(Model.)

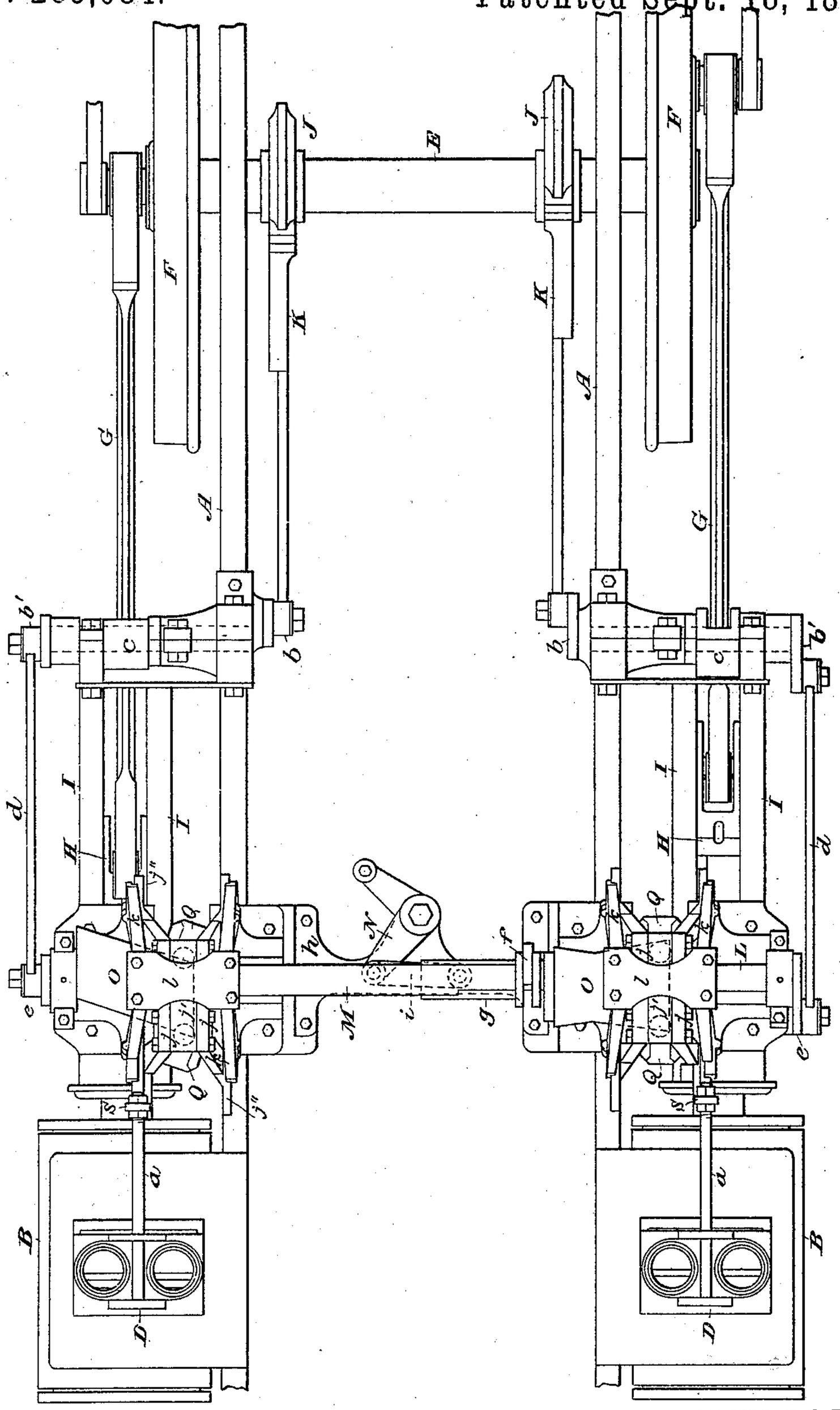
3 Sheets—Sheet 1.

F. M. STEVENS.

VALVE GEAR FOR STEAM ENGINES.

No. 285,084. Patented Sept. 18, 1883.

Fig. 1.



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INVENTOR:

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(Model.) 3 Sheets—Sheet 2.

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Fig. 2.

