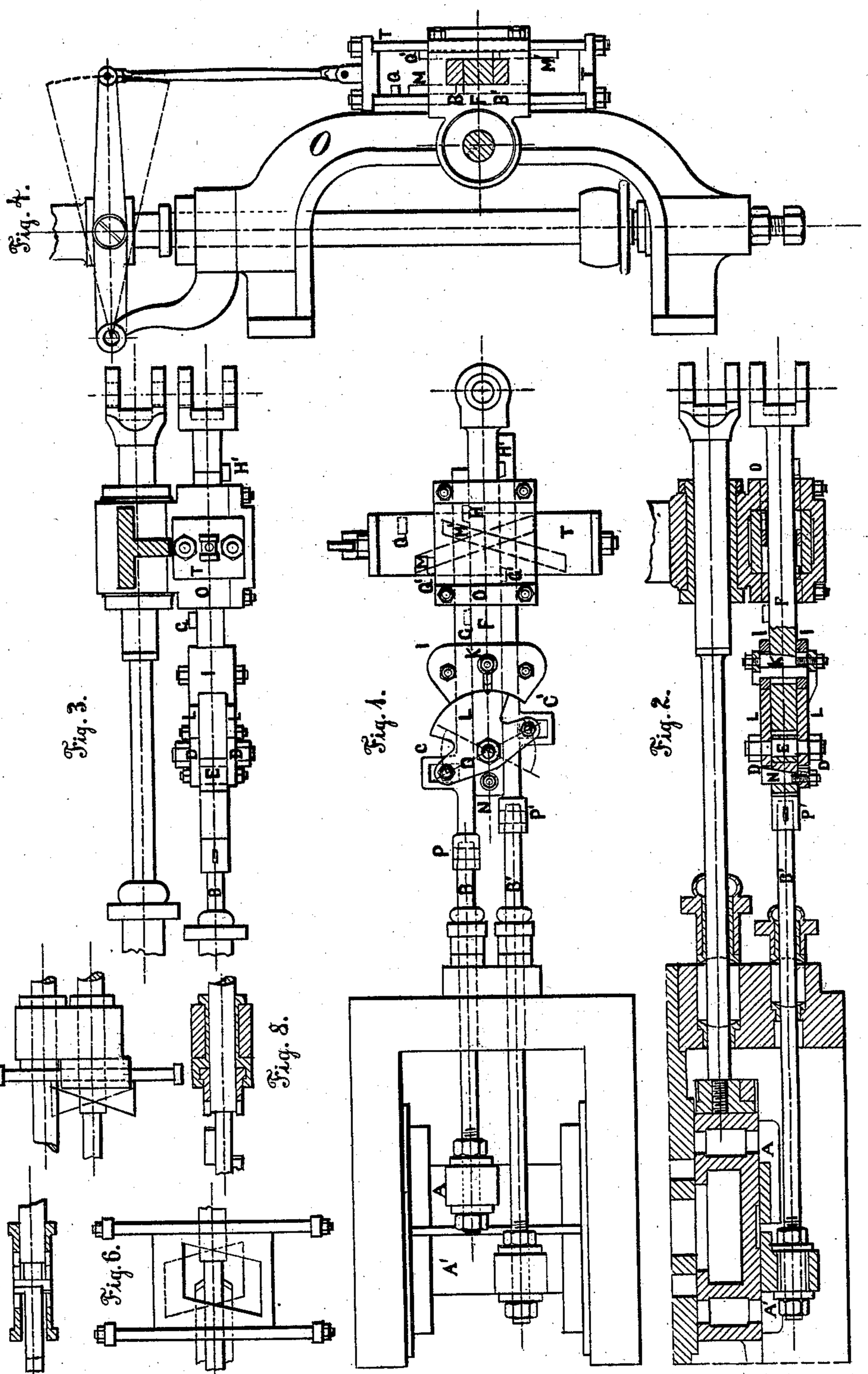
C. J. CARIO.

EXPANSION GEAR FOR STEAM ENGINE.

No. 176,832. Patented May 2, 1876.



Witnesses
Harry Howson Jr
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UNITED STATES PATENT OFFICE.

CARL JOSEPH CARIO, OF NIENBURG-ON-THE-SAALE, PRUSSIA.

IMPROVEMENT IN EXPANSION-GEAR FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **176,832**, dated May 2, 1876; application filed March 20, 1876.

