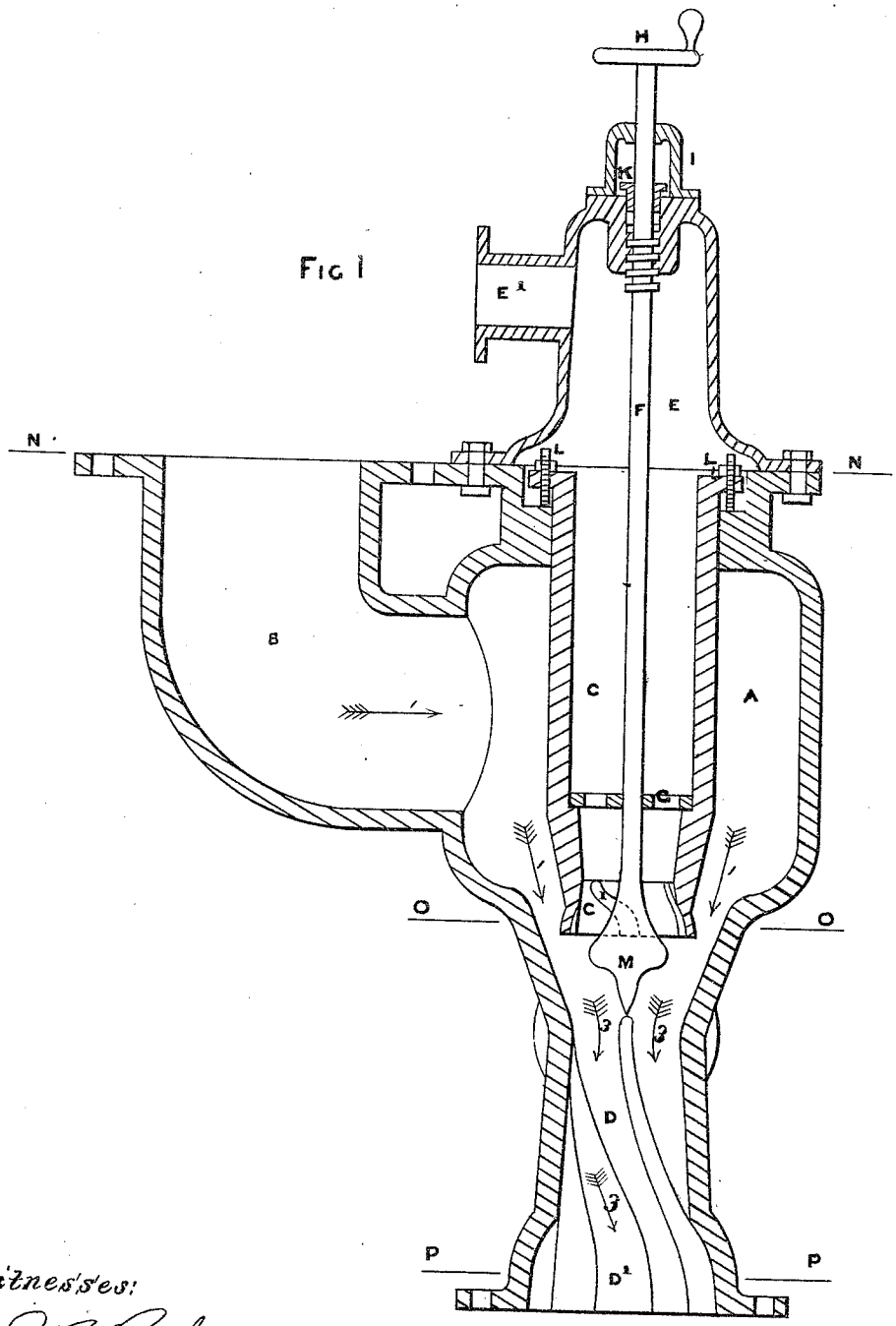
5 Sheets—Sheet 1.

J. E. BOTT.

Injector Condenser.

No. 214,090. Patented April 8, 1879.

