(No Model.)

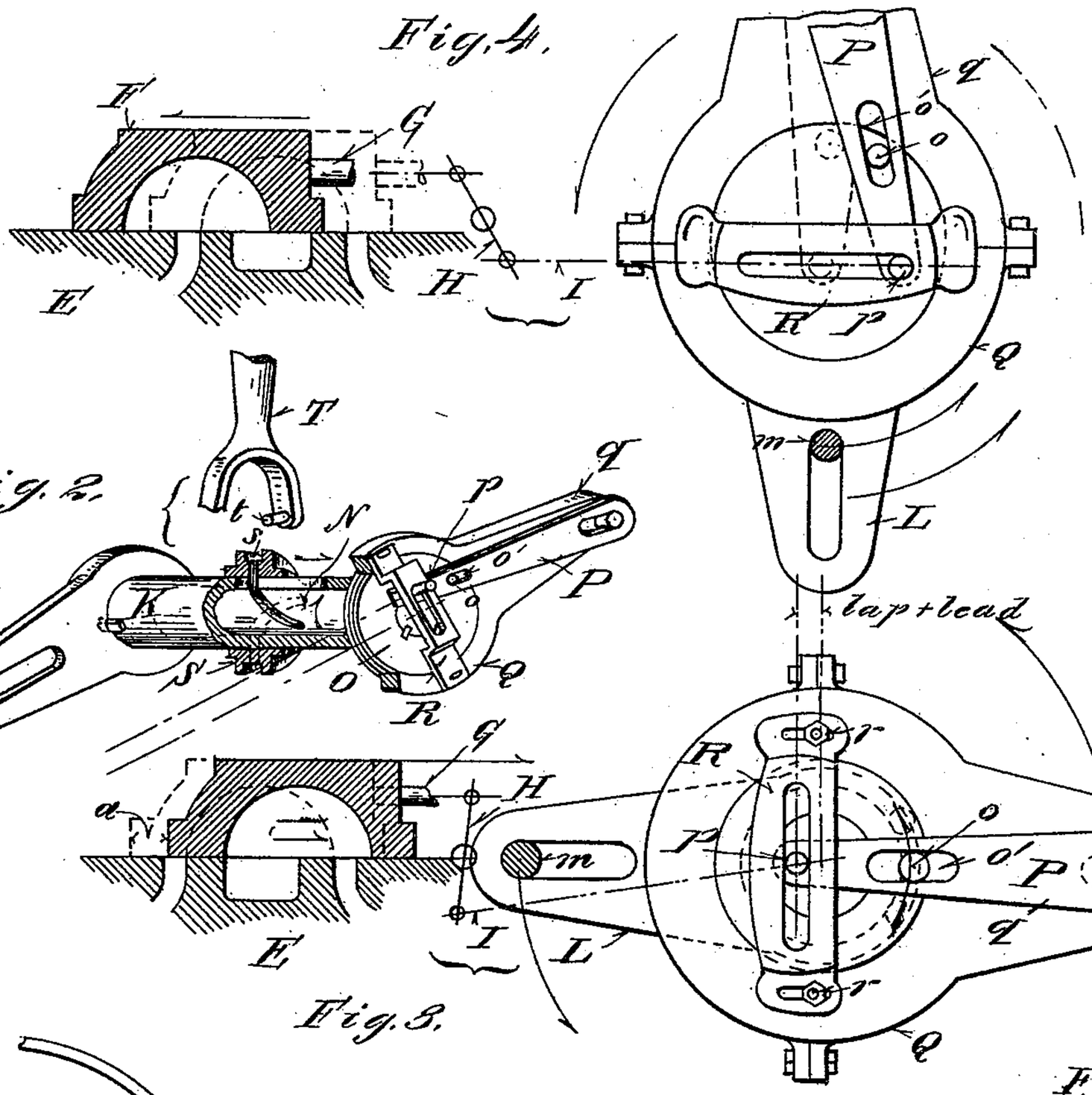
2 Sheets—Sheet 1.

R. E. STEPHENSON.

VALVE OPERATING MECHANISM.

No. 488,780. Patented Dec. 27, 1892.

Fig. 4.



WITNESSES:

A. M. Halsted.

Jas. C. Dawley.

