(No Model.)

3 Sheets—Sheet 1.

A. RADOVANOVIC.

REVERSING GEAR.

No. 490,754. Patented Jan. 31, 1893.

Fig. 2.

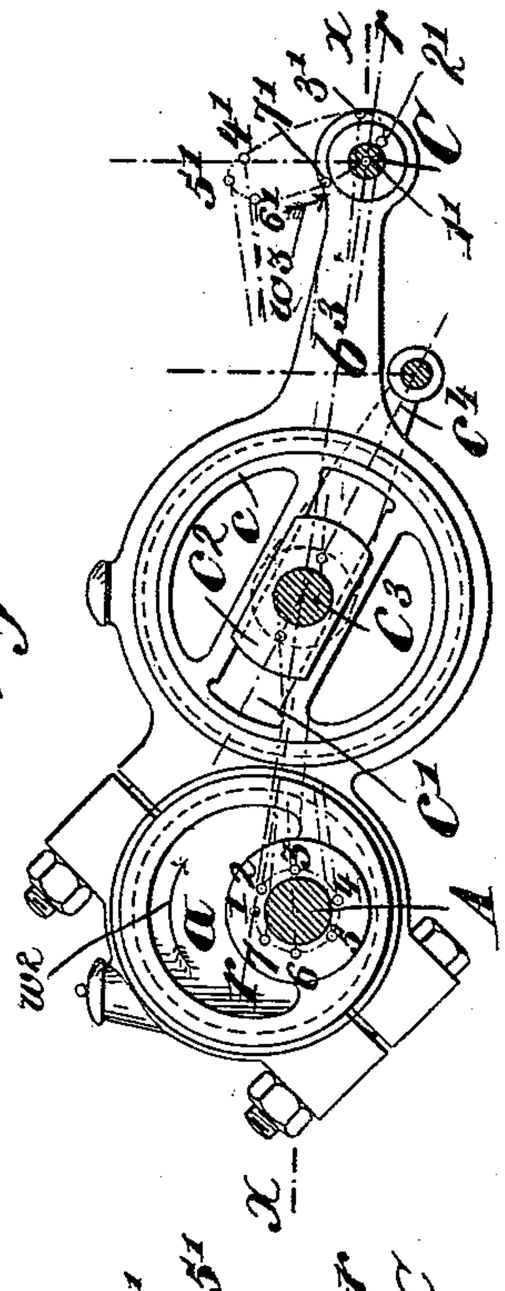


Fig. 3.

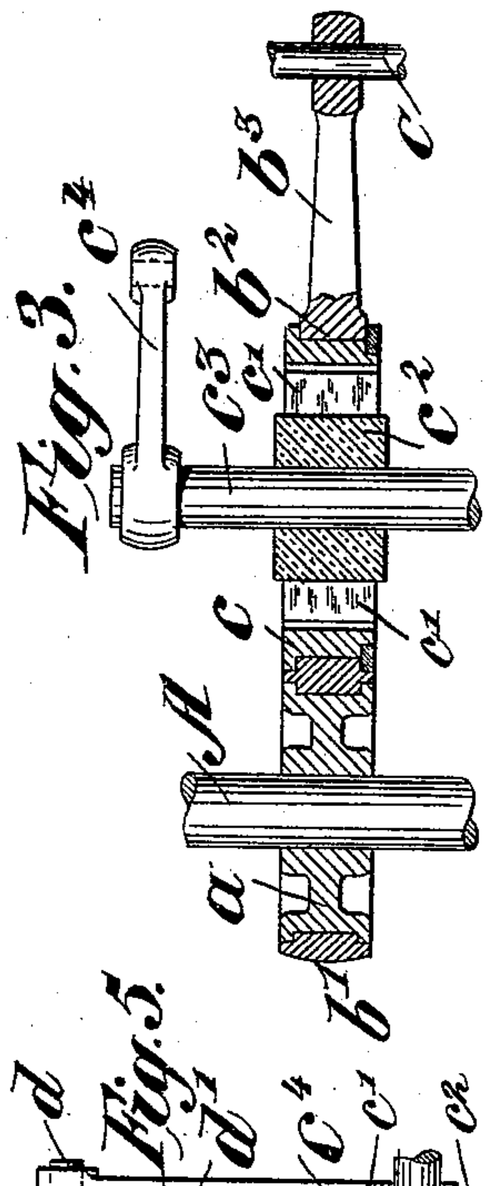


Fig. 1.

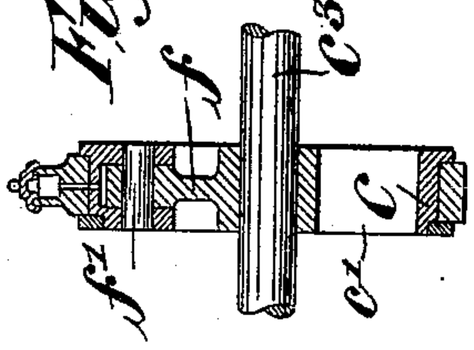


Fig. 5.

