H. UHRY & H. A. LUTTGENS.

VALVE GEARING FOR STEAM ENGINES.

No. 12,564. PATENTED MAR. 20, 1855.

fig. 1

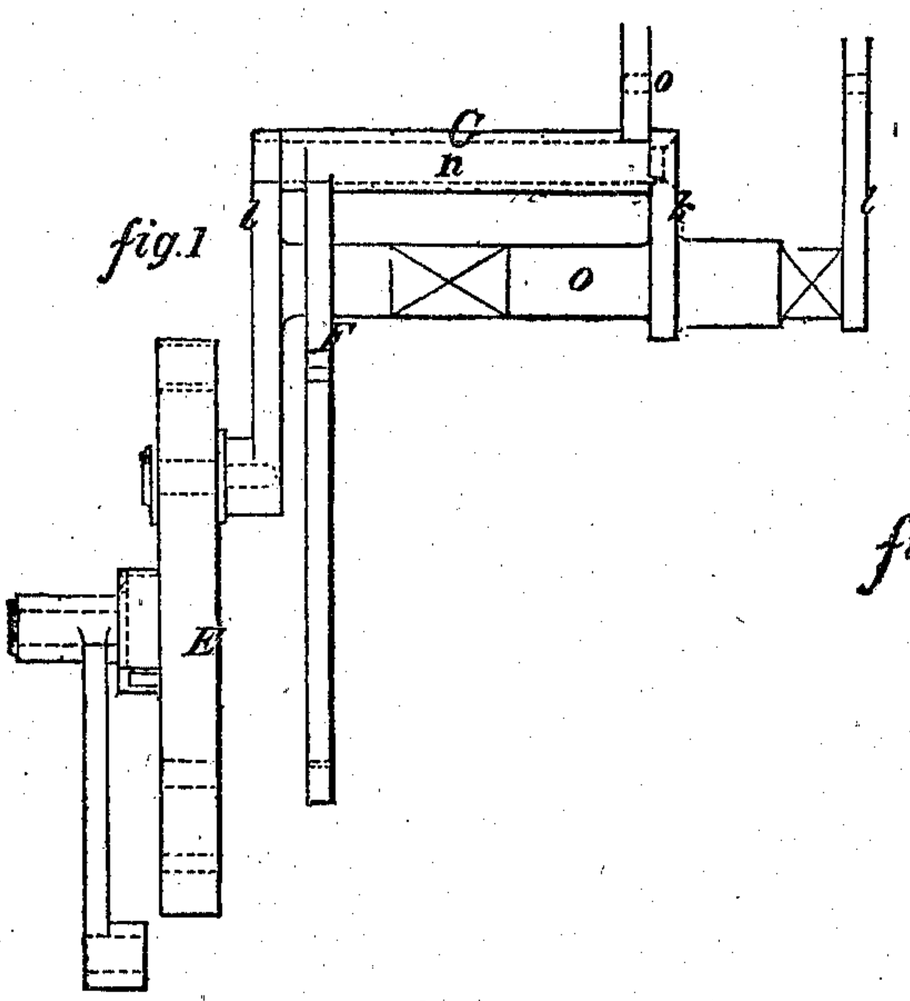


fig. 2

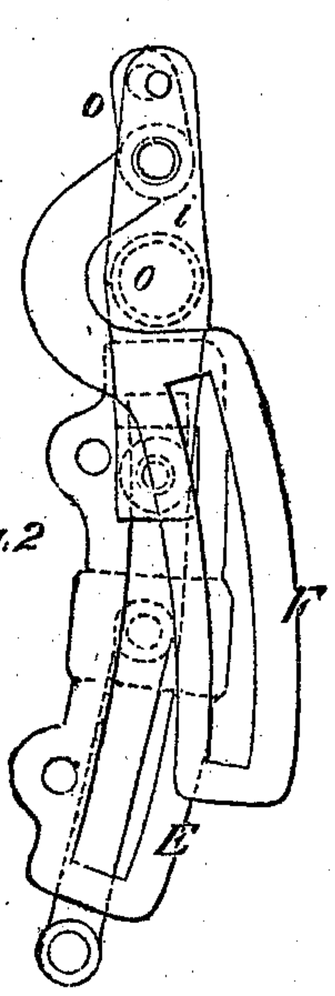


fig. 3

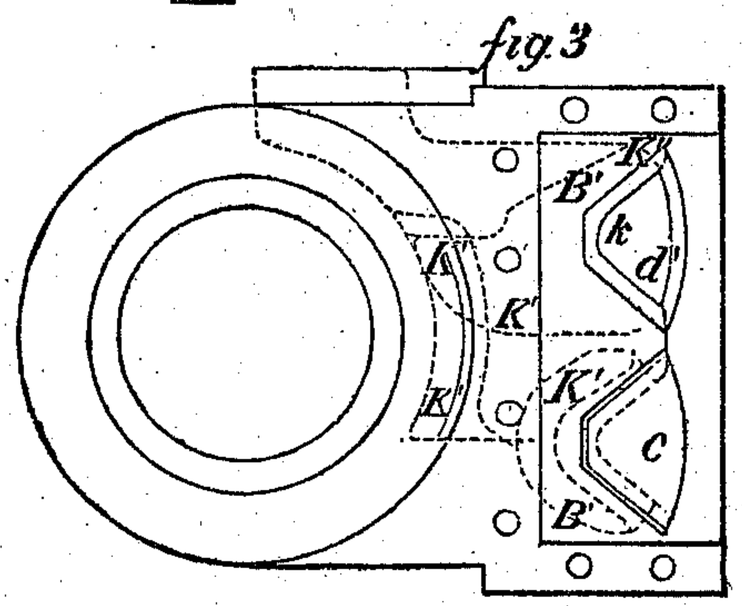
