(No Model.) 3 Sheets—Sheet 1.

R. RADLEY.

VALVE GEAR FOR STEAM ENGINES.

No. 483,328. Patented Sept. 27, 1892.

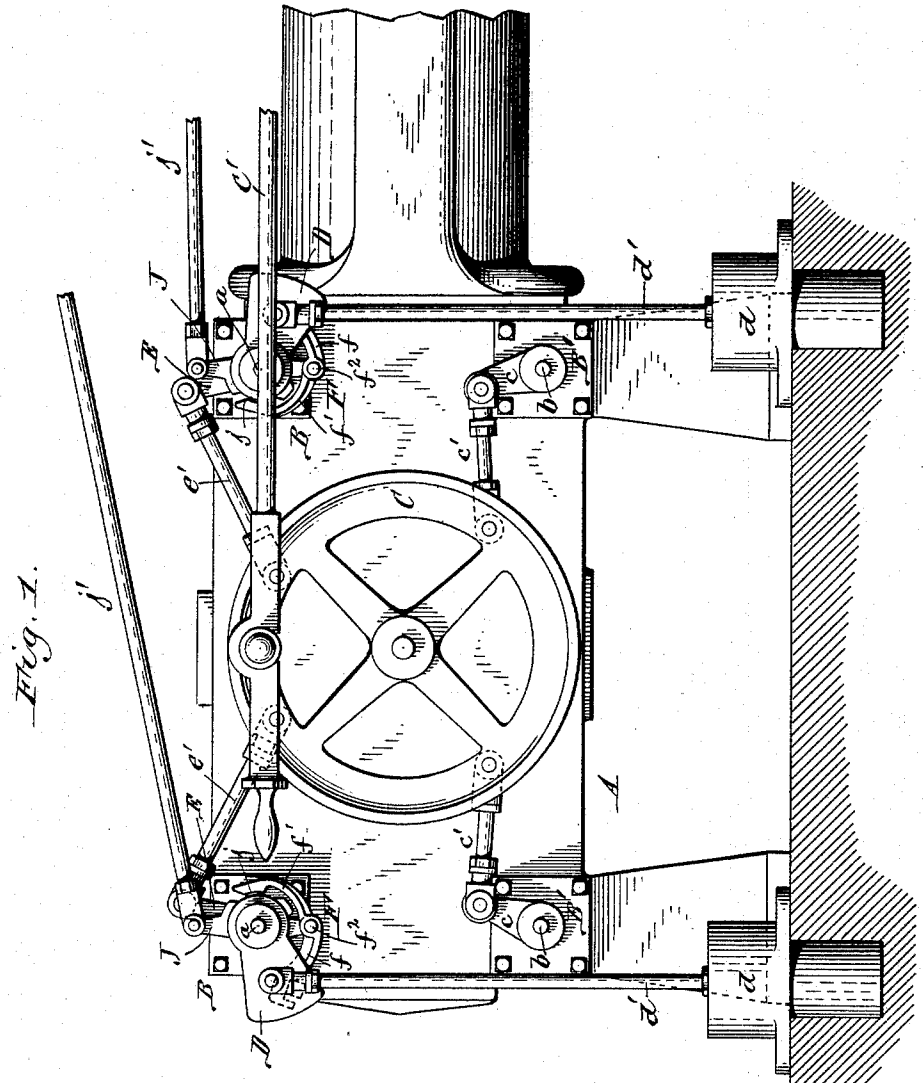

Fig. 1.

Witnesses:
Theo. L. Popp
Emil Neuhart

Richard Radley Inventor.
By Wilhelm & Bonnet
Attorneys.

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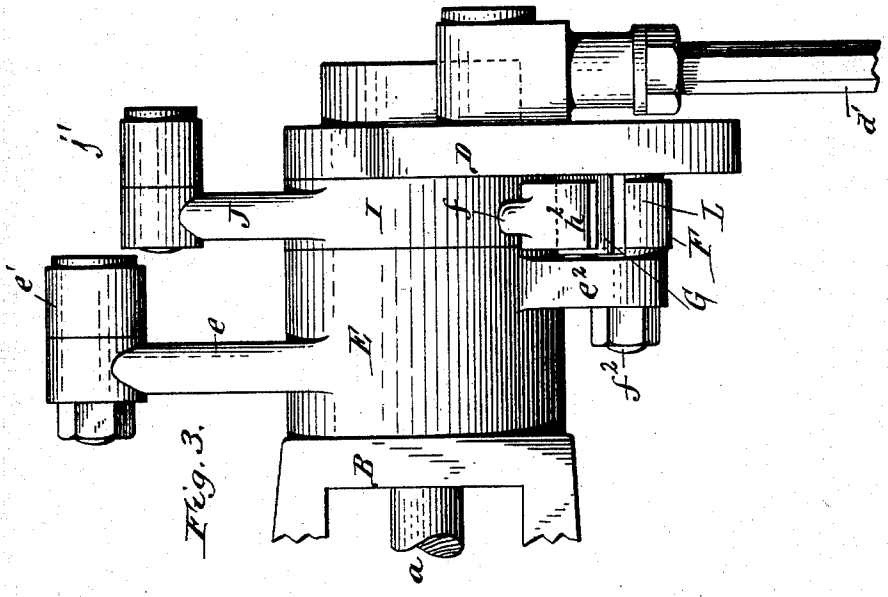

Fig. 3.