Fig. 7.

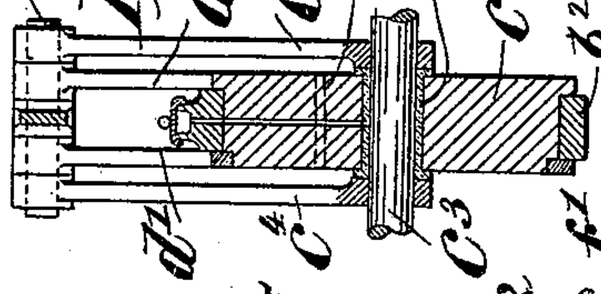


Fig. 6.

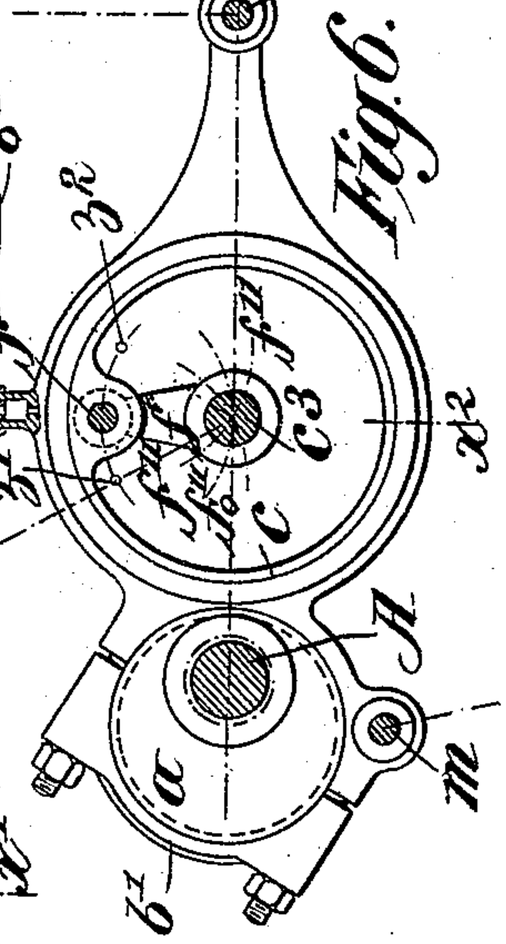
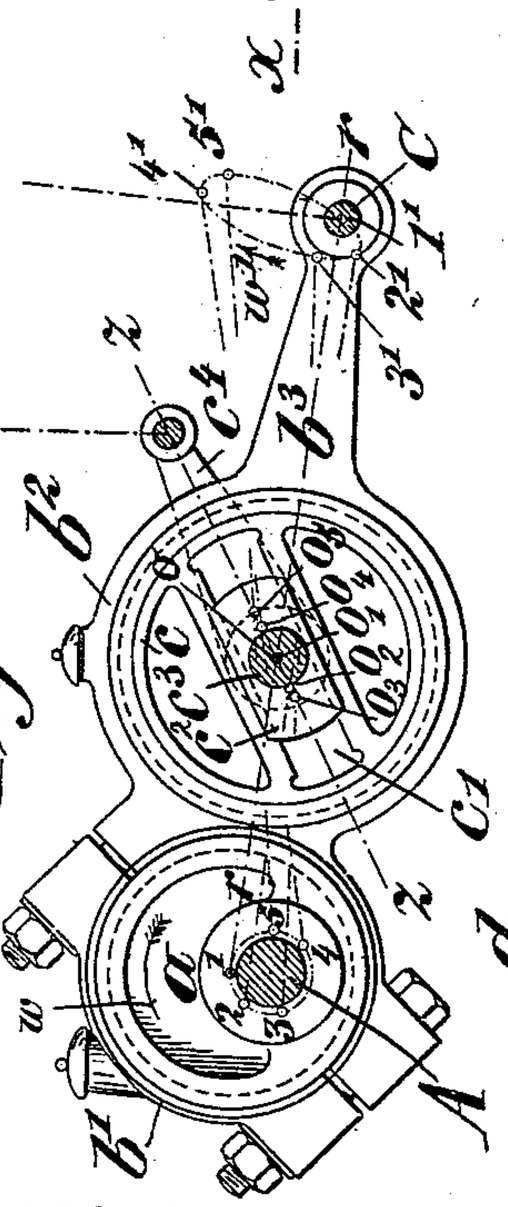


Fig. 4.



