(No Model.) 3 Sheets—Sheet 1.

H. MOEHRING & A. PFLÜGER.

STEAM OR OTHER MOTOR.

No. 383,405. Patented May 22, 1888.

Fig. I

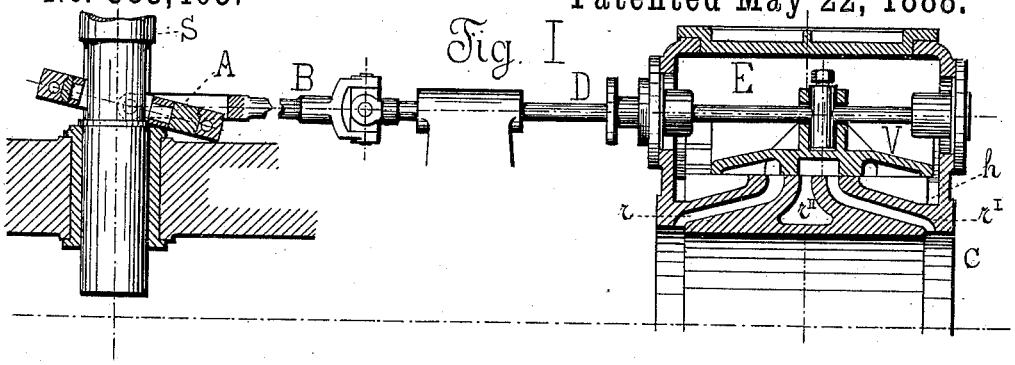


Fig. II

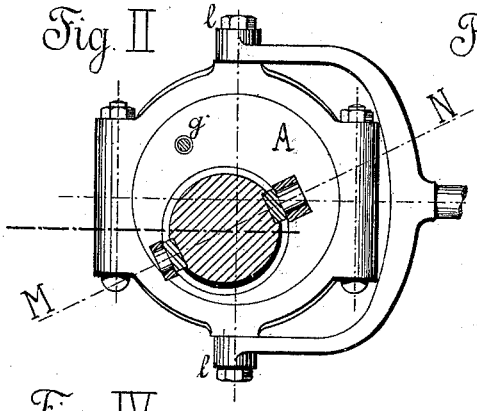


Fig. III

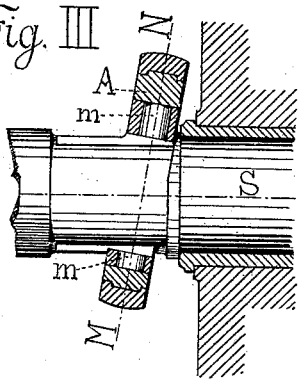


Fig. IV

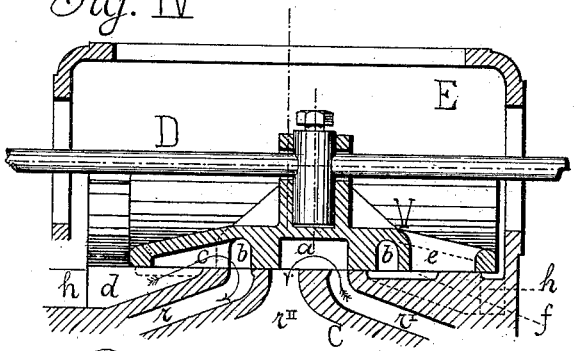


Fig. V

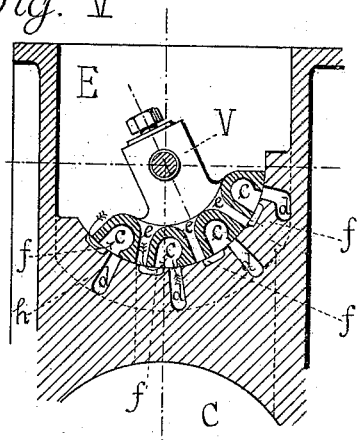


Fig. VI

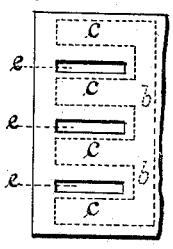
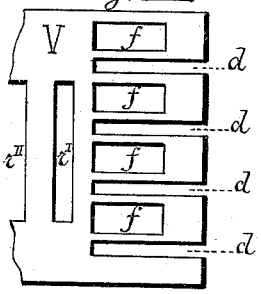


Fig. VII



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Inventors:
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Albert Pflüger

(No Model.)