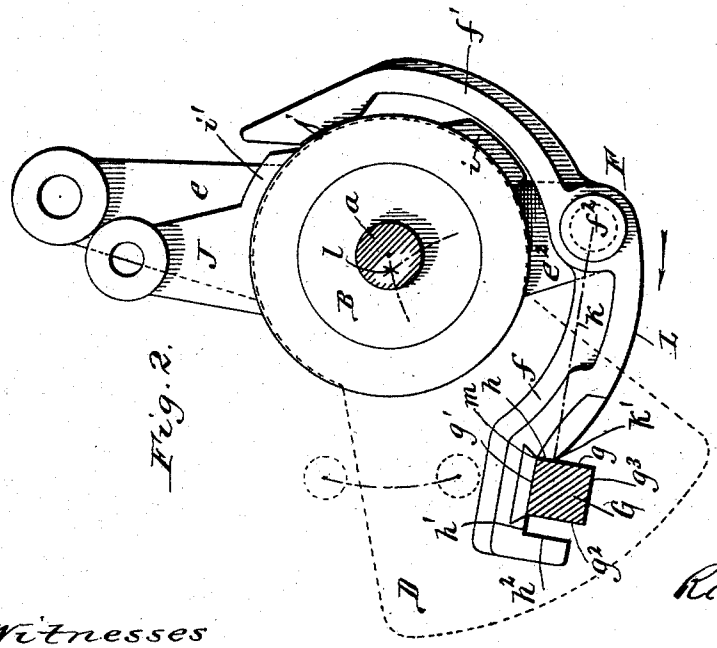

Fig. 2.

Witnesses
Theo. L. Popp
Emil Neuhart

Richard Radley
Inventor.
By Wilhelm & Bonnett
Attorneys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 3.

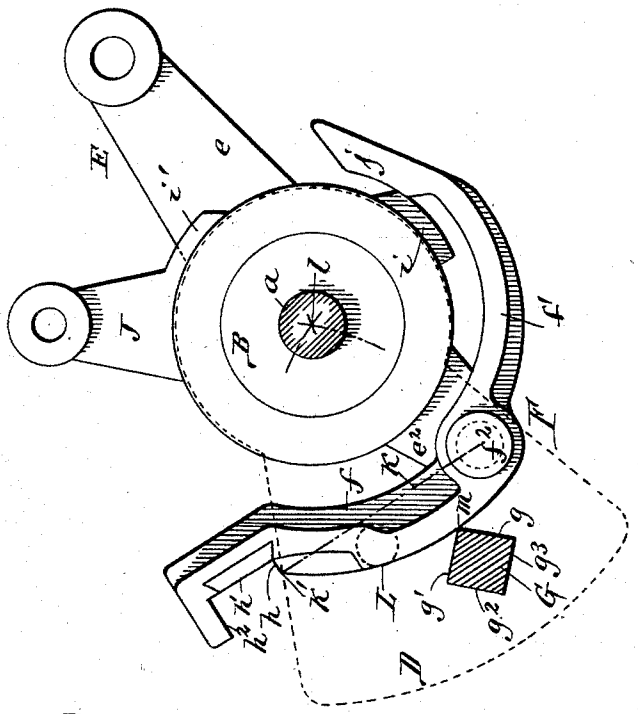
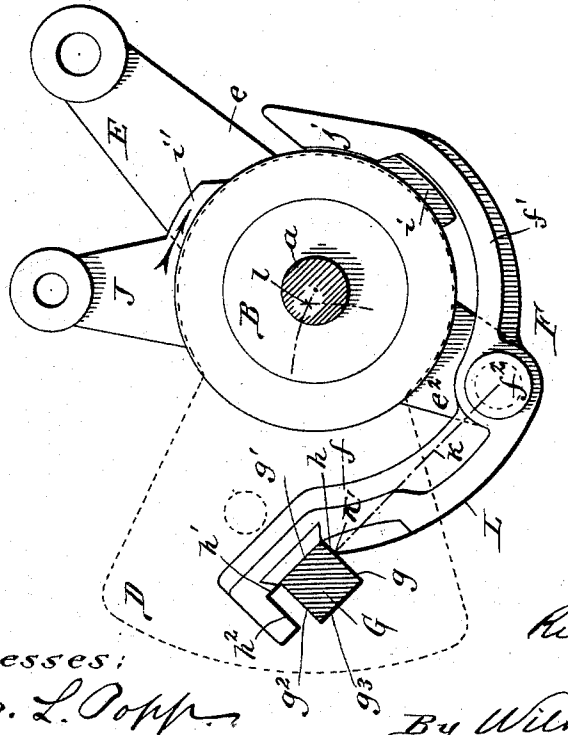


Fig. 4.