Witnesses:

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(No Model.) 3 Sheets—Sheet 2.

A. RADOVANOVIC.

REVERSING GEAR.

No. 490,754. Patented Jan. 31, 1893.

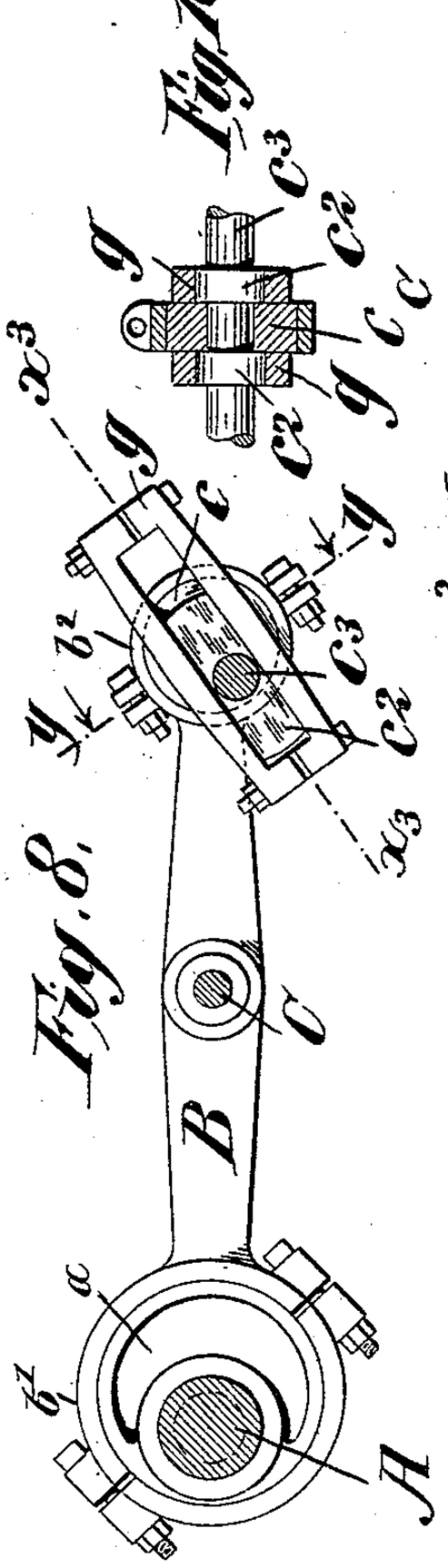

Fig. 8.

Fig. 9.

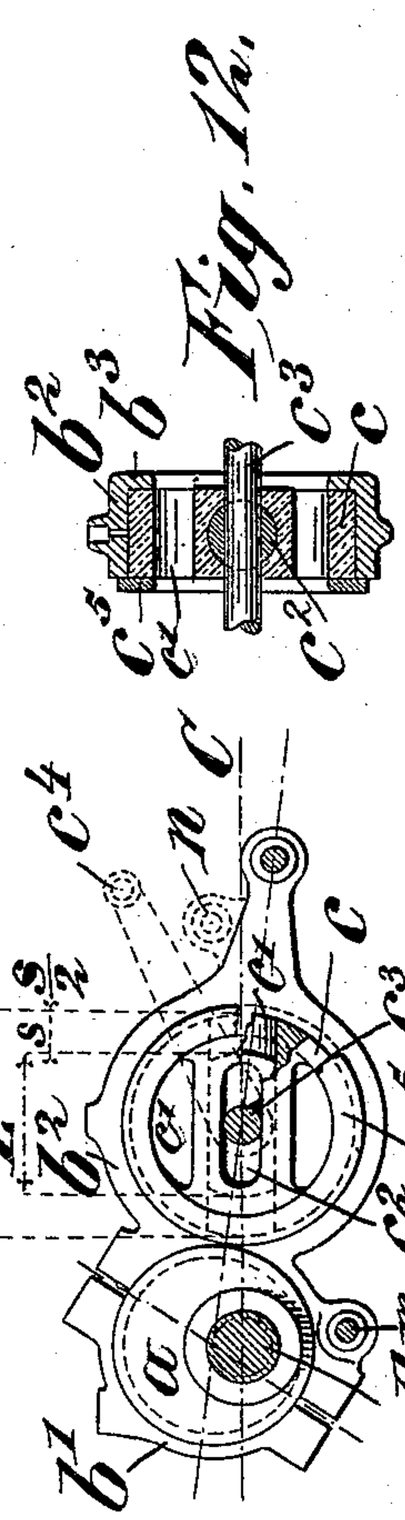

Fig. 11.

Fig. 13.

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(No Model.) 3 Sheets—Sheet 3.

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REVERSING GEAR.

No. 490,754. Patented Jan. 31, 1893.