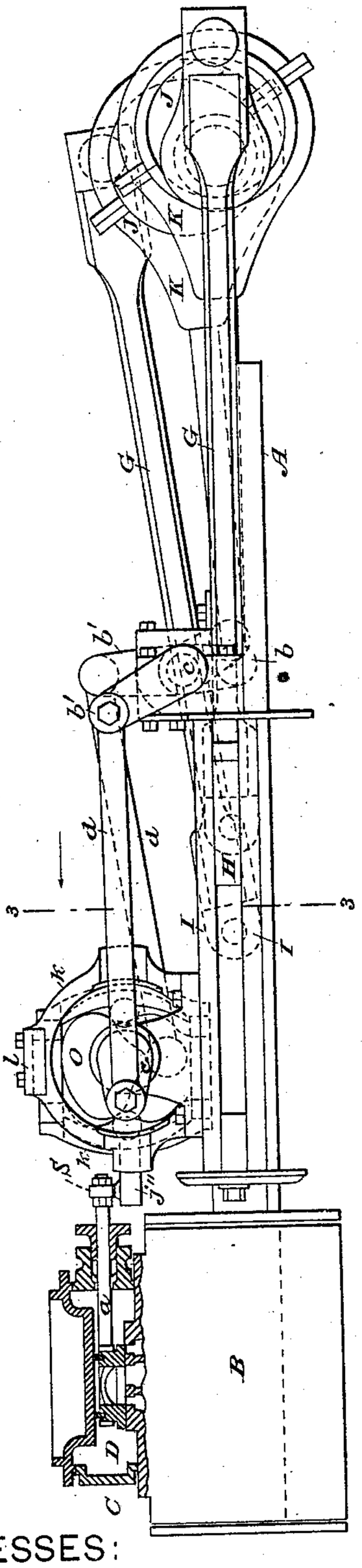
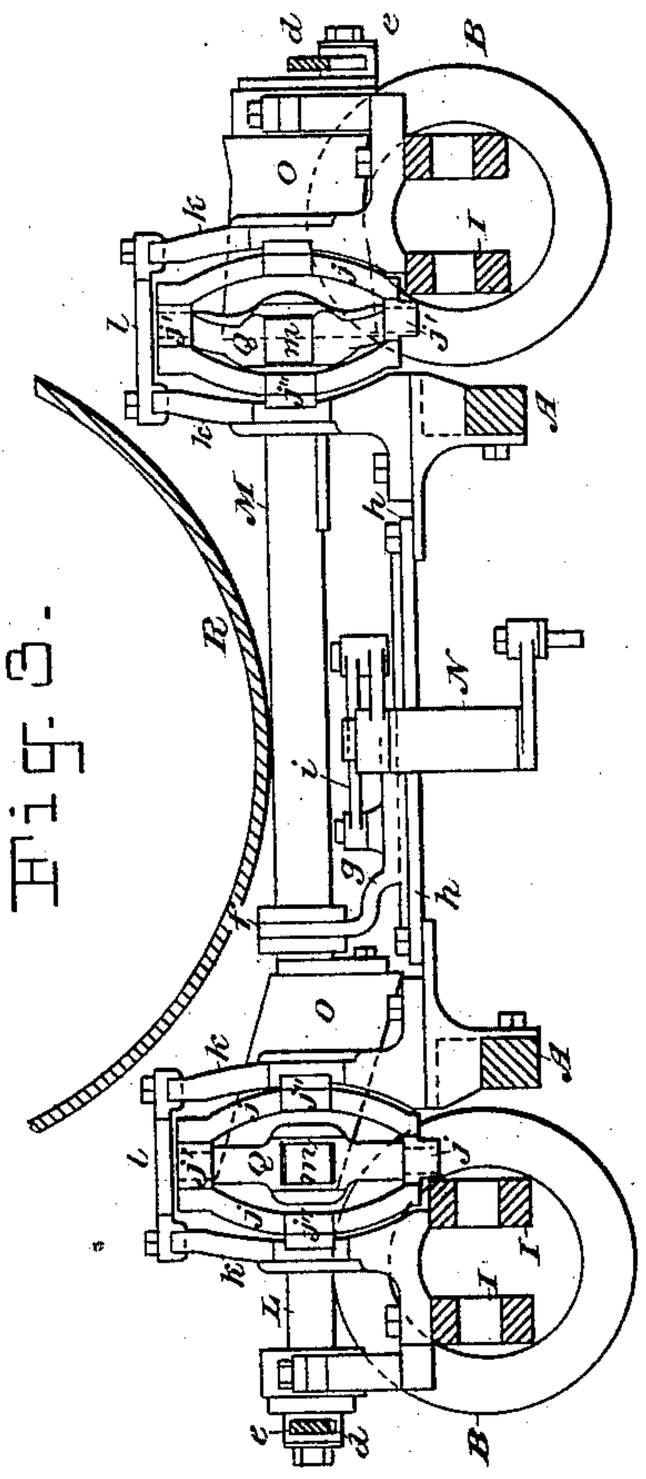


Fig. 3.



