No. 656,888. Patented Aug. 28, 1900.

W. S. HAINES.

ENGINE VALVE.

(Application filed Sept. 30, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

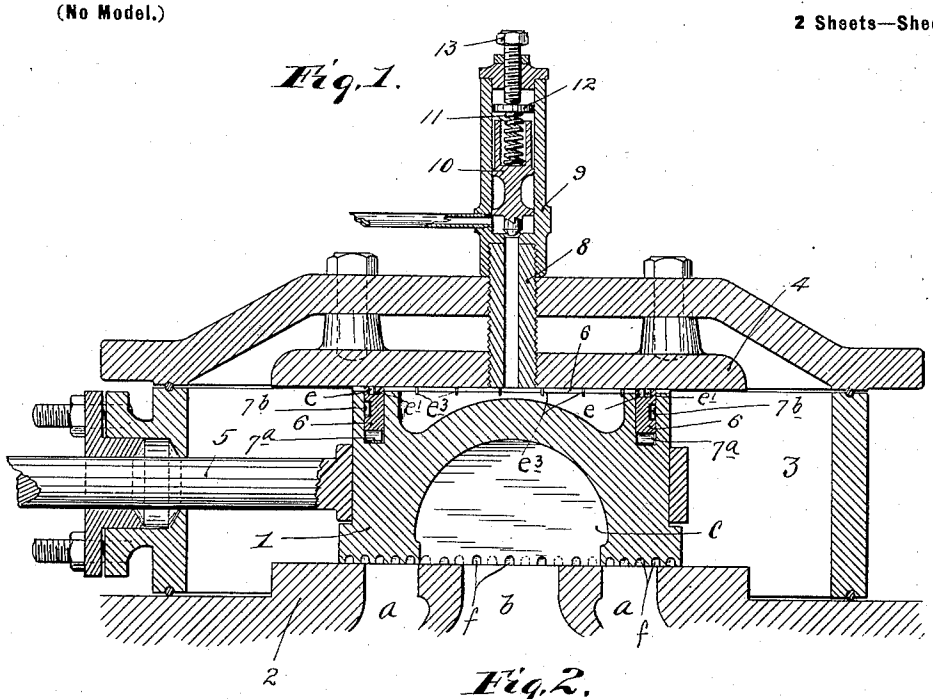
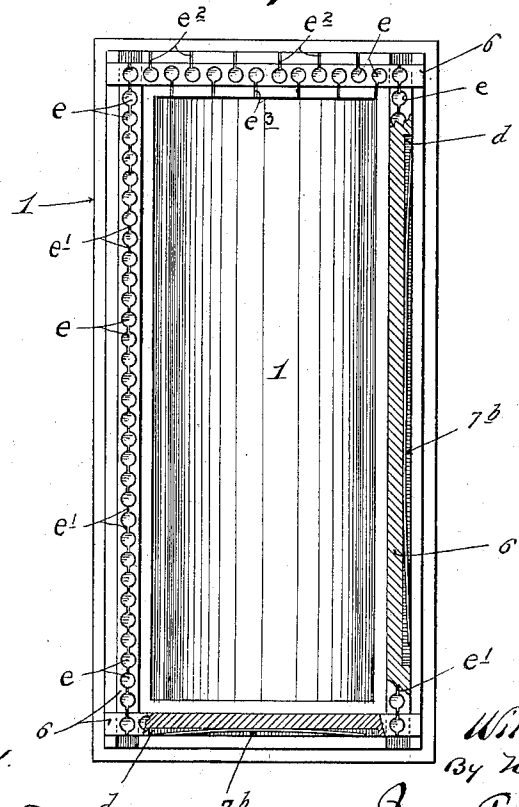


Fig. 2.



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Fig. 3.

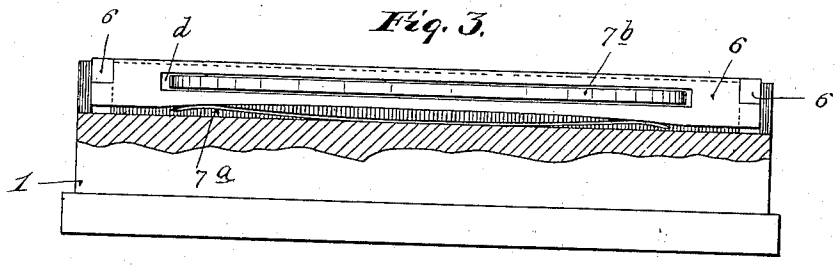


Fig. 4.

