

Fig. 1.

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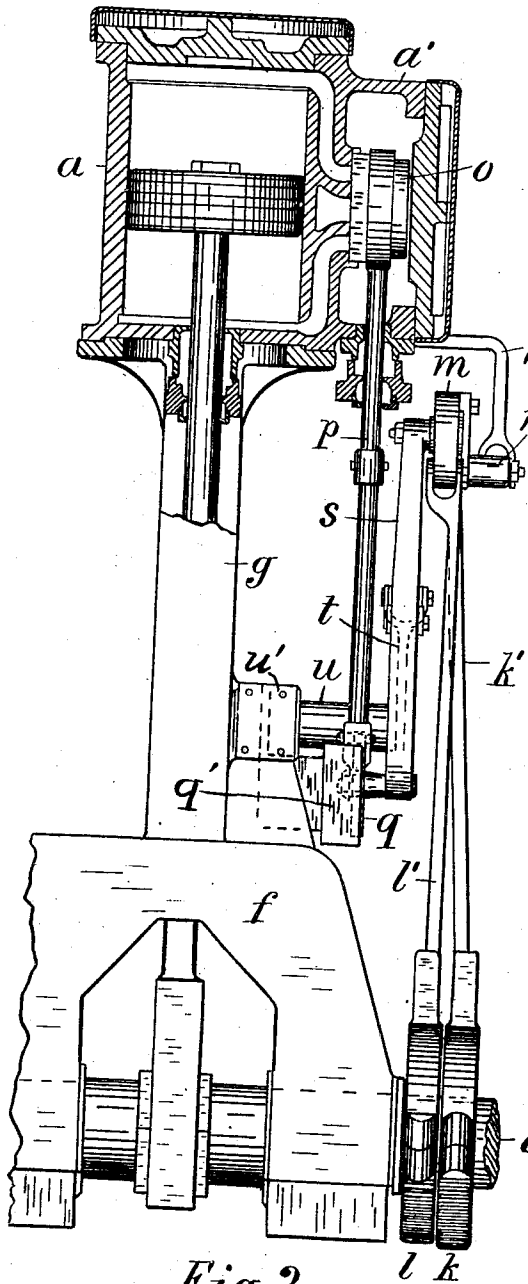


Fig. 2.

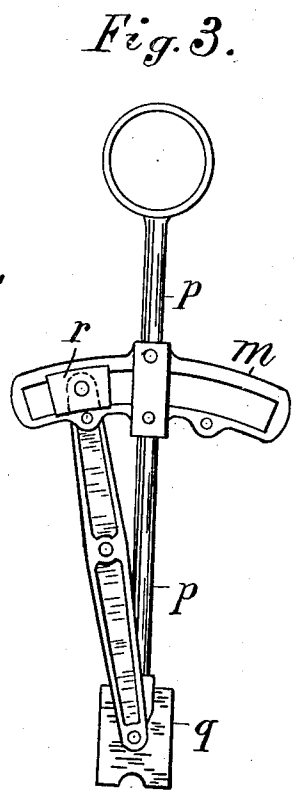


Fig. 3.

