No. 792,038. PATENTED JUNE 13, 1905.

E. HOCKE & S. LÖFFLER.

REVERSING GEAR FOR STEAM ENGINES.

APPLICATION FILED MAY 20, 1902.

2 SHEETS—SHEET 1.

Fig. 2.

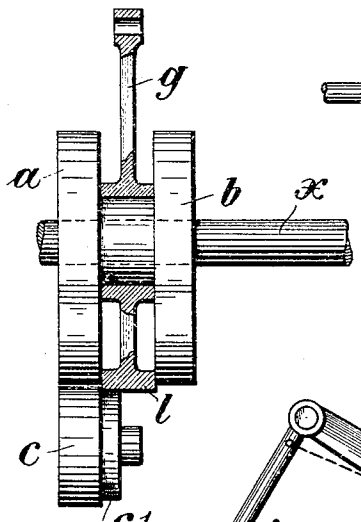
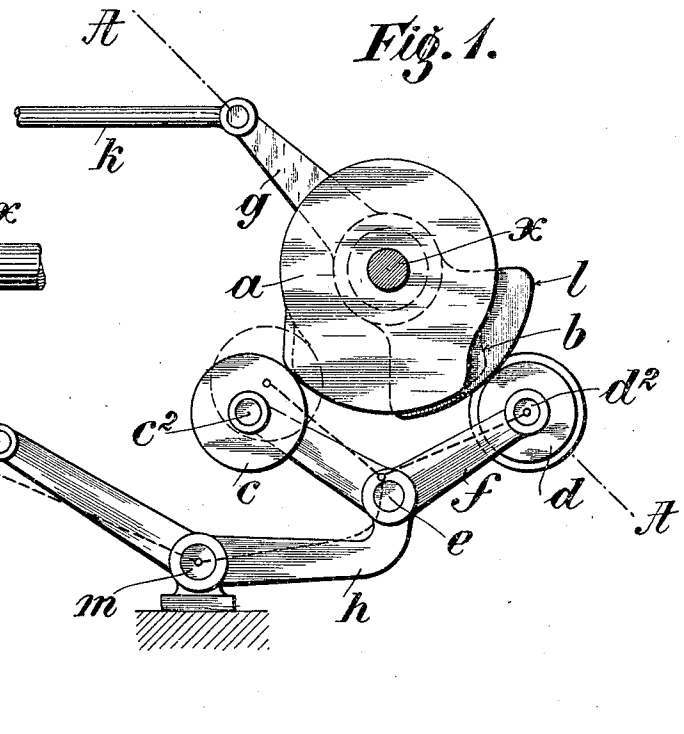


Fig. 1.



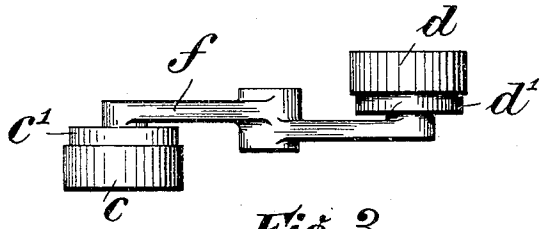


Fig. 3.

Witnesses:
Heinrich Wagner
Emil Stein

Inventors:
Enrico Hocke.
Samuel Löffler

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2 SHEETS—SHEET 2.

Fig. 4.

