W. K. AUSTIN.

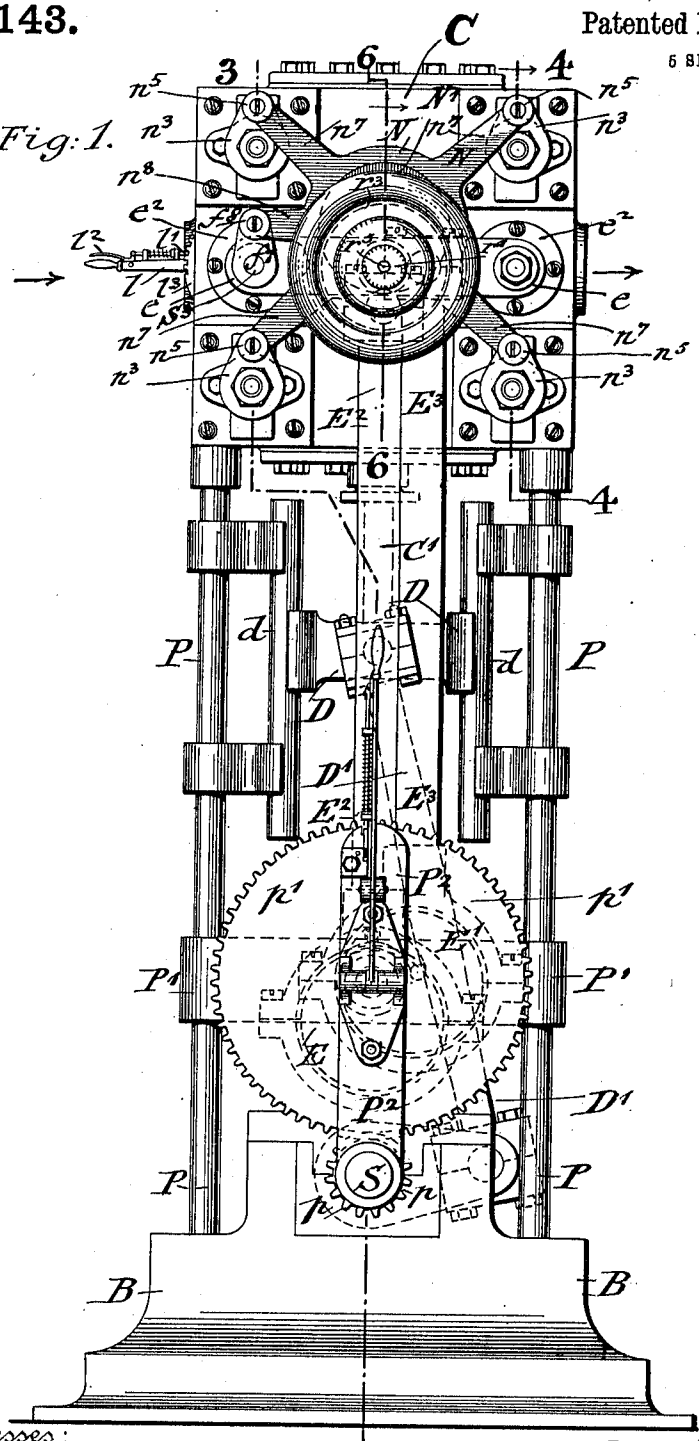
STEAM ENGINE.

APPLICATION FILED AUG. 9, 1907. RENEWED SEPT. 3, 1910.

992,143. Patented May 16, 1911.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

Inventor

William Kerr Austin

By his Attorneys Church & Church.