Fig 1



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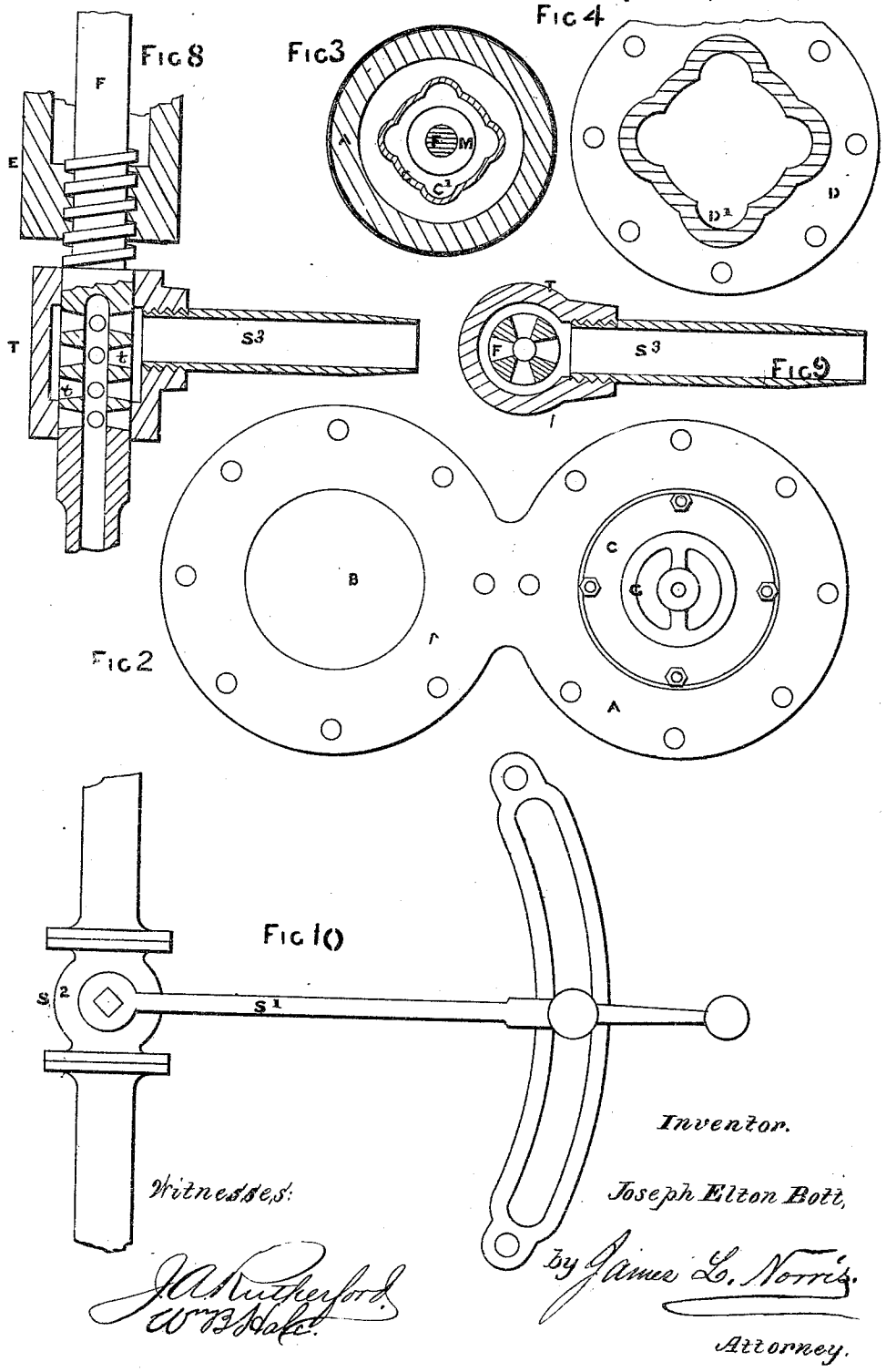