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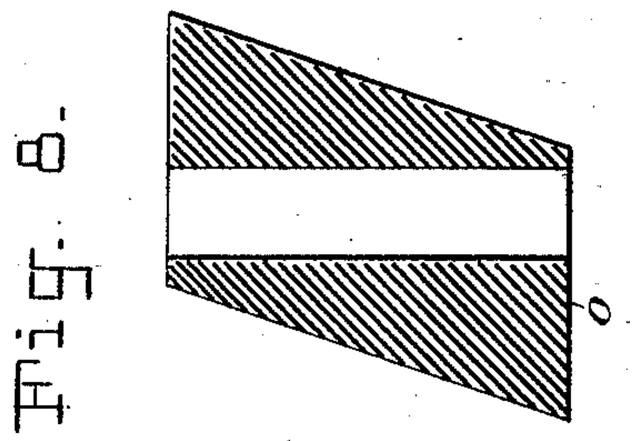

Fig. 3.

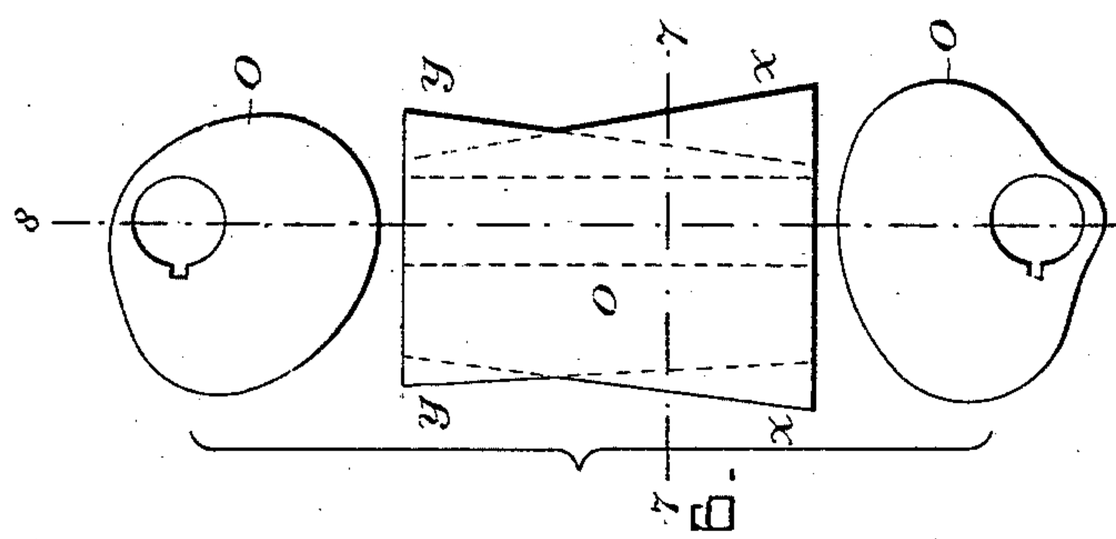

Fig. 6.

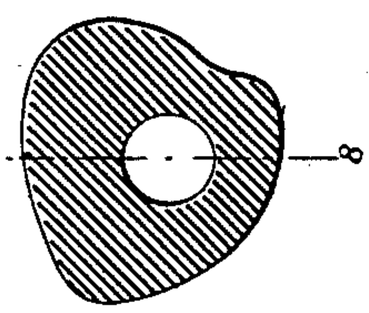

Fig. 7.