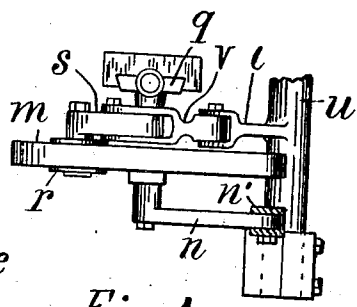
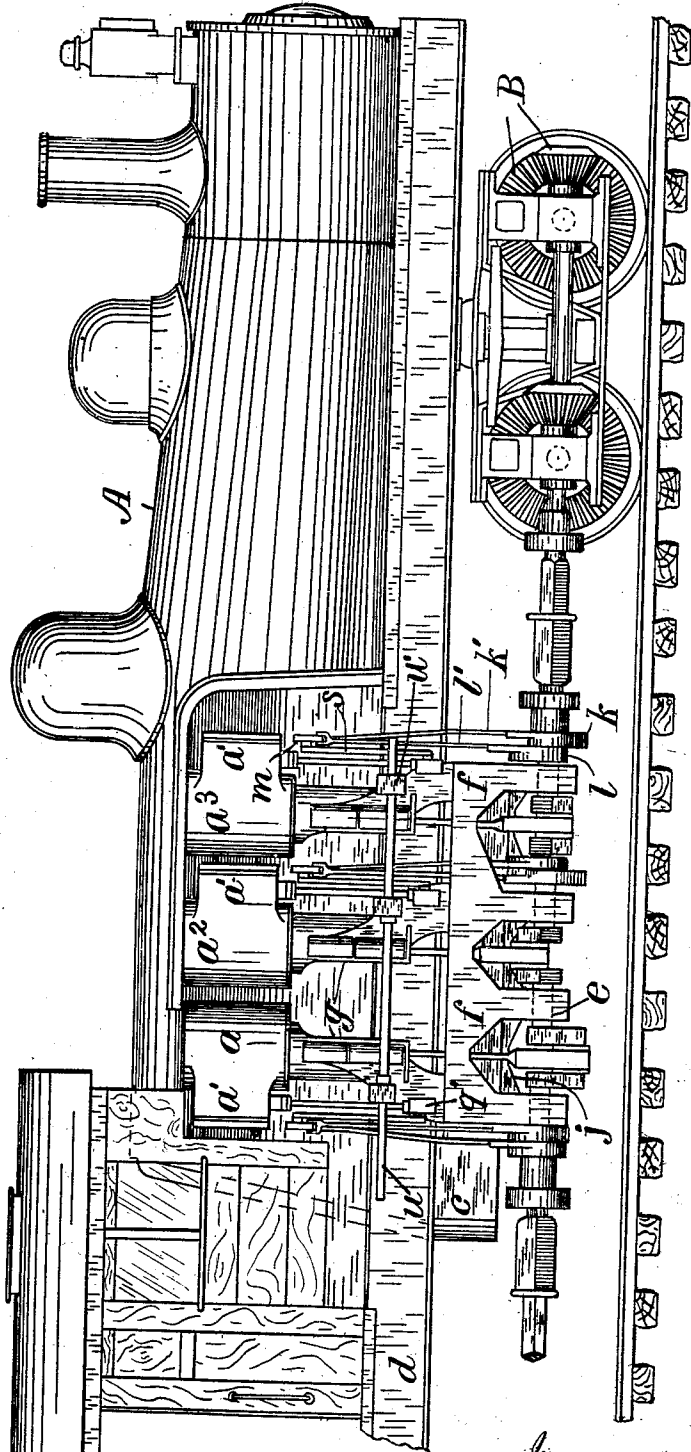


Fig. 4.

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Fig. 5.



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# UNITED STATES PATENT OFFICE.

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## VALVE-GEAR.

No. 895,995.

Specification of Letters Patent.

Patented Aug. 11, 1908.

Application filed February 10, 1908. Serial No. 415,022.

To all whom it may concern:

Be it known that I, LEWIS E. FEIGHTNER, a citizen of the United States, residing at 715 South Broadway, Lima, county of Allen, and State of Ohio, have invented certain new and useful Improvements in Valve - Gear, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The present invention consists of a particular application of the so-called "Gooch link valve-motion" to the Shay locomotive, in which several vertical cylinders are fastened side by side upon the firebox and their pistons connected to a crank-shaft parallel with the side of the engine frame. In this construction the vertical steam cylinders are set close to the locomotive firebox so that the space between the center of the cylinder and the firebox is not sufficient for the motion of a so-called Stevenson link, which in its ordinary operation is shifted endwise upon a link-block attached to the valve-stem.

In the Gooch link valve-motion the link is not shifted, but the link-block is connected with the valve-stem through a "radius-bar" and is adjustable in the link-slot to reverse the valve-motion or vary the point of cut-off.

The cylinders could, of course, be set far enough from the side of the boiler to use a Stevenson link, but such an arrangement would be very undesirable, as the cylinders are held much more firmly and securely when attached close to the surface of the boiler.

By means of the modification of the Gooch link valve-motion which is shown herein, I am able to set the cylinders close to the boiler and operate the cylinder slide-valve in the required manner.

To avoid an excessive motion of the tumbling-shaft, and the lever and arm attached thereto, which shift the link-block in this construction, I connect the arm upon the tumbling-shaft with the radius-bar at the middle of its length; so that the movement of the arm is only one-half that of the link-block.

