(No Model.)

H. C. BEHR.

VALVE GEAR FOR STEAM ENGINES.

No. 348,309. Patented Aug. 31, 1886.

Fig. 7.

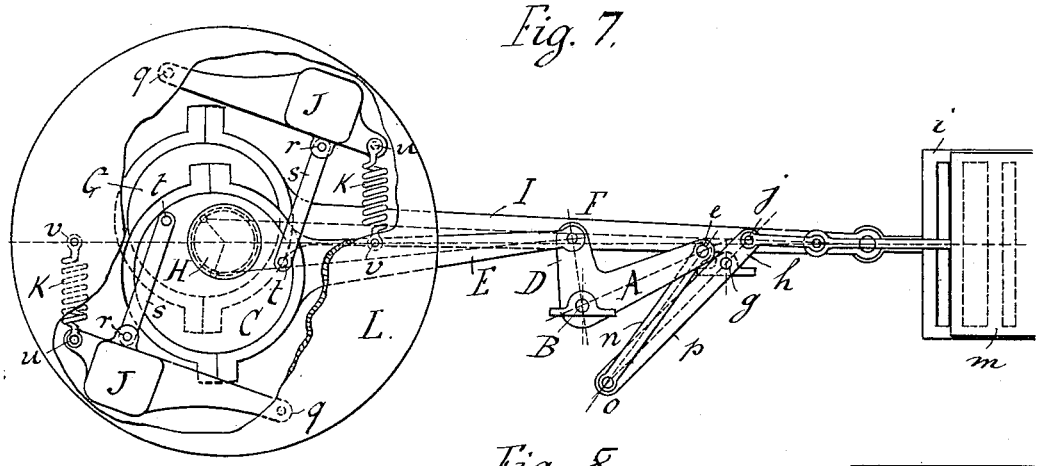


Fig. 8.

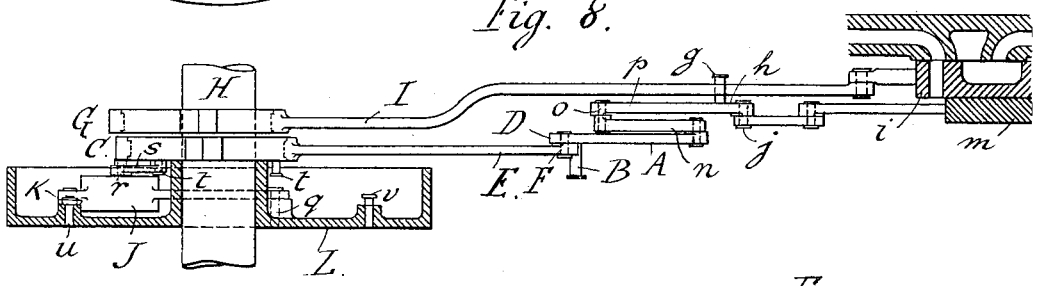


Fig. 10.

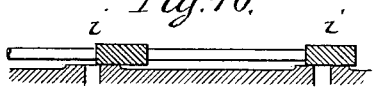


Fig. 9.

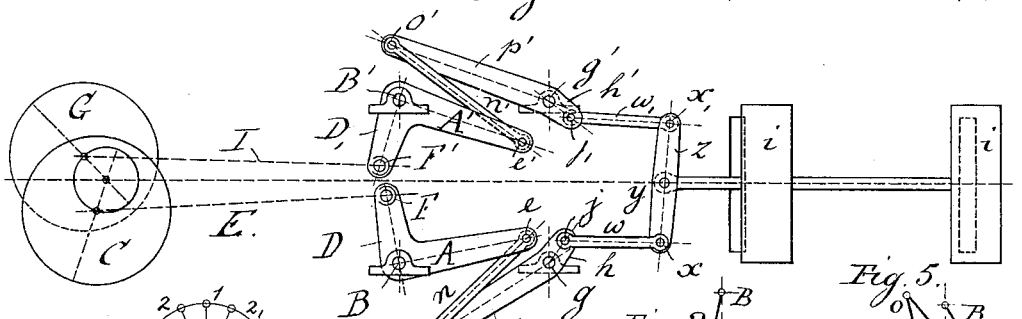


Fig. 6.