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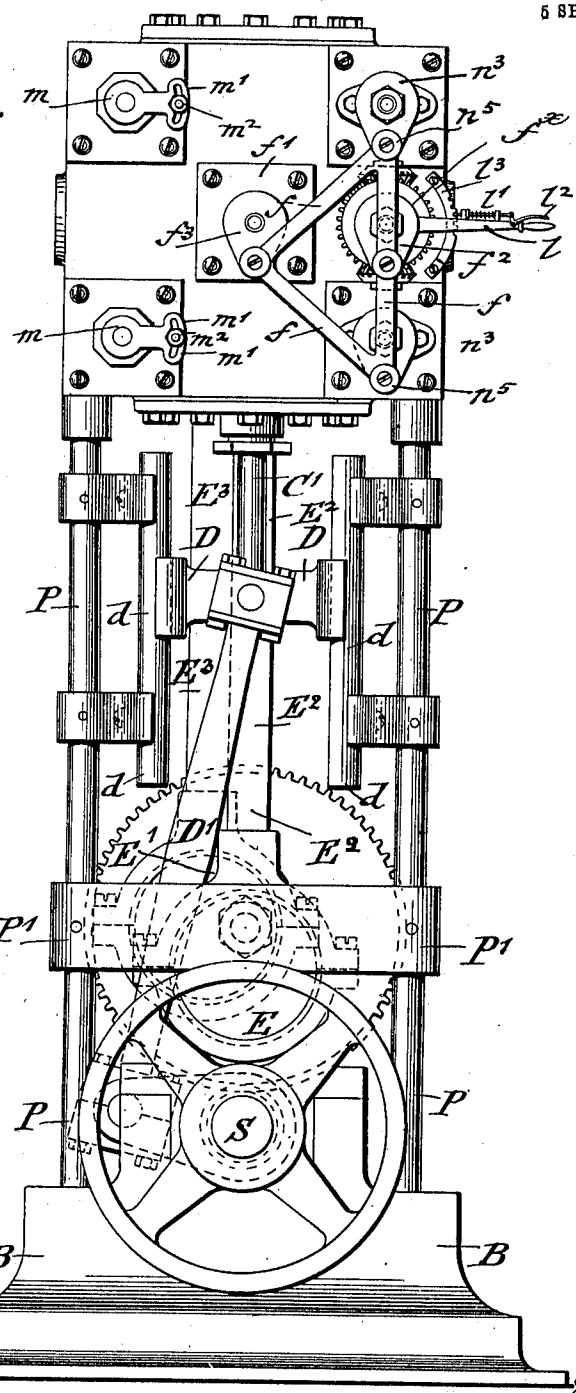
5 SHEETS—SHEET 2.

Fig. 2.



Witnesses.

Henry J. Sahrbier.

Inventor

William Kerr Austin

By his Attorneys Howell Gosnell.

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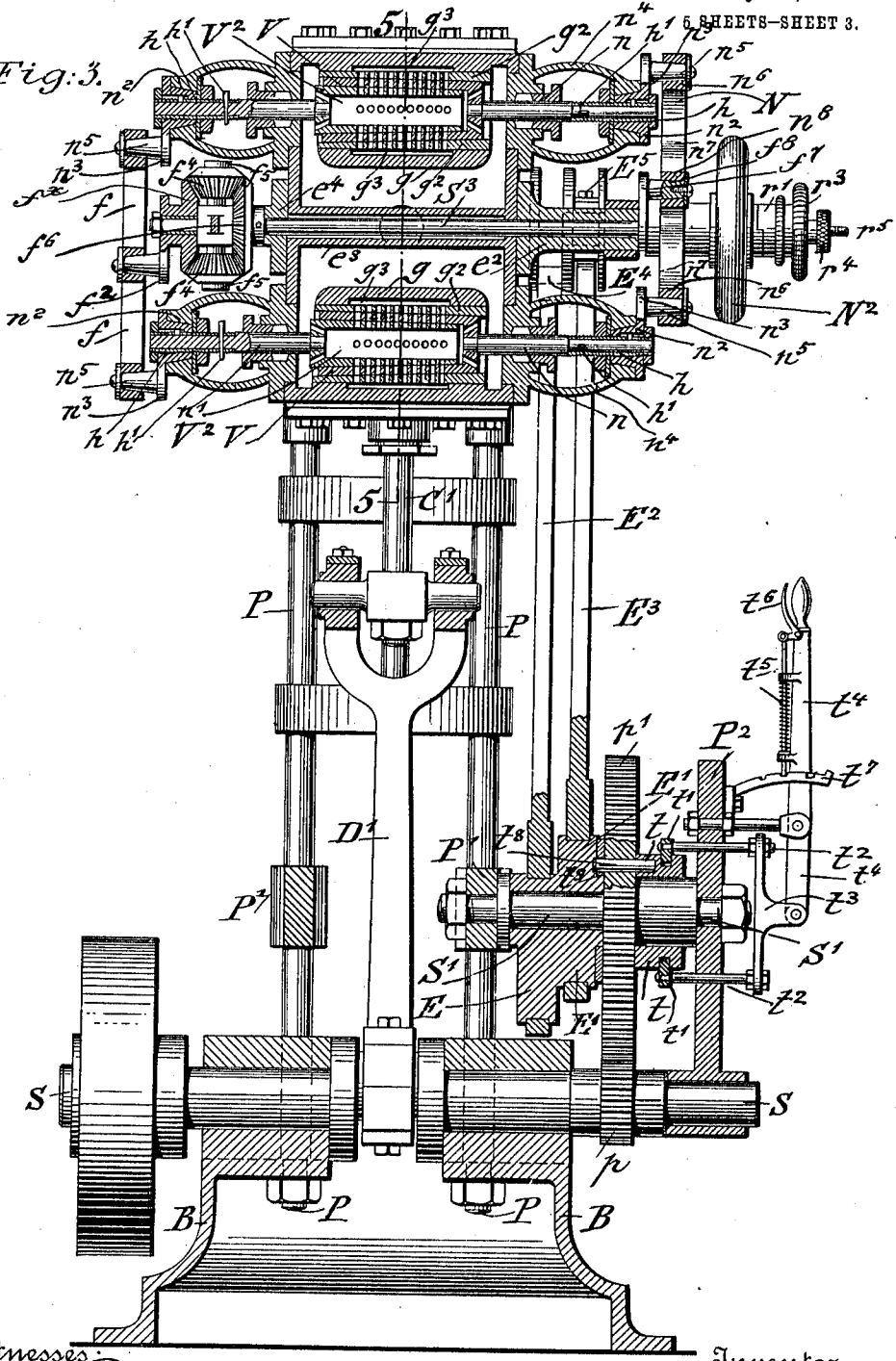
5 SHEETS—SHEET 3.