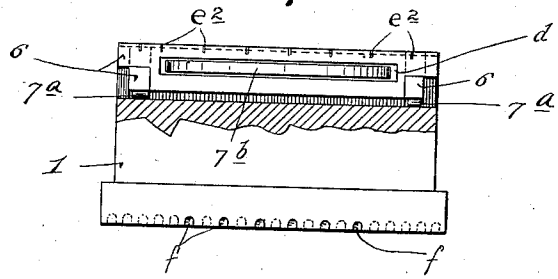


Fig. 5.

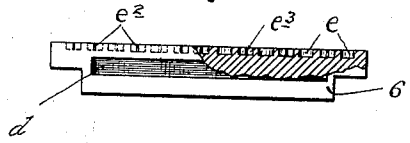
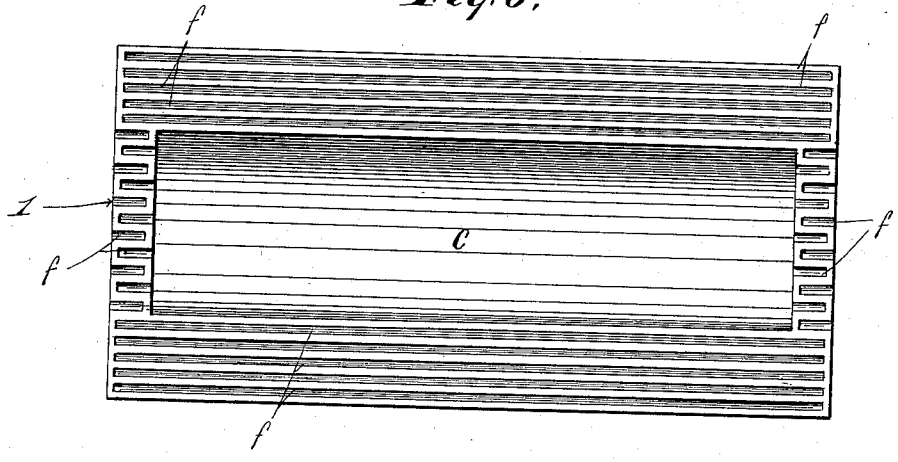


Fig. 6.



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UNITED STATES PATENT OFFICE.

WINFIELD S. HAINES, OF GLADSTONE, MICHIGAN.

ENGINE-VALVE.

SPECIFICATION forming part of Letters Patent No. 656,888, dated August 28, 1900.

Application filed September 30, 1899. Serial No. 732,254. (No model.)

To all whom it may concern:

Be it known that I, WINFIELD S. HAINES, a citizen of the United States, residing at Gladstone, in the county of Delta and State of Michigan, have invented certain new and useful Improvements in Engine-Valves; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide an improvement in balanced slide-valves for locomotives or other engines with a view of securing an engine of increased capacity and efficiency. The improvement is of special value for use in compound locomotives of the modern type, wherein steam is used at high pressures, as compared with the older practice.

To this end my invention consists of the novel devices and combinations of devices, which will be hereinafter described, and defined in the claims.

The invention is illustrated in the accompanying drawings, wherein like notations referring to like parts throughout the several views, Figure 1 is a vertical longitudinal section through a balanced valve and part of its seat constructed in accordance with my invention, some parts being broken away. Fig. 2 is a view, chiefly in plan, but partly in horizontal section, looking at the back of the valve, with the packing-strips in working position. Fig. 3 is a detail, partly in elevation and partly in vertical section, with some portions broken away to show the mounting of the packing-strips. Fig. 4 is an end view with some parts in vertical section to show the relations of the side to the end members of the packing-strip. Fig. 5 is a detail, chiefly in elevation, but partly in section, showing one of the end members of the packing-strips detached; and Fig. 6 is a plan view showing the face of the valve.

The numerals 1, 2, and 3 represent, respectively, the slide-valve, the valve-seat, and the valve-chest of a locomotive or other engine.

The valve 1 is of the proper construction for coöperating with a suitable balancing-plate 4 and is provided with the customary exhaust-cavity *c*. The valve c^2 is provided with the customary distribution-ports, the admission members being marked *a* and the exhaust member *b*. The valve-stem 5 is of the customary construction for engagement with the valve 1 in the usual way. The valve 1 is provided with packing-strips 6, mounted in suitable seats on the back of the valve for packing the joints between the valve and the balancing-plate 4. These packing-strips 6 and the mounting of the same involve certain features of improvement which will hereinafter appear. The principal feature of my invention has for its special object to provide means whereby such a slide-valve may be more completely balanced when in use on a compound high-pressure locomotive. The necessity for the improvement may be rendered more distinct by a brief reference to the difficulty which it was designed to overcome.