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Richard Radley
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Attorneys.

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UNITED STATES PATENT OFFICE.

RICHARD RADLEY, OF BUFFALO, NEW YORK.

VALVE-GEAR FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 483,328, dated September 27, 1892.

Application filed May 12, 1892. Serial No. 432,724. (No model.)

To all whom it may concern:

Be it known that I, RICHARD RADLEY, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Valve-Gears for Steam-Engines, of which the following is a specification.

This invention relates to that class of valve-gears in which separate steam-valves and exhaust-valves are used—as, for instance, in steam-engines of the "Corliss" type—and in which the steam is cut off automatically at different parts of the stroke.

The object of my invention is to improve the construction of the devices whereby the steam-valves are liberated, to reduce the wear of these parts, and to render the working thereof comparatively noiseless in operation.

In the accompanying drawings, consisting of three sheets, Figure 1 is a side elevation of the cylinder and connecting parts of a steam-engine provided with my improved valve-gear. Fig. 2 is a sectional elevation, on an enlarged scale, of the tripping mechanism of one of the steam-valves, showing the position of the parts preparatory to opening the valve. Fig. 3 is an end elevation of the same at right angles to Fig. 2. Fig. 4 is a sectional elevation of the tripping mechanism, showing the position of the parts when the valve is opened. Fig. 5 is a similar view showing the position of the parts when the valve has been liberated and closed.

Like letters of reference refer to like parts in the several figures.

A represents the steam-cylinder, provided at its ends with upper steam-inlet valves having stems *a a* and exhaust-valves having stems *b b*, the valve-stems being journaled with their outer ends in bearings B B′ in the usual manner.

C represents the oscillating wrist-plate, which is actuated by the usual eccentric-rod C′ from the main shaft. The wrist-plate C is connected with the stems *b* of the exhaust-valves by arms *c* and links *c′*. Each of the stems of the steam-valves is provided with a valve-arm D, which is connected at its outer end with a dash-pot *d* by a rod *d′* in the usual manner.

E represents a rock-lever, which is arranged in rear of the valve-arm and journaled on the cylindrical portion of the bearing of the valve-stem concentric with the latter. The upper arm *e* of the rock-lever is connected with the wrist-plate by a link *e′*.

F represents a trip-lever, whereby the valve-arm is raised for opening the steam-valve and released for closing the same. This trip-lever consists of a front or advancing arm *f* and a rear or trailing arm *f′*, and is pivoted between these arms to the lower arm e^2 of the rock-lever E by a bolt f^2, whereby the trip-lever is caused to take part in the oscillating movement of the rock-lever.

G represents a square stud secured to the rear side of the valve-arm D and provided, preferably, with four flat sides *g g′* g^2 g^3. The advancing arm of the trip-lever is arranged between the stud G and the valve-stem, and is provided in its under side with a notch which is adapted to engage with the inner side of the stud for the purpose of connecting the valve-arm with the rock-arm. The notch in the trip-lever is flat sided and forms a shoulder *h* on its inner side, a stop *h′* on its upper side, and a valve-closing hook h^2 on its outer side. When the notch of the trip-lever is in engagement with the stud of the valve-arm for opening the valve, as represented in Figs. 2 and 4, the shoulder *h* at the inner end of the notch engages squarely against the inner flat side *g* of the stud, and the stop *h′* or bottom of the notch, rests upon the upper flat side *g′* of the stud. Upon moving the trip-lever in the direction of the arrow in Fig. 2, when the shoulder *h* of the trip-lever engages with the stud of the valve-arm the latter is raised and the steam-valve connected therewith is opened. For the purpose of releasing the valve the notched arm of the trip-lever is moved inwardly or toward the valve-stem, thereby disengaging the trip-lever from the stud and permitting the dash-rod to draw the valve-arm downwardly and close the valve.