Fig. 3.



Witnesses:

Henry J. Sukrbier.

Inventor

William Kerr Austin

By his Attorneys Fowler & Gopel.

W. K. AUSTIN.

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5 SHEETS—SHEET 4.

Fig. 4.

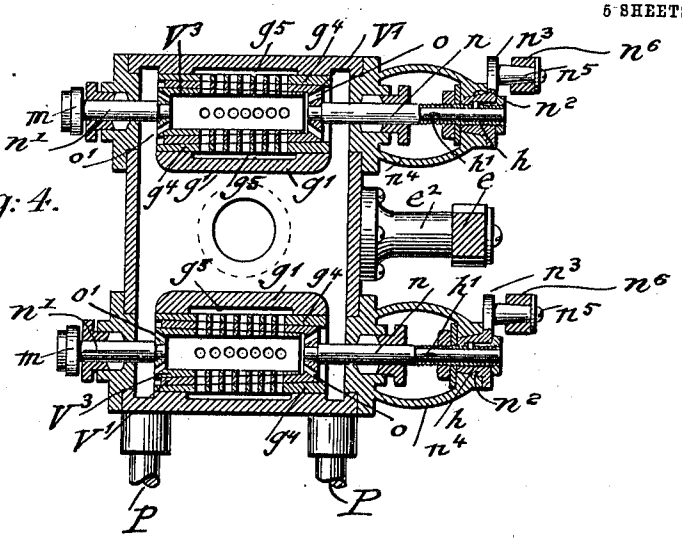
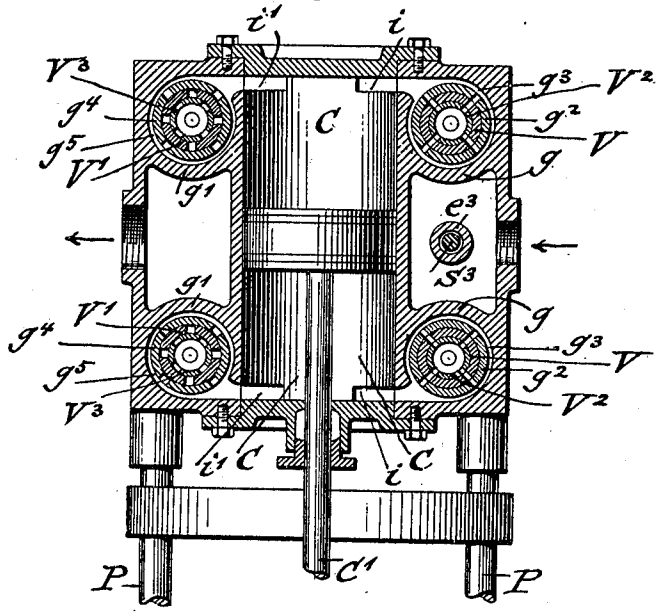


Fig. 5



Witnesses:

Henry J. Buhrlen.