The nature and operation of my construction will be understood by reference to the annexed drawing, in which

Figure 1 is an end elevation of a locomotive firebox with an engine-cylinder attached and a steam-valve connected with a Gooch valve-gear; Fig. 2 is a side view of a portion of the crank-shaft and its bearing-bracket,

with one cylinder and steam-chest in section and the Gooch valve-motion arranged to connect two eccentrics upon the crank-shaft with the valve; Fig. 3 is a front view of the reversing mechanism without the eccentric connections; Fig. 4 is a plan of the steam-valve and its crosshead with the radius-bar and its link connections; and Fig. 5 is a side elevation of the forward end of a Shay locomotive showing the connection of the engines with the crank-shaft. Fig. 5 shows three cylinders  $a$ ,  $a^2$  and  $a^3$  attached to the same side of the locomotive firebox  $c$ , Fig. 1 showing the foot-piece  $b$  by which each cylinder is attached.

The locomotive-frames  $d$  are shown extended at opposite sides of the firebox and of the locomotive boiler  $A$ , with a longitudinal crank-shaft  $e$  mounted in a bracket  $f$  which is extended parallel with the crank-shaft below the cylinders. This bracket is connected to one of the frames  $d$  by braces  $i$  and  $j$ , and also to each cylinder by an engine-frame  $g$ .

In Fig. 5, the crank-shaft is shown coupled, as is usual in Shay locomotives, to gearing  $B$  for driving the truck-wheels under the forward end of the boiler, but the rear end of the locomotive and the truck-wheels under the same are omitted from this figure.

The crank-shaft has eccentrics  $k$  and  $l$  thereon for each cylinder, such eccentrics having their eccentric-rods  $k'$  and  $l'$  connected with the Gooch link  $m$  which rods support or carry the link close below the steam-chest  $a'$ , the link being held from endwise movement by a hinge-bar  $n$  pivoted at one end to the center of the link and at the opposite end to a stationary foot  $n'$  upon the steam-chest. The steam-chest is upon the side of the cylinder, over the crank-shaft, and contains the valve  $o$  having a valve-stem  $p$  extended past the link toward the crank-shaft and connected at its lower end with a valve-stem crosshead  $q$ . The crosshead is vertically movable in a guide  $q'$  upon the side of the engine-frame  $g$ .

The steam-chest is shown connected with a steam-pipe  $o'$  and an exhaust pipe  $p'$ .

Owing to the arrangement of the crank-shaft  $e$  parallel with the side of the firebox, the link is necessarily placed at right angles to the firebox, and is prevented from endwise movement by its nearness to the side of the firebox. The use of the Gooch link-gear

avoids the setting of the cylinder farther out from the firebox, and thus secures a very compact and rigid arrangement for the cylinder support *b*.

5 A block *r* is fitted movably in the link, as is usual, and a radius-bar *s* jointed thereto and extended toward the crank-shaft. The lower end of the radius-bar is pivoted to the crosshead *q*; and the radius-bar can be  
10 rocked, to bring the block *r* in line with either of the eccentric-blades, by an arm *t* upon a tumbling-shaft *u*, which arm is connected with the radius-bar intermediate to its ends by a connecting-rod *v*. The tumbling-shaft is mounted in bearing *u'* upon the  
15 inner side of the engine-frame *g*.

The lower end of the radius-bar participates in the rectilinear motion of the valve-stem crosshead, while the upper end can be  
20 oscillated by the arm *t* to reverse the valve, or cut off steam in the usual manner.

The arrangement of the link close below the steam-chest places it at the farthest possible point from the crank-shaft, thus giving the eccentric-rods *k'* and *l'* the greatest  
25 length possible in this construction, which produces the most advantageous movement of the link.

By extending the valve-stem past the link  
30 toward the crank-shaft, and the radius-bar from the block *r* toward the crank-shaft, the radius-bar may be made of suitable length and the motion of the link thus transmitted to the valve advantageously.

35 To exhibit the swinging of the radius-bar, I have shown it by dotted lines *s'* in Fig. 1 with the block moved to the right hand end of the link; and in Fig. 3 I have shown it with the block moved to the left hand end of the  
40 link, this illustration showing clearly that the connecting-rod *v* moves only half as far as the link-block *r*, because the connecting-rod is attached to the middle of the radius-bar.

Where several cylinders are mounted  
45 closely adjacent upon the side of the boiler over the crank-shaft, as is usual in Shay locomotives, it is common at the present time to connect the series of crank-bearings between the adjacent cranks by a single bracket-casting  
50 *f*, as shown in Fig. 5 herein, and claimed in L. E. Feightner's Patent No. 879,617 dated February 18, 1908, and the uninterrupted extension of such casting above the crank-shaft greatly contracts the space between the crank-shaft and the cylinders, and renders the application of a Stevenson link very undesirable, for which reason I have devised the present construction, in which the valve-stem is connected to a crosshead  
55 *q* near the top of the bracket-casting *f* and is thus guided effectively on a straight line, irrespective of any position into which the radius-bar is moved, and a great length of the radius-bar is not therefore essential.