3 Sheets—Sheet 2.

H. MOEHRING & A. PFLÜGER.

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Fig. IX

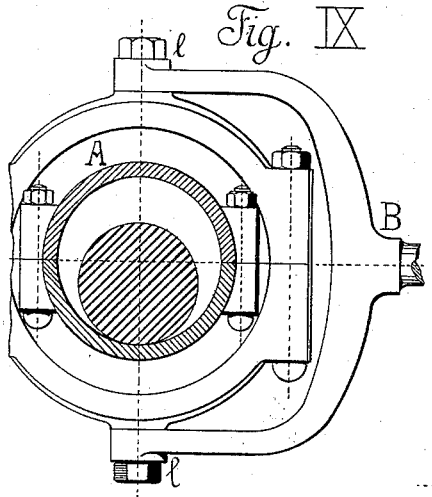


Fig. VIII

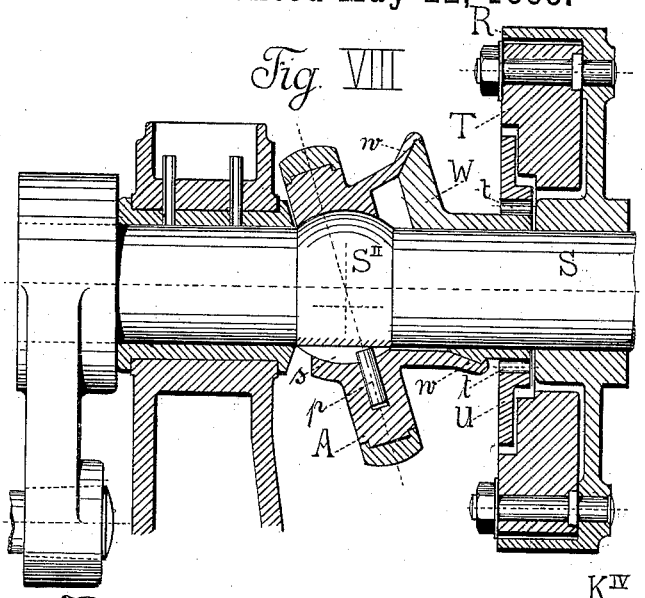


Fig. X

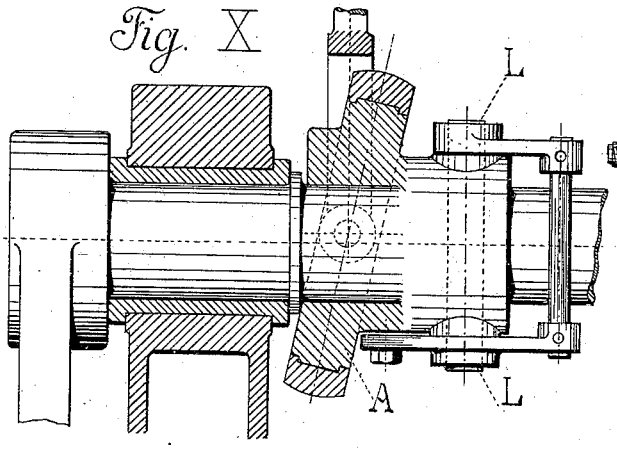


Fig. XI

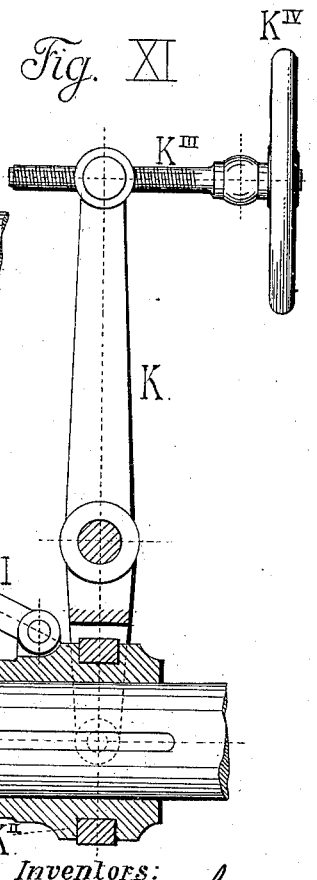
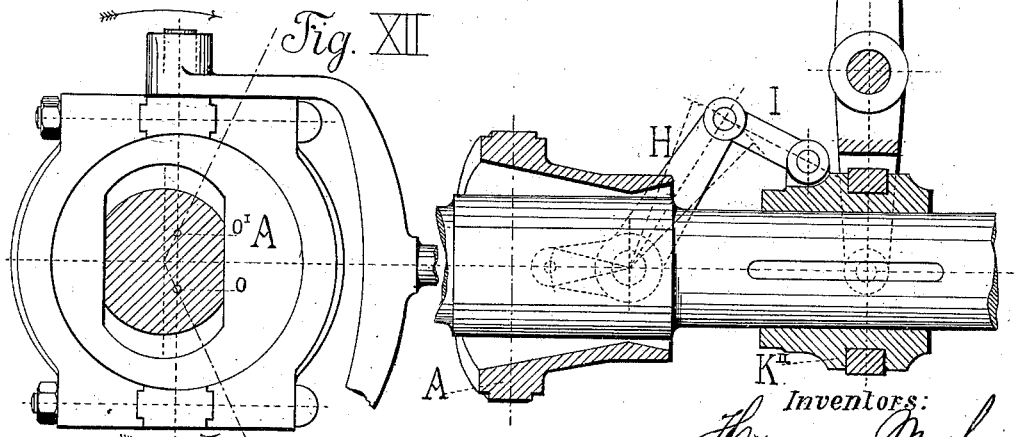


Fig. XII



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(No Model.) 3 Sheets—Sheet 3.

