3 Sheets—Sheet 1.

A. CUNNINGHAM.

AUTOMATIC EXPANSION GEARING FOR STEAM-ENGINES.

No. 195,804. Patented Oct. 2, 1877

Fig. 1.

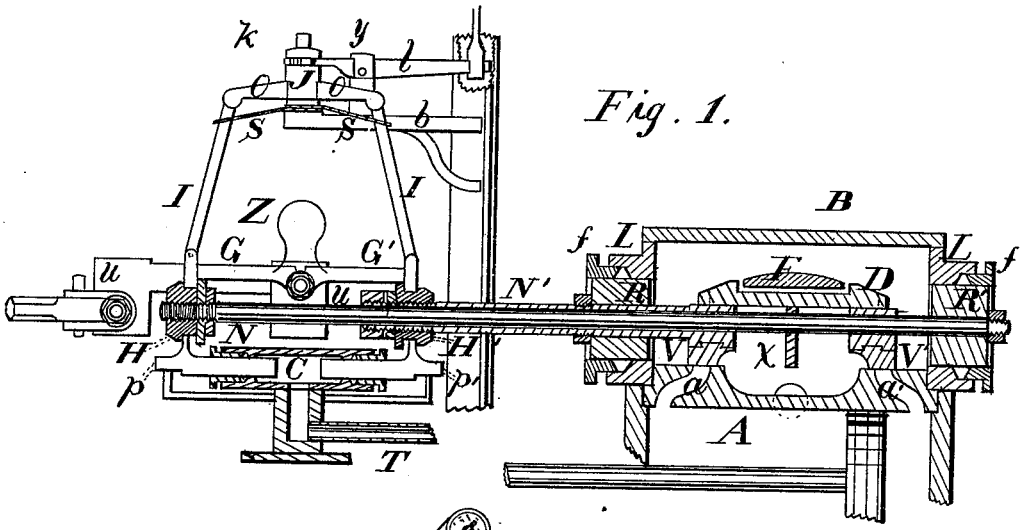


Fig. 2.

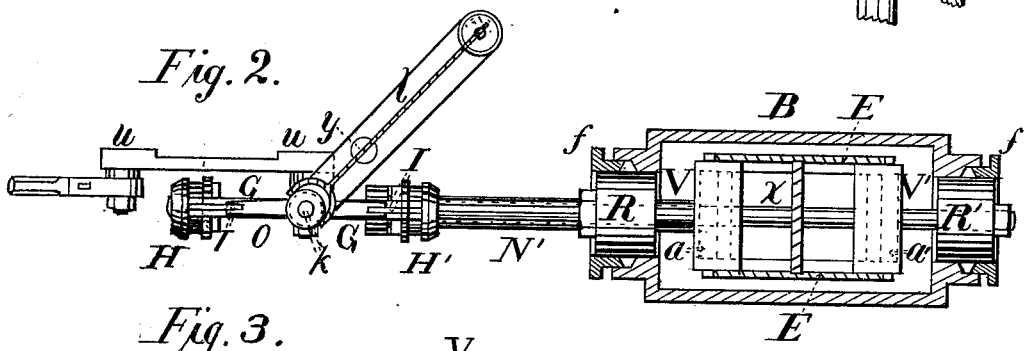


Fig. 3.

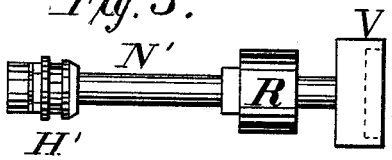
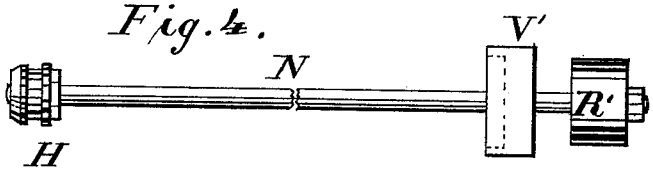


Fig. 4.



Witnesses;
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J. T. Goodfellow.

Inventor:
Andrew Cunningham.

3 Sheets—Sheet 2.

A. CUNNINGHAM.

AUTOMATIC EXPANSION GEARING FOR STEAM-ENGINES.

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Fig. 5.