To all whom it may concern:

Be it known that I, CARL JOSEPH CARIO, of Nienburg-on-the-Saale, Prussia, have invented an Improved Expansion-Gear for Steam-Engines, of which the following is a specification:

The object of my invention is to cause an automatic adjustment of expansion-valves in steam-engines by means of the governor, and especially of those expansion-valves which consist of two parts sliding on the back of the distributing-valve, and which cut the steam off at an earlier or later period of the stroke, according as the distance between the two parts is increased or decreased. The adjustment of the expansion-valve may be effected by some kind of hand-gear, or it may be caused automatically by the governor of the engine. All the arrangements, however, hitherto designed for the latter purpose either do not fulfill their object at all, or they require so much power from the governor that the same not only becomes very insensitive, but also quite uncertain in its action as soon as it may have to overcome any accidental increase of resistance, the consequence being that the adjustment of the expansion-valve is incomplete and defective. I attach to each expansion-valve part a separate rod, passing through a stuffing-box of the valve-chest. Outside of the latter these rods are, by preference, made rectangular. Between them lies a third rectangular rod, jointed to and forming part of the rod of the expansion-eccentric. On a bolt passing through this center rod a lever turns, the pins at either end of which project into vertical slots of the two horizontal valve-rods, so that the center rod, being kept stationary, and the lever being turned, the two expansion-valve parts will be equally moved in opposite directions, thereby altering their distance from each other without affecting the distance between the center of the entire valve and the eccentric. To the lever a sector of a circle is attached, on which an adjustable break acts, for causing sufficient friction, so as to prevent any undesired alteration of the relative position of the valve-rods. Each of these (the one on the right, the other on the left-hand side) bears two tappets, which strike against two vertically-movable inclined bars or ledges, the distance between the tappets on either rod being such that they just touch the corresponding ledges at the end of the stroke. The said ledges are suitably attached to the governor, and moved vertically up or down by the same in proper guides. As soon as the position of the inclined ledges is altered, one of the tappets will strike on one of the same sooner than before, but the eccentric continuing on its course, will either draw or push the center bar onward; the lever consequently turning on that one of its pins as a fulcrum which is in relation to the rod arrested by its tappet, the pin at the other end will shift the corresponding rod in the direction in which the center rod works, but it will shift it double the amount of its own motion from the moment the tappet struck the inclined ledge. The two valve parts will therefore be shifted farther apart or closer together, as the case may be, and the point of cut-off will be altered accordingly. The said inclined ledges are at liberty to move up and down by the action of the governor, and have not themselves to operate the shifting of the slides; they only give the measure for the shifting, which is then carried out by the full power transmitted through the eccentric.

This arrangement is represented on the annexed sheet of drawings in Figures 1 to 4.

A and A′ are the two parts of the expansion-valve, to which are attached the rods B and B′. Outside of the valve-chest these are provided with the slotted lugs C and C′, through which pass the pins at the ends of the double lever D, the arms of the latter being equal. This lever turns by a bolt, E, in a bearing at the end of the rod F, which is jointed to the eccentric-rod, or which forms part of the same.

As long as the lever D is retained in its relative position to the rod F, the valve-rods B and B′ have to partake of the motion of the eccentric-rod; but if one of the valve-rods strikes with one of the lateral tappets G G′ or H H′ on any fixed point before having finished its course, the lever D will turn, and the rods B and B′ will be shifted with respect to each other, so as either to increase or to decrease the distance between the valve parts.

The piece T embraces the three rods B, B′, and F, and an adjustable wedge, K, serves to

press the same against the sectors L, attached to the double lever D, so as to cause friction between the two. This piece T consequently acts as a brake to prevent the lever and the valve-rods from altering their relative position by any accidental cause, and the wedge K has to be so adjusted that the friction between the brake-block T and the sectors L is just sufficient for the stated purpose without causing an undue resistance against the desired shifting of the valve parts. This friction, however, need but slightly to exceed the greatest possible difference between the frictional resistance of the one valve part with its rod and that of the other.

The fixed points alluded to above, against which the tappets of the valve-rods strike, are given by the two inclined bars or ledges M and M′. These are attached to the inside of a suitable sliding frame, T, moved vertically up and down by the sliding collar of the governor, as shown by Fig. 4. In Fig. 1 these inclined ledges are nearly in their lowest position, so that the valve parts are close together. Supposing now the governor to rise by an increase of speed, the ledge M will be raised, and the rod F moving to the left, tappet H meets the ledge sooner than before, consequently the rod B is arrested; but rod-eccentric F, moving onward, overcomes the friction between L and T, and shifts the rod B′ and valve part A′ in the same direction forward for double the amount of that part of its own course traveled through from the moment in which tappet H met the ledge M to the end of the stroke. The consequence is that the valve part A′ will close the left-hand steam part of the distributing-valve sooner than before. The effect of the rising of the governor is consequently such as to cause an earlier cut-off of the steam for the same stroke of the engine, and, as will be perceived from the whole design, the alteration in the relative position of the valve parts is carried out quickly.

