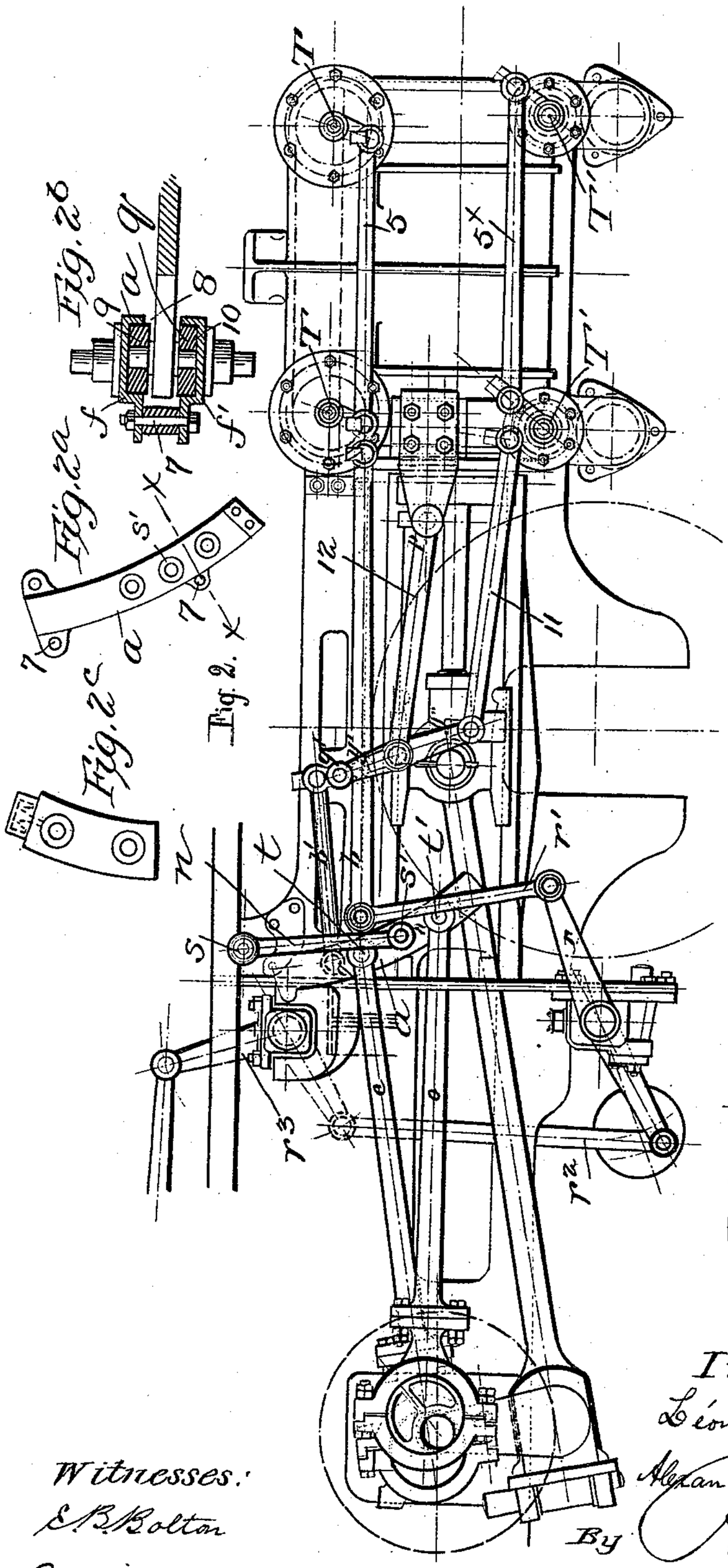
(No Model.)

2 Sheets—Sheet 1.

L. DURANT & A. LENCAUCHEZ.

STEAM ENGINE.