Fig. 13a

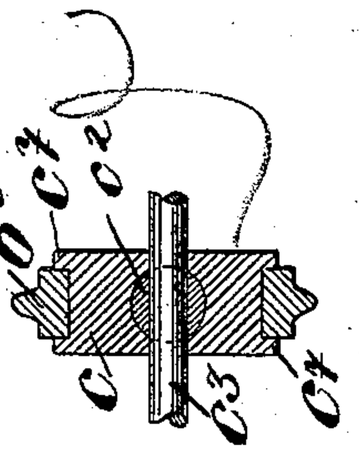

Fig. 14a

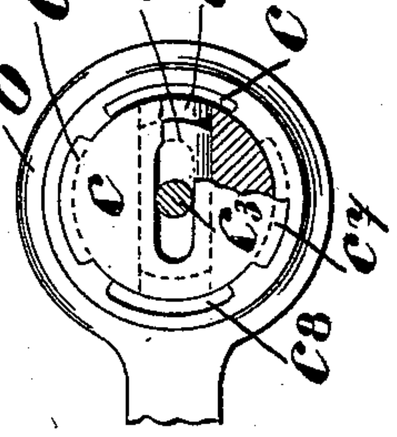

Fig. 15.

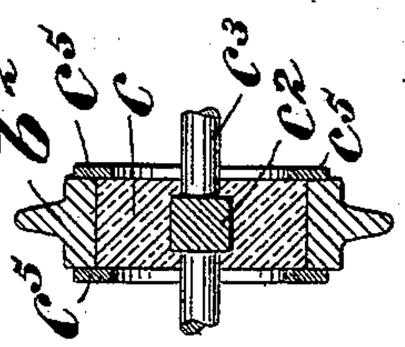

Fig. 14

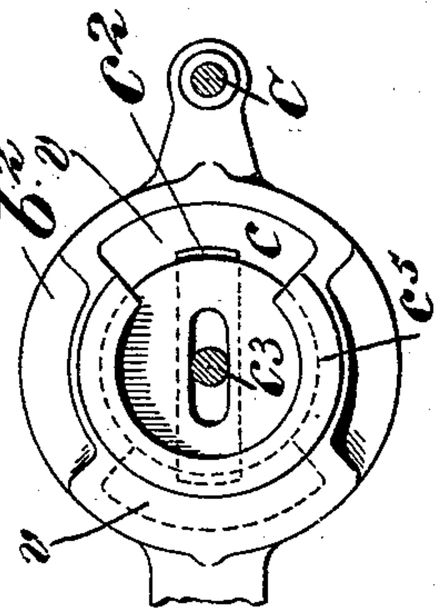

Fig. 16.

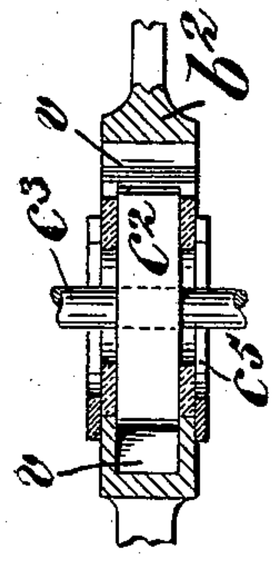

Fig. 23

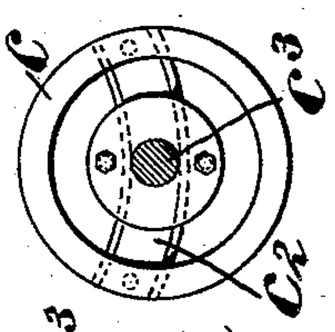

Fig. 22

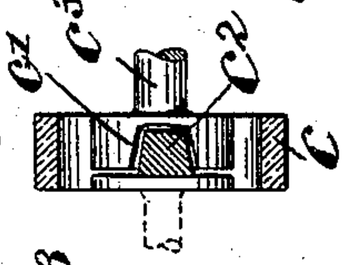

Fig. 21

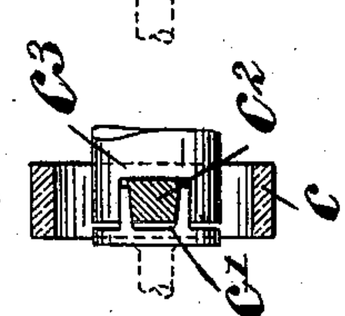

Fig. 20.