H. MOEHRING & A. PFLÜGER.

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Fig. XIII

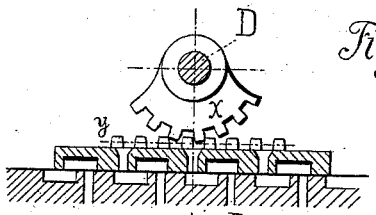


Fig. XIV

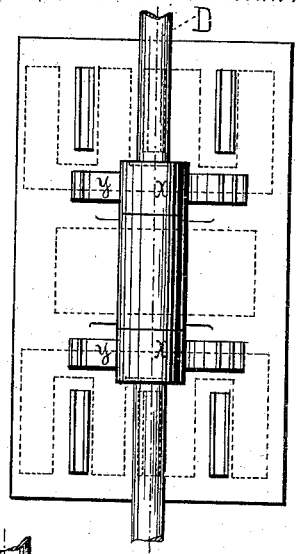


Fig. XV

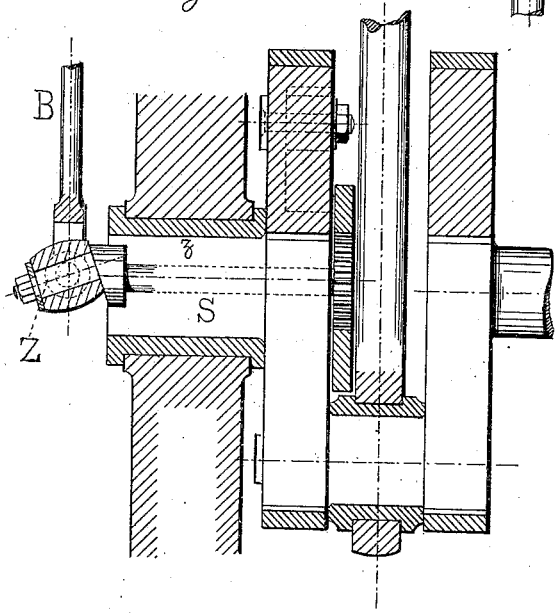
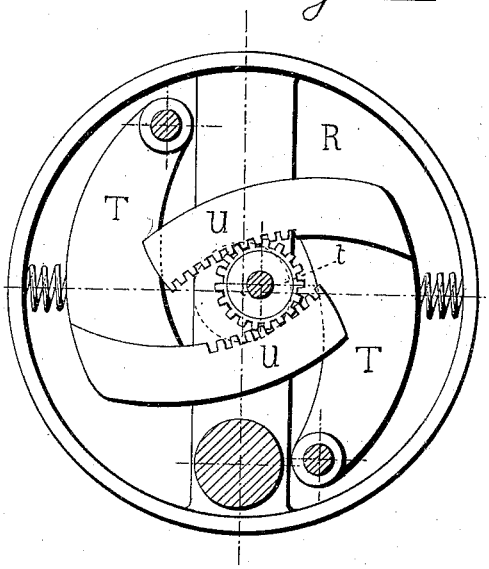


Fig. XVI



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Inventors:
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UNITED STATES PATENT OFFICE.

