they are constructed, are defective more or less. The defect in the former class arises from the fact that in order to change the steam-supply, there must be a change in the speed, and hence the very fluctuation in speed, which it is desirable to avoid and overcome, must necessarily occur in a measure before the change in the steam-supply can be effected. The defect in the latter class arises from relying wholly upon the changes in the exertion of the engine to effect the steam-supply, and thereby necessarily producing fluctuations in the speed. It has been attempted to remedy these defects by combining both by providing the engine with dual valves, one of which is operated by one style of governor and the other by the other style of governor, each of which operates separately, and thereby seeks to secure the desired result by a sort of general average obtained by mixing the defects and benefits of both governors, using the cylinder of the engine as a kind of hotchpot, wherein are mixed two separate steam-supplies. As might be expected, such a system is defective. What is wanted is a steam-supply wholly regulated by the action of a single mechanism, and this mechanism sensitive alike to the changes of speed and to the changes of load, and capable of instantly effecting the

steam-supply whenever either of these changes occur. To effect this is the object of my invention.

My invention has also for its object to so construct a governor that it will keep the engine at a uniform speed, regardless of changes in the load, and, incidentally, I produce a governor which can, if desired, be so adjusted as to carry the engine at a greater speed when running under a heavy load than when running light, which result is very desirable in many kinds of work—as, for instance, in running a hoisting-machine or dredge. I may also here remark that in the construction herein shown and described I produce a device which, if used wholly as a centrifugal governor—that is to say, a governor which is sensitive only to changes in speed—will operate very perfectly, and is, in fact, an improvement on that class of governors.

My invention therefore consists, first, in providing a steam-engine-governing apparatus wherein are combined means whereby a change of speed or a change of load without a resultant change of speed is made to effect the steam-supply; second, in providing a steam-engine-governing apparatus wherein are combined elements whereby an increase of load will produce an increase of speed; third, in providing certain new and useful improvements in the construction of that class of centrifugal governing devices which are adjusted upon the main shaft of the engine and operate upon the valve-eccentric.

The above will fully appear from the following general description, reference being had to the accompanying drawings, in which the invention is illustrated as follows:

Figure 1 is a perspective view of the governor upon the main shaft of the engine. Fig. 2 is a side view of the same, taken from the opposite side from that seen in Fig. 1. Fig. 3 is a vertical section on the line *xx* in Fig. 2, looking toward the left. Figs. 4, 5, 6, 7, 8, and 9 are detached views of the parts indicated by the letters of reference thereon, and show details of construction. The full-line arrows in the drawings show the forward movement of the engine and the centrifugal movement of the balls or weights. The dotted-line arrows show the direction of resistance of the load

and the effect of the same as to direction of movement upon the parts of the governing mechanism—viz., the valve-gear, balls, &c.

The construction and operation are as follows, the various parts being referred to by the letters of reference marked thereon:

Upon the shaft of the engine A is keyed a cross-head or frame, B, which has a hub or sleeve, B'.

C is the main drive-wheel or belt-pulley of the engine, and it is mounted loosely upon the sleeve B' of the cross-head, and is kept in place thereon by a collar, c.

B² is a collar on the shaft for the purpose of forming an extension of the hub of the cross-head in the opposite direction from the sleeve B'. In place of being a collar, it may be a part of the hub.

Abutting against the collar B², and mounted loosely upon the shaft, is a disk, D, which has on its face which is away from the cross-head B an eccentric, D', and a sleeve, D². Upon the eccentric D' is a collar, D³, which has at one side a pin, e.

E is the valve-moving eccentric, and E' the valve-rod yoke, and E² the valve-rod. The pin e on the yoke or collar D³ enters a hole, e', in the eccentric E. The eccentric E has an elongated opening for the passage of the shaft, and as this eccentric is suspended by a rod, E³, from a pin, E⁴, on the cross-arm B, it can swing like a pendulum across the shaft, and thereby so change its position as to affect the steam-supply without in any way affecting the lead of the valve. This eccentric is moved in this manner whenever the yoke D³ is moved, (by reason of its being connected therewith by the pin e,) and such a movement takes place whenever the disk D is rotated upon the shaft. (Perhaps I should say "oscillated" in place of "rotated," for such is the degree of movement of this disk.)

If the governor is to operate upon an independent cut-off valve, the valve-rod yoke E' may be upon the eccentric D', and the eccentric E, arm E³, yoke D³, and pin e may be dispensed with, for they are necessary only when the governor is used to operate the steam-valve.