Inventor

William Kerr Austin

By his Attorneys

Gifford & Gifford.

W. K. AUSTIN.

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5 SHEETS—SHEET 5.

Fig: 6.

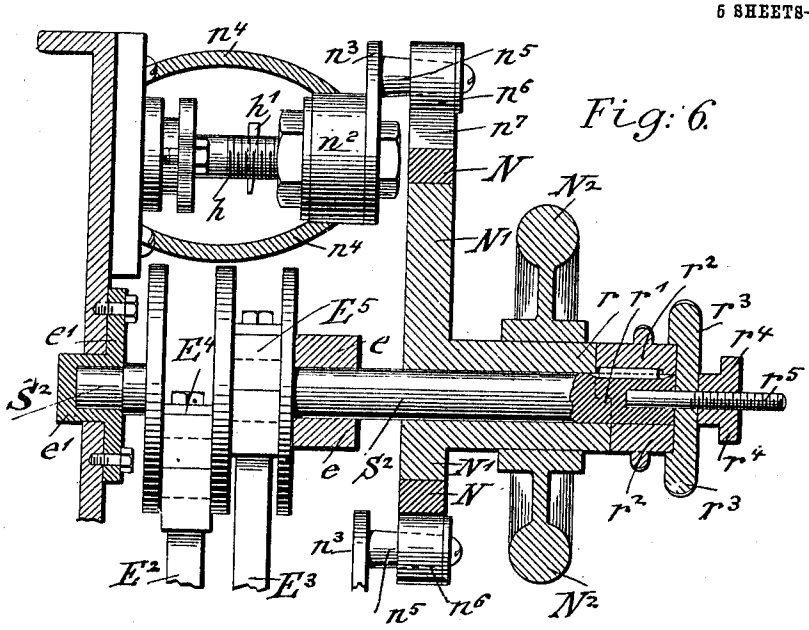
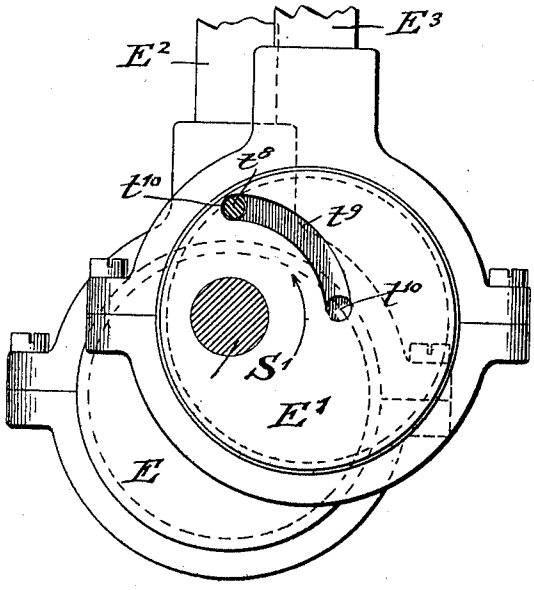


Fig: 7.



Witnesses:

Henry J. Dubrier.

Inventor

William Kerr Austin

By his Attorneys

Farnell Goepel.

UNITED STATES PATENT OFFICE.

WILLIAM KERR AUSTIN, OF NEW YORK, N. Y., ASSIGNOR TO EQUILIBRIUM VALVE ENGINE COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

STEAM-ENGINE.

992,143. Specification of Letters Patent. Patented May 16, 1911.

Application filed August 9, 1907, Serial No. 387,797. Renewed September 3, 1910. Serial No. 580,300.