HERMANN MOEHRING AND ALBERT PFLÜGER, OF FRANKFORT-ON-THE MAIN, PRUSSIA, GERMANY.

STEAM OR OTHER MOTOR.

SPECIFICATION forming part of Letters Patent No. 383,405, dated May 22, 1888.

Application filed April 6, 1886. Serial No. 197,945. (No model.) Patented in England April 7, 1886, No. 4,859; in France April 7, 1886, No. 175,333; in Belgium April 7, 1886, No. 72,682; in Germany April 8, 1886, No2. 37,554 and 40,827, and July 10, 1886, No. 41,149, and December 14, 1886, No. 41,921; in Italy June 30, 1886, No. 19,777, and June 30, 1887, No. 21,552, and in Austria-Hungary September 13, 1886, No. 14,984 and No. 41,064.

To all whom it may concern:

Be it known that we, HERMANN MOEHRING, a citizen of the United States, residing at Frankfort-on-the-Main, and ALBERT PFLÜGER, a subject of the Emperor of Germany, residing at Frankfort on-the-Main, Germany, have invented certain new and useful Improvements in Steam and other Motors, (for which the following patents have been granted: in England April 7, 1886, No. 4,859; in Germany April 8, 1886, Nos. 37,554 and 40,827, July 10, 1886, No. 41,149, and December 14, 1886, No. 41,921; in France April 7, 1886, No. 175,333, and March 31, 1887, No. 175,333, Certificate of Addition; in Austria-Hungary September 13, 1886, No. 14,984 and No. 41,064; in Italy June 30, 1886, No. 19,777, and June 30, 1887, No. 21,552; in Belgium April 7, 1886, No. 72,682, and Certificate of Addition thereto, March 31, 1887,) of which the following, taken in connection with the accompanying drawings, is a specification.

It is well known that in order to obtain economy in the use of steam or any elastic fluid in steam-engines or motors, the steam or elastic fluid must be cut off when a small part of the stroke has been performed, thus allowing it to work expansively during the remainder; that, furthermore, the best method of obtaining a uniform speed of the engine under variable resistance or variable pressure of the steam or elastic fluid is to vary the point of cutting off in accordance therewith, either by hand or, as in most cases preferable or necessary, by mechanism influenced by a governor. It is also necessary in many cases that the direction of the motion of the engine can be readily reversed, as in locomotives, steamers, &c.

The object of our invention is to accomplish the above in a more simple and perfect manner than hitherto attained.

It consists in giving a peculiarly-constructed valve two motions, one a longitudinally back and forward motion, the other either a rotary oscillating (when the face of the valve is constructed cylindrical) or a transverse back and forward motion, (when the valve is made flat,) the valve and cylinder having such passages or ports and construction that by one of its above-described motions the valve performs the functions of the ordinary slide-valve in giving admission and eduction, while by the other it acts as an expansion or cut-off valve.

Our invention further consists in attaching or placing an eccentric or an eccentric-pin on its driving-shaft oblique to or at an inclination to the latter. The eccentric in revolving will then give two motions to the eccentric-rod, one the usual back and forward longitudinal motion, due to the eccentricity of the eccentric—such as eccentrics placed on their shafts in the usual manner employed up to now give to their rods—the other being a part of a rotation in one direction and then returning back again, the amount of rotation being due to the greater or less inclination of the eccentric or eccentric-pin to its shaft, and the period when this motion takes place relative to the period of the longitudinal motion being due to the position of the inclination.

Our invention further consists in so constructing the eccentric or eccentric-pin and mounting it on its driving-shaft that the position of its inclination can be readily altered, either by hand or by the influence of a governor, and, where desirable, the position of the eccentric also so altered by a suitable reversing-gear that the motion of the valve becomes reversed and the engine driven, in consequence, backward.