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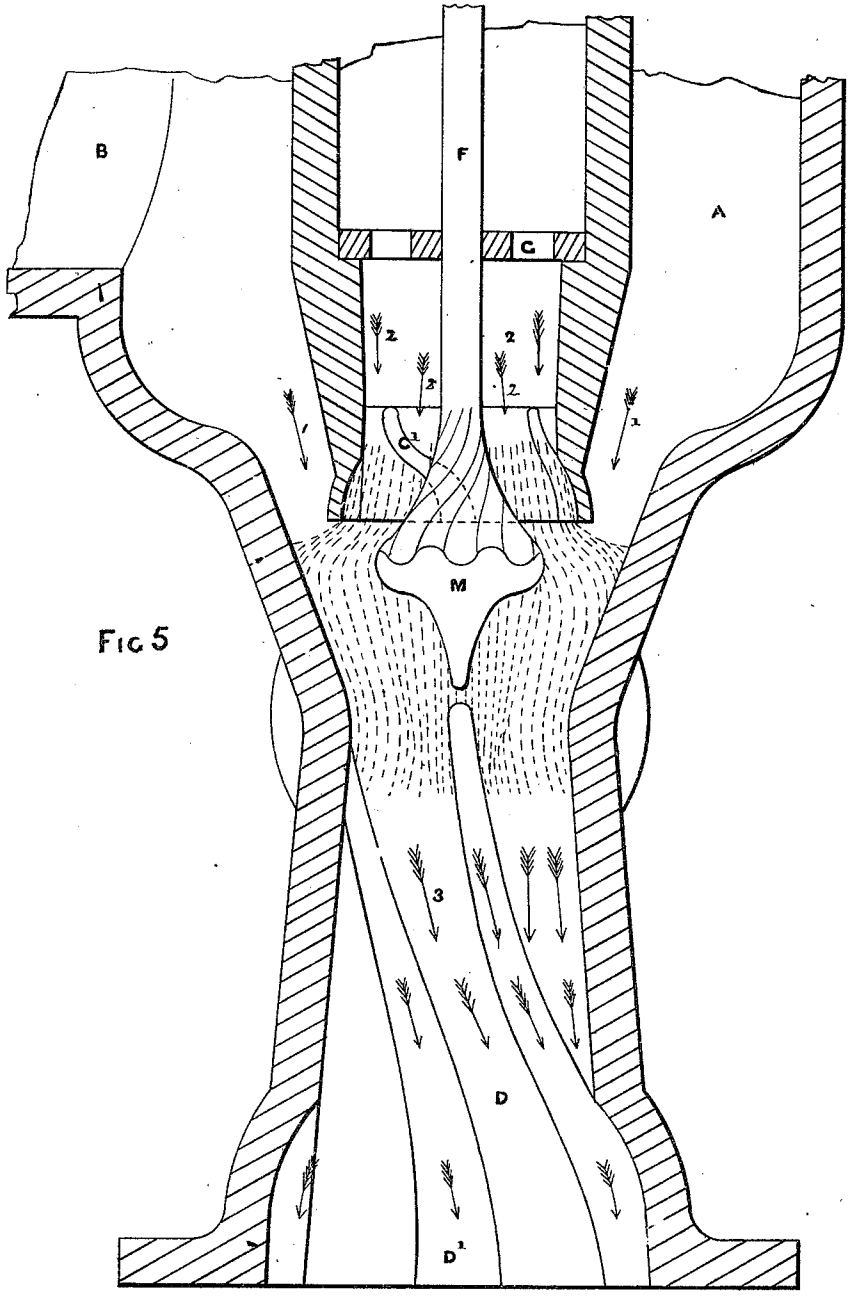