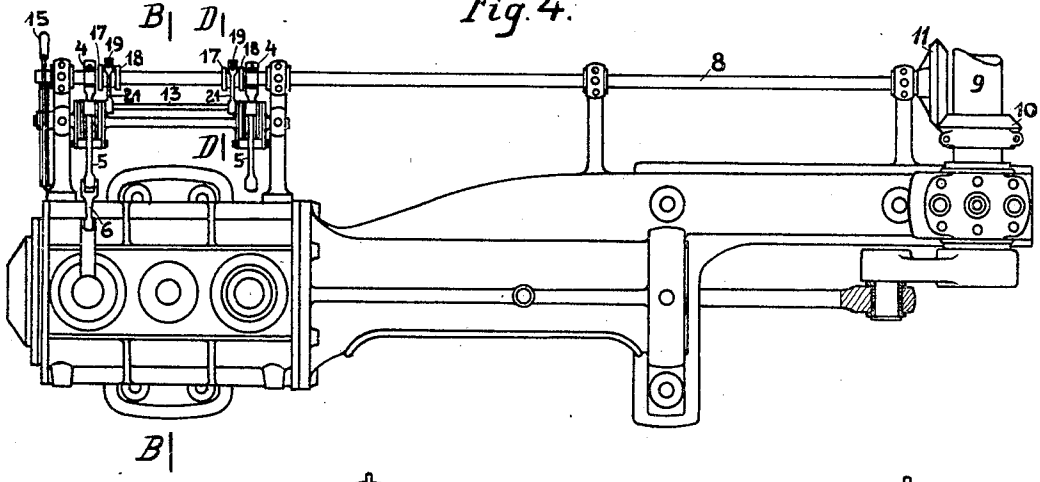


Fig. 5.

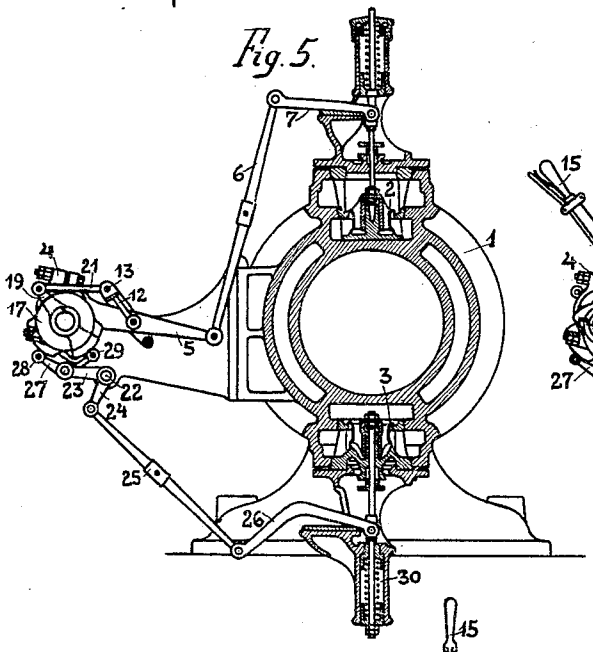


Fig. 6.

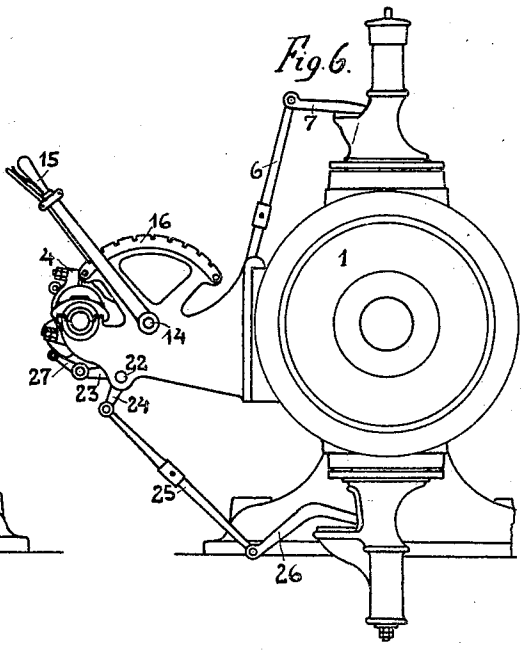


Fig. 7.