INVENTOR

Robert E. Stephenson,

BY

H. A. Toulmin

His ATTORNEY.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 7

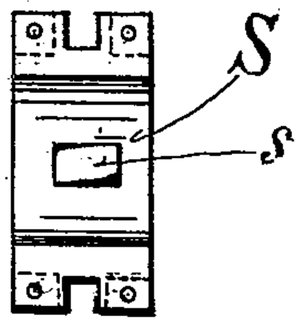


Fig. 6

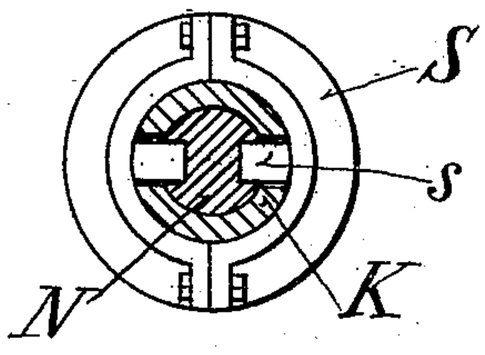


Fig. 5

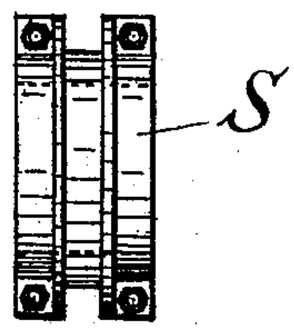


Fig. 8

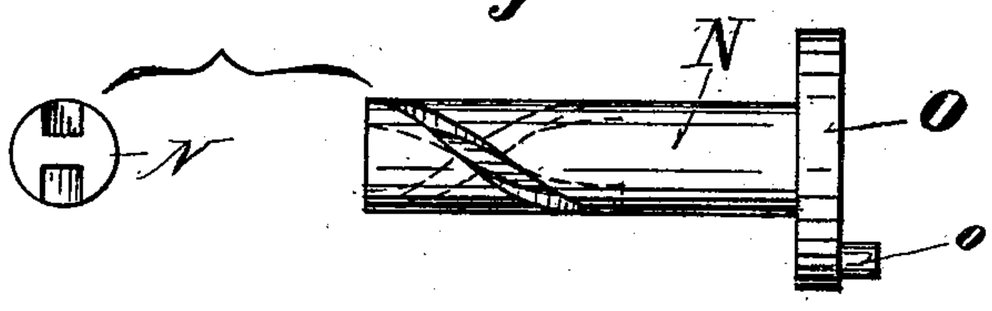
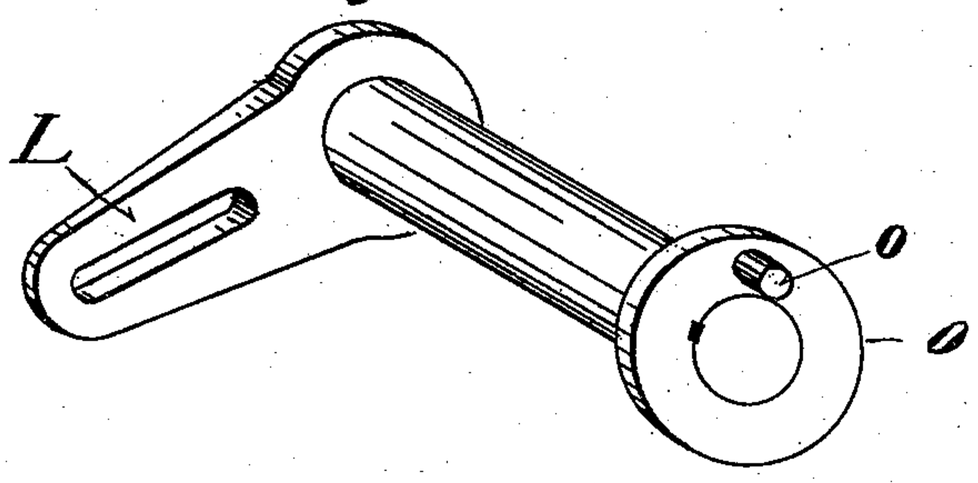


Fig. 9



WITNESSES:

H. M. Plaisted.

Fred Ernest

INVENTOR

Robert E. Stephenson,

BY

H. A. Toulmin,

HIS ATTORNEY.

UNITED STATES PATENT OFFICE.

ROBERT E. STEPHENSON, OF INDIANAPOLIS, INDIANA.

VALVE-OPERATING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 488,780, dated December 27, 1892.