Figure I is a sectional view of the cylinder-ports, valve, valve-rod, eccentric-rod, eccentric, and shaft of an engine. Fig. II is an end view of the eccentric with its eccentric strap or hoop and rod. Fig. III is a side view of the eccentric in section, showing its attachment to its shaft. Fig. IV is a side section through the valve and ports of an engine. Fig. V is an end view in section through the valve and cylinder-valve face. Fig. VI is a top view of a portion of the valve, and Fig. VII a top view of a portion of the valve-face of the cylinder, both considered as if unrolled or laid out flat. Fig. VIII is a section through the eccentric and its attachments to a governor, and section through lat-

ter showing a manner of varying position of the inclination of the eccentric by means of a governor. Fig. IX is an end view, the governor and attachments being removed. Fig. X shows a sectional top view of the eccentric with a reversing-gear attached; Fig. XI, a side view of the same, and Fig. XII an end view of the eccentric and its shaft to illustrate the two positions for forward and reverse motion of the engine. Fig. XIII is a section, and Fig. Fig. XIV a top view, of the valve when constructed with a flat instead of a curved face. Fig. XV is a partly-sectional, and Fig. XVI an end view, of the arrangement for giving the two movements to an eccentric-rod when it is preferred to use an eccentric-pin or crank-pin as an equivalent for or instead of an eccentric, and showing, moreover, a manner of altering the position of the inclination of said eccentric-pin by means of a governor.

Similar letters refer to similar parts throughout the several views.

In Figs. I, IV, and V, C represents a steam-cylinder with the usual steam-passages, *r r'*, and exhaust or eduction port *r''*. Its valve-face (see also Fig. VII) has, furthermore, the passages *d d d*, communicating at their ends respectively with the channel-ways *h h*, which latter are open to the steam-chest E. It has, furthermore, the depressions or cavities *f f f f*. This valve-face is represented curved, being a segment of a cylinder, of which the center line corresponds with the center line of the valve-rod D, and the valve-face of the valve V is made to correspond and fit exactly thereto. These valve-faces may be, however, made flat instead of cylindrical, as I shall describe farther on.

The valve V has on its face the transverse covered passages or cavities *a* and *b b;* also on each side a number of longitudinal covered passages or cavities *c c c c*, which communicate with *b b*, and also a number of passages, *e e e*, through the valve. The valve receives, as already mentioned, two motions, the one being the usual longitudinal back and forward motion of a slide-valve, the other being, when the valve-face is curved or cylindrical, a partial revolution and a return back again, (oscillation,) and when the valve is constructed with a flat surface, being a back and forward motion transverse to the longitudinal motion of the valve.

The valve being in the position as shown by the drawings, it is apparent that steam admitted into the steam-chest E can freely pass through the passages *h*, *d*, *c*, and *b*, and also through *e*, *f*, *c*, and *b* on one side of the valve to the passage *r*, and thence to the forward end of the cylinder, the steam from the other end of the cylinder escaping freely through the passage *r'* to the cavity *a* of the valve, and thence to the exhaust or eduction passage *r''*.

The described passages being the same on both sides of the valve and cylinder-valve face, when the valve is moved forward the steam will in a similar manner be admitted to the back end of the cylinder through passage *r'*, while it escapes from the forward end through passage *r* to the eduction-port *r''*. Thus if the valve were moved merely longitudinally back and forward, as usual in an ordinary slide-valve, it would distribute the steam and change its admission to and eduction from the two ends of the cylinder in the usual manner in which slide-valves act; but, as mentioned above, we give the valve another motion transverse to the longitudinal one. This motion closes the passages *d c b* and *e f c b*, thus cutting off the admission of steam, while it does not interfere with the free discharge of the steam from the other end of the steam-cylinder; and, moveover, the period at which this motion cuts off the admission of steam relative to the position of the piston of the engine can be made fixed or variable either by hand or by the influence of a governor, as shall be shown farther on.

We have found that by this construction of the valve, and particularly by giving it the two motions described, we obtain a very free admission and eduction of steam and a very rapid cutting off of the same, the period of which is easily adjusted or controlled. We also avoid the well-known disadvantages resulting from the employment of a valve with merely one motion, imperfect action, or a number of valves, great complication, and consequent liability to disarrangement and repair.

It is obvious that we could increase or decrease the number of the passages *c c c*, *d d d*, *e e e*, and *f f f*. Slow-running engines not requiring large passages may be made with less, while engines with high speed of piston should have an ample number to give sufficient area for the rapid passage of steam to the cylinder without being obliged to make the passages of large size and necessitating thereby an inconveniently large motion to the valve.