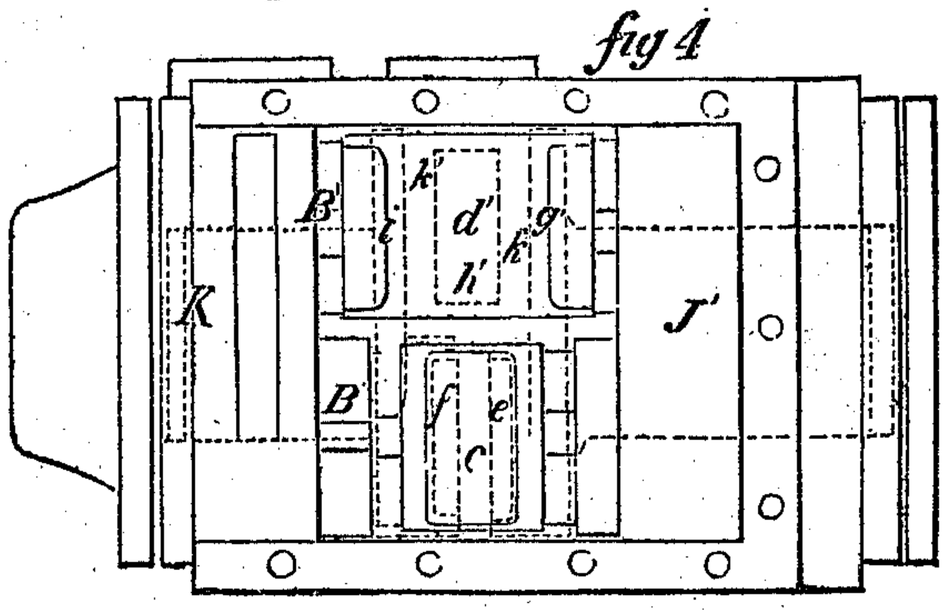


fig 4



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UNITED STATES PATENT OFFICE.

H. UHRY AND H. A. LUTTGENS, OF PATERSON, NEW JERSEY.

VALVE-GEARING FOR STEAM-ENGINES.

Specification of Letters Patent No. 12,564, dated March 20, 1855.