No. 485,614. Patented Nov. 8, 1892.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

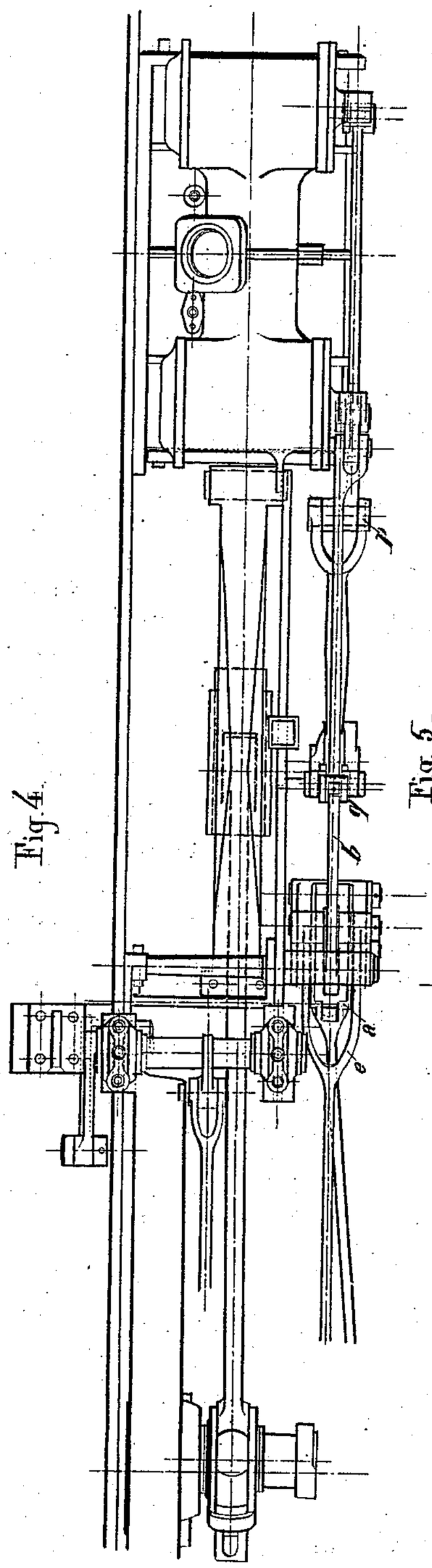
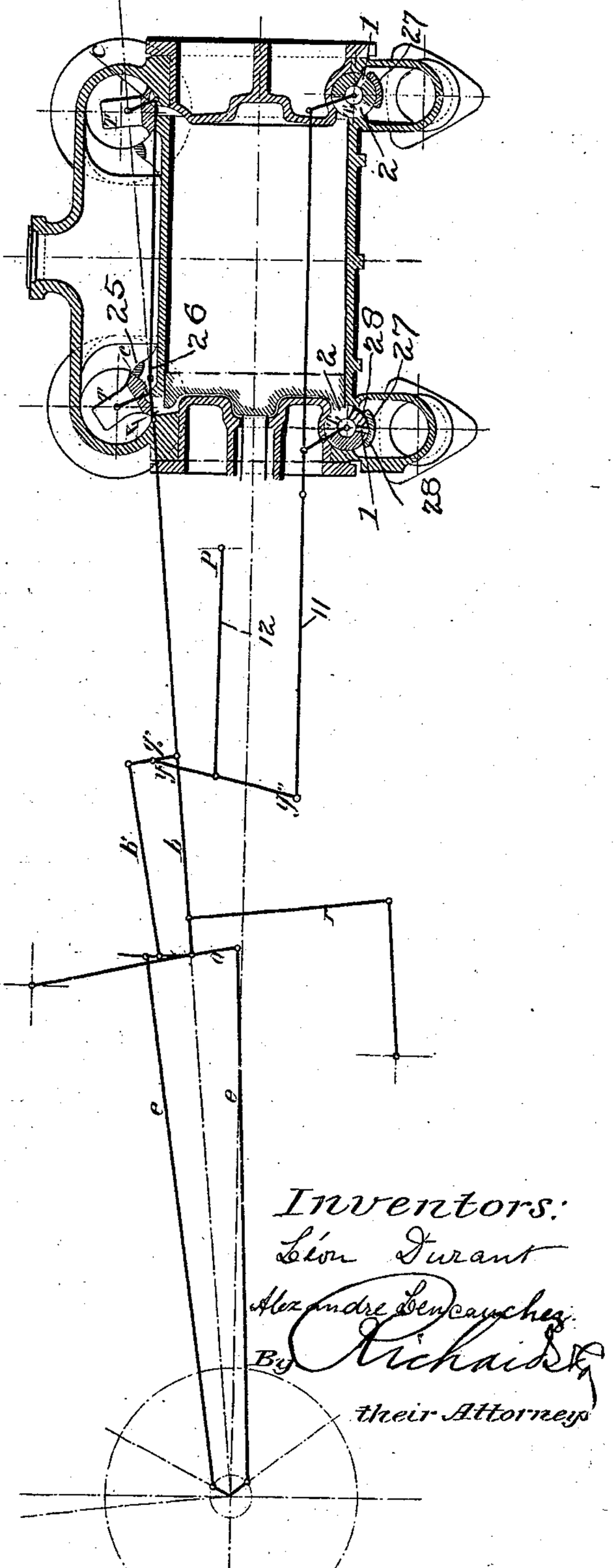