To all whom it may concern:

Be it known that I, WILLIAM KERR AUSTIN, a citizen of the United States, residing in New York, in the borough of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

This invention relates to reciprocating steam-engines of the type specially intended for use as marine-engines, and which can be easily reversed while running and adjusted to any desired degree of cut-off.

The object of the invention is to provide an engine of this type having an improved arrangement of valves and improved means whereby these valves are operated.

With these ends in view the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawings, Figure 1 represents a front-elevation of my improved steam-engine, Fig. 2 is a rear-elevation of the same, Fig. 3 is a vertical transverse section on line 3, 3, Fig. 1, Fig. 4 is a detail vertical section through the eduction-valves, taken on line 4, 4, Fig. 1, Fig. 5 is a vertical transverse section on line 5, 5, Fig. 3, Fig. 6 is a detail side-elevation, partly in section on line 6, 6, Fig. 1, of the valve-gear, drawn on a larger scale, and Fig. 7 is a detail side-elevation of the eccentrics by which motion is transmitted to the valve-gear from the driving-shaft.

Similar letters of reference indicate corresponding parts throughout the several figures of the drawings.

Referring to the drawings, B is the bedplate of the improved steam-engine, C the cylinder and S the driving crank-shaft. The cylinder C is supported on the bedplate B by a number of upright pillars P that are firmly bolted to the bedplate and inserted into sockets at the bottom of the valve and cylinder casing. On the upright pillars P are supported guides *d* for the cross-head D to which the piston-rod C^1 as well as the forked upper end of the connecting-rod D^1 are pivoted. The lower end of the connecting rod D^1 is pivoted to the wrist-pin of the crank of the driving-shaft S. At each side of the cylinder C is arranged a valve-chest one for the steam induction-valves and one for the eduction-valves, two valves being arranged in each chest, said valves being rotated by a valve-gear that is connected with eccentrics E E^1 located on an intermediate transmitting-shaft S^1. The live-steam pipe is connected with the valve-chest for the induction-valves, and the exhaust-pipe with the valve-chest for the eduction-pipes by means of the openings shown in Fig. 5. The engine shown is of the vertical reciprocating double acting type which is mainly intended for use as a marine-engine.

Motion is transmitted from the driving-shaft S to the intermediate shaft S^1 by means of a pinion *p* on the driving crank-shaft S, which meshes with a gear-wheel p^1 on the intermediate shaft S^1, which latter is supported in suitable bearings of a cross-piece P^1 which is attached to the upright pillars P, and an upright P^2 supported by a sleeve on the end of the driving crank-shaft S, as shown in Fig. 3. On the intermediate shaft S^1 are mounted the two eccentrics E E^1 to which are strapped the lower ends of two connecting-rods E^2, E^3 the upper ends of which are pivoted to two cranks E^4 E^5 that are located at an angle of 90° to each other, so as to impart rotary motion to the valve-operating shaft S^2 and to a spindle S^3 which passes centrally through the steam-chest of the induction valves. The two eccentrics and their connecting rods are used to insure the steady rotation of the valve-gear and to prevent its stopping on a dead center. The valve-operating shaft imparts continuous rotary motion in the same direction to the valve-gear of the induction- and eduction-valves, while the spindle S^3 and suitable differential gear operated by the same impart motion in the opposite direction to the cut-off mechanism of the induction-valves. The crank-shaft S^2 is supported in bearings in a cross-piece *e* which is applied to horizontal pillars e^2 on the valve-casing and in a socket e^1 at the middle portion of the valve-casing, as shown respectively in Figs. 4 and 6. The spindle S^3 passes through one of the pillars e^2 and through a tubular housing e^3 in the valve-chest of the induction-valves to the rear-part of the valve-casing, turning in the tubular pillar e^2 and a journal-bearing e^4 on the rear-wall of the valve-casing, as shown in Fig. 3.

The valve-chambers.—At the inside of the valve-chest for the induction-valves are

arranged two cylindrical chambers g, which are open at both ends, and which are preferably cast integral with the steam-chest, as shown in Fig. 5. These cylindrical chambers are connected by induction-ports i with the opposite ends of the cylinder C. In the valve-chambers are arranged fixed valve-seats g^2 for the induction-valves. An annular space g^3 is arranged around the induction-valves in the valve-chambers, so that the steam can freely pass through the hollow valves into the annular spaces surrounding the valves, and from the same to the induction-ports In the steam-chest for the eduction-valves similar cylindrical valve-chambers g^1 are arranged, the length of which is shorter than the width of the exhaust valve-chest, and which communicate in the same manner with the eduction-ports i^1 at opposite ends of the cylinder, the walls forming the chambers being likewise preferably cast integral with the exhaust steam-chest. Fixed valve-seats g^4 surrounded by anular spaces g^5, are likewise arranged in the valve-chambers for the eduction-valves.