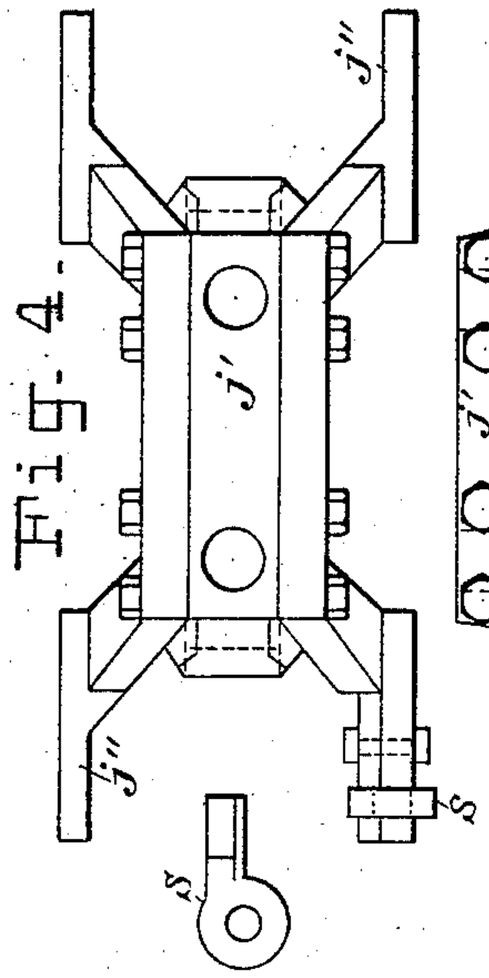

Fig. 4.

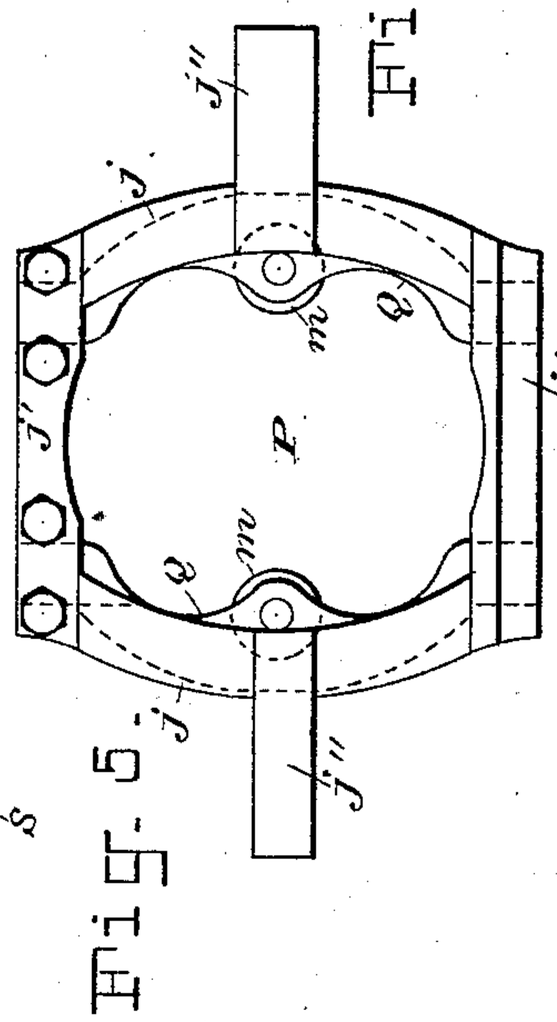

Fig. 5.

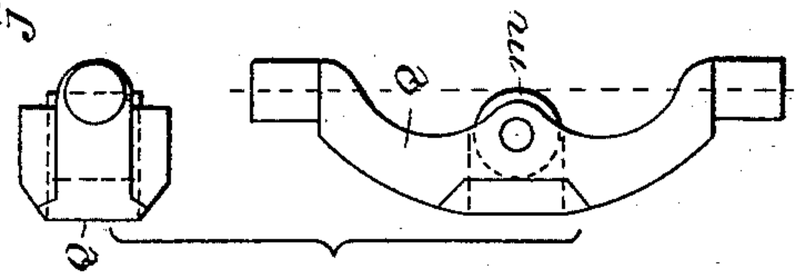

Fig. 8.

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UNITED STATES PATENT OFFICE.

FRANK M. STEVENS, OF NEW YORK, N. Y., ASSIGNOR TO THE STEVENS LOCOMOTIVE AND MACHINE COMPANY, OF SAME PLACE.

VALVE-GEAR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 285,084, dated September 18, 1883.

Application filed February 13, 1883. (Model.)

To all whom it may concern:

Be it known that I, FRANK M. STEVENS, a citizen of the United States, residing in the city, county, and State of New York, have invented certain Improvements in Valve-Gear for Steam and other Engines, of which the following is a specification.