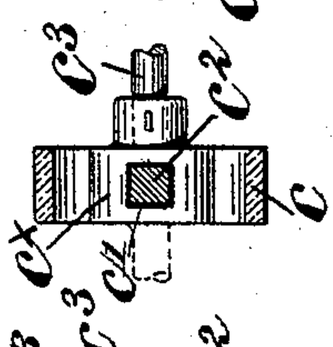

Fig. 19

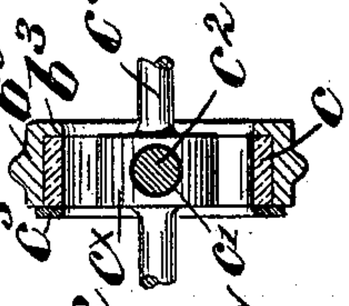

Fig. 17.

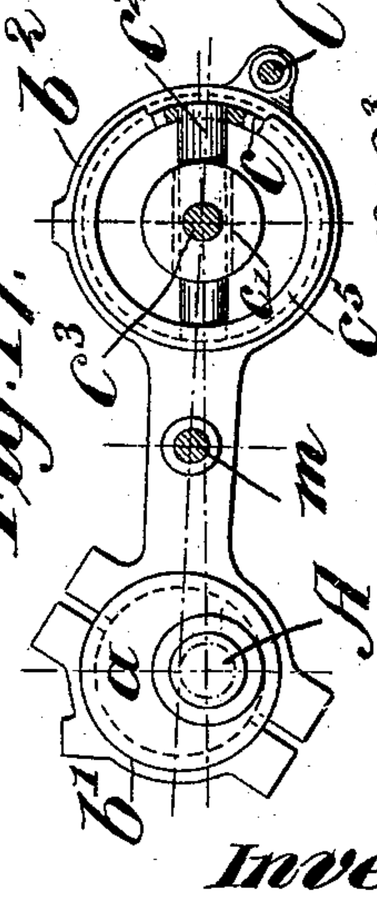

Fig. 18.

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B. W. Sommers.

Inventor:

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By Emery Otto

Atty:

UNITED STATES PATENT OFFICE.

ANDREAS RADOVANOVIC, OF PILSEN, AUSTRIA-HUNGARY.

REVERSING-GEAR.

SPECIFICATION forming part of Letters Patent No. 490,754, dated January 31, 1893.

Application filed April 13, 1892. Serial No. 429,043. (No model.) Patented in Austria-Hungary May 26, 1887, No. 5,178 and No. 24,398, and in Germany November 11, 1888, No. 51,247, and July 28, 1891, No. 62,083.

To all whom it may concern:

Be it known that I, ANDREAS RADOVANOVIC, engineer, a subject of the Emperor of Austria-Hungary, residing at Pilsen, in the Province of Bohemia, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Reversing-Gear, (for which Letters Patent have been granted in Austria-Hungary, No. 5,178 and No. 24,398, dated May 26, 1887, and in Germany, No. 51,247, dated November 11, 1888, and No. 62,083, dated July 28, 1891;) 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, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

My invention has relation to reversing gear of that class or description in which a variable motion is imparted to a point of the reversing lever connected with the slide valve rod for controlling the position and movement of the slide valve relatively to the inlet and exhaust ports.

My invention has for its object the provision of means whereby these movements of the eccentric are controlled by an element connected therewith and acting independently of the eccentric that vibrates the lever, and the provision of means for controlling the operation of said element through the medium of a controlling element, as for instance the usual reversing shaft and lever. Various arrangements of these devices may be resorted to to produce the desired results, as for instance a slotted disk or ring seated in a suitable bearing in the eccentric lever, and means, as a block, secured to the reversing shaft for adjusting the disk within its seat in the lever. It is obvious that when the eccentric of the lever revolves and the disk is adjusted so that its slot will lie at a given angle to the axis of rotation of the said eccentric, the movements of said lever will be in conformity to the relative position of the slot, so that in the various positions to which the disk can be adjusted, the point of the reversing lever controlling the steam distributing devices will describe various curves, that determine the movements of said devices.

In view of the fact that the movements of the eccentric lever, or more properly, of that point of said lever which directly controls the movements of the steam distributing devices, are dependent upon the adjustment of the disk, the relative arrangement as well as the construction of the parts may be variously modified without departure from the nature of my invention, as above alluded to, and as will hereinafter appear. But that my said invention may be fully understood, I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figures 1 and 2 are sectional side elevations of a reversing gear embodying my invention, the controlling disk being provided with a rectilinear guide slot, the parts being shown in the relative positions they occupy when the reversing lever is brought into its opposite extreme positions respectively. Fig. 3 is a longitudinal central section, the parts of the reversing gear being shown in the position they occupy when the reversing lever is in its middle position. Fig. 4 is a sectional side elevation of a reversing gear in which the controlling disk is provided with a curvilinear slot of limited radius, the center of the circle of which the slot is an arc lying outside of the disk. Fig. 5 is a sectional view taken on line x', x', of Fig. 4. Fig. 6 is a sectional side elevation of a reversing gear similar to that shown in Fig. 4, except that the center of the circle of which the slot in the disk is an arc lies within said disk. Fig. 7 is a sectional side view taken on line x^2, x^2, of Fig. 6. Fig. 8 is a sectional side elevation of a reversing gear in which the guide slot is not formed in the disk, there being two guide blocks guided in suitable slots or frames on opposite sides of and secured to or forming an integral portion of the disk. Fig. 9 is a sectional view taken on the line x^3, x^3, of Fig. 8, the parts being shown in their middle position. Fig. 10 is a similar view taken on line y, y, of Fig. 8. Figs. 11, 12, and 13 illustrate a reversing gear in which the adjusting disk has motion with the adjusting block on the reversing shaft, Fig. 11 being a sectional side