The induction and eduction-valves.—The induction-valves are designated by the letter V and the eduction-valves by the letter V^1. The valves V and V^1 are inclosed by valve-seats g^2, g^4 in which they are rotated. In the induction-valves are located cut-off valves V^2 and in the eduction-valves, so-called compression-valves V^3, which are made like the valve-seats slightly tapering at their faces, adjacent to the induction and eduction-valves, so that the valves fit tightly one into the other. The object in tapering or coning the valve-seats and the cut-off and compression-valves is to obtain a steam-tight fitting of one valve within the other and to maintain this condition throughout without requiring refitting, the tight fitting of the valves being accomplished by adjusting them longitudinally in their valve-seats when they become loose by wear. This adjustment has to be accomplished when the valves are in warm or heated condition. Owing to the construction and mode of operation of the valves, the wear is perfectly uniform and can be compensated for by merely moving the induction- or eduction-valves in the direction of their axes, and securing them in their new position by keying their stems n to sleeves h to which the ends of the stems are fastened by means of tapering keys h^1 that pass through the sleeves and stems. The induction- and eduction-valves V and V^1 are open at one end and closed at the other end, the closed ends being connected with the valve-stems n and provided with channels o for permitting the live steam to pass to the interior of the cut-off and compression-valves respectively. The cut-off and compression-valves are likewise closed at one end and open at the other end, the closed ends being located opposite to the closed ends of the induction and eduction-valves and also provided with channels o^1 for the steam. The stems n^1 of the cut-off and compression-valves V^2, V^3 as well as the stems n of the induction and eduction-valves V and V^1 are passed through stuffing-boxes in the walls of the steam-chests to the outside of the same. The outer ends of the stems n and n^1 with the exception of the stems n^1 of the compression-valves V^3 are inclosed by and splined to the hubs n^2 of valve-cranks n^3 that are supported in bearings of brackets n^4 which are preferably cast integral with the main-plates of the stuffing-boxes for the valve-stems, said hubs being held in position by means of screw-nuts at the outer ends, and washers and screw-nuts at the inner ends of the hubs, as shown clearly in Fig. 6, so that the latter are securely, yet freely, held in position in the ends of the supporting-brackets. The cranks n^3 of the induction-valves are connected by crank-pins n^5 with sockets n^6 at the outer ends of four arms n^7 which extend radially from a ring-shaped frame N that is strapped onto an eccentric disk N^1, which is keyed to the spindle S^2 so that thereby continuous rotary motion in one direction is imparted to the cranks n^3 and the induction- and eduction-valves.

The compression-valves V^3 at the interior of the eduction-valves V^1 serve for the purpose of regulating the opening and closing of the exhaust which can be done from the outside, while the engine is running, by means of crank-arms m connected with the stems n^1 and having arc-shaped slots m^1 and set-screws m^2 for said arms, as shown in Fig. 2. Each compression-valve V^3 may be separately adjusted so as to provide for the free exhaust in the upper and lower ends of the cylinder, the lower end requiring a somewhat smaller opening than the upper end owing to the compression action exerted by the weight of the descending piston on the steam in the lower end of the cylinder.

The valve-gear.—As before stated, the valve-gear comprises a ring-shaped frame N with radial arms n^7, which are connected with the cranks on the stems of the induction- and eduction-valves. The ring-shaped frame is seated on an eccentric disk N^1, the hub r of which is placed on the shaft S^2 of the valve-gear. On the hub of the eccentric disk N^1 is placed a hand-wheel N^2 by which the valves can be turned independently of the driving-gear, preparatory to starting the engine. The hub r is provided with a shoulder r^1, at its end, which intermeshes with a hand-clutch that is formed of a shouldered sleeve r^2 which is splined to the spindle shaft S^3 and rotated with the same, and which is held in intermeshed position with the hub by a nut r^3 and lock-nut r^4