To all whom it may concern:

Be it known that we, H. UHRY and H. A. LUTTGENS, of Paterson, in the county of Passaic and State of New Jersey, have invented new and useful Improvements in the "link motion" applicable to locomotive, marine, and stationary steam-engines for the purpose of increasing the amount of opening of the steam-ports at the higher grades of expansion and retarding and varying the time of the exhaust; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front elevation of a steam engine with the improvements applied, Fig. II an end elevation and Fig. III a plan of the same; Figs. IV and V are a plan and end elevation, of the steam cylinder, with the valve chest uncovered, on a larger scale and Figs. VI and VII are front and side elevations, of a part of the valve gear on a larger scale.

Similar letters of reference, indicate corresponding parts in each of the several figures.

Our invention consists in a differential rocker, forming a part of the main rocker, whose movements are controlled by the ordinary "link motion," and a quadrant rocker arm, which is operated upon by an eccentric. The motion produced by the ordinary link motion, and that of the differential rocker actuate two valves, which are arranged side by side in the steam chest; one valve or the one operated upon by the ordinary link motion, fulfils the offices of distributing the steam to the cylinder, supplying outside lead, and cutting-off the steam in proportion to the decrease of travel; the other valve, or the one operated upon by the differential rocker fulfils the office of exhausting the steam, while at the same time it opens and cuts off the admission of steam near full stroke of the piston.

The differential rocker is hung upon a spindle parallel to the main rocker shaft, and the spindle is stationary within two arms of the same, while the differential rocker turns freely upon it; the latter is provided with two arms, one forming a quadrant arm, which holds a sliding block, operated by an eccentric; the extremity of the other arm forms a joint, to receive a valve rod, operating the exhaust valve, the motion of which is mainly due to the motion of the main rocker, which is connected to the stationary- or shifting- link motion, but is modified and regulated, by the position of the block, within the quadrant arm of the differential rocker. The eccentric which operates the quadrant arm of the differential rocker, is fitted and fastened upon the crank shaft, beside the two eccentrics, which operate the ordinary link-motion, all three having in this case the same amount of throw; the throw of the additional eccentric may however be varied as deemed proper. The eccentric near its extremity is secured by a pin to a block which latter is fitted, so as to slide freely within the slot of the quadrant rocker arm; the end of the eccentric rod is fastened, by a pin to a connecting piece, which forms a link between the former and the reversing lever, the fulcrum of which has its bearing in a part of the framing of the engine; the second arm of this lever forming about an angle of 90 deg. with the former, has secured to its end the reversing rod, which latter may be secured at its other extremity, to an ordinary reversing lever, being supplied with a handle and catch, the latter fitting into corresponding notches, made at the periphery of a segment (in this case the reversing rod is itself supplied with notches, fitting upon a bar fastened to the framing of the engine).

The main valve, or the one operated upon by the ordinary link motion, is a solid plate without cavities, and its seat is provided with two steam-ports, by which the steam

enters passages leading to the ends of the cylinder. The second valve, or the one operated upon by the differential rocker, is supplied with the exhaust cavity, its seat has two steam ports and one exhaust port, the steam ports opening into the same passages, which lead to the ends of the cylinder, these passages being properly extended so as to meet their respective steam-ports. The valve-seats may be made of a \/\/ shape, each \/ forming a seat for one of the two valves, or they may have the shape of an /\ each side of the figure forming a seat for one of the two valves.

To enable others skilled in the art to make and use our invention we will proceed to describe its construction and operation.

A^3 represents the framing of a steam-engine.

A is the crank-shaft; one of the bearings supporting the same being represented by S'' which is firmly secured to the framing of the engine.

C and D are two eccentrics operating the link E, and B a third eccentric operating the quadrant arm F of the differential rocker G; all three eccentrics are fitted and fastened upon the crank shaft A. Eccentrics C and D are set in advance of the center line of the shaft, to provide for the lead and lap of the valves, while the center line of eccentric B, falls in the center line or nearly so of the crank, and its center opposite the crank-pin, if the connection between eccentric and valve is intermediate (eccentric and valve moving in opposite direction); on the same side with the crank pin, if the connection between eccentric and valve is direct (eccentric and valve moving in the same direction. The eccentric rods R'' and Q'' of the eccentrics D and C, are connected to the link E by pins *a* and *b*.