We have mentioned that the valve and cylinder faces may be made flat instead of cylindrical. This modification is clearly shown by Figs. XIII and XIV, wherein we have also shown a method of giving the transverse motion by means of the toothed sectors *x x*, working in the racks *y y*. In engines with long stroke, where it is desirable to shorten the admission-passages to the cylinder *r* and *r'*, two valves connected together so that they are near the ends of the cylinder may be used in the usual and well-known manner in which this is done with the usual slide-valves.

We have described above that the longitudinal motion of our valve performs certain functions, while the transverse or oscillating motion performs others. It is obvious that we can reciprocally substitute these motions one for the other, the position and direction of the steam-passages in the valve-faces being modified accordingly.

Referring, now, to the second part of our invention, it will be seen on Figs. I, II, and III that we do not place or mount our eccen-

tric on its driving-shaft in the manner hitherto done, but at an inclination or oblique to the same.

A represents the eccentric.

B is the eccentric-rod, the fork of which is attached to the eccentric-hoop by hinges *l l*.

The line M N shows the inclination of the eccentric to the shaft. Where it is merely desirable that the degree of expansion with which the engine is to work be fixed or invariable, the eccentric can be fixed or keyed fast to the shaft at the proper inclination and in the proper position, and the shaft on being revolved will give the two motions to the eccentric-rod already described, the one being longitudinal motion, due to the eccentricity of the eccentric, and the other being the part of a rotation and return or oscillation, due to the inclination of the eccentric to its shaft, and the relative periods to one another at which these motions take place will depend on the position of the inclination of the eccentric. These motions, being conveyed by the eccentric-rod B and valve-rod D to the valve V, will give the latter the proper movements, which we have already described in this specification; but where it is desirable, as in most all cases, to have the degree of expansion variable, the eccentric is not rigidly fast on its shaft, but mounted so that the position of its inclination can be readily changed or altered. A mode of doing this is the following:

Figs. II and III show two pins or trunnions, *m m*, fastened to the shaft at a proper angle to the same, and on these the eccentric is swung. The angle which the line passing through the center line of the trunnions makes with the center line of the shaft is thus fixed or invariable; but by turning the eccentric on the trunnions the position of its inclination is changed. This change, however, produces a change of the relative periods of the two motions, or, in other words, the transverse or oscillating motion will commence sooner or later relatively to the longitudinal motion, according to the direction in which the eccentric is turned on its trunnions *m m*. These motions communicated to the valve will cause a sooner or later cutting off of the steam, and consequently its greater or less degree of expansion in the cylinder, while the lead of the valve and the eduction remains constant and uninterfered with. From the above it will be readily seen that by attaching to any part of the eccentric—for example, *g*—an appliance for moving it on its trunnions *m m*, either by hand or by the influence of a governor, we accomplish a variable expansion-gear, variable by hand or by a governor.

In Figs. VIII and IX another mode of constructing and mounting our eccentric on its shaft and connecting it to a governor is shown. The governor in this instance is of the kind wherein weights hung on pins on the face of a wheel, R, are impelled outward toward the periphery by their centrifugal force, which latter is controlled according to the speed desired by suitable springs. By reference to Fig. XVI the construction of this governor is more easily seen. T T are the weights, a part of which are prolonged to form the toothed segments U U, which gear into or with the pinion *t*. In Fig. VIII this pinion *t t* is shown attached to or forming part of an eccentric wheel or disk, W, mounted on the shaft S, so that it can revolve on the same. The face of this eccentric W is inclined to or forms an angle with the shaft S, and its periphery is beveled or conical and fits to the similarly-formed portion *w w* of the eccentric A, which in this case is mounted on a spherically-formed portion, S″, of the shaft S. A pin, *p*, working in the slot *s*, prevents the eccentric A from turning on the shaft, but does not prevent other motion, so that A would be free to change its position of inclination if it were not held or controlled by the position of W; but, as we have described above, the pinion is attached to or forms part of W and gears into the toothed segments U U of the weights T T. Therefore any movement of these weights on their pins or pivots will be communicated to W, causing it to move around the shaft. It is manifest that such a movement of W will change the position of the inclination of the eccentric A, and we have shown above that such a change will cause a corresponding change in the relative periods of the two motions produced by the eccentric, one to the other, and this change will cause the valve to cut off the steam sooner or later, as the case may be.