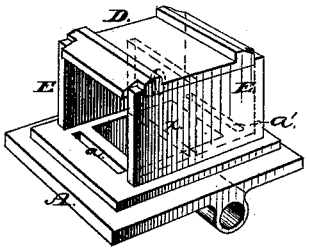


Fig. 6.

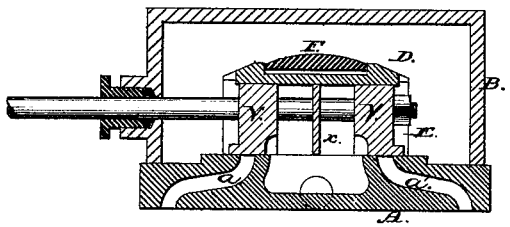
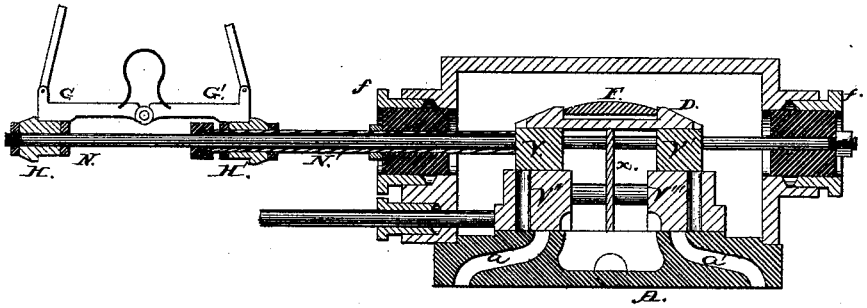


Fig. 7.



Attest:

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Inventor:

Andrew Cunningham,

3 Sheets—Sheet 3.

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AUTOMATIC EXPANSION GEARING FOR STEAM-ENGINES.

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Fig. 8.

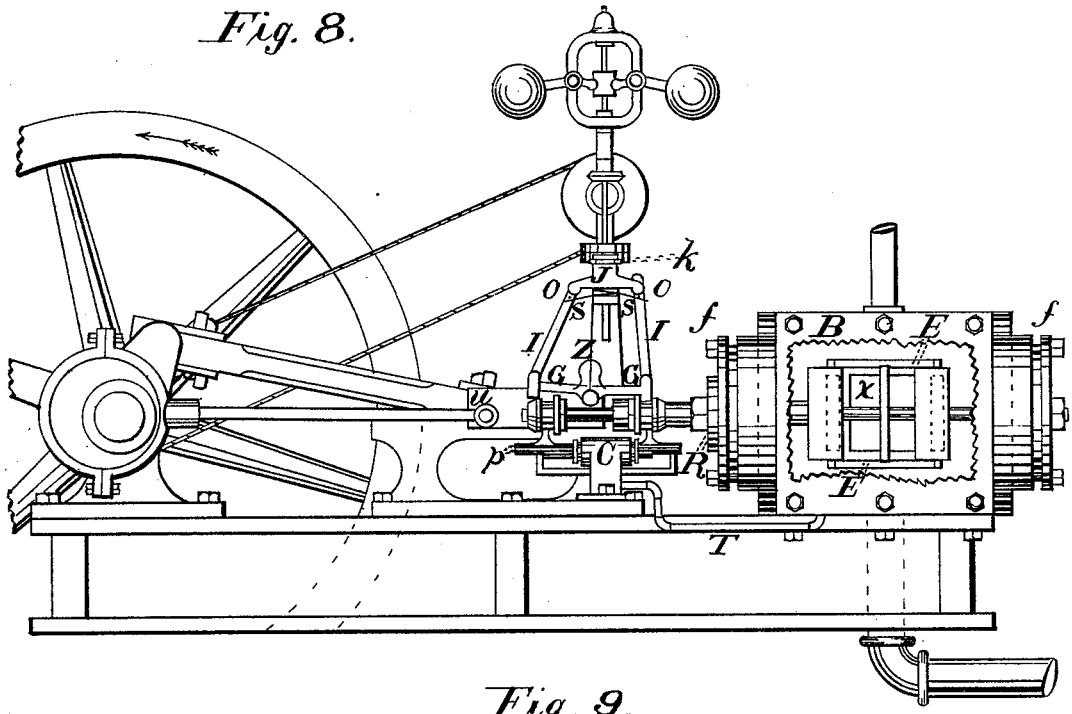
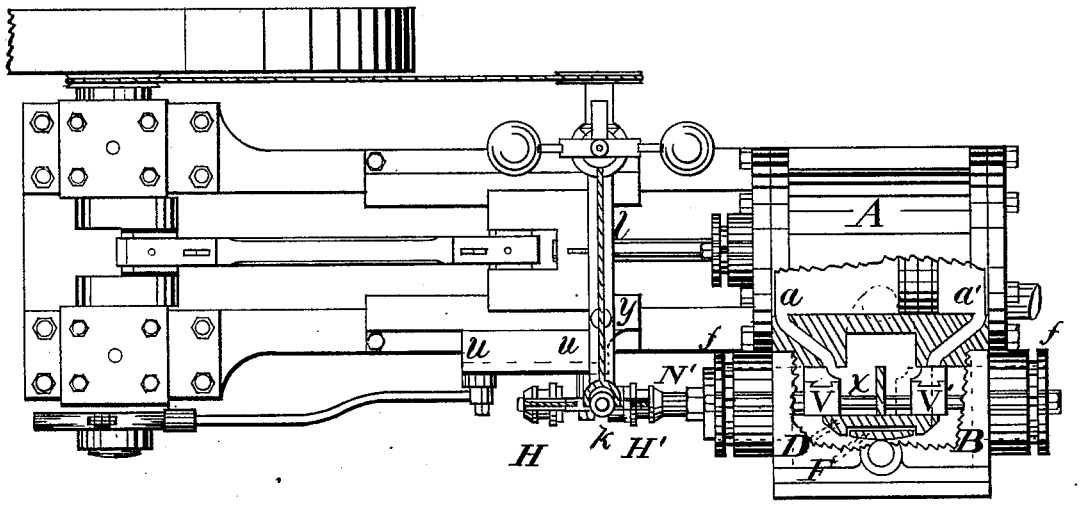