The link is provided with a saddle *c*, bearing a pin upon which is fitted the joint *d* of the supporting link *e;* the other extremity of which, forming the joint *f*, is connected by a pin to the end of the reversing lever H, the fulcrum of which forms a socket L, fitted so as to turn freely upon the stationary spindle T, which is firmly secured to a part of the framing of the engine; one end of the arm K, forming part of the reversing lever, is fitted and keyed upon the socket L, and its other end is connected by a pin, to the end of reversing rod M, which is provided with notches *a'*, a^2, a^3, fitting upon the stationary bar N, which latter is firmly secured to a part of the framing of the engine.

A block *g*, which has flanges on both sides of the link, to prevent its lateral motion, is fitted so as to slide freely within the slot of the link E, and is provided with a hole fitting upon the rocker pin *p*.

The main rocker O, is provided with three arms *i*, *k*, *l*, the arm *l* having a hub *m*, so as to allow room for the eccentric rod ends, and it is also extended beyond the center of the rocker shaft, so as to provide one of the rocker arms, supporting the stationary spindle *n*, which is fitted into and passes through the center of the differential rocker G, and also in the ends of the rocker arms *l* and *k*, into which it is secured by riveting, as shown at *k'''*, while the rocker G is fitted so as to turn freely upon it. The main rocker O, may be only provided with arms *l* and *i*, in which case the spindle *n* extends from *l* to *i* as also the socket of the differential rocker G.

The upper part of the quadrant rocker-arm F is of such a shape, as not to come in contact with the main rocker O while at the extremity of its motion; the end of the rocker G is provided with an arm *o*, the extremity of which forms a joint for the valve rod *p*, while the end of the rocker arm *i* forms a joint for valve rod *q*. The bearings *r* and *s*, supporting the main rocker O at *r'* and *s'*, are secured to some stationary part of the engine, sufficiently strong to support them, being secured in this case to the frame and slides.

The eccentric rod P'' of the eccentric B, is near its extremity secured by a pin *t*, to the block *u*, which latter is fitted, so as to slide freely within the slot of the quadrant on F. The end of this eccentric rod, is fastened by a pin to a connecting piece u^3, which forms a link between the eccentric rod P'' and reversing lever *v*, having its fulcrum secured by a pin *y*, to a part of the framing of the engine, and being fitted so as to turn freely upon the pin; the arm *w*, which forms part of this lever, is about at an angle of 90 degrees with the arm *v*, and has secured to its end by a pin the reversing rod *x*, which latter is provided, near its other extremity with notches *b'*, *b''*, *b'''*, fitting upon the stationary bar N. The valve rods *p* and *q*, which are jointed at *z* and *z'*, pass through stuffing boxes *m'* and *l'* into the steam chest, and are each connected to their respective valves *c'* and *d'*.

The main valve *c'*, rests with its full surface upon its valve seat, which latter is provided with steam ports *e'* and *f'*, while the valve *d'* is provided with an exhaust cavity *k'*, which reaches in this case, from the edge of steam port *i'* to steam port *g'*; its seat has two steam ports *i'* and *g'*, and an exhaust port *h'*. Both valves are of a V shape, and both ends of the steam valve *c'*, form solid plates, to provide strength for the surface in contact with the seat, the sides of the exhaust cavity *k'*, of valve *d'* answer the same purpose, the shape of both valves may however be modified, and yet answer the mechanical purpose involved in the claim of the letters patent. Both valve seats, being

parallel with each other, are cast in one piece with the steam cylinder H′, as also the three sides of the steam chest C″, D′ and E′, the back of the steam chest or the side F′ facing the slides, which has secured to it two stuffing boxes l' and m', is fitted and bolted to the steam cylinder H′, and the sides C″ and E′ of the steam chest.