elevation, Fig. 12, a vertical central sectional view of the guide disk reversing lever and guide blocks, the reversing shaft being shown in elevation, and Fig. 13 a horizontal sectional view of the disk. Figs. 14, 15, and 16, are views similar to Figs. 11, 12 and 13, illustrating a modification of the reversing gear shown in the latter figures, and Figs. 14^a, and 15^a, are views similar to Figs. 14 and 15, illustrating a further modification of the reversing gear. Fig. 17 is a sectional side elevation illustrating still another modification, and Figs. 18 to 23 are sectional detail views thereof.

Referring to Figs. 1 to 3, inclusive, A, indicates the driving shaft, to which is keyed an eccentric, a, confined as usual within an eccentric strap, b', which, together with a ring, b^2, and the arm, b^3, projecting radially from said ring, constitute the eccentric lever.

Within the ring, b^2, of the lever is confined a disk, c, that has a transverse rectilinear guide slot, c', in which is seated a block, c^2, keyed to the reversing shaft, c^3.

In the position of the parts as shown in Fig. 1, the reversing lever, c^4, is supposed to have been moved into one of its extreme positions, whereby the guide disk, c, through the medium of the block, c^2, has also been moved into a corresponding position within the ring, b^2. The driving shaft revolving in the direction of arrow, w, causes the center of the eccentric strap, b', to describe the circle, 1, 2, 3, 4, 5, and simultaneously therewith the center, o, of the ring, b^3, of the eccentric lever under the action of the disk, c, sliding on block, c^2, will be moved from o', to o^2, o^3, o^4, o^5, which movement corresponds with the circle, 1, 2, 3, 4 and 5, described by the center of the eccentric strap, b', and this causes the axis of symmetry, r, r, of the eccentric lever to take the positions, 1, o', 2, o^2 3, o^3 4, o^4 and 5, o^5, and cause the point, C, connected with the steam distributing devices to describe the ellipsoidal curve, 1′, 2′, 3′, 4′, and 5′, in the direction of the arrow, w'. This ellipsoidal curve varies with the position of the reversing lever, c^4, between its two extreme positions inasmuch as each displacement of said lever will result in a corresponding displacement of the disk, c, on block, c^2, from a curve having its longer axis perpendicular to the axis of the point, C, when the reversing lever is in its middle position to curves having their longer axes inclined toward the right or left of a perpendicular, as shown in Figs. 1 and 2. In the latter figure the elements of the reversing gear are shown in their relative positions when the reversing lever, c^4, is moved from its extreme position Fig. 1, to its opposite extreme position, the point, C, describing an ellipsoidal curve, 1′, 2′, 3′, 4′, 5′ 6′ and 7′, in the direction of arrow, w^3, or in a direction the reverse of that indicated in Fig. 1, whereby the steam distributing devices are moved to a corresponding position so as to reverse the rotation of the driving shaft, A, as indicated by arrow, w^2. It follows that the amplitude of motion of the point, C, depends upon the position of the reversing lever, said motion being least or nearly *nil* when the lever is in its middle position, and greatest when in either of its extreme positions.

In Fig. 4, the slot, c', in disk, c, is of curvilinear form, it being an arc of a circle of greater diameter than the disk, and of a suitably limited radius, and in order to more effectually support and guide the disk in its movements under the action of the block, c^2, I suspend the same from the crank or fulcrum pin, d, of the reversing lever, c^4, by means of suitable hanger arms, d', d', loosely mounted on said shaft or fulcrum. The reversing lever in Fig. 4 is shown in its middle position, and when moved from that position to one of its extreme positions, as z, the disk, c, will be turned so that its slot, c', will occupy the inclined position, c^{10}, c^{10}. In this construction the disk is not only displaced by the partial rotation of the adjusting block, c^2, but also by the arms or hangers, d', d', as will be readily understood, a double guide being here provided, and, as the driving shaft, A, revolves, the disk, c, will oscillate on the line c^{10}, c^{10}, about the crank pin or fulcrum of the reversing lever. In this case, the point, C, connected with the steam distributing devices also describes variable ellipsoidal curves, according to the position of the reversing lever in the direction of arrows, w^4, and w^5, according to the angular displacement of the slot, c', in disk, c.