that are placed on a screw-post r^5 inserted permanently in the end of the spindle, as shown in Fig. 6. On releasing the nut r^3 and lock-nut r^4 sufficiently, the splined clutch-sleeve is liberated and can be moved back on the spindle shaft S^3, so that its shoulder clears the shoulder on the hub and permits thereby the starting of the valve-gear by the hand-wheel N^2, independently of the motion-transmitting mechanism of the engine. This is necessary preparatory to starting the engine, so as to permit the heating up of the valves and their operating parts. As soon as this is accomplished and the engine ready to be started, the clutch-sleeve is replaced in mesh with the hub on the valve-operating eccentric N^1, by resetting the nut and lock-nut. When the engine is started, the cranks E^4, E^5, driven by the eccentrics E E^1, keep up the motion of the shaft S^2 valve-gear and valves and communicate a constant rotary motion in one direction to the same.

The automatic cut-off.—The automatic cut-off is illustrated in Figs. 2 and 3. The cut-off valves V^2 are cylindrical and placed within the induction-valves. They are constructed in exactly the same manner as the induction-valves, with the same rows, number and size of holes and channels in their ends, from which the stems n^1 extend outwardly through stuffing-boxes to the rear-wall of the steam-induction-chest, said cut-off valves being tapered in the same manner as the valve-seats and longitudinally adjustable in the same manner as the induction-valves. The induction-valves serve as seats for the cut-off valves, which rotate within, but independently of, the induction-valves. The valve-gear consists of a triangular frame f which is pivoted at the upper and lower corners to the cranks n^3 on the stems of the cut-off valves V^2 and at a point intermediate of the corners of the frame f to a driving-crank f^2 and at the apex of the triangular frame, sidewise to the driving-crank f^2, to a rocker- or idler-crank f^3 which is pivoted to a center-plate f^1 on the rear-wall of the cylinder. The driving-crank f^2 is placed on the hub of a bevel gear-wheel f^1 which is driven by a differential gear consisting of two bevel-pinions f^4 that are supported on short vertical stud-shafts f^5, which are supported in suitable bearings and which receive motion from a gear-wheel f^6 that is keyed to the rear-end of the spindle S^3. The spindle S^3 is provided at its front-end with a crank f^7, the crank-pin f^8 of which is connected to a short lateral arm n^8 on the rotating frame N of the valve-gear, as shown in Fig. 1. Rotary motion is imparted by the spindle S^3 and the differential gear to the driving-crank f^2 and crank-frame f^1, of the cut-off valves in a direction opposite to the valve-gear of the induction- and eduction-valves. The connecting crank-frame f of the cut-off valves is steadied in its motion by its pivot-connection with the idler- or rocker-crank f^3. When the cut-off valves are in a normal position, the holes in the same coincide with the holes in the valve-seat of the induction-valves, so that when the steam-valves arrive at the open position, the full area of port-opening is reached. When the engine is running, the cut-off valves, being rotated by the differential-gear in a direction opposite to that of the induction-valves, decrease the period of port-openings and cut off the steam in a quick and effective manner. The driving-crank f^2 of the cut-off valves is provided with a hand-lever l having a spring-pawl l^1 and auxiliary handle l^2, said pawl engaging a toothed segment l^3 that is attached to the rear-wall of the induction steam-chest. The hand-lever and pawl l, l^1 permit the setting of the hand-lever l into a higher or lower position, and thereby the setting of the crank-frame and cut-off valves into position relatively to the induction-valves. The change in the position of the cut-off valves controls the proper time for the cutting off of the steam. This adjustment of the cut-off valves is effected entirely independently of the induction-valves, so that certainty of action, an easy adjustment and the reliable working of the cut-off valves are obtained. The differential gear which drives the cut-off valves, can be adjusted so as to cut off at any point, running either way. It can also be attached to the governor and made to run automatically.