My invention relates to a valve-gear which is especially adapted for locomotive-engines, and all engines of a similar character where it is necessary to reverse them quickly and frequently.

In the drawings which serve to illustrate my invention, I have shown the gear adapted to a pair of locomotive-engines, and the cams driven from the driving-axle of the locomotive.

Figure 1 is a plan of the valve-gear and its driving mechanism. Fig. 2 is a side elevation of the same, the valve and its chest being shown in section. Fig. 3 is a cross-section taken on line 3 3 in Fig. 2. Fig. 4 is a plan, and Fig. 5 an elevation, of the cam-yoke. Fig. 6 comprises a plan and end elevation of the cam in one position. Fig. 7 is a cross-section on line 7 7 in Fig. 6, and Fig. 8 is a longitudinal mid-section on line 8 8 in Fig. 6. Fig. 9 comprises an end and side elevation, detached, of the oscillating lever, which is mounted in the cam-yoke. Figs. 4 to 9 are drawn to a larger scale than the general views.

I will first refer to the several parts of a locomotive herein shown, but not specifically claimed.

A is a part of the main frame. B B are the engine-cylinders; C C, the steam or valve chests; D D, the valves, and *a a* the valve-stems. E is the locomotive-axle; F, the wheels; G, the connecting-rods; H, the cross-heads, and I the cross-head guides. To these parts I make no claim herein.

On the axle E are set two eccentrics, J J, connected through straps and rods K K with cranks *b b* on rock-shafts *c c*, mounted on the main frame.

On the outer ends of shafts *c* are other cranks, *b′ b′*, which are coupled by connecting-rods *d d* with short cranks *e e* on the ends of a cross-shaft, L, which is mounted rotatively in bearings on the frame, over the cross-head guides, and extends across at right angles to the axis of the engine-cylinders. The throw of the eccentrics J and the cranks *b b′* and *e* is such that the shafts *c* are oscillated while the shaft L is rotated.

On the shaft L is mounted a sleeve, M, which is free to slide endwise on the shaft, and between collars on this sleeve engages a fork, *f*, on a sliding frame, *g*, mounted to slide on a suitable cross-frame, *h*. (Shown in Fig. 3.) This sliding frame is coupled by a link, *i*, to one arm of a bell-crank, N, the other arm of which may be connected by a rod with an actuating-lever in the locomotive-cab.

I have not deemed it necessary to show the operating-lever and connecting-rod. It will be sufficient to say that by their means the engineer will be enabled to shift the sleeve M back and forth on shaft L.

On each end of the shaft L are mounted valve-actuating cams O. (Shown detached in Figs. 6, 7, and 8.) These cams are secured rigidly to the ends of the sleeve M and move with it, and they may be considered as a part of said sleeve, the latter being merely a means of connecting the cams, so that both will be shifted simultaneously. The cams are splined on shaft L, whereby they and the sleeve M are compelled to rotate with said shaft, while free to play lengthwise for a limited distance thereon. These cams are precisely alike, but are set on the shaft in such a way as to shift the valves of the engines in the usual way with locomotive-engines—that is to say, one cam is a quarter-turn ahead of the other; but as the cams are alike in form, and the cam-yokes and other parts connected with the cams are the same for each engine, I will only describe one set of parts. One end of the cam acts to reciprocate the valve when the engine is going "forward," and the other end when it is going "backward." The forward end I have lettered *x x* in Fig. 6, and the backing end *y y*. The shape of the cam is clearly illustrated in the detached figures. I will say, however, that the forward and backing ends of the cam are not exactly alike, although they might be made alike. I prefer to give the forward end more throw than the backing end, as it opens the admission-port wider when cutting off short. This is not so important in backing; still if the locomotive be designed for running backward in one direction, as is sometimes the case, then both ends of the cam may be alike. In order, however, to construct the cam so that cylindrical bearing-rollers of same

length may be employed in the yoke, and these may bear on the cam throughout their full length at some point on their peripheries, and this at all points on the cam, and that the cam may be shifted endwise between the said rollers without rotating the cam, I prefer to, and usually do, give to the forward end, *x x*, of the cam a little more throw than the backing end *y y*. Thus when the engine is backing with the maximum cut-off, the port is opened full, and when going ahead with the maximum cut-off, the valve has a surplus of throw or movement. This gives me the best possible distribution of the steam in going ahead, while in backing the admission is only slightly interfered with when the minimum cut-off is employed.