In the reversing gear shown in Fig. 6, the center of the circle of which the slot, c', in disk, c, is an arc, lies within said disk, that is to say, it coincides with the center of said disk, the slot being a circular one or nearly so, and in this case an auxiliary guide, as d', d', Fig. 4, can be dispensed with, for the reason that the disk is connected directly with the reversing shaft, c^3, through the medium of a crank or radial arm, f, having a pin, f', fitting loosely a bearing formed in a lug projecting from the inner periphery of the circular slot, *i. e.*, from the inner periphery of the disk, c, which in this case takes the form of a ring. It is obvious that if the reversing shaft, c^3, is revolved to carry the point of suspension to one or the other limit of its movements, z', or z^2, the disk c, will be correspondingly displaced and will oscillate about its point of suspension during the revolutions of the driving shaft, so that the point, C, of the eccentric lever here also moves in a predetermined or given path.

In the construction shown in Figs. 4 to 7, the eccentric, a, may be used for operating the exhaust valve in engines provided with lifting valves, and the expansion slide in engines controlled by a slide valve, and to this end, I provide a suitable bearing as, m, on the eccentric strap, b' for the actuating rod that controls said exhaust valve or expansion slide.

In Figs. 8 to 10, I have shown two slotted

guides or guide frames, g, g, one on each side of the disk, c, in which frames is fitted an actuating block, c^2, for the disk, the point of connection, C, of the steam distributing devices being here located between the disk, c, and driving shaft, the same results as above described being obtained when the guide frames, g, g, and through them the disk, c, are displaced through the medium of the actuating blocks, c^2, keyed to the reversing shaft, c^3, which passes loosely through said disk, c, causing the latter to oscillate about the reversing shaft.

In the constructions hereinbefore described, and in the drawings illustrating the same the three points of the eccentric lever, namely the driving shaft, A, the center of ring, b^2, and the point of application, C, are arranged in the same plane, but this is not absolutely necessary as they may be arranged in different planes, for instance, the center of the ring, b^2, may be in a plane above or below the plane, A, C.

In the construction shown in Figs. 11 to 13, the disk, c, is provided with two slots, c', c^{21}, Fig. 13, at right angles to each other and extending clear through said disk, so that the latter can slide to and fro on the adjusting block, c^2, without impeding the movements of the latter even if its length, L, is equal to the diameter, D, of the disk, minus the length of its stroke, s, whereby a better support for the disk is provided. The eccentric, a, in this construction may have a rotary motion as in the reversing gear hereinbefore described, or it may have a derived motion on other curvilinear lines.

To prevent lateral displacement of the eccentric lever on its controlling disk, c, its ring, b^2, may be provided with an annular confining flange, and a like ring, b^3, c^5, respectively, Fig. 12, or with two confining rings, c^5, Fig. 15, arranged on opposite sides of the disk, c, to confine the same within the ring, b^2.

Instead of the described means for preventing lateral displacement of the eccentric lever on the disk, c, means such as shown in Figs. 14^a, and 15^a, may be employed. The disk as shown in the last named figures is provided with projections, c^7, adapted to be brought into register with corresponding recesses, c^8, formed in ring, b^2, when the disk is inserted in the ring, and when so inserted it can be confined by imparting to it a partial rotation to carry the lugs or projections out of register with the recesses.

In order to admit of the use of as long a sliding block as possible, with a view to increasing the bearing surfaces for the disk and therethrough the stability of the elements, the ring, b^2, has as shown in Fig. 14, two recesses, v, v, diametrically opposite each other on the line of motion of the block, c^2, said recesses forming a prolongation or extension of the diametral slot in disk, c, the same function being performed by the recesses, c^8, described in reference to Fig. 14^a, for the insertion of the disk into ring, b^2.

Instead of securing the actuating block, c^2, to the reversing shaft, it may be secured to the disk, c, itself, as shown in Figs. 17 and 18, the guide slot, c', being here formed in an enlargement, $c^\times$, of the reversing shaft, and the disk, c, is a ring in which the actuating block, c^2, is secured, so as to slide in the opening or slot, c', formed in the enlargement, $c^\times$, at right angles to the longitudinal axis of the reversing shaft, c^3, so that when a partial rotation is imparted to the latter, a corresponding rotation will be imparted to the ring, c, through the block, c^2, which is free to reciprocate within slot, c', when the eccentric lever is vibrated by the rotation of the driving shaft to move the point, C, of said eccentric lever in a given path, the said ring and enlargement, $c^\times$, of the reversing shaft, c^3, being concentric with the confining ring, b^2, of the eccentric lever.