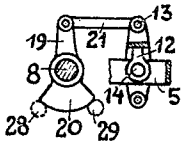
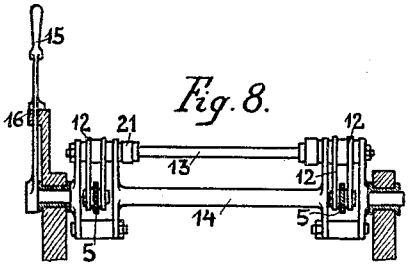


Fig. 8.



Witnesses:

For Enrico Hocke:

For Samuel Löffler:

Inventors:

Enrico Hocke.

Samuel Löffler.

No. 792,038. Patented June 13, 1905.

UNITED STATES PATENT OFFICE.

ENRICO HOCKE, OF GENOA, ITALY, AND SAMUEL LÖFFLER, OF WITKOWITZ, AUSTRIA-HUNGARY.

REVERSING-GEAR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 792,038, dated June 13, 1905.

Application filed May 20, 1902. Serial No. 108,164.

To all whom it may concern:

Be it known that we, ENRICO HOCKE, a subject of the King of Italy, residing at Genoa, in the Kingdom of Italy, and SAMUEL LÖFFLER, a subject of the Emperor of Austria-Hungary, residing at Witkowitz, in the Empire of Austria-Hungary, have invented a new and useful Reversing-Gear for Steam-Engines, of which the following is a specification.

Our invention relates to a reversing-gear for actuating the exhaust-valves in cylinders of steam-engines; and the objects of our invention are, first, to so arrange the reversing-gear that it may be employed in combination with a reversing-gear of any kind for actuating the inlet-valves and varying the cut-off points.

In opposition to known reversing-gears the new reversing exhaust-valve gear affords several important advantages. The points of the piston-stroke at which the compression and the exhaust, respectively, on either side of the piston commence remain invariable under any circumstances, no matter what positions the cut-off points may occupy—*i. e.*, whether the degree of expansion be large or small. For this reason the engine will run smoothly and uniformly for all degrees of expansion, both for the one and for the other direction of the revolution. The exhaust-valves will be actuated in the same manner for both directions of revolutions of the crank-shaft. The driving fluid will work under uniform conditions as to speed and resistance, so that all the parts of the reversing-gear will be strained in uniform proportions. It is, further, a decided advantage that the engine can be reversed at any moment without disturbing its work. The amount of power required for this reversing is very small, since the parts of the new reversing-gear are so arranged that only rolling resistance between them needs be overcome, so that the wear and tear of these parts is reduced to a minimum. A further advantage is that the governor of the engine is enabled to vary with the least waste of power the cut-off point for both directions of the revolution without interfering in any way with the proper working of the exhaust-valves, since the reaction from the gear upon the governor is like *nil* during the variation of the cut-off point. The new reversing-gear further offers the advantage that the reversing-levers for both the inlet and the outlet valves can be actuated simultaneously either by hand or from the governor. The new reversing-gear is arranged symmetrically, so that for both directions of the revolution the series of occurrences is alike. Moreover, the reversing-gear is simple, easily to be handled, and will work most effectively.

The new reversing-gear, according to our invention, is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of the reversing-gear. Fig. 2 is a sectional view on the line A A in Fig. 1, certain parts being shown in side view; and Fig. 3 is a plan of the two-armed lever *f* and the rollers *c d* shown in Fig. 1. Fig. 4 is the plan of a horizontal steam-engine provided with the new reversing-gear, the upper parts of the latter actuating the right inlet-valve being omitted. Fig. 5 shows, on an enlarged scale, a vertical cross-section through the same on the line B B in Fig. 4, part of the reversing-shaft being omitted. Fig. 6 is an end view of the same. Fig. 7 is a sectional view on the line D D in Fig. 4, part of the reversing-shaft being broken away; and Fig. 8 is a vertical section through the line C C in Fig. 6.

Similar characters of reference refer to similar parts throughout the several views.