65 By the use of such a crosshead-guide for

the valve-rod, and the connection of the tumbling-shaft arm with the radius-bar at the middle of its length, I make the whole valve-gear very compact and thus secure the desired operation of the slide-valve. 70

Having thus set forth the nature of the invention what is claimed herein is:

1. In a valve-gear for locomotives, the combination, with the locomotive boiler, a crank-shaft adjacent the boiler extending  
75 substantially parallel therewith, and an engine cylinder for operating said crank-shaft secured adjacent the boiler, of a curved link held from endwise movement located between the valve-chest of said cylinder and  
80 the crank-shaft and having its concave side toward the shaft, a movable link-block for said link, a rectilinearly movable valve connection adjacent said crank-shaft, a radius-bar connecting said block with said connection, eccentric means on said crank-shaft for operating said link, and means for shifting  
85 said block along said link.

2. In a valve-gear for Shay locomotives having vertical cylinders upon the side of the boiler firebox and a crank-shaft below the  
90 same, the combination, with the locomotive boiler and the crank-shaft adjacent the boiler extending substantially parallel therewith, of a vertical engine-cylinder for operating  
95 said crank-shaft secured upon the side of the boiler firebox close to the same, the valve-stem for the slide valve being arranged to reciprocate vertically over the crank-shaft, the link *m* held from endwise movement adjacent  
100 to the bottom of the steam-chest and having its concave side toward the crank-shaft, the link-block *r* movable in the said link, a rectilinearly movable valve-connection adjacent said crank-shaft connected with the valve-stem  
105 *p*, a radius-bar connecting the link-block with said valve-connection, eccentric means on said crank-shaft for operating said link, and a tumbling-shaft and connection to the radius-bar for shifting said block in said  
110 link.

3. In a valve-gear for Shay locomotives having vertical cylinders upon the side of the boiler firebox and a crank-shaft below the  
115 boiler firebox and the crank-shaft adjacent to the boiler extending substantially parallel therewith, of a series of vertical engine-cylinders for operating said crank-shaft secured upon the side of the firebox close to the same and  
120 over the said crank-shaft, a steam-chest *a'* upon the side of each cylinder over the crank-shaft with valve-stem *p* projected therefrom toward the crank-shaft, a link *m* held from endwise movement adjacent to the bottom  
125 of the steam-chest and having its concave side toward the crank-shaft, the link-block *r* movable in the said link, the crosshead *q* attached to the valve-stem adjacent to the crank-shaft, a radius-bar connecting such  
130

crosshead with the link-block, two eccentrics on said crank-shaft with connections to the ends of the link, and the tumbling-shaft *u* having arm *t* with connecting-rod *v* jointed to the middle of the radius-bar for shifting the said block in the link.

4. In a valve-gear for Shay locomotives having vertical cylinders upon the side of the boiler firebox and a crank-shaft below the same, the combination, with the locomotive boiler and the crank-shaft adjacent the boiler extending substantially parallel therewith, of a series of vertical engine-cylinders *a* attached to the side of the fire-box each having the frame *g* depending therefrom, the casting *f* uniting said frames and provided with bearings *f'*, the crank-shaft *e* fitted to said bearings and connected to the pistons of the said cylinders, a steam-chest *a'* at one side of each cylinder over the crank-shaft with valve-stem *p* projected downward therefrom, the crosshead *q* fitted to a guide *q'* upon each engine-frame and connected to the

valve-stem *p*, the eccentrics *k* and *l* upon the crank-shaft with the eccentric-rods *k'* and *l'* 25 projected toward each steam-chest, the link *m* carried by the said connecting-rods and held from endwise movement by the hinge-bar *n*, the link-block *r* movable in the link, the radius-bar *s* jointed to the link-block and 30 the crosshead *q*, the bearings *u'* upon the inner side of the engine-frames with tumbling-shaft *u* journaled therein, and an arm *t* upon the tumbling-shaft adjacent each radius-bar with connecting-rod *v* jointed to such arm 35 and to the middle of the radius-bar, the whole arranged and operated as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing 40 witnesses.

LEWIS E. FEIGHTNER.

Witnesses:

H. C. HAMMACK,  
K. C. HOVER.