In view of what has been said it will be readily understood that the cross sectional form of the adjusting block may be variously modified, as also the mode or means of connecting the controlling disk or ring, c, with the reversing shaft, c^3. I have shown several such modifications in Figs. 17 to 23, the guide slot or slots being either rectilinear, as in Figs. 17 to 22, or curvilinear as in Fig. 23; thus in Figs. 17, 18 and 19, the block, c^2 is shown of cylindrical form, in Fig. 20 of square form, and in Figs. 21 and 22 of the form of a truncated cone in cross section, the cross-sectional form of the slot, c', in which the block works or is fitted, corresponding with that of said block.

The enlargement, $c^\times$, Figs. 17 to 20, may form an integral part of the reversing shaft, or may be secured thereto in any desired manner, in which case the shaft is made in two sections, as will be readily understood. The driving or crank-shaft, A, the center of disk or ring, c, and the points of application, m, C, of the steam distributing devices may be arranged in the form of a triangle or polygon; a single eccentric may control several distributing parts as above explained, and the center of the disk or ring, c, need not necessarily coincide with the center of the reversing shaft, furthermore, the described reversing gear may be used merely for regulating or controlling the expansion or compression instead of the rotation of the driving or crank shaft, A.

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

1. The combination with a driving shaft and the steam distributing devices of the motor for said shaft, of a reversing gear comprising an eccentric lever on the driving shaft, said lever connected with the steam distributing devices, and an adjusting device as an adjustable ring seated in and controlling the

movements of said lever, for the purpose set forth.

2. The combination with a driving shaft and the steam distributing devices of the motor for said shaft, of a reversing gear comprising an eccentric lever on the driving shaft, said lever provided with a ring bearing, a disk or ring seated in said bearing, and a shifting device for shifting the position of said disk or ring relatively to the eccentric that operates the lever, for the purpose set forth.

3. The combination with a driving shaft and the steam distributing devices of the motor for said shaft, of a reversing gear comprising an eccentric lever on the driving shaft, said lever provided with a ring bearing, a disk or ring seated in said bearing, and a shifting device for displacing the center of said disk or ring relatively to the axis of oscillation of the lever and to its point of connection with the steam distributing devices, for the purpose set forth.

4. The combination with a driving shaft and the steam distributing devices of the motor for said shaft, of a reversing gear comprising an eccentric lever on the driving shaft, connected with said steam distributing devices, a reversing shaft, a disk or ring on said shaft, said disk or ring revoluble in a bearing of the eccentric lever, and a shifting device for shifting the center of the disk or ring relatively to the center of the reversing shaft, for the purposes set forth.

5. The combination with an eccentric lever provided with a ring bearing and a disk or ring seated in said bearing, of an adjusting device, as a revoluble shaft, and a block or blocks, as c^2, revoluble with the shaft and connected with the ring or disk so as to displace the center of the latter relatively to the center of the eccentric that actuates the lever and cause said disk or ring to oscillate or reciprocate in the plane of displacement of its (the disk's) center, for the purpose set forth.

6. The combination with an eccentric lever provided with a ring bearing, as b^2, and a disk or ring, as c, seated in bearing, b^2, of an adjusting device, as a revoluble shaft, a block or blocks revoluble with the shaft, and a guide or guides connected with the disk or ring in which said block or blocks work so as to displace the center of the disk or ring relatively to the center of the eccentric that actuates the lever when a partial rotation is imparted to the shaft, and to cause said ring or disk to oscillate or reciprocate on or with the block or blocks in the plane of the displacement of its (the disk's) center, for the purpose set forth.

7. The combination with an eccentric lever provided with a ring bearing and a disk provided with a slot, as c', seated in said bearing, of an adjusting device, as a revoluble shaft, and a block, as c^2, revoluble with said shaft and working in the slot of the disk so as to displace the center of the latter relatively to the center of the eccentric that actuates said lever when said shaft is partly revolved and cause the disk to oscillate or reciprocate on the block in the plane of displacement of its (the disk's) center, for the purpose set forth.

8. The combination with an eccentric lever provided with a bearing, as m, a ring bearing, as b^2, and a disk or ring, as c, seated in bearing b^2, of an adjusting device, as a revoluble shaft, a block or blocks revoluble with the shaft, and a guide or guides connected with the disk or ring in which said block or blocks work so as to displace the center of the disk or ring relatively to the center of the eccentric that actuates the lever when a partial rotation is imparted to the shaft, and to cause said ring or disk to oscillate or reciprocate on or with the block or blocks in the plane of the displacement of its (the disk's) center, for the purpose set forth.

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

ANDREAS RADOVANOVIC.

Witnesses:
W. B. MURPHY,
PAUL BERGER.