Figs. 1 to 3 show the new reversing-gear proper, while its application to a steam-engine will be explained later on. On the shaft *x*, driven in any suitable manner from the crank-shaft, (not shown in the drawings,) two equal cam-disks *a* and *b* are keyed, and between them a reversing-lever *g* is mounted to oscillate. The reversing-lever *g* is made in one piece with a segment *l*, so that the latter is obliged to partake in the movement of the former. A bell-crank lever *h* is mounted on an axle *m* to rock and carries at the free end of its bent arm a pin *e*, on which a two-armed lever *f* is mounted to swing. The free ends of the two arms of the lever *f* carry pins c^2

and d^2, on which the rollers c and d, respectively, revolve. These rollers are adapted to bear against the circumferences of the two cam-disks a and b, respectively. In the drawings the segment l is assumed to have a radius a little exceeding that of the concentrical projections of the cam-disks a and b, and the rollers c and d having a greater width than that of the cam-disks are reduced a little in diameter on their projecting parts c' and d', respectively, so that the two parts $c\,c'$ or $d\,d'$ of either roller may touch periodically both the peripheries of the segment l and of the projection of the respective cam-disk. The straight arm of the bell-crank lever h is to be connected by a rod i with the respective part of the engine for actuating the exhaust-valve. The reversing-lever g is to be connected by a rod k with the reversing-lever proper of the engine, which controls the inlet-valves and is not shown. In Fig. 1 the reversing-lever g occupies the one extreme position on the left side, so that the roller part d' bears against the segment l, and is thereby prevented from oscillating. The bent arm of the bell-crank lever h is pressed upward in any known manner, be it by means of a weight or a spring acting upon the rod i for normally closing the exhaust-valve, so that the roller c bears against the periphery of the cam-disk a. The shaft x may run in the direction of the hands of a watch while taking along with it the two cam-disks a and b, of which, however, only the one—viz., a—at present is active. It will be seen that during the revolution of the shaft x the roller c will alternately bear against the projection of the cam-disk a, as shown by the full lines, and against the periphery of the smaller radius of this disk, as indicated by the dotted lines. The consequence of this is that the two-armed lever f will be swung in both directions around the axis of the roller d and that the bell-crank lever h will be rocked in the one and the other direction to open and close the exhaust-valve. When the reversing-lever proper is moved to reverse the direction of the revolution of the engine, it will move at the same time by the rod k the reversing-lever g. When it is assumed that the latter now occupies the opposite extreme position on the right side in Fig. 1, the roller part c' will bear against the segment l, and its axis will be prevented from oscillating, while the roller d, bearing against the cam-disk b, only will be allowed to oscillate around the axis of the roller c. The bell-crank lever h will then be again rocked to and fro much in the same manner as before, only that the points of the crank-circle at which the compression and the exhaust, respectively, commence will be transferred from the one side to the other side of the dead-point. It is evident that in case the cylinder of the engine is provided with two exhaust-valves the two exhaust-valves will require each a complete set of the parts shown in Fig. 1, the two sets of cam-disks of course occupying opposite positions on the shaft x. The segment l has such an extension of the periphery that it will simultaneously bear against the reduced parts c' and d' of the two rollers when the reversing-lever g is placed vertically—*i. e.*, occupies its middle position. This position corresponds with that of the reversing-lever proper when the engine is stopped. In this case both rollers c and d are prevented from oscillating. When the reversing-lever proper of the engine is moved from its middle position to an intermediate position and not to the one extreme position, in which case the degree of expansion is higher than for the extreme position, the new reversing-gear will act exactly the same as before, since the one roller c or d will be prevented by the segment l from oscillating, while the other roller is allowed to oscillate.

In order to better explain the manner in which the reversing-gear may be applied to a steam-engine and connected with the reversing-lever proper of the same, by which the inlet-valves are controlled, we will now proceed to describe an example.