FIG 5

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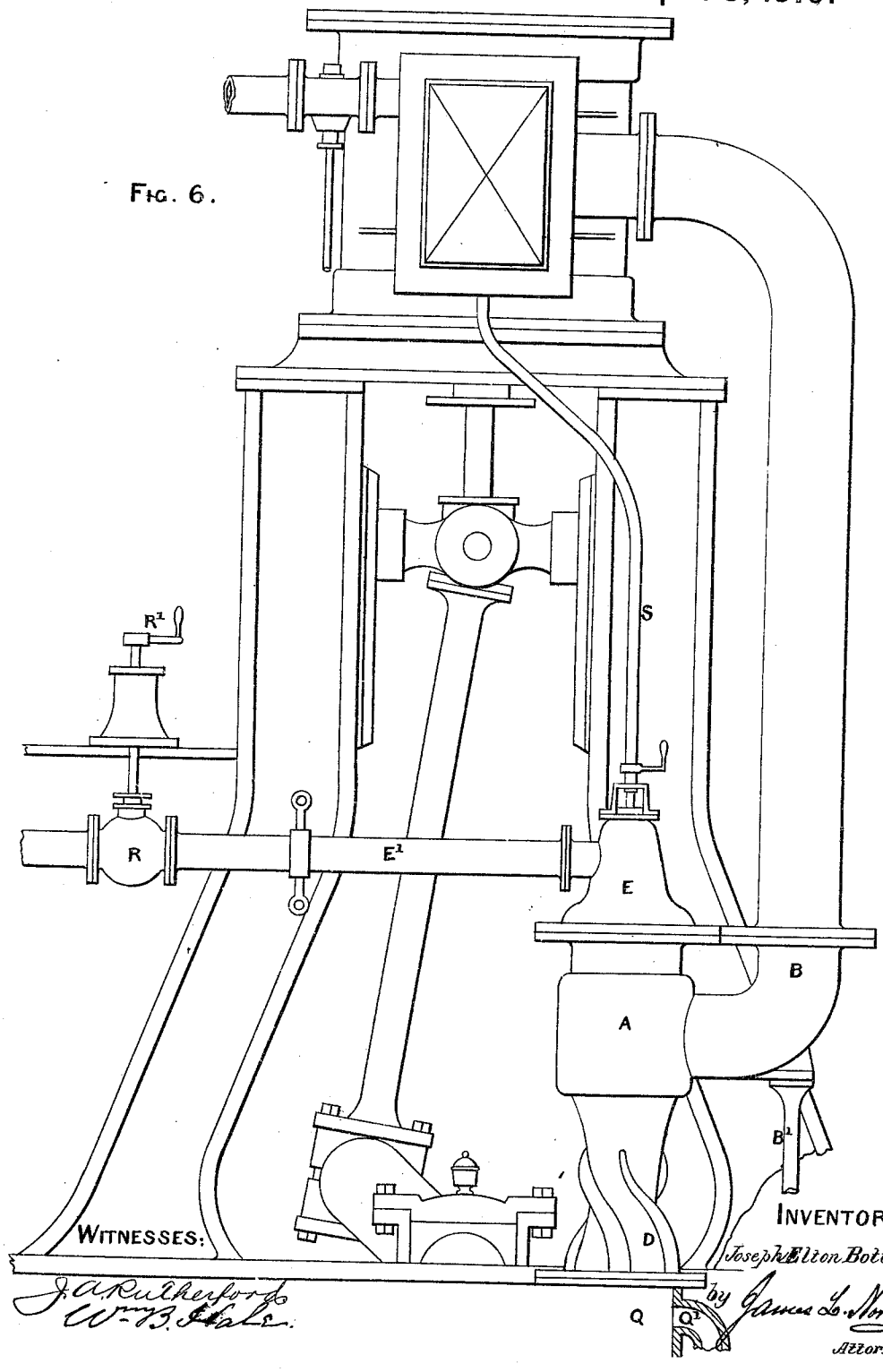
FIG. 6.



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5 Sheets—Sheet 5

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FIG. 7.