The so-called "Allan" or "Richardson" or "Allan-Richardson" balanced slide-valve is one which is in extensive use on locomotives. When a slide-valve is balanced by an ordinary balancing-plate, as in the Allan or Richardson valve, it is necessary to employ packing-strips or packing-rings between the back of the valve and the balancing-plate. The steam holds the strips up into their packing position when at work, and hence the steam coming between the under surfaces of the strips and the strip-seats in the back of the valve renders that much of the valve subject to high-pressure steam. There is also more or less additional surface of the valve which is necessarily exposed to high-pressure steam, tending to force the valve down onto its seat, notwithstanding the effect of the so-called "balancing-plate." Moreover, more or less leakage past the packing-strips into the space between the back of the valve and the balancing-plate is inevitable. Hence this large area between the back of the valve and the balancing-plate speedily becomes subject to high-pressure steam from the valve-chest, and unless some provision for escape is provided the balance of the valve speedily becomes very incomplete. In the Richardson-Allan valve it was sought to overcome this trouble from leakage past the packing-strips by providing an escape-port through the bridge of the valve into the exhaust-cavity of the same. When, however, this Richard-

son-Allan valve was put into use on compound engines, another difficulty at once appeared. The exhaust-cavity of the high-pressure valve is of course subject to receiver-pressure, and hence the same pressure will become operative over the top of the valve in the space between the packing-strips and the balancing-plate when there is a leakage-port through the bridge into that space, as in the Richardson-Allan valve. The receiver-pressure therefore no longer became available on the under surface of the valve for counteracting the pressure of the high-pressure steam on the top of the valve. In practice it was therefore found that the balance was bad. It was far from a balanced valve. Moreover, because of the inherent difficulties in the problem it was not commercially practicable to overcome the same by the simple matter of proportioning the areas of the relative surfaces subject, respectively, to the high and the low pressure steam. By a simple expedient I overcome this difficulty and secure a valve which when in use on a compound engine may be perfectly balanced, or substantially so. To this end I provide, as shown, a tube 8, tapping the space between the back of the valve, the packing-strips, and the balancing-plate and extending outward through the valve-chest. On its projecting end said tube 8 is provided with a regulating-valve. As shown, the casing 9 of the regulating-valve is screwed to the top of the tube 8 and is provided with a suitable valve-seat and a valve 10, subject to a spring 11, reacting between the valve and a disk 12, subject to a set-screw 13, working through the cap of the casing for varying the tension on the valve.

The distribution-valve 1 has a solid bridge or, in other words, is without any port through the walls of its exhaust-cavity. Still, otherwise stated, it is in the form of the old-fashioned slide-valve when provided with a balancing-plate. Hence said valve 1 when in use on a compound engine is subject to receiver-pressure on its under surface only—to wit, at the wall of the exhaust-cavity *c*. It follows that by properly setting the regulating-valve the high pressure due to leakage into the space between the back of the valve and the balancing-plate may be fixed as required for balancing purposes. Otherwise stated, the leakage may be permitted to escape only at the needed pressure for holding down the valve under the varying conditions of the surface. The low or receiver pressure at the exhaust-cavity *c* will of course vary somewhat, according to the speed and the point of cut-off. At average speeds and average cut-offs when the steam is used in the high-pressure cylinder at one hundred and eighty pounds the receiver-pressure will average somewhere around fifty-five pounds; but at high speeds and late cut-offs this receiver-pressure will run up to sixty or sixty-five pounds at the point of greatest compression in the receiver. The regulating-valve for the leakage-port through the tube 8 will of course be set to afford sufficient pressure on the back of the valve 1 to keep the same down to its seat under all its working conditions, or, in other words, it will be sufficient to hold down the valve under the maximum receiver-pressure. The distribution-valve by this simple expedient will be nearly but not quite balanced under average conditions or average speeds and cut-offs and will be exactly balanced at maximum speeds and latest cut-offs. By actual usage I have demonstrated the efficiency of this feature for the purpose had in view. I have found that the difference in results as compared with the results when the Richardson-Allan valve was in use on the same locomotive or as compared with results on other locomotives exactly the same in all respects with the exception of this difference in the valve is very marked. The hauling capacity of the engine is greatly increased or a corresponding saving in coal will appear for any given load.