The construction of the cam is somewhat peculiar, my object being to mount it between plane-faced cylindrical bearing-rollers, which in practice are usually three inches long and three inches in diameter. These rollers are mounted rotatively in oscillating levers in the yoke, which will be more particularly described hereinafter; but I will say that the vertical pivotal axis of the lever tangents the inner face of the roller, whereby the roller is enabled to adjust itself properly to the inclined plane face of the cam at all times. It is necessary, however, in order that the roller may always bear evenly on the cam its entire length, in whatever position the cam may stand, and that the cam may be readily shifted at all times by sliding it endwise between said rollers, that the face of the cam shall be so formed that some part of the periphery of the roller will always, in the movement of the cam in shifting, rest firmly on the cam througout the length of the roller.

The cam is constructed to effect two results, namely: the proper throw or movement of the valve, which is accomplished by mounting the cam obliquely on the shaft; and, second, the cutting off of the steam at the proper point of the stroke. The middle point of the cam is of course a neutral or nearly neutral point, respecting both the throw of the cam and the cut-off—that is to say, the cam cuts off shortest nearest its middle and holds the port open longest at its end.

In order to convey a clear idea of the shape of the cam, I will briefly describe one method of making it which I have employed. I cast the cam of about the proper size and shape, bore it, and mount it on a shaft. This shaft passes through it obliquely, of course, and it is mounted in a planing-machine in such a manner that a vertical plane passing through the shaft-axis longitudinally passes also through the axis of the cutting-tool of the planer at all points of its travel.

On the ends of the cam are fixed metal disk-like templets having the exact form of the end of the cam to which they are affixed, and these templets rest on fixed bearing-rollers, the shaft being capable of vertical play in guides. The tool or cutter has a round nose exactly the size of the roller that is to bear on the cam when the latter is in use—that is to say, ordinarily three inches. The cam is fed to the cutter by intermittent rotation on its shaft, and the cutter moves along the cam from end to end. Thus by a series of longitudinal cuts the entire surface of the cam is dressed. The broad-nosed tool touches at some part of its edge every part of the surface of the cam, and the movement of the templets over their bearing-rollers, which are also three inches in diameter, like the tool, raises or depresses the cam properly as it is rotated. Thus it will be seen that the tool follows precisely the same path that the bearing-rollers in the yoke must follow when the cam is moved longitudinally in practice. The distance between the bearing-rollers on which the templets rest and the cutting-tool is the same as that between the bearing-rollers in the cam-yoke.

I have been thus particular in describing the peculiar shape and characteristics of the cam, as this is the most important feature of my present invention. The cam so constructed has no lumps or projections to lift the bearing-rollers, and no cavities or hollows to be bridged over by the roller, which may thus have a long bearing-surface. As both bearing-rollers between which the cam plays embrace the cam snugly at all times, and are unyielding, it follows that the distance between the centers of said rollers, which is the true diameter of the cam, is invariable. As the rollers must have some length, and are usually in practice three inches long, and as the middle of the roller longitudinally is the theoretical operative point or contact, I make the cam somewhat longer than would be necessary if the roller were a mere disk, for example, so that when the cam is shifted to its fullest extent in either direction the end of the roller will not project to any appreciable extent beyond the end of the cam. In other words, there is an extension of the cam at both ends, to support the otherwise overhanging ends of the rollers.

Referring now particularly to Figs. 4, 5, and 9, I will describe the cam-yoke P, to which the valve-stem is connected, and which embraces the cam. This yoke comprises two ring-like frames, *j j*, connected together at top and bottom by means of plates *j' j'*, and provided with bearing-slides *j'' j''*, which find bearings in fixed frames *k k*, connected by a bridge-piece, *l*.

In suitable bearings in the plates *j'* of the yoke are pivotally-mounted curved oscillating levers Q, (see Fig. 9,) each of which is provided with a bearing-roller, *m*, at its middle. These rollers are cylindrical, and are rotatively mounted in the levers in such a manner that a line drawn through the pivotal axes of the levers will tangent the bearing-faces of the rollers, as indicated by dotted lines in Fig. 9. Thus when the cam presents an oblique face to the bearing-roller the lever Q turns on its axis until the bearing-face of the roller ac-

commodates itself to the changed position or angle of the cam; but the roller, as before stated, always rests fairly on the cam, some portion of its periphery for its entire length resting on the face of the cam. I am thus enabled to employ a cam of a very peculiar and irregular character, adapted to move endwise as well as rotatively, and at one and the same time, and yet to obtain as firm and broad a bearing-surface on it as if it were a simple eccentric; and this is the main purpose of my invention. The lever Q may be considered as a part of the yoke P, and the rollers *m* may be considered as mounted in the yoke, the lever being merely an intermediate to permit the rollers to be oscillated.