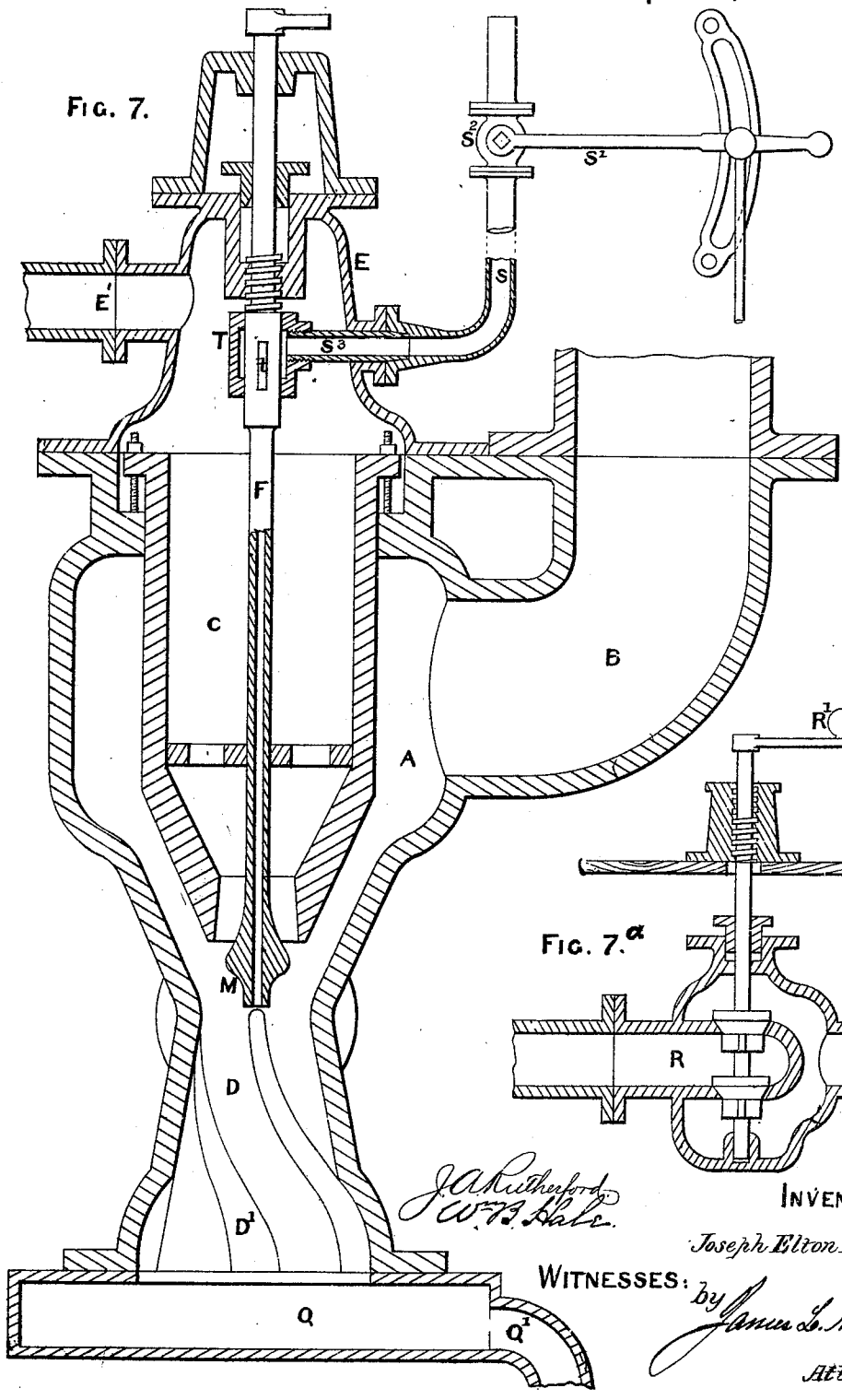

FIG. 7.ª

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UNITED STATES PATENT OFFICE.

JOSEPH E. BOTT, OF NOTTINGHAM, ENGLAND, ASSIGNOR OF ONE-HALF HIS RIGHT TO CHARLES ADLING, OF SAME PLACE.

IMPROVEMENT IN INJECTOR-CONDENSERS.

Specification forming part of Letters Patent No. **214,090**, dated April 8, 1879; application filed January 24, 1879; patented in England, May 27, 1878.

To all whom it may concern:

Be it known that I, JOSEPH ELTON BOTT, of Nottingham, England, have invented new and useful Improvements in Injector-Condensers applicable to single or double cylinder steam-engines, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to improvements in condensers, and is applicable to single or double cylinder steam-engines.