In Figs. 4 to 8 a horizontal steam-engine is assumed, which is provided with a well-known inlet-valve expansion and reversing gear. The single cylinder 1 has at the top two inlet steam-valves 2 and at the bottom two exhaust-valves 3. The two inlet-valves 2 are actuated from two eccentrics 4 4 by means of the eccentric-rods 5 5, the connecting-rods 6, and the levers 7. The two eccentrics 4 4 are keyed upon the shaft 8, which is driven from the crank-shaft 9 by means of equal bevel-wheels 10 and 11. The two eccentric-rods 5 5 are pivotally connected with two pairs of links 12 12, which are suspended from a common rod 13 and arranged to swing within two spaces of the reversing-shaft 14, the construction of which is clearly shown at Figs. 7 and 8. By means of the reversing-lever 15 and its notched bow 16 (see Fig. 6) the axis of the two pairs of links 12 12—that is, the rod 13—can be brought into two extreme positions, a middle position, and several intermediate positions. When the rod 13 occupies the one extreme position—say on the left, as shown in Figs. 5 and 6—the crank-shaft 9 of the engine will revolve in the one direction. On bringing the reversing-lever 15 into the other extreme position, on the right in Fig. 6, the crank-shaft 9 will be caused to revolve in the opposite direction. For both extreme positions of the reversing-lever 15 and the rod 13 the degree of the expansion will be a minimum, while for any intermediate position of the reversing-lever 15 and the rod 13 on either side the degree of the expansion will be higher, as is well known. When the reversing-lever 15 occupies its middle vertical position, the engine is stopped. For actuating the two exhaust-valves 3 two pairs of cam-disks 17

and 18 (corresponding to those, *a* and *b*, in Figs. 1 and 2) are fastened on the shaft 8 and oppositely to each other the same as the eccentricities of the two eccentrics 4 4 are placed on opposite sides of the shaft 8, as is well known. Between the two cam-disks 17 and 18 of each pair a reversing-lever 19, with a segment 20, (see Fig. 7,) is mounted on the shaft 8 to oscillate in a similar manner as the reversing-lever *g* with the segment *l* in Figs. 1 and 2. The two reversing-levers 19 19 are pivotally connected with the rod 13 by means of two rods 21 21, and thereby positively connected with the reversing-lever proper, 15. On a horizontal shaft 22 two bell-crank levers 23 24 (corresponding to *h* in Fig. 1) are mounted to rock for actuating the two exhaust-valves 3 by means of the two rods 25 (corresponding to *i* in Fig. 1) and the two levers 26. The upper arm 23 of each bell-crank lever 23 24 carries a two-armed lever 27 (corresponding to *f* in Fig. 1) with two rollers 28 and 29, which are adapted to bear against the cam-disks 17 and 18, respectively, and against the segment 20 under the action of the helical spring 30, which latter serves at the same time for pressing the exhaust-valve 3 upon its seat, as usual.

The manner in which the engine is operated is obvious and as follows: When the engine is to be started in either direction, the reversing-lever proper, 15, is brought from its middle vertical position into any intermediate position or into the extreme position on the respective side, as the case may be. Then the engine will start in the known manner, and the two eccentric-rods 5 5, actuated from the respective eccentrics 4 4 on the shaft 8, will move about and rock on the lower pins of the swinging links 12 12 while alternately actuating the two inlet-valves 2 by means of the rods 6 and the levers 7. The cam-disks 17 or 18, as the case may be, actuate the two exhaust-valves 3 alternately by means of the rollers 28 or 29, the two-armed levers 27, the bell-crank levers 23 24, the rods 25, and the levers 26. It is evident that the segment 20 will hold the respective rollers 29 or 28 and cause the other rollers 28 or 29 to oscillate around the axes of the former no matter whether the reversing-lever proper, 15, occupies the extreme position or any intermediate position. This means that the points of the crank-circle, at which the compression and the exhaust, respectively, commence on either side of the piston, remain invariable for either direction of the revolution and for any degree of expansion.