The weights are so adjusted, and their centrifugal force for any desired normal or constant speed so counterbalanced by springs of suitable tension, that at the normal speed of the engine they occupy a position between the extremes of their motion toward the periphery and toward the center of the wheel to which they are attached, and our eccentric is mounted on the shaft at such an inclination and in such a position of the same that our valve will cut off the steam at the point or period when the desired proportion of the stroke of the engine has been accomplished.

Should the engine accelerate its speed, the greater centrifugal force of the weights created thereby will move them outward, causing thereby rotative motion of the pinion *t*, and consequently of the eccentric wheel or disk W. This movement of W changes the position of the angle of the eccentric A and causes the proper motion of the valve to take place sooner, thus cutting off the steam when a less proportion of the stroke has been performed. The reverse of this takes place if the engine diminishes its speed. The centrifugal force of the weights being then less, the springs will force them to move inward, reversing the motion of W, just described, and changing the position of the inclination of the eccentric A, so that the valve will cut off the steam at a later period, or when a greater proportion of the stroke has taken place.

The form or kind of governor may be any other than the one we have described. Any governor which will turn the disk W in the proper direction when its speed is accelerated and reverse this motion when its speed is diminished may be employed.

We have mentioned that by employing a suitable reversing-gear the position of our eccentric can be readily altered, so that the engine may be driven forward or backward, as desired. Figs. X, XI, and XII show a proper arrangement for this purpose. The shaft S is flattened on two opposite sides, as shown in Fig. XII.

The eccentric having its proper angle to the shaft, as shown in Fig. X, and having its hub of a suitable shape, as shown in Fig. XI, is mounted on this flattened portion of the shaft, so that its position can be changed by the action of the double-armed lever H, which turns on its fulcrum L. By moving the hub or sleeve K″ on the shaft by means of the lever K and its screw and hand-wheel K‴ and K^{IV} the link I will communicate the motion to the double armed lever H, which, being connected with the eccentric, will change the position of the center of the eccentric, its inclination, and the position of the same. Supposing, now, that when the center of the eccentric is at the point marked *o*, Fig. XII, the engine would go ahead, then by moving the levers by the hand-wheel toward the center line of their movement the center of the eccentric will be so moved that the valve will cut off the steam shorter and shorter until the center of the eccentric arrives at the center line of the engine, when the steam will be cut off altogether and the engine brought to stop. On continuing the motion the center of the eccentric will proceed toward the point *o′*, the engine will change its direction and go backward, and the cut-off motion of the valve will take place later and later as the movement progresses. We have mentioned that where we prefer to use an eccentric pin instead of an eccentric in carrying out our invention we can readily do so. Fig. XV shows this very clearly. Z is the eccentric-pin, the axial line of which is inclined to the axial line of the shaft, just as we have described is the case with our eccentric. This eccentric-pin is fastened to or forms a part of the small shaft *z*, the axis of which is parallel to the axis of the shaft, but which has the suitable eccentricity to give the longitudinal motion desired to the rod B. The amount of inclination of the pin Z is determined by the amount of the other motion required, as we have described while explaining our eccentric. The shaft *z* passes through shaft S and has attached to it the pinion *t*. This pinion *t* being turned, will alter the position of the inclination of the pin Z and cause a corresponding change in the relative periods of the two motions, one to the other, which the pin gives to the rod B, as we have also explained in describing the action of the eccentric.

We remark that where in this specification we have spoken of "steam" or "steam-engines" we do not limit our invention merely thereto. Our invention applies also to all engines or motors using in the same manner as steam-engines use steam any elastic fluid, air, or gas. We also remark that the shaft S, on which our eccentric or eccentric-pin is placed, need not to be the main shaft of the engine or motor, as where it is desirable they may be placed on a secondary or supplementary shaft.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a slide-valve constructed and arranged to receive a longitudinal movement and an oscillating or lateral movement, a shaft, a movable eccentric or eccentric pin arranged at an angle with reference to said shaft, and a rod connecting said eccentric or eccentric-pin and the valve, whereby the point of cut off of the valve may be varied by a change in the position of the angle of the said eccentric or eccentric-pin, substantially as and for the purpose herein set forth.