Application filed August 22, 1892. Serial No. 443,815. (No model.)

To all whom it may concern:

Be it known that I, ROBERT E. STEPHENSON, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Valve-Operating Mechanism, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to certain new and useful improvements in valve operating mechanism. for steam engines.

The object of my improvements is to provide means, operated directly by the main rod, or the side rod of an engine, whereby the steam valve is adjusted, reversed and returned as desired, thereby doing away with the two eccentrics and adjunctive devices ordinarily employed in such operation, and accomplishing the same results with greater ease and simplicity of parts.

To this end my improvements have reference to an attachment for the main rod, adapted to be adjusted to equalize the cut-off of the valve, by its connection with my form of mechanism; have reference to a pair of shafts, one mounted within the other, and adapted to be adjusted circumferentially; have reference to a disk mounted on the inner shaft and an annulus supporting the adjusting lever set to different adjustments through its connection with said inner shaft; have reference to a slotted piece or guide, also carried by said annulus, adapted to be adjusted thereon according to the amount of lap and lead on said valve; and have reference to other points of detail hereinafter described and claimed.

In the accompanying drawings on which like reference letters indicate corresponding parts: Figure 1, represents a side view of the principal parts of an engine, the steam chest and cylinder being in section and my valve-operating mechanism attached to the main rod; Fig. 2, a perspective view partially in section, of one form of my valve-operating mechanism; Fig. 3, an enlarged view of a valve, and the steam ports in section, illustrating their position with regard to said mechanism, shown enlarged in end view; and Fig. 4, a similar view to Fig. 3, showing another view of the valve with regard to its ports, and the corresponding position of the operating mechanism, illustrating an extreme position of the same. Figs. 5, 6 and 7 enlarged detail views of a sliding collar; Fig. 8, a similar view of the inner shaft, and Fig. 9 a perspective view of a simple shaft for valves not requiring to be reversed.

The ordinary form of operating mechanism for the valves of locomotives and similar engines which are required to be reversed readily, is by means of the well known eccentric rods and operating eccentrics, with their adjunctive operative connections. In my form of operating mechanism for valves, I propose to do away with these eccentrics and their adjacent parts, and connect said mechanism directly with the main rod (or if desired, the side rod in a locomotive,) of an engine, which parts will give the necessary rotative action to the mechanism as will be hereinafter described, illustrated and claimed.

The letter A designates the fly wheel of a stationary (or the driving wheel of a locomotive) engine. The letter B, the crank connected by the main rod C, to the piston rod D, mounted in the cylinder E, supplied with steam by the operation of a valve F, having a valve rod G, and rocker H, at the other end of which is the connecting rod I to which my valve-operating mechanism is connected as will now be described. A box J, Fig. 1, supplies a bearing for a shaft K, having a slotted crank L at one end, which is rotated by a connecting pin operating in said slot,—the pin *m*, being carried by a bracket M adjustably mounted on said main rod, as seen in Fig. 1. This pin will travel in the path of an ellipse as the crank rotates, as indicated by dotted lines in this figure. The shaft K is hollow and affords a bearing for the inner shaft N, having a disk O, keyed to one end opposite the crank L, and carrying a pin *o*, operating an adjusting lever P, by engagement with a slot *o'* therein, as seen in the figures. The outer end of the lever is pivoted to an extension *q*, of an annulus Q, mounted on the disk O, as seen in Fig. 2. The other, or inner, end of the leves carries a pin *p*, which engages with the connecting valve rod I, as indicated by the dotted lines, Fig. 2. I propose to adjust this pin *p* to different positions with regard to the central axis of the shafts K and

N, and thus vary the throw of the valve as desired.

The annulus Q carries a slotted bracket or guide R, having slotted lugs, secured by bolts *r*, to said annulus, so as to allow of adjusting the center of the guiding slot to and from the central axis of the shafts. This adjustment is made in every engine, according to the amount of lap and lead given to the valve. By the term "lap" is meant the distance or amount that the valve overlaps the steam port when centrally located, as dotted in Fig. 3. By the term "lead" is meant the width of opening of the steam port when the piston is at the end of its stroke, as shown in Fig. 1, and in a larger view in Fig. 3. For instance, if the lap be three-fourths of an inch, and the lead determined on be one-eighth of an inch, the total, or seven-eighths of an inch, is the distance that the center of the guiding slot in the guide R is set away from the central axis of the shafts. This distance is indicated by the two vertically dotted lines in Fig. 3, passing through said points, and is constant for each engine. The cut-off or amount of travel of the valve is variable, however, in order to allow of giving the engine more steam when greater power is required, either in operating machinery or hauling a train. In these circumstances, the valve ports are opened wider and kept open longer, to allow the steam greater action on the piston.