Returning to a consideration of the packing-strips 6, it has hitherto been the custom to let these packing-strips rest loosely in their seats on the back of the valve. Reliance was placed upon the steam to force the strips into their proper working position when the engine was at work. Assuming the strips to be nearest to the proper surfaces with which they should coöperate for packing purposes, then when the steam was turned on the strips would be thrown into their proper working positions and held there by the steam. It did not necessarily follow, however, that the strips would be nearest to the proper surfaces when the steam was turned on. When mounted in the old way, the strips would when steam was off drop by gravity and under the motion of the valve might move laterally, more or less, in their seats. Hence when the steam was turned on the strips would hug the nearest surface of the valve. That might be the outermost instead of the needed innermost or proper packing-surface of their seats. Under such conditions a large leakage would occur. To overcome this difficulty, I provide springs 7^a and 7^b for holding the packing-strips 6 so that they cannot move away from the surfaces with which they coöperate for packing purposes. The springs 7^a I place in the strip-seats underneath the side strips 6, and the springs 7^b I place between the outer surfaces of the strips and the adjacent walls of their seats in the back of the valve. The strips 6 are recessed on their outer surfaces, as shown at *d*, to afford seats for the strips 7^b. The end and side strips are joined together in such a way that the long strips carry the short strips. With the use of these springs 7^a and 7^b it is obvious that the packing-strips 6 cannot leave the surfaces with which they coöperate for packing purposes. Being therefore always in proper position they are ready for the proper packing action when the steam is turned on, and no leakage by displacement

of strips can occur. As another feature respecting the strips they are cupped or pitted on their faces, as shown at *e* in Fig. 2. The pits or cups *e* on the side strips are all connected together and open to the valve-chest by small ducts *e'*, running lengthwise of the strips. The pits or cups *e* on the end members of the strips 6 are not connected together; but the alternate members thereof are provided, respectively, with the ducts e^2 and e^3. The ducts e^2 lead to the valve-chest and the ducts e^3 to the leakage-space between the back of the valve and the balancing-plate 4. Hence more or less steam can always enter the ducts *e'*, e^2, and e^3 for keeping full the cups or pits *e* on the faces of the strips 6, and will thereby partly counteract the pressure from the steam underneath the strips, to this extent balancing the strips, and the steam will also carry in sufficient oil to afford good lubrication between the faces of the strips and the surface of the balancing-plate contacting therewith. It should be noticed as a detail that the ducts *e'* extend entirely across the line of travel of the strips on the balancing-plate in one direction, while the ducts e^2 and e^3 together do the like across the line of travel of the end strips on the balancing-plate, thereby insuring complete lubrication. This admission of some steam over the faces of the packing-strips is a material improvement for high-pressure engines. In these modern high-pressure engines the pressure underneath the strips is greater than is needed for balancing purposes. The strips must be strong in order to do their work, and hence they must have considerable mass or bulk. They cannot be thinned down in proportion to the increased pressure. Therefore under the excess of pressure the strips as hitherto constructed would ride against the balancing-plate with unnecessary friction, giving rise to large wear and tear. By partly counterbalancing the strips, as herein provided, that portion of unnecessay drag is removed from the valve and the wear and tear are correspondingly decreased.

As another detail of advantage, although not claimed herein as an improvement, the face of the distribution-valve is corrugated, as shown at *f* in Fig. 6. These corrugations *f* serve to cage more or less of the steam at the time when the valve travels over the ends of its seat and to carry the same in with the valve over the face of the seat, thereby rendering that much steam available underneath the valve for balancing purposes, and the steam thus carried in will also take with it enough oil to afford good lubrication for the valve. It is assumed, of course, that the ordinary force-feed-cylinder lubricator is used in connection with the valve herein disclosed.

These details of improvement in respect to the strip and the corrugations on the face of the valve have also been tested in actual practice and found to give the improved results herein stated or implied.

Respecting the main feature of the invention—to wit, the escape provided from the space between the balancing-plate and the back of the valve to the atmosphere under the control of a regulating-valve—it must be obvious that the details of the construction might be varied without departing from the spirit of my invention.

What I claim, and desire to secure by Letters Patent of the United States, is as follows:

1. In a balanced slide-valve, the combination with the valve and the balancing-plate, of packing-strips having pits or cups in their faces open to steam-pressure, whereby the strips are lubricated and are partly balanced, substantially as described.

2. In a balanced slide-valve, the combination with the valve and the balancing-plate, of the packing-strips carried by the valve and the springs for preventing the strips from falling away from the surfaces which they are intended to pack when the steam is turned off, whereby the said packing-strips will always be forced into proper packing position when the steam is turned on, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WINFIELD S. HAINES.

Witnesses:
M. M. McGRORY,
JAS. F. WILLIAMSON.