My invention consists in the combination, with the outer casing of a condenser for steam-engines, of an interior bell-mouthed nozzle and an adjustable spindle extending through said nozzle and terminating in an enlarged or flaring lower end or tip arranged below or partially within the bell-mouth of the nozzle, whereby the injection-water which flows through said nozzle is guided into the form of an annular sheet-like jet, so that the whole of the water is brought in contact with the exhaust-steam, which enters the condenser-casing, and a rapid and thorough condensation effected; further, in the combination, in a condenser for steam-engines, of an interior water-nozzle provided at its mouth with internal tapered spiral grooves and a conoidal or outwardly-flaring discharge-chamber provided with similar grooves, whereby a rapid gyratory motion is given to the injection-jet, the exhaust steam entering the casing is rapidly condensed, and the products of condensation speedily carried off; further, in the combination, in a condenser-casing, of an interior bell-mouthed nozzle having at its mouth internal spiral tapered grooves, and a spindle extending through said nozzle and terminating at its lower end in an enlargement or flaring tip, the inclined surface of which next the nozzle is provided with spiral grooves, which co-operate with those of the nozzle in imparting a rapid gyratory motion to the injection or condensing jet of water which flows through said nozzle.

Referring to the drawings, Figure 1 is a vertical sectional view of my improved condenser as constructed for one-cylinder engines. Figs. 2, 3, and 4 are, respectively, a plan and two cross-sectional views of the same. Fig. 5 is a vertical sectional view of the lower part of Fig. 1, enlarged. Fig. 6 is an elevational view, showing my improved condenser applied to a marine engine. Fig. 7 is an enlarged vertical sectional view of the condenser seen at Fig. 6, with the addition of several regulating parts hereinafter referred to. Fig. 7^a is a vertical central section of the injection-valve and connections; and Figs. 8, 9, and 10 are portions of the same shown separately.

The corresponding parts in each figure are lettered alike.

The arrangement and construction of the first-named form of my improved condenser shown in Figs. 1 to 5, inclusive, consist of the following parts—that is to say: A is an outer case forming the exhaust-chamber of the condenser. B is a branch for the exhaust-steam from the engine-cylinder. The condenser is shown as having the exhaust branch turned upward; but it may be constructed with the branch turned downward or on either side, as required. C is an injection-nozzle. C′ are tapered spiral injection-grooves. D is a discharge-space to the hot-well or waste-pipe. D′ are tapered spiral discharge-grooves. E is the body of the water-injection valve. E′ is a branch for water from a supply-tank. F is an injection-water regulating-spindle. G is a lower guide for the spindle F. H is a hand-wheel for operating the spindle F. I is a bracket-guide for spindle. K is an air-tight gland. L represents screwed studs for adjusting the injection-nozzle. M is a diverging disk of spindle F.

Fig. 2 is a plan on the line N N of Fig. 1, with the body E of the injection-valve removed. Fig. 3 is a cross-section of the condenser on the line O O, and Fig. 4 a cross-section on the line P P, Fig. 1.

In Figs. 1 and 5 the arrows marked 1 show the direction of the exhaust-steam, the arrows marked 2 show the direction of the injection-water, and the arrows marked 3 show the direction of discharge.

The body of the condenser is of cast-iron or other suitable metal, and has an exhaust-chamber, A, fromwhich projects an exhaust-branch, B, leading to the cylinder or cylinders of the engine to which the condenser may be attached.

The chamber A terminates at its lower end in a double conoidal chamber, the lower part of which contains four or more tapered spiral discharge-grooves, D', the number of such grooves varying according to the size of the condenser.) These grooves gradually increase in radius to the bottom, thus giving a large cooling-surface. The upper portion of the said exhaust-chamber is recessed to receive the flange of an injection-nozzle, C, carrying four or more screws, by which it is adjusted vertically. This nozzle is bell-mouthed at its lower end, and has four or more tapered spiral injection-grooves, C', gradually increasing in radius to the point of discharge. To the upper flange of the exhaust-chamber is secured the body of a water injection-valve, E, from which projects a branch, E', for water from a supply-tank. Inside the aforesaid nozzle is fixed a spindle, F, the lower end of which forms a reversely-coned diverging disk, M, which is held centrally in the nozzle C by a guide-ring, G, near its lower end, and at its upper end by a guide-bracket, I, below which the spindle passes through an air-tight gland, K, and below the gland the spindle is screw-threaded, being capable of adjustment vertically in the upper screw-threaded portion of the injection-valve E by means of the hand-wheel H.