Referring to Fig. 3, the dotted position of the valve shows it lapping equally over both ports; the full line shows it in the position it assumes when the operating mechanism is as shown in this figure,—that is, with the pin *p* in the center of the guiding slot, and at a distance from the central shaft axis equal to the distance at *a*, representing the lap plus the lead of the valve. The rotation of the mechanism by the main rod would now merely open each port the amount of the lead. That is, it will open the steam port on the right the amount of the opening as shown on the left, when the point in the pin *p* is carried to the other side of the central axis. To increase the amount of opening, or vary the cut off, the pin is adjusted back and forth within the guiding slot according to which way the engine is desired to run. This is done by rotating the disk O and the pin *o* carried thereon, which acts on the adjusting lever to effect this change of position. This rotation of the disk is effected by sliding a collar S, carrying pins *s*, which pass through straight slots in the outer shaft K and engage with spiral slots in the inner shaft, as shown in the sectional perspective view Fig. 2. This axial sliding is done by any suitable means, such as a lever T having pins *t*, which engage with the groove in said collar S to allow the latter to rotate with the shafts. The collar and the two shafts rotate together, but the said shafts are varied in their positions with regard to each other, by this sliding collar. Other suitable means may be employed, and the slots may be reversed on the two shafts instead of as shown in the figure. Referring to Fig. 2, if the collar be slid axially to the right, the pin *o* will be thrown in the direction of the arrow and throw the pin *p* from the extreme position shown in this figure; the effect of this action on the valve will be explained later. Thus it will be seen that the rotation of the inner shaft with regard to the outer shaft, will vary the distance of the pin *p* from the central shaft axis,—this rotation being accomplished in this construction by the sliding collar and intermatched grooves, as above described. The action of this adjustment of the pin *p* to and from the central axis, with regard to the valve, will be explained by reference to Fig. 4. When the shafts rotate in the direction of the arrows, Fig. 3, the crank arm L and extension *q* of the annulus, will assume the vertical position shown in Fig. 4,—the pin *p* being in the dotted position in the center of the slot. The corresponding position of the valve is shown by dotted lines. If now the disk, and pin *o* thereon, be thrown in the direction of the arrow, by the means above described, the adjusting lever and its pin *p* will likewise be thrown to the right, and move the valve from the dotted position to that shown in full lines. The full port opening is thus secured, and, as shown, the travel of the valve will be the greatest, when the pin *o*, which operates the valve connecting rod, is at one extreme. This action reverses the engine and admits the steam through the opposite port from that shown in Fig. 3.

In order to open the left port, when the valve is in the dotted position, and thus effect a movement of the engine in the other direction, it is only necessary to slide the collar S in the other direction, or to the left, Fig. 2, and thus throw the pin *o* over to the left from the position shown in Fig. 4. It will be understood that the pin *p* may be stopped at any position within the guiding slot, and thus at any distance from the central axis, whereby the amount of opening of the valve is varied as may be desired, or as circumstances require. The adjusting lever may also be slotted at its pivot end as in the latter figure, or the slot may be made in the extension of the annulus as in Fig. 3. When the guiding slot is straight, as shown, more or less play should be given at the pivot. I do not limit myself, however, to the construction herein shown and described, and in fact I may use the adjusting lever without the slotted guide piece R. The construction shown, however, is preferable.

Referring to Fig. 1, it will be observed that the bracket piece M is also slotted. This is to allow of adjustment of the bracket on the main rod in order to equalize the cut off of the valve; that is, to make each side of the valve travel the same with regard to the steam ports. The slot in the crank L allows the pin *m*, to travel in the path of an ellipse, as indicated by the dotted line, and effects a sliding

action of said pin with the crank. Thus it will be seen, that this mechanism for operating the valve is directly connected to the main rod; is simple and effective in its operation; and does away with the ordinary devices usually employed for operating the valve, with their bulky arrangement and construction.