The cover G′ is fitted and bolted on the four sides C″, D′, E′ and F′ of the steam chest. The steam ports g' and e' of the two valve seats B′, B″ join into a single passage T′ leading the steam to the front end of the cylinder, while the steam ports i' and f' join into passage K′ leading the steam to the back end of the cylinder; the end of the exhaust port and passage h' is provided with a flange L′, while at M′ a flange and cavity is provided, for the admission of steam from the boiler into the steam chest, through the port N′.

The steam cylinder H′ is as usual provided, with cylinder heads O′ and P′, the slides Q′ and R′ being bolted to the latter, having a bracket X′ to support them at their other extremity; the bearing S supporting the main rocker O being bolted to the top of the slide Q′. The steam cylinder H′ is firmly secured to the framing A^3 of the engine.

The operation is as follows: The improvements being connected to the link motion, now in general use on locomotive and marine-engines, we purpose to consider the operation and effect of the ordinary link motion, in connection with the operation and effect of the improved link motion, as detailed in the above specification, the latter being inseparably connected to the former. The eccentrics D and C which are used on an ordinary link motion, move each end of the link in opposite directions to each other, the motion being limited by the throw of the eccentrics. The stationary joint f holds the link in a certain position which is controlled by the position of reversing rod M, upon the stationary bar N, being connected to the reversing lever K and H, and supporting link e; a different position of the reversig rod M will consequently raise or lower the link E upon the block g, and thereby decrease or increase as the case may be the amount of motion of the rocker pin h of main rocker O, valve rod q, and main valve c' producing the effect, of cutting off sooner or later the amount of steam admitted to the cylinder. The motion of the valve d', is mainly derived from the link motion, and is in reference to the increase or decrease of its motion, influenced by that motion; it is however effectually modified by the differential rocker G, which while it partakes of the motion of the main rocker O, from the fact that its center is located upon the rocker arms l and k, is itself connected to and moved by the eccentric B. The nature of this motion, in reference to the effect it produces upon the valve d', is regulated by the position of the block u, within the quadrant arm F; the reversing rod X, which is held by its notches in a certain position upon the stationary bar N, determines the relative position of the block within the quadrant arm, being connected to the eccentric rod P″, by reversing lever v, w and connecting link u, the highest position of the block in the quadrant, producing more motion than the lowest position; however the difference of effect, does not mainly depend upon this difference of motion, but upon the position in which it places the valve in reference to the steam ports i', g'; the highest position of the block within the quadrant arm, having a similar effect upon the time of exhaust, within the valve d', which increase of inside lap, would have upon a valve connected to the ordinary link-motion, without increasing the amount of compression, which attends increase of inside lap in an ordinary valve, as the valve d', does not necessarily require any inside lap, the compression beginning at the time of the exhaust.

To compare the action produced by the common link motion and this improved link motion we subjoin a table of the relative mean values of certain numbers, embracing those positions of the valve motion, which are generally taken as a test of its performance at different degrees of expansion. The products will be similar with a longer or shorter radius of link, or distance between center of axle and rocker, with exception of the lead and port, which will (for the shifting link) be slightly increased with a shorter radius; in this case 5 ft. 6 in. radius. The dimensions of the link motion used for these examples were such, as to produce $5\frac{1}{8}$ inches throw of main valve, at full-stroke of valve. Length of main rocker arms 8 inches. Distance from center of rocker shaft O to center of differential rocker G 5 inches. Distance from center of differential rocker G to center of valve rod joint 3 inches. Distance from center of differential rocker G to the nearest end of the slot within quadrant arm F, 8 to $8\frac{1}{2}$ inches. Length of that slot 16 inches.

The quadrant arm F, is divided in eight equidistant positions for the block within it, the eighth position being nearest to the center of the rocker. In the table the valve moved by the common link is understood by the letter Z, being compared to the valve motion produced by the main valve c', and valve d'; valve Z has $\frac{5}{8}$ inch outside, and $\frac{1}{4}$ inch inside lap; valve c' 1 inch outside lap; valve d' 1 inch outside and no inside

lap, adjusted so as to exhaust at equal times near both ends of the stroke. Steamports $1\frac{1}{4}$ inch. Exhaust port 3 inches. 22 inches length of stroke.

Forward motion.