The movement of the disk D upon the shaft is effected by the following mechanism: The weights or balls F F are suspended by their arms F' F' from the disk D on pivot-pins G and by links f f to the rim of the wheel C, and their movement outward or inward by the increase or diminution of the speed of the engine will cause a movement of the disk upon the shaft. Such outward movement of the balls is opposed by the load of the engine by reason of the following devices: Levers F³ F³ are fulcrumed upon the cross-arm B at its ends upon the pins E⁴ E⁴, and links F² F² and F⁴ F⁴ connect the ends of the levers F³ F³ respectively to the disk D and the drive-wheel C, and, bearing in mind the fact that the said wheel C is loose upon the shaft, it will be seen that the centrifugal move-

ment of the balls is opposed by the load of the engine. The centrifugal movement of the balls is also opposed by the springs S S, which connect the weight end of the levers F³ F³ with the wheel C. It will therefore be seen that the resistance of the load and also the resistance of the springs S S is carried by the centrifugal force of the weights, and consequently any change in the load is immediately felt by the weights and their position instantly changes in consequence of this change of resistance without waiting for any change in the speed. For instance, if the load is increased, more force is exerted in the direction of the dotted arrows and the balls are pulled down (or in) against the speed force which is holding them up, (or out,) and the valve is affected without changing the speed, and the proper steam-supply is obtained before any change in the speed can occur, and hence the engine will run at a uniform speed no matter what changes occur in the load. I have found this to be the case by actual and severe tests. I have also found by these tests that by connecting the links F⁴ F⁴ with the levers F³ F³ at points farther removed from the fulcrum than is shown in Fig. 2 an increased speed can be obtained when an increase of load occurs, and vice versa.

If the drive-wheel C should be made fast to the sleeve B' or to the shaft, the governor will operate like or in a similar manner to a centrifugal governor; but for such a governor the outer ends of the levers F³ and the links F⁴ must be omitted or disconnected, and, in fact, the levers F³ may be wholly omitted and the springs S S be connected to the links F², or directly to the disk D. The essential parts of such a governor are the wheel C or the frame B, made fixed upon the shaft, the disk D and eccentric D', the yoke D³, pin e, eccentric E, pin-hole e', and suspending-bar E³, and if used on an independent cut-off valve the eccentric E and hanger E³ may be omitted, as has been hereinbefore explained.

My governing apparatus, as shown in the drawings, may be used upon some other shaft than the main engine-shaft if proper connection is made with the valve. The centrifugal balls need not necessarily be upon the same shaft as the drive-wheel, for gearing may be arranged to connect the two at a distance. The essential feature of the device is that the load of the engine shall be exerted against the centrifugal force of the balls or other centrifugal device. In cases where the main shaft of the engine is also the main shaft of the machinery operated—as, for instance, in operating the screw or paddle-wheels of a steamboat—the device would be applied by dividing said shaft and putting the cross-arm B on one part and the drive-wheel upon the other part.

It will therefore be seen that I do not wish to be limited to the exact construction shown, but desire my invention to be construed to apply to all governing apparatus wherein the

load is sustained by the centrifugal force of the balls or weights of said governing device, or the equivalents of said balls or weights.

What I claim as new is—

5 1. In the governing apparatus of a steam-engine, the combination, substantially as shown, of the following elements: a centrifugal governing device mounted upon the main shaft and having its frame firmly attached
10 thereto, a drive-wheel mounted loosely upon said shaft and connected therewith so as to receive its motion therefrom by being flexibly connected with said governor-frame, and finally
15 a valve-moving eccentric mounted to move upon said shaft and geared to be so moved both by the flexible movement of said drive-wheel and the centrifugal movement of said governing device.

20 2. In the governing apparatus of a steam-engine, the combination, substantially as described, of the following elements: a centrifugal governing device connected with or receiving its motion from the main shaft of the engine and geared to operate upon the steam-
25 supply valve, and a drive-wheel or driving-shaft which is connected to the main shaft or receives its motion therefrom by being connected with said centrifugal governing device, whereby the resistance of the load acts against
30 or opposes the centrifugal force of the said centrifugal governing device, for the purposes mentioned.

3. In the governing apparatus of a steam-engine, the combination, substantially as shown,
35 of the following elements: a centrifugal governing device mounted upon the main shaft and operating concentrically therewith, and a drive-wheel mounted to move concentrically with said main shaft and connected therewith
40 so as to receive its motion therefrom by being

connected with the centrifugally-moving parts of said governing device in a manner substantially as shown, whereby the resistance of the load opposes the centrifugal movements of the balls of the said governing device, for the 45 purposes named.

4. The combination, substantially as shown, in the governing apparatus of a steam-engine, of the following elements upon the main shaft
50 of said engine: a frame or cross-head, B, keyed upon said shaft, a disk, D, having an eccentric, D', mounted loosely on said shaft, centrifugal balls F F, connected by their arms
55 F' F' to said disk, a drive-wheel, C, mounted loosely on said shaft, and finally the bars f f F² F² F⁴ F⁴, levers F³ F³, and the springs S S, arranged in connection with said cross-head, disk, and drive-wheel, substantially as and for the purposes mentioned.

5. In a steam-engine-governing device, the 60 combination, with a frame fixed upon the main shaft, of the disk D, with eccentric D', centrifugal balls F, connected by arms to said disk, and adapted, substantially as shown, to move said disk upon the shaft, a yoke, D³,
65 upon said eccentric D', an eccentric, E, having an elongated shaft-opening and connected to said yoke D³, substantially as shown, a pendant, E³, for suspending said eccentric E from the frame, and, finally, springs S S for oppos-
70 ing the centrifugal movement of the said balls F F, all substantially as and for the purposes mentioned.

In testimony that I claim the foregoing I have hereunto set my hand this 21st day of April, 75 1882.

FRANK H. BALL.

Witnesses:

JNO. K. HALLOCK,
W. R. EDELEN.