Fig. 9.



Witnesses;
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J. T. Goodfellow.

Inventor:
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UNITED STATES PATENT OFFICE.

ANDREW CUNNINGHAM, OF TROY, NEW YORK.

IMPROVEMENT IN AUTOMATIC EXPANSION-GEARING FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **195,804**, dated October 2, 1877; application filed February 2, 1877.

To all whom it may concern:

Be it known that I, ANDREW CUNNINGHAM, of the city of Troy, Rensselaer county, New York, have invented an Improved Automatic Expansion-Gearing for Steam-Engines, of which the following is a specification:

The general object of my improved automatic expansion-gear attachment to the governor and engine is to regulate the supply of steam to the cylinder proportionately to the demand for power or resistance to be overcome.

The invention will be first described, and then pointed out in the claims.

In the accompanying drawings, Figure 1 is an elevation, designed particularly to show the connection and arrangement of my automatic cut-off attachment or gearing in a sectional view. Fig. 2 is a plan of the same, showing more clearly the arrangement of the valve-rods and their connections. Fig. 3 is a plan of the tubular rod N′, having piston-head R and valve V and nut H′ in proper position. Fig. 4 is a plan of the solid rod N, with parts corresponding to those shown in Fig. 3. Fig. 5 is a detached view of the valve-chamber, showing the respective parts of the same, excepting the bridge-piece F, (seen in Fig. 1,) said chamber being constructed and arranged to co-operate with the movements of the valves and rod-connections seen in Fig. 2. Fig. 6 shows the valve-chamber when used with a single valve-rod moved by the eccentric. Fig. 7 shows my valve-chamber when used in connection with a single valve-rod moved by the eccentric, and another set of valve-rods moved by my tripping attachment. Fig. 8 is a general view of my expansion-gearing in its arrangement with a steam-engine. Fig. 9 is a plan of the same.