Figs. 3 and 4, are partly in the nature of diagrams, the rock shaft simply being indicated, to illustrate the operation of the valve corresponding to the movement of the operating mechanism. Also Fig. 1, is taken from the front, while the other figures are taken from the opposite side, as a point of view, in order to illustrate the parts more clearly. The pin *m* may be otherwise carried by the main or side rod than by the bracket piece M thereon. Such, however, is a convenient construction to allow of adjusting the same to equalize the cut-off.

In Figs. 5, 6 and 7, I have shown in detail and enlarged, the preferred form of sliding collar S. It is made in two parts and bolted together as shown, each part being provided with a stud or projection *s* as shown in Figs. 6 and 7, which stud or projection extends through a spiral slot on each side of the shaft K into engagement with the spiral groove in the shaft N, as shown by the section of said shafts in Fig. 6. Fig. 8 shows the spiral grooves in the inner shaft, and the end view shows the strengthening center portion of the shaft left between the grooves. The collar being thus in two sectons may be readily removed when necessary. The stud *s* being square and chamfered as shown in Fig. 7, provides sufficient strength to rotate the inner shaft and to slide in the spiral grooves therein. The valve may thus be readily reversed and the cut-off adjusted.

I have thus far illustrated and described my valve operating mechanism adpated to a valve which requires to be reversed. It is to be remarked, however, that when the mechanism is applied to an engine having but one motion, and not requiring to be reversed, the sliding collar and other parts of the reversing mechanism may be dispensed with. Fig. 9 shows the simple slotted shaft without the reversing mechanism; in this form it is employed to give a constant lead with an equal cut-off, the two shafts being then combined in one. This equal cut-off with constant lead is an advantage that my device possesses over a single eccentric, the latter not being capable of giving such constant lead and equal cut-off of the valve. My mechanism may be employed either with a rocker arm as shown, or it may be directly coupled to the valve stem G giving a cheaper and simpler construction.

The slotted bracket M on the main rod, is very important, as it can be set to give an equal cut-off of the valve on any engine, although after once set it may never need to be changed. I lay claim to the same broadly.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a valve operating mechanism, the combination with the main or side rod of an engine, and a pin or projection carried thereby, of a crank having a slot for said pin or projection, a shaft for said crank, an inner shaft mounted therein, means to rotatively adjust one shaft with respect to the other, and maintain such adjustment, a valve for the engine, operating rods therefor, a pin or projection engaging with the valve rods, and interconnecting means between the latter pin or projection, and the said inner shaft, whereby the throw of the valve is effected, and the same varied according to the adjustment of said pin or projection of the valve rod to and from the center of the shafts.

2. In a valve operating mechanism, the combination with the main or the side rod of an engine, carrying a pin or projection, of a double shaft mounted in bearings adjacent thereto, a crank on one shaft operatively connected to said pin or projection, a pin or stud carried by the other shaft eccentric to the axis, means to rotatively adjust said shafts with respect to each other, a lever rotated by the latter shaft and having a pin or projection, and engaged by the said pin or projection of the inner shaft to vary the position of the lever pin to and from the central shaft axis, a valve, and an interconnection between the lever pin and said valve.

3. In a valve operating mechanism, the combination with the main or the side rod carrying a pin or projection, of a pair of shafts, one mounted within the other, and supported adjacent to said main rod, a slotted crank on the outer shaft, the slot slidingly engaging with said pin or projection, a stud pin rotated by said inner shaft, means to effect and maintain the adjustment of one shaft with regard to the other, an annulus about said inner shaft, a lever pivoted thereto and engaging with the latter stud pin to be oscillated by it as desired, a valve, and operative connections between said pivoted lever and said valve, substantially as and for the purpose described.

4. In a valve operating mechanism, the combination with the main or the side rod of an engine, and a pin or projection therefrom, of a crank operatively connected to said pin or projection, a hollow shaft therefor, an inner shaft and a stud pin rotated with and supported by said inner shaft, an annulus outside of said latter pin and a movable piece supported by said annulus and engaging with the pin carried by the shaft, to be moved thereby, and having a projecting pin, a guide therefor, a valve and interconnections between said valve and pin on said movable piece, whereby the travel of the valve is varied, and means to adjust and maintain said hollow and inner shafts with regard to each other.