Owing to the necessity of getting the rock-shaft *c* down low on the frame, I make or form an arch in it where it extends over the connecting-rod G, in order to give the latter room for its vertical play.

Other well-known means may be provided for actuating the cam than that shown, and I do not limit myself to the particular means described.

The cams might be connected by a simple bar under or over the shaft; but in locomotives there is not room for this, and I employ the sleeve M, constructed and arranged as shown.

Attention is called to the manner of shifting the cams when two or more are employed, as in locomotives. The cams are shifted simultaneously to the right or left, the left-hand ends of the cams being alike and the right-hand ends alike. As herein arranged, the left-hand ends of the cam are the forward ends and the right-hand ends the backing ends; but this might be reversed.

It will be obvious, also, that where the engine is to be run in but one direction, one end of the cam will never be employed, and this end might be cut off without affecting the operation of my improved gear. Indeed, where the valve-gear is to be used on a non-reversible engine, I omit one end of the cam—the backing end, for example—in the construction.

I have herein shown the cam adapted for both reversing and non-reversing engines. Where the valve-gear is to be employed on an engine not designed to be reversed, I may also employ an ordinary cam in connection with my oscillating levers Q, as the oscillation will be sufficient to permit the faces of the rollers *m* to align themselves at all times with the face or surface of the cam.

R in Fig. 3 represents a part of the locomotive-boiler. S is a lug secured to one of the slides *j''* on the yoke P, which is perforated, as seen in the detached view, Fig. 4, to receive the end of the valve-stem *a*, to which it is secured by nuts on the stem, as shown in the principal figures. This forms the connection of the stem with the yoke, the nuts serving to adjust the position of the valve with reference to the yoke.

Having thus described my invention, I claim—

1. The combination, in a valve-gear, of a reciprocating yoke and two cylindrical bearing-rollers mounted to oscillate in said yoke, as described, the cam O, constructed substantially as described, and adapted to be rotated and to be moved endwise, and suitable mechanism for imparting motion to said cam, all arranged to operate substantially as set forth.

2. The reciprocating cam-yoke provided with the pivotal oscillating levers Q and the cylindrical bearing-rollers *m m*, mounted in said levers, with their inner peripheries arranged to tangent a line drawn through the pivotal axis of their respective levers, substantially as described, and for the purposes set forth.

3. The combination, in a valve-gear, of the eccentric on the axle or shaft, and its yoke and rod, the rock-shaft *c*, provided with cranks *b b'*, the cross-shaft L, provided with a crank, *e*, the connecting-rod *d*, the cam O, arranged to slide on the shaft L, and the reciprocating yoke P, provided with the oscillating levers Q and cylindrical bearing-rollers *m*, all arranged to operate substantially as set forth.

4. The combination, in a valve-gear, of a rotating cam and a reciprocating yoke to embrace said cam, provided with rollers mounted to oscillate on pivotal axes, as described, whereby said rollers are enabled to adapt themselves to the inclined faces of the cam, which the latter presents to them in its rotation, as set forth.

5. In a valve-gear for steam and other engines, a reversing and variable cut-off cam constructed and arranged to operate substantially as described—that is to say, having a regular surface from end to end on any given plane, adapted to contact with some portion of the bearing-periphery of the pivotally-mounted cylindrical bearing-roller at all points on the length of said roller, whereby the cam may be moved lengthwise between the bearing-rollers at any and all times, in whatever position it may stand with respect to the latter, and the rollers at all times may have a full bearing on the cam, as set forth.

6. In a valve-gear, the combination, with the cylindrical bearing-rollers *m*, mounted to oscillate in the yoke, of the cam O, made long enough at its ends to extend under and support the ends of said rollers, whereby the middle or theoretically operative part of the roller is given a firm bearing on the cam when the latter is shifted, as and for the purposes set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FRANK M. STEVENS.

Witnesses:
HENRY CONNETT,
ARTHUR C. FRASER.