If the eccentric-rod, with the rod F, moves in the direction opposite to that supposed before, the tappet G′ will now meet the inclined ledge M′ sooner than before, so as thereby to be arrested, the effect on the valve being different only in so far that the slide part A is now advanced to the right, so as to cause the earlier cut-off by this port, through which the steam is entering at the moment. The governor descending, either one of the tappets G or H′ comes into action, so as to shift the valve parts closer together. The amount of inclination of the ledges M and M′ is to be equal to the greatest difference in the distance of each valve part from the center line of the entire valve. In case a great nicety and correctness of regulation is desired, these ledges should have a curved shape, as the relation between the variations in the lift of the governor and the variations of the engine-power from an alteration in the expansion are not to be expressed by a simple mathematical proportion; but, in general, it will be preferred to make the ledges straight.

As has been stated, the tappet should just touch the corresponding inclined ledges at the ends of the stroke. To adjust them properly, so as to fulfill this condition, a wedge, N, has been arranged acting on the bearing of the bolt E. By this wedge, and another one, K, the relative position of the rod F to the rods B and B′ may be slightly altered, so as to make up for any minor inaccuracy of workmanship.

The ledges M and M′ being inclined, the tappets will cause a certain angular pressure on the same, which will even affect the governor in case the angle of inclination is smaller than the angle of friction between tappets and ledges. In general, this angle should be larger, but in case it is desired to give a short lift to the governor, the ledges may be made rough, or they may be provided with horizontal furrows, the tappets being fitted with a sharp edge corresponding to the furrows. These sharp edges may be made in separate pieces, out of steel, which are then to be hardened and fastened to the tappets.

For sake of facility in the manufacture, I prefer to make the valve-rods out of two parts, and to join them together by a cotter, P. The part passing through the stuffing-box is, of course, to be round, while the other part should be of rectangular section, as also the rod F, this shape allowing the rods to be placed close together, and to let them work in one guide. The part O, designed for this purpose, is conveniently cast together with the standard of the governor, and is shown in the drawing, Figs. 2, 3, and 4. It may, at the same time, serve for guiding the rod of the main steam-valve, and also the frame T.

If the governor is driven by a strap, as supposed in the drawing, the engine is in danger of assuming an exceedingly high velocity in case the strap breaks, or if it falls off from the pulleys, as the governor stopping in consequence, would allow the ledges M and M′ to assume their lowest position, and to adjust the expansion-valve to the greatest possible admission of steam. To prevent the danger which might arise from such an occurrence, the two projections Q and Q′ have been fixed inside of the frame T. These correspond to the lower ends of the ledges M and M′, and act in the same manner as these, so that the frame T dropping down altogether, the valve will be adjusted to the shortest admission of steam. If the governor is driven by tooth-wheels, this arrangement may be dispensed with. On the sector L of the brake a scale may be engraved, on which a fixed pointer (shown in the drawing as a projection on the washer of the wedge K) shows at every moment the amount of steam admitted. In the engine fitted with the gear of the drawing, this admission varies from 0.052 to 0.949 of the stroke. The shape and arrangement of the inclines M and M′ may be modified in

various ways. Each of the valve-rods, for instance, may have but one tappet, which moves between the inclined edges of two wedge-shaped plates united at the ends, so as to form a hollow parallelogram, as shown by Figs. 5 and 6. Of those wedge-pieces, the one may be left away, so that the adjustment of the valves is effected but once at every revolution, and this arrangement (shown by Figs. 7 and 8) may be considered preferable for engines running at a high speed.

The adjustment of the valve parts according to the position of the governor at the time being is not carried out gradually, but, on the contrary, suddenly and before the closing of the steam-port. Consequently the smallest as well as the greatest deviation from the mean speed is immediately counteracted in a corresponding degree, so that an increase of such deviation (as may easily arise from an incomplete or a retarded correction) can never take place, the number of revolutions which the engine makes remaining almost exactly the same.

The entire expansion-gear being placed outside of the valve-box, it is easy of access, and no parts are exposed to set fast from heat.

The construction is simple, it does not contain any parts uncertain in their action, and it is not liable to any material wear.

I claim as my invention—

1. The combination of the sliding frame T, controlled by the governor, and having inclined projections or slots M, with the expansion or cut-off valve rods B B′, each having a tappet or tappets G H′, as and for the purpose set forth.

2. The combination of the sliding frame T, having inclined projections or slots M, and the expansion-valve rods B B′, and rod F, with friction mechanism, substantially as described, whereby the relative positions of the rods are maintained, as set forth.

3. The combination of the rod F, carrying the friction-block I, with the lever D and sector L, and the valve-rods B B′.

4. The combination of the sliding frame T, having inclined projections M and projections Q Q′, with the valve-rods B B′, having tappets G H′, as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CARL JOSEPH CARIO.

Witnesses:
CARL ROSHE,
E. W. FRIZSCH.