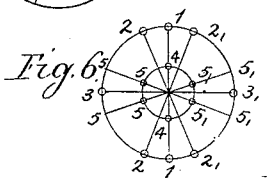


Fig. 1.

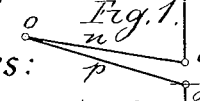


Fig. 4.

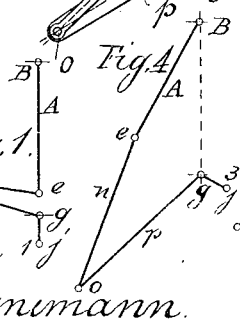


Fig. 2.

Fig. 3.

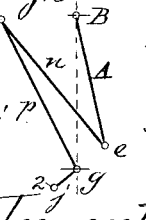
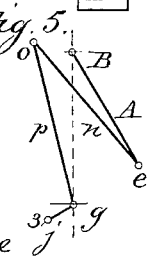


Fig. 5.



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Inventor:
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UNITED STATES PATENT OFFICE.

HANS CHARLES BEHR, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR OF ONE-HALF TO LIONEL H. HEYNEMANN, OF SAME PLACE.

VALVE-GEAR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 348,309, dated August 31, 1886.

Application filed October 5, 1885. Serial No. 178,993. (No model.)

To all whom it may concern:

Be it known that I, HANS CHARLES BEHR, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented a new and useful Improvement in Valve-Gear for Steam-Engines, of which the following is a specification.

My invention relates to that class of valve-gear in which the supply of steam into the cylinder is cut off by positive mechanism, in distinction from that class known as "trip-gear," in which gravity, springs, air, steam, or other outside agents are used to close the valves.

The object of my invention is to obtain a rapid positive movement of the valves, especially in cutting off the steam, and a comparative rest between opening and closing. This object I accomplish by means of the mechanism illustrated in the accompanying drawings, in which—

Figures 1 to 5 show diagrams of the rapid-motion valve-gear. Fig. 6 shows a diagram of the angle through which the eccentric travels. Figs. 7 and 8 show an elevation and plan of the ordinary valve-gear, with one main slide-valve, *i*, and a cut-off valve, *m*, on the back of *i*, arranged with the rapid-motion gear. Fig. 9 shows an elevation of this rapid-motion gear as applied to engines which admit and cut off steam with one and the same valve. Fig. 10 shows a section through the valve and steam ports.

Similar letters are used to designate like parts throughout the several views.

In Figs. 1 to 5 the lever A swings upon the fixed center B, receiving motion through an eccentric-rod pivoted to any point of the lever A. One end of a link, *n*, is attached to the lever A at *e*, and the other end to an arm, *p*, at *o*. The arm *p* is rigidly attached to the lever *h*, or forms part of the same, and is free to turn around the fixed point *g* as a center. The usual rods and links for moving the valve are attached at *j* to the lever *h*.

The operation is as follows: When the eccentric is in the middle of its stroke, the levers A and *h* are in their central position, and the point *e* is in its nearest position to the fixed center, *g*, as shown in Fig. 1. When the eccentric-rod swings the lever A either to the right or to the left, it causes the lever *h* to swing upon the center *g*, whereby the distance between *e* and *g* is increased, and the effective lever-arm, which receives motion from A, is lengthened, whereby a rapid diminution of the angular velocity of the lever *h* is produced. It will be noticed, therefore, that when the lever A is at or near its central position by far the greatest part of the entire angular motion of *h* is completed during a comparatively slight angular motion of A from its central position, the rest of the motion of A producing merely slight additional motion of *h*.