Steam cut-off.	Travel.			Lead.		Size of steam ports.			Size of steam-ports open for the exhaust.			Time of exhaust.			Compression.	Notches for different rocker which may be used for the different grades of cut-off.	Differential exhaust equal to an amount of inside lap on a valve moved by the ordinary link motion.
										Different notches.			Different notches.				
z and c'.	*z.*	*c'.*	*d'.*	*z.*	*c'.*	*z.*	*c'.*	*d'.*	*z.*	*d'.*	*d'.*	*z.*	*d'.*	*d'.*	*z.*		
$20\frac{1}{4}$	$5\frac{1}{8}$	$5\frac{1}{8}$	$3\frac{3}{4}$	$\frac{1}{16}$	$\frac{1}{16}$	$1\frac{1}{4}$	$1\frac{1}{4}$	1	$1\frac{1}{4}$	$\left\{\begin{matrix}1\\1\frac{1}{4}\end{matrix}\right.$	8 $1\frac{1}{4}$	$21\frac{3}{4}$	$\left\{\begin{matrix}1\\21\frac{5}{8}\end{matrix}\right.$	8 $21\frac{15}{16}$	$21\frac{1}{8}$	1 to 8	.....
18	$3\frac{9}{16}$	$5\frac{1}{8}$	$3\frac{3}{8}$	$\frac{3}{16}$	$\frac{1}{16}$	$1\frac{3}{16}$	$1\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{4}$	$\left\{\begin{matrix}1\\1\frac{1}{4}\end{matrix}\right.$	3 $1\frac{1}{4}$	$21\frac{3}{8}$	$\left\{\begin{matrix}1\\21\frac{9}{16}\end{matrix}\right.$	3 $21\frac{11}{16}$	$19\frac{7}{8}$	1 to 3	.....
16	$2\frac{7}{8}$	$4\frac{1}{4}$	$2\frac{13}{16}$	$\frac{1}{4}$	$\left\{\begin{matrix}\text{full.}\\\frac{1}{8}\end{matrix}\right.$	$\frac{13}{16}$	$1\frac{3}{16}$	$\frac{3}{8}$	$1\frac{3}{16}$	$\left\{\begin{matrix}1\\1\frac{1}{4}\end{matrix}\right.$	4 $1\frac{1}{4}$	$20\frac{3}{4}$	$\left\{\begin{matrix}1\\21\frac{1}{4}\end{matrix}\right.$	4 $21\frac{1}{2}$	$18\frac{1}{2}$	1 to 4	.....
14	$2\frac{1}{2}$	$3\frac{11}{16}$	$2\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{5}{8}$	$\frac{13}{16}$	$\frac{1}{8}$	1	$\left\{\begin{matrix}1\\1\frac{1}{8}\end{matrix}\right.$	5 $1\frac{3}{16}$	$20\frac{1}{8}$	$\left\{\begin{matrix}1\\20\frac{3}{4}\end{matrix}\right.$	5 $21\frac{1}{2}$	17	1 to 5	.....
$12\frac{1}{2}$	$2\frac{5}{16}$	$3\frac{3}{8}$	$2\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{16}$	$\left\{\begin{matrix}\text{full.}\\\frac{1}{2}\end{matrix}\right.$	$\frac{3}{4}$	$\frac{1}{16}$	$\frac{7}{8}$	$\left\{\begin{matrix}1\\1\end{matrix}\right.$	6 $1\frac{1}{8}$	$19\frac{1}{2}$	$\left\{\begin{matrix}1\\20\frac{1}{4}\end{matrix}\right.$	6 $21\frac{1}{2}$	16	1 to 6	$*\frac{1}{4}$
11	$2\frac{3}{16}$	$3\frac{1}{4}$	$1\frac{7}{8}$	$\left\{\begin{matrix}\text{full.}\\\frac{1}{4}\end{matrix}\right.$	$\frac{1}{4}$	$*\frac{1}{2}$	$\frac{5}{8}$	0	$\frac{13}{16}$	$\left\{\begin{matrix}1\\\frac{7}{8}\end{matrix}\right.$	7 1	19	$\left\{\begin{matrix}1\\19\frac{5}{8}\end{matrix}\right.$	7 $21\frac{1}{2}$	15	1 to 7	$\frac{3}{8}$
9	2	3	$1\frac{5}{8}$	$\frac{5}{16}$	$\frac{1}{4}$	$*\frac{7}{16}$	$\frac{1}{2}$	0	$\frac{3}{4}$	$\left\{\begin{matrix}1\\1\frac{13}{16}\end{matrix}\right.$	7 $\frac{7}{8}$	$18\frac{1}{4}$	$\left\{\begin{matrix}1\\19\end{matrix}\right.$	7 $21\frac{3}{8}$	$13\frac{1}{2}$	1 to 7	$*\frac{7}{16}$
$7\frac{1}{2}$	$1\frac{15}{16}$	$2\frac{13}{16}$	$1\frac{1}{2}$	$\frac{5}{16}$	$\frac{1}{4}$	$*\frac{3}{8}$	$*\frac{7}{16}$	0	$\frac{11}{16}$	$\left\{\begin{matrix}1\\1\frac{11}{16}\end{matrix}\right.$	7 $\frac{3}{4}$	$17\frac{1}{4}$	$\left\{\begin{matrix}1\\17\frac{3}{4}\end{matrix}\right.$	7 21	$12\frac{1}{4}$	1 to 7	.....