The reversing mechanism.—In connection with the intermediate or eccentric-shaft S^1 a clutch is arranged, which is shown in detail in Figs. 3 and 7, and which serves for stopping the engine when desired. This clutch acts also as a reversing mechanism in connection with the eccentric E^1. It is constructed of a sliding member t which is splined to the intermediate shaft S^1 so as to rotate therewith, and at the same time be movable lengthwise of said shaft to a limited extent by connection with a ring t^1 which enters into a circumferential groove of the sliding member t, said ring being connected by short rods t^2, with a cross-piece t^3 which is pivoted to the lower end of a fulcrumed reversing-lever t^4. A spring-actuated rod t^5 is guided in keepers on the reversing-lever and operated by an auxiliary handle t^6 alongside of the handle of the reversing-lever t^4. The spring-rod enters into notches of a segmental bracket-arm t^7 which is attached to the upright supporting-standard P^2 located on the driving-shaft S. The sliding member t carries a clutch-pin t^8 which passes through a hole in the gear-wheel p^1 into an arc-shaped groove t^9 on

driving-eccentric E^1. The ends of the arc-shaped groove t^9 are provided with depressions or sockets t^{10} into which said pin takes. When the engine runs in one direction, the clutch-pin engages the depression or socket at one end of the groove. When it is desired to reverse the engine, the lever is operated so that the sliding member t is shifted and the clutch-pin withdrawn from the socket at one end of the segmental groove and placed in the socket at the opposite end of the same. The length of the groove t^9 is such that by the shifting of the clutch-pin from one end to the other of the groove, the clutch causes the engine to run in one or the opposite direction, that is to say, when the valves are set to run the engine in one direction, say from left to right, when the left-hand valve is open and the right-hand valve closed, by changing the position of the valves and the clutch-connection with the eccentric, the motion of the engine is reversed.

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

1. In a steam-engine, the combination, with rotary induction- and eduction-valves, of cut-off valves located inside of the induction-valves, a valve-gear connected with the stems of the induction-valves, means for imparting rotary motion to said valve-gear, a differential gear driven by the valve-gear, cranks on the stems of the cut-off valves, a driving-crank on said differential gear, and a valve-gear connecting the cranks of the cut-off valves with said driving crank for imparting rotary motion to the cut-off valves in a direction opposite to the induction-valves.

2. In a steam-engine, the combination, with rotary induction- and eduction-valves, of cut-off valves located within the induction-valves, a valve-gear for operating said induction- and eduction-valves, a spindle rotated by said valve-gear, a differential gear driven by said spindle, a driving-crank on said differential gear, and means for connecting said driving-crank with both of the cut-off valves.

3. The combination, with the cylinder and steam-chest of a steam-engine, of rotary cylindrical induction-valves, cylindrical cut-off valves incased therein, said valves communicating with the steam-chest, cylindrical eduction-valves, valve-gears for moving the induction- and eduction-valves in harmony with each other, compression-valves located at the interior of the eduction-valves, and means for adjusting said compression-valves from the outside of the valve-chest independently of each other and of the eduction-valves.

4. In a steam-engine, the combination with a cylinder and steam-chest, of rotary cylindrical induction- and eduction-valves, a valve-gear for rotating said induction- and eduction-valves in one direction, a crank-shaft for imparting rotary motion to the valve-gear, a clutch on said crank-shaft, and means for releasing said clutch from the crank-shaft so as to produce the disconnection of the induction- and eduction-valves from the crank-shaft for permitting hand-driving of the valves for heating up the same preparatory to starting the engine.

5. In a steam-engine, the combination, with a cylinder and the steam-chest for the same, of rotary cylindrical induction- and eduction-valves, valve-seats for said valves, a valve-gear for rotating said valves, connected with cranks applied to the stems of said valves, threaded sleeves on said stems, nuts and jam-nuts for connecting the hubs of the cranks to said threaded sleeves, and tapering keys passing through the sleeves and valve-stems for securing the tight fitting to the valves to their valve-seats.

6. In a steam-engine, the combination, with a cylinder and the steam-chest for the same, of rotary cylindrical induction- and eduction valves, cut-off valves in the induction-valves, a valve-gear for rotating said valves and connected with cranks applied to the stems of said valves, threaded sleeves on said stems, lock-nuts for securing the hubs of the valve-cranks to the sleeves on the valve-stems, and tapering keys for connecting the valve-stems with the sleeves for adjusting the valves endwise and keeping them in tight fit with each other.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

WILLIAM KERR AUSTIN.

Witnesses:
PAUL GOEPEL,
HENRY J. SUHRBIER.