In Figs. 2 and 3 it will be noticed that the lever *h* has almost completed its stroke, having arrived at position 2′ in Fig. 2, and at position 2 in Fig. 3, (positions 3′ and 3 indicating the extreme positions of *h* as shown in Figs. 1 and 5, respectively.) At the same time the lever A, and consequently also the eccentric, has only passed through a comparatively small angle.

In Fig. 6 the corresponding angles through which the eccentric has passed, actuating a valve by means of this rapid-motion gear, are denoted on the large circle by the same numbers as in Figs. 1 to 5; and it will be noticed how small a motion of the eccentric is required to almost complete the stroke of the valve, and thus give a very rapid opening or closing of the ports. The small circle in Fig. 6 gives the full travel of the valve, and also that of an eccentric if it were directly attached to the valve in the usual manner; and it will be observed that this eccentric would have to pass through the angle 4 5 or 4 5′, and almost complete its stroke, in order to bring the valve *i* to the same positions as indicated by the numbers 2 or 2′ on the large circle. If the eccentric, directly attached, without the rapid-motion gear, had turned through the angle 1 2 or 1 2′, the valve *i* would just be opening the port, or, in case of closing, it would close very slowly, for the same angle turned by the eccentric with the rapid-motion gear the valve would, as demonstrated above, have almost completed its stroke and given a free passage for the steam to enter

the cylinder, or performed a very rapid cutting off of the steam.

Figs. 7 and 8 show an elevation and plan of a valve-gear with one main slide-valve *i*, performing the functions of admitting and releasing the steam, and a cut-off valve, *m*, on the back of *i*, serving only to cut off the admission of steam. The main valve *i* is moved in the usual manner by the eccentric G, rigidly attached to the shaft H. The cut-off valve *m* is moved by the rapid-motion gear worked from the eccentric C, which latter, in order to vary the point of cut-off automatically, may be arranged to turn upon the shaft H by a governor, as shown, or by other suitable mechanism. The governor here shown is rigidly attached to the shaft H, and consists of the disk L, which carries the weights J J, pivoted at *g g* to the disk L, and at *r r* to links *s s*, pivoted at *t t* to the eccentric C. Springs K K take hold of the weights J J at *u u*, and are secured to the disk L at *v v*. When the speed of the engine increases, the weights J J fly apart and turn the eccentric upon the shaft, thus obtaining an earlier closing of the steam-ports. The rapid-motion gear in Figs. 7 and 8 shows an angular lever, A. This arrangement is designed to get the eccentric-rod E in line with the direction of the travel of the valve. The lever A carries in this case, rigidly attached, the lever D, to which the eccentric-rod E is attached at F. This rapid-motion gear can also be used for the main valve. It may also be applied to engines which admit and cut off steam with one and the same valve, using independent exhaust-valves. Figs. 9 and 10 show such an application to slide-valve gear. The valves *i i* are attached on the same valve-rod, and one end of the latter has pivoted to it a double-armed lever, Z, the free ends of which are pivoted at *x x'* to links *w* and *w'*. The link *w* is pivoted at *j* to the lever *h* of one rapid-motion gear worked from the admission-eccentric C, while the link *w'* is pivoted at *j'* to the lever *h'* of the other rapid-motion gear worked from the cut-off eccentric G, which latter may be made adjustable upon the shaft by a governor, as shown in Figs. 7 and 8, or by other means. This last-mentioned arrangement may also be applied to oscillating rotary valves, such as the "Corliss" type.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The swinging link *n*, pivoted at one end to the free end of the lever A, and with the other end to an arm forming a rigid piece with the lever *h*, which transmits motion to the valve, substantially as herein described, and for the purposes set forth.

2. The combination of the lever A and links *n* and *p* and lever *h* with an automatically or otherwise adjustable eccentric, substantially as herein described.

3. In an engine, the combination of the eccentric C, rod E, lever A, links *n* and *p*, lever *h*, and valve *i*, substantially as herein described, and for the purposes set forth.

In witness whereof I have hereunto set my hand.

HANS CHARLES BEHR.

Witnesses:
WM. B. UPTON,
L. H. HEYNEMANN.