5. In a valve operating mechanism, the com-

bination with a hollow crank shaft and means to rotate it, of an inner shaft having a disk and a projecting pin on said disk, means to rotatively adjust said shafts with regard to each other, an annulus loosely mounted on said disk, a movable piece carried by said annulus and having a pin or projection, a slotted guide on said annulus for said pin or projection, the pin on the disk engaging with said movable piece to vary the position of the pin on the movable piece within its guide, a valve, and connections between said valve and the latter pin to vary the throw of the same by the change of position caused by adjustment of the disk and pin with regard to said annulus.

6. In a valve operating mechanism, the combination with a pair of shafts concentrically mounted, and means to rotate the outer shaft, of a disk carried by the inner shaft and having a stud pin projecting therefrom, means to rotatively adjust the shafts with regard to each other, an annulus loosely mounted on said disk, and having an extension, a lever pivoted to said extension at one end and having a pin at the other end, and a slot slidingly engaged by said disk pin or the stud to change the position of the lever pin to and from the axis of the shafts, a slotted guide carried by said annulus and engaging with the lever pin, a valve, and interconnections between the valve and lever pin, substantially as and for the purpose described.

7. In a valve operating mechanism, the herein described disk having a stud pin or projection, and an annulus loosely mounted thereon having an extension, of an adjusting lever pivoted to said extension at one end and having a pin at the other end, and a slot between the ends for engagement with said stud pin on the disk, whereby the lever is oscillated by the adjustment of the disk within the annulus, substantially as and for the purpose described.

8. In a valve operating mechanism, the combination with a shaft and a disk thereon having a stud pin or projection, of an annulus loosely mounted on said disk, and a slotted guide piece adjustably carried by said annulus, the said piece being mounted on the annulus according to the lap and lead of the valve to be operated, an oscillating and adjustable lever adjustably pivoted to said annulus and having a pin at the opposite end engaged by said slot in the guide, and a slot slidingly engaged by a disk pin or projection to operate the lever and carry the lever pin back forth in its guiding slot, for the purpose described.

9. In a valve operating mechanism, the hereindescribed slotted guide and annulus, the same consisting of a bracket piece having a slot lengthwise therein, and adjustably mounted on said annulus, a rotatable piece loosely mounted within said annulus, a movable piece carried by said annulus and having a pin guided by said slot and engaged by said inner rotatable piece to cause the pin to vary its position in its guiding slot, substantially as and for the purpose described.

10. In a valve operating mechanism, the hereindescribed slotted guide, the same consisting of a bracket piece having a longitudinal slot adapted to guide a pin as described, and transverse slots for adjusting the said piece on its support, substantially as shown and described.

11. In a valve operating mechanism, the combination with a rotatable disk having a pin or projection, and an annulus loosely mounted thereon, of an adjusting lever, one end pivoted to said annulus, and the other end having a pin or projection adapted to be connected to a valve rod, and having a slot slidingly engaged by said pin on the disk to oscillate said lever and maintain it in its adjusted position, and a guide having a longitudinal slot and adjustably mounted on said annulus for the purpose described, whereby the rotation of the disk within its annulus will vary the position of the pin in the guiding slot, substantially as and for the purpose described.

12. In a valve operating mechanism, the herein described slotted bracket M, the same consisting of a slotted plate portion adapted to be mounted on the main rod of an engine, and a pin portion or projection adapted for engagement with adjunctive devices, whereby said engagement may be varied according to the adjustment of the plate portion on said main rod.

13. In a valve operating mechanism, the combination with the main or the side rod of an engine, and a valve for said engine, of a valve operating device consisting of a shaft, a crank at one end adjustably connected to the main or side rod to be rotated thereby, and having a pin or projection located out of the axis at the other end of said shaft, operative connections between said pin or projection and said valve to operate the latter.

14. In a valve operating mechanism, the combination with the main or the side rod of an engine, and a valve therefor, of a bracket piece slotted for adjustment on said main or side rod to effect an equal cut-off, and valve operating mechanism consisting of a shaft, a slotted crank at one end slidingly engaged with a pin or projection from said bracket piece, to be rotated thereby, and having a pin or projection from the other end of the shaft eccentric to the axis thereof, and operative connections between said pin or projection and said valve, for the purpose described.

15. The hereindescribed sliding collar S, the same consisting of split pieces, each having a projecting pin or stud *s* extending inward, substantially as and for the purpose described.

16. In a valve operating mechanism, a rotating shaft having a crank at one end and an eccentric pin or projection at the other end, the said pin or projection being mounted on