Fig. 5.



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UNITED STATES PATENT OFFICE.

LÉON DURANT AND ALEXANDRE LENCAUCHEZ, OF PARIS, FRANCE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 485,614, dated November 8, 1892.

Application filed January 9, 1891. Serial No. 377,292. (No model.) Patented in France March 4, 1887, No. 181,973.

To all whom it may concern:

Be it known that we, LÉON DURANT and ALEXANDRE LENCAUCHEZ, citizens of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in Steam-Engines, (for which we have obtained Letters Patent in France, No. 181,973, dated March 4, 1887;) and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

The invention which forms the subject of this application for Letters Patent is intended to better the actual conditions of the operation of steam in the cylinders of steam-engines in general, and especially in locomotive and marine engines reversing by slides.

The objects attained by our invention are to diminish the amount of combustion to the horse-power, both by the better utilization of the steam in the cylinders and the lessening of the friction of the parts.

In the accompanying drawings, forming a part of this specification, Figure 1 is a vertical section through the steam-chest, showing the arrangement of the induction-ports and their valves. Fig. 2 is a side elevation of the valve-gear of a steam-engine embodying our improvements. Fig. 2^a is a detail view of the link. Fig. 2^b is a cross-section enlarged on line $x\,x$ of Fig. 2^a. Fig. 2^c is a separate view of the sliding block. Fig. 3 is a section through the exhaust-ports and their valves. Fig. 4 is a plan view of the mechanism shown in Fig. 2. Fig. 5 shows, in section, a cylinder with its steam chest, ports, and valves, and by diagram our arrangement of mechanism for operating the valves for reversing and cutting off.

The valves for the admission and escape of steam or vapor are separated or placed at the extremities of the cylinders, with the object of reducing the dead-space therein. The working-farce of each induction-valve T is provided with an arched recess, as C, and, owing to the relative arrangement of the steam-chest and these valves, steam is admitted directly from the steam-chest to the cylinder at its extreme ends through the respective valves. Each exhaust or escape valve T is provided with at least two channels 1 2, Figs. 3 and 5, to facilitate the escape of steam, as will appear hereinafter. The induction valve and ports may also be provided with the double feature of construction to facilitate the admission of the steam. The drawings represent, Figs. 2 and 4, one form of mechanism designed to secure the operation of the induction and exhaust valves. This arrangement allows of the obtaining very simply and at will the variation of stroke or cut-off. The arrangement includes a channeled link a, made up of cheeks $f\,f'$, held together on their rear edges by the bolts 7, and arranged to leave a slot 8 at the front edge, Fig. 2^b. This link is pivoted at s' to an arm n, which in turn is suspended from the frame at s. The link is operated from the crank-shaft through eccentrics thereon and the rods $e\,e$, connected above and below the pivot s' of the link to give the same an oscillating movement. This is communicated to the inlet and exhaust valves T T', respectively, by the rods $b\,b'$, the ends of which extend through the slot 8 of the link and are pivotally connected to the sliding block q, formed of the two sides 9 10, arranged to slide in the channel of the cheeks $f\,f'$. The position of the slide within the channel-bar controls both the admission and exhaust of the steam to and from the cylinder or the reversing action, and this position is regulated, as desired, through the lever r, the link r', and the connections r^2 and r^3, extending from the lever r. The link r' connects with the rod b, and through this connection the whole adjustment is effected. The rod b connects directly with the nearest inlet-valve, the other being operated simultaneously by the interposed link 5. The rod b' is connected with the lever q', pivoted to the rod b, from which lever a second lever $y\,y'$ extends, its lower end being pivoted to the connection 11 to the nearest exhaust-valve, while its intermediate fulcrum-point is carried by the oscillating arm 12, pivoted at P. A link connection $5^\times$ extends between the exhaust-valves. By adjusting the two rods $b\,b'$ relatively to each other the relative condition of admission, escape, and compression can be varied, so as to produce, according to the circumstances or requirements, the greatest possible economy in the use of the steam.