* Steam exhaust.

The back-motion is substantially the same as the forward motion.

The table shows under the head "travel" that the motion of d' is less than that of Z and c'. The lead of the main valve C' is less than Z. Size of steam ports of c' larger than those of Z. Size of steam ports of valve d' is of no practical value except near full stroke, where it cuts off the steam from 18 to $20\frac{1}{4}$ inches by shifting the differential rocker motion from the first to the eighth notch. Size of steam ports open for the exhaust, for the different notches of valve d', is somewhat larger for d' than it is for Z. Time of exhaust of the valve d', throughout the whole of its motion, begins at a later part of the stroke, than it does for valve Z. while if changed to the different notches the steam exhausts still nearer to the end of the stroke. Time of compression, which is only marked for the valve Z, is for the valve d' which has no inside lap, equal with the time for exhaust. The number of notches which may be used for the different points of cut-off, is not alike, as if the notches would be used beyond those indicated, valve d' would leave opening for the steam to enter, after valve c' has cut off. The last column indicates for three points of the cut-off, the amount of inside lap necessary to produce, the difference in time of the exhaust, given by the variable exhaust.

By increasing the lap of the main valve from 1 inch to $1\frac{1}{4}$ inches, the port at half stroke is increased, and by increasing the proportions of the differential rocker, at the same rate, the other points remain substantially the same.

The application of these improvements, from the fact that they are applicable to most any steam machinery, where motion is converted from reciprocating into rotary, is capable of considerable modification, without changing its character. Both main and differential rocker may have their arms straight or inverted; the location of bearings, and the construction of other parts connected to the improvement are necessarily modified to suit the design of their respective engines, as also the result of the valve gear may be considerably modified by in and outside lap throw of valves and the connections of the differential rocker.

We do not desire to confine our claim to any precise manner of construction or application of the improvement, as from its capability of being applied to steam engines of different designs and purposes, its adaptation may as already stated call for modifications of parts connected to the improvement; but

We do claim—

1. The differential rocker G, operated substantially as described, in connection with the stationary- or shifting-link motion, for the purposes of increasing the opening of the steam ports, at the higher grades of expansion, and retarding and varying the time of exhaust, without incurring early compression, attending increase of inside lap on an ordinary valve.

2. We also claim the duplicate valve seats

B″ and B′, being arranged parallel to each other, provided with steam ports *f′ e′—i′ g′* and an exhaust port *h′*; the two steam ports *g′* and *e′* toward the front of the cylinder, joining in one passage T′, lead the steam to that end of the cylinder; the other two steam ports *i′* and *f′* leading the steam into one passage K′ toward the back end of the cylinder.

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Witnesses:
J. A. DAY,
AND. MEAD.