As will be seen by reference to the drawings, in the operation of my automatic expansion-gearing, the valve-chamber, Fig. 5, is an essential element in diminishing the friction of the valves, and in preventing the waste of steam, and in promoting economy of power, and the same is constructed and arranged substantially as follows:

I cast or mount the bridge-piece F, projecting forward in the steam-chest, as seen in Fig. 1, and use the same as a brace or support for the valve-chamber, to be adjusted underneath it. This valve-chamber is located within the steam-chest, adjoining the cylinder, and over the space included between the steam-ports *a a′*, and is placed in location substantially as follows: The grooved nuts on the ends of the valve-rods being removed, and the half D-valves adjusted on the rods in position as shown, the solid rod N is thrust through the opening of the partition-plate *x*, which is placed equidistant from the steam-ports, and the valve-rods are placed in position as seen in Fig. 1. I then adjust the side pieces E, the cover D under the support or bridge F, the side pieces and top of this chamber or valve-passage being adjusted in slots and held by suitable spring attachments, when the valve-chamber presents the appearance as seen in detached view, Fig. 5, and in position seen in Fig. 1 is ready to co-operate with the expansion-gearing, of which it forms a part. I now adjust the grooved nuts H H′ at or near the ends of the rods to act in concert with my tripping attachment, as seen in Figs. 1 and 8.

The arrangement of the tripping attachment with the governor-stem is substantially as follows: The lever *l*, resting on the fulcrum *y* at one end, connects with the stem of the governor. The other end, by its prongs, fits in the grooves of the shoulder of the arms O J O, which slides up and down on the guide K, supported by the bracket *b*.

The reversing-stops S, resting around the socket shown, engage by their pronged ends with cross-pins *i* in the suspension-arms I, which are jointed with the rocking pawls or dogs G, keyed to the eccentric-slide *u*, which, by means of the eccentric-rod, gives positive motions to the valve-rods.

The valves work steam-tight in the valve-chamber, and open and close the steam-ports alternately in periods measured by the movements of the rods working one within another in the same plane, which movements, under the positive action of the eccentric, are made by the dogs G engaging with and disengaging from the grooved nuts H H′; and the valve-rods, in their motion, are further regulated by the steam-cushioned chamber C, operated by the nib projections on the cushioned pistons *p p′*, working from underneath in the grooved nuts of the valve-rods. Steam enters by the

tube T from the boiler or steam-chest to this chamber; or, without change of principle, wire coils may be substituted for the cushioned piston-rods.

Having given a particular description of my improved automatic expansion-gear attachment and valve-chamber combined and co-operating therewith, I now proceed to a more comprehensive statement of the principle, scope, and operation of my improvements, and especially as to the effective arrangement of my valve-chamber, located within the steam-chest, and acting in combination with the valves and rod-connections, substantially as described, by which means pressure exists on the valves only on the admission side of the valve, and the valves are relieved from friction caused by steam-pressure on their other sides, and they operate speedily and effectually in the admission, cut-off, and exhaust of steam, which triple effect is accomplished alternately by each movement of the valves operated by the eccentric-rod connections and tripping attachment, all co-operating for that purpose.

I have found from experience that, in doing good, effective work with the least loss of power or waste of steam, my expansion-gear and connections, as herein set forth, give the initial pressure of steam—that is, the pressure from the point of admission to the point of cut-off—nearly equal to the pressure in the boiler; and inasmuch as, by the geared connections set forth, actuated by the governor, the port-passages are rapidly opened and closed, there is a minimum of wire-drawing and a maximum of effective work by the expansive power of steam after cut-off, and, as a resultant of the automatic admission and exhaust of steam, the pressure at the end of the stroke is nearly equal to the atmosphere; and in operation, by means of my improvements, the opening and closing of ports, when the resistance to be overcome is steady, follow regularly and uniformly; but when the resistance to be overcome is accelerating or decreasing in ratio, the point of cut-off is proportionately regulated automatically by the means above set forth.

I claim—

1. In a steam-engine having suspended arm-linked connections operated by the governor, the combination therewith of the eccentric-slide *u*, tripping-dogs G, valve-rods N N′, substantially as described, and for the purpose set forth.

2. The pistons R R′, valve-rods, and grooved attachments H H′, in combination with the steam-cushioned rods *p p′* and chamber C, substantially as described.

3. In a steam-engine having the valve-chamber arranged within the steam-chest, substantially as described, the combination therewith of the valves and valve-rods, slide *u*, tripping-dogs G, and valve-rods N N′, operated by the eccentric, all arranged substantially as set forth, in performing the triple effect of admission, cut-off, and exhaust of steam, as described.

4. The reversing-stops S, suspension-arms I, cross-pieces O J O, in combination with the governor, substantially as described, for the purpose of stopping the engine in case of accident.

ANDREW CUNNINGHAM.

Witnesses:
COLE H. DENIO,
J. T. GOODFELLOW.