We do not wish to limit ourselves strictly

to the precise connections intermediate of the valves and the rods *b b'*, as above described, although we consider the connections shown simple and effective for the purpose. This combination allows, in fact, to realize in improving them all the phases in the (actual) distributions by lengthening the expansion and by reducing the compression to the limits which suit practice. The dead-spaces also are notably lessened; and, more, under these conditions, the linear lead at the introduction, which is ordinarily from five to six millimeters could be reduced to three to four millimeters, and it would then be possible to allow the dead-point five to six per cent. so that, the noxious-space being four per cent., the real admission would be ten per cent., and the expansion being prolonged to eighty per cent., the steam would expand with a volume of eighty plus ten, equal ninety. The expansion could then be ninety-tenths or nine volumes. Steam being admitted at ten kilograms would escape at one kilogram instead of three kilograms, two, as indicated above. The theoretic advantage is then incontestable and very noteworthy. In consequence of condensations, which would result from cooling off and decrease of pressure, practical results are not in conformity with theoretic calculations; but it is none the less evident that with all things equal there must be a noteworthy economy, first, by prolonging the expansion for thirty per cent. more; second, by diminishing the compression; third, by facilitating the introduction and escape of steam by means of steam-ports of a large section; fourth, by avoiding contact, as in machines of one slide-valve, of the exhaust-steam with the walls of the passage through which live-steam is admitted. All these conditions aid in obtaining a better utilization of steam.

Independent of the advantages which can be called "thermiques," which, as well as those resulting from mechanical combinations, tend to render the steam adiabatic, this disposition possesses other advantages from different points of view. It facilitates the reversing of the machine, for the sliding valves are in great part equally balanced. While working with counter-steam the resisting strain is augmented principally by the diminution of the dead-space. The disposal of the sliding valve to the lower part of cylinder allows a natural cleaning by the escaping steam. The inlet-valves work against supplemental bearings 25, between which and the cylinder-shell are the passages 26, and the outlet-passages are provided with similar bearings 27, Fig. 5, against which the outlet-valves bear and on each side of which are the double outlets 28.

We claim—

1. In combination, the inlet and exhaust valves and the valve-gear therefor, consisting of the pivoted link, the crank-shaft with connections to the link, the sliding block movably carried by the link, the rods *b b'*, both connected thereto, and means for adjusting the block on the link and the rods simultaneously, and the connections from the rods *b b'* to the inlet and outlet valves, respectively, substantially as described.

2. In combination, the cylinder, the inlet and exhaust valves, the eccentric on the crank-shaft, the link *a*, the pivoted support for the link *a*, consisting of the depending pivoted arm *n*, the block sliding in the link, the rods *b b'*, with connections to the valves, both of said rods being connected to the block, and the means for adjusting the block, consisting of the rod *r'*, connected to the rod *b*, substantially as described.

In testimony whereof we have signed this specification in the presence of two subscribing witnesses.

LÉON DURANT.
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Witnesses:
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