i i′ represent the front and rear knock-off blocks whereby the trip-lever is disengaged from the valve-arm for releasing the valve. These blocks are formed on a collar I, which is arranged between the rock-lever E and the valve-arm D and journaled upon the valve-stem bearing concentric with the valve-stem. The rear or trailing arm of the trip-lever is provided with a shoe *j*, which stands, when in its normal position, between the knock-off blocks, as represented in Figs. 2 and 4. Dur-

ing the first portion of the forward movement of the trip-lever its shoe stands between the knock-off blocks and its hook is in engagement with the stud of the valve-arm. As the forward movement of the trip-lever continues its shoe strikes the front knock-off block *i* and rises upon the same, whereby the trailing arm of the trip-lever is swung outwardly and the notched front arm thereof is swung inwardly and disengaged from the stud of the valve-arm. The collar carrying the knock-off blocks is provided with an upwardly-extending arm J, which is connected with the governor of the engine by a rod *j'*, whereby the position of the knock-off blocks is shifted concentrically with the valve-stem, so as to disengage the trip-lever from the stud at different points of the stroke. When the governor-belt breaks or runs off the pulley, the governor drops and rotates the collar I sufficiently in the direction of the arrow in Fig. 4 to cause the rear knock-off block to move the trailing arm of the trip-lever outwardly and hold it in this position, which prevents the notched arm of the trip-lever from engaging with and raising the valve-arm, thereby causing the engine tocome to a state of rest.

It is very essential that the liberating of the trip-lever from the stud of the valve-arm be effected with the least possible amount of friction, in order to prevent the shoe of the trip-lever from bearing so hard against the end of the front knock-off block that the operation of the governor is disturbed. For this purpose the shoulder *h* of the trip-lever is arranged at right angles to a radial line *k*, drawn from the pivot of the trip-lever to the outer corner *k'* of the shoulder, and the flat face *g* of the stud against which the shoulder bears is arranged parallel with the same when they are in engagement. This arrangement of the contact-surfaces between the shoulder *h* and stud permits the trip-lever to obtain a firm and reliable hold on the stud while opening the steam-valve, and also permits the trip-lever to easily release itself from the stud with a very small amount of friction.

It is very desirable that excessive vibration of the trip-lever on its pivot-bolt f^2 be avoided to reduce the wear on this pivot-bolt and also to render the operation of the trip-lever less noisy. In order to avoid this undue vibration, the under side of the front arm of the trip-lever is provided with a convex riding-face L, extending from the outer corner *k'* of the shoulder *h* toward the pivot-bolt in the form of an arc, the center of which is at *l*. The radius of this arc is equal to the distance between the upper inner corner *m* of the stud and the center of the valve-stem. When the shoulder is in engagement with the stud, the center of the arc is eccentric to the valve-stem, as shown in Figs. 2 and 4; but when the front arm of the trip-lever is raised by the knock-off blocks to permit the valve-arm to drop the center of the arc is shifted to a point concentric with the valve-stem, as represented in Fig. 5, which permits the stud to ride downwardly along the curved face of the trip-lever without further change in the position of the latter. During the subsequent backward movement of the trip-lever it rides with its curved face upon the stud without vibrating upon its pivot until its shoulder *h* passes the face *g* of the stud, when the front arm of the trip-lever drops and its shoulder again engages with the stud preparatory to again opening the steam-valve. While the stud in its downward movement bears against the curved face of the trip-lever and the latter in its subsequent return movement rises upon the stud, the trip-lever only partakes of the movement of the rock-lever, to which it is attached by the pivot-bolt f^2; but the trip-lever does not itself vibrate on the pivot-bolt f^2, because the curved riding-face of the trip-lever is concentric with the rock-lever and valve-stem during the return movement of the trip-lever. This reduces the wear on the bolt f^2 to a minimum and also renders the tripping action comparatively noiseless. If the dash-pot should from any cause become inoperative and refuse to draw the valve-arm downwardly for closing the valve when released from the trip-lever, the hook h^2 of the trip-lever during its return movement will catch against the stud of the valve-arm and carry the same downwardly, thereby positively closing the steam-valve.

I claim as my invention—

1. The combination, with the valve-stem, the valve-arm provided with a stud, and the rock-lever pivoted concentrically with the valve-stem, of a trip-lever pivoted on said rock-lever and provided with a shoulder which engages with the stud for opening the valve and having a convex riding-face which extends from the shoulder toward the pivot of the trip-lever and which supports the latter upon the stud after the trip-lever has been released from the stud, substantially as set forth.

2. The combination, with the valve-stem, the valve-arm provided with a stud, and the rock-lever pivoted concentrically with the valve-stem, of a trip-lever pivoted upon the rock-lever and provided with a shoulder which engages with the stud for opening the valve and having a convex riding-face which extends from the shoulder toward the pivot of the trip-lever and which rides upon the stud after the shoulder of the trip-lever has been disengaged from the stud, said convex face being eccentric with the valve-stem when the face rides upon the stud, substantially as set forth.

Witness my hand this 4th day of May, 1892.

RICHARD RADLEY.

Witnesses:
JNO. J. BONNER,
ALICE G. CONNELLY.