2. The combination of a slide-valve constructed and arranged to receive a longitudinal and an oscillating or lateral movement, a shaft, an eccentric or eccentric-pin carried by said shaft at an angle or inclination thereto, a rod connecting said eccentric or eccentric-pin, and the valve and mechanism for varying the position of the inclined eccentric or eccentric-pin to vary the point of cut-off of the valve, substantially as and for the purpose herein set forth.

3. The combination of a slide-valve constructed and arranged to receive a longitudinal and an oscillating or lateral movement, a shaft, an eccentric or eccentric-pin carried by said shaft at an angle or inclination thereto, a rod connecting said eccentric or eccentric-pin with the valve, a governor and devices connecting the same with the eccentric or eccentric-pin to automatically vary the position of the inclined eccentric or eccentric-pin in order to automatically vary the point of cut-off of the valve, substantially as and for the purpose herein set forth.

4. The combination of a valve seat provided with steam and exhaust ports and with cavities *f* and passages *d*, a slide-valve having transverse covered passages *a* and *b* and longitudinal passages *c* and *e*, and mechanism for communicating longitudinal and transverse movements to the said slide-valve, substantially as and for the purpose herein set forth.

5. The combination of a slide-valve, a revolving shaft, an eccentric or eccentric-pin revolving with the said shaft and mounted at an inclination to the same, and a rod pivotally connected to the said eccentric or eccentric-pin and to the slide-valve, so that the said valve receives longitudinal and transverse movements, substantially as and for the purpose herein set forth.

6. The combination of a valve-seat provided with steam and exhaust ports and with cavi-

ties *f* and passages *d*, a slide-valve having transverse covered passages *a* and *b* and longitudinal passages *c* and *e*, a revolving shaft, an eccentric or eccentric-pin revolving with the said shaft and mounted at an inclination to the same, and a rod pivotally connected to the said eccentric or eccentric-pin and to the slide-valve, so that the said valve receives longitudinal and transverse movements, substantially as and for the purpose herein set forth.

7. The combination, in a valve gear, of a revolving shaft having trunnions projecting from it at an inclination to its axis, and an eccentric or eccentric-pin pivoted on the said trunnions and adapted to transmit a longitudinal and an adjustable transverse movement to the valve, substantially as and for the purpose herein set forth.

8. The combination, in a valve gear, of a revolving shaft, an eccentric or eccentric-pin mounted on the said shaft at an inclination to its axis, and a pin or device connecting the eccentric or eccentric-pin with the shaft, so that the position of the said inclined eccentric or eccentric-pin may be varied, substantially as and for the purpose herein set forth.

9. The combination of a slide valve, a revolving shaft, an eccentric or eccentric-pin mounted on the said shaft at an inclination to its axis, a pin or device connecting the eccentric or eccentric-pin with the shaft, so that the position of the said inclined eccentric or eccentric-pin may be varied, a rod pivotally connected to the eccentric or eccentric-pin and to the slide-valve, so that the said valve receives longitudinal and transverse movements from the eccentric or eccentric-pin, and a speed-governor connected to the eccentric or eccentric-pin for automatically varying its inclination and the transverse movement of the valve, substantially as and for the purpose herein set forth.

10. The combination of a slide-valve, a revolving shaft provided with the spherical portion S″ and slot *s*, an eccentric mounted on the said spherical portion at an inclination to the axis of the shaft and provided with the conical beveled face *w*, the pin *p*, connecting the eccentric with the slot in the shaft, a rod pivotally connected to the eccentric and to the slide-valve, the eccentric-disk W, having the pinion *t* secured to it, and a governor connected to the said pinion for automatically varying the position of said inclined eccentric and the transverse movement of the valve without altering its longitudinal movement, substantially as and for the purpose herein set forth.

11. The combination, in a valve-gear, of a revolving shaft, an eccentric or eccentric-pin mounted on said shaft at an inclination thereto and adapted to transmit longitudinal and transverse movements to the valve, and mechanism connected to the eccentric for changing the position of its center and of its inclination, so that the direction of the movements transmitted by it to the valve may be reversed, substantially as and for the purpose herein set forth.

Frankfort-on-the-Main, the 18th day of March, 1886.

HERMANN MOEHRING.
ALBERT PFLÜGER.

Witnesses:
ANTON BALDUS,
JACOB BÜCHSEL.