The reversing-gear according to our invention may be also applied to any other reversing steam-engine provided with a suitable known variable expansion valve-gear, to which the reversing-gear can be adapted.

The new reversing-gear described so far may be varied in its details without deviating from the spirit of our invention. For instance, the reversing-lever *g* in Figs. 1 and 2 may be placed outside the two cam-disks *a* and *b*. The segment *l* may have the same radius as the concentrical projections of the cam-disks *a* and *b*, and the two rollers *c* and *d* may have the same diameter throughout their widths, or the segment *l* may be so arranged as to keep either of these two rollers out of contact with the respective cam-disk. The bell-crank lever *h* may be omitted and the rod *i* be pivotally connected direct with the two-armed lever *f* at its middle.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a steam-engine, the combination with a shaft running with the engine, of two cam-disks fastened on said shaft, a segment loose on said shaft between said two cam-disks, a pin, means for guiding said pin in a plane at right angles to said shaft and positively connecting it with an exhaust-valve, means for pressing said pin toward said shaft, a two-armed lever mounted to rock on said pin, two rollers mounted to revolve on the free ends of said two-armed lever and adapted to bear against the peripheries of said two cam-disks respectively and said segment, and means for adjusting said segment in several positions, so that in its middle position it bears on both of said two rollers and prevents them from being actuated by said two cam-disks, while in any position on either side of its middle position the segment holds either of said two rollers out of engagement with the respective cam-disk and allows the other roller to be actuated by its cam-disk for opening and closing the exhaust-valve.

2. In a steam-engine, the combination with an inlet-valve, of a reversing-lever, a reversible variable expansion-gear controlled by said reversing-lever for actuating said inlet-valve, an exhaust-valve, a shaft running with the engine, a pin, means for guiding said pin in a plane at right angles to said shaft and pivotally connecting it with said exhaust-valve, means for pressing said pin toward said shaft, two cam-disks affixed on said shaft, a segment loose on said shaft between said two cam-disks, a two-armed lever mounted to rock on said pin, two rollers mounted to revolve on the free ends of said two-armed lever and adapted to bear against the peripheries of said two cam-disks respectively and said segment, and means for pivotally connecting said segment with said reversing-lever, so that in the middle position of the latter the segment bears on both of said two rollers and prevents them from being actuated by said two cam-disks, while in any position of the reversing-lever on either side of its middle position the segment holds either of said two rollers out of engagement with the respective cam-disk and allows the other roller to be actuated by its cam-disk for opening and closing the ex-

haust-valve, whereby the points of the crank-circle, at which the exhaust and the compression respectively commence, are kept invariable for either direction of the revolution and for either degree of expansion.

3. In a steam-engine, the combination with an inlet-valve, of a reversing-lever, a shaft running with the engine, a reversible variable expansion-gear actuated from said shaft and controlled by said reversing-lever for actuating said inlet-valve, two cam-disks affixed on said shaft, a segment loose on said shaft between said two cam-disks, an exhaust-valve, a bell-crank lever, means for pivotally connecting the one arm of said bell-crank lever with said exhaust-valve, a two-armed lever mounted to rock on the other arm of said bell-crank lever, two rollers mounted to revolve on the free ends of said two-armed lever and adapted to bear against the peripheries of said two cam-disks respectively and said segment, and means for pivotally connecting said segment with said reversing-lever, so that in the middle position of the latter the segment bears on both of said two rollers and prevents them from being actuated by said two cam-disks, while in any position of the reversing-lever on either side of its middle position the segment holds either of said two rollers out of engagement with the respective cam-disk and allows the other roller to be actuated by its cam-disk for opening and closing the exhaust-valve, whereby the points of the crank-circle, at which the exhaust and the compression respectively commence, are kept invariable for either direction of the revolution and for either degree of expansion.

ENRICO HOCKE.
SAMUEL LÖFFLER.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.