In large condensers I spirally corrugate the upper surface of the diverging disk M, each corrugation gradually increasing in width to the circumference, as shown in the drawings, Fig. 5.

The action of the condenser is as follows—that is to say: Water being admitted by any suitable controlling-valve or cock into the nozzle reaches the disk M, by means of which and of the spiral tapered grooves of the injector-nozzle it is guided into a spreading annular surface of water, which impinges upon the lower contracted surface of the exhaust-chamber, acquiring a gyratory motion increasing in velocity; and upon the exhaust-steam meeting the water at the bottom of the nozzle condensation is rapidly effected, the thin annular film of water projected against the upper portion of the conoidal chamber completely absorbing and condensing the exhaust or other steam; and by reason of the rapid gyratory motion of the annular injection-jet the cylinder or cylinders of the engine are effectually relieved of any back-pressure, and an almost perfect vacuum is created by reason of the atmosphere being excluded by the annular film of water extending completely across the conoidal chamber, and the diagonal surface of the jet affords a greater cooling-surface for the condensation of the steam, as the whole of the water used is economically employed in condensation, instead of, as in other condensers, a portion thereof being wasted, owing to the central particles of the water-jet not being available for condensation.

In the modification of my improved condenser shown at Figs. 6 to 10, inclusive, Fig. 6 is an elevation showing the application of the said condenser to a marine engine. Fig. 7 is an enlarged vertical sectional view of a portion of the same. Figs. 8 and 9 are, respectively, an enlarged vertical section and cross-section of a socket, T, spindle F, and connecting-pipe S^3, hereinafter referred to. Fig. 10 is an enlarged side view of the steam-valve S^2 and lever S^1, shown at Fig. 7.

In this modification the condenser employed is of similar form to the one first herein described; but with the addition of several regulating parts, hereinafter referred to, it is equally applicable to high-pressure, low-pressure, or compound steam-engines.

Referring to Figs. 6 and 7, the following is a general description of the several parts: A is the condenser-body. B is the exhaust branch and pipe connecting the condenser with the cylinder of an engine. B' is a cast or wrought iron pedestal or support for the exhaust branch. D is the discharge portion of the condenser attached to Q, the hot-well from whence it may be ejected overboard through the branch pipe Q', either by means of a steam-pump or water-ejector. F is the injection-water regulator, the stem of which is bored out for a portion of its length, and has slots or orifices *t*, as shown at Figs. 7 and 8. R is the injection-valve, adjusted by means of the screwed rod operated by the handle R', by which means water is admitted to the condenser through the branch E'. S is a pipe to convey steam from the high-pressure steam-chest to the hollow spindle F for the purpose of exhausting the air from the low-pressure cylinder of a compound engine, thus aiding in quickly starting heavy engines. S^1 is a bell-crank lever for operating the steam-valve S^2. S^3 is a connecting-pipe screwed into a boss on one side of a guiding-socket, T, which is chambered. This socket may be either separate from (as shown in the drawings) or may form a continuation of the neck of the body E. The pipe S^3 may be connected to the high-pressure steam-pipe S by a flange or other suitable connection.

The action of the condenser and the above-enumerated parts is as follows—that is to say: When applied to a marine engine or a winding-engine, the starting wheel or lever of the engine may have a clutch-connection with the lever S^1, and will thus open the valve S^2 on the starting of the engine, and so allow steam to leave the high-pressure steam-chest and pass into the body of the condenser by the pipes S S^3 through the chambered socket T on the regulating-spindle F, entering the same through the slots or orifices and issuing with great force as a jet through the point of the spindle near the diverging disk. This jet of steam will exhaust all the air from the exhaust side of the low pressure piston, thus greatly assisting the starting of the engine, especially those of the larger kinds. Immediately the low-pressure piston has arrived at the end of the stroke

and high-pressure steam begins to exert its force the steam-valve S^2 must be closed, either by disconnecting the lever S^1 by hand or by any mechanical apparatus for automatically doing the same. Immediately the low-pressure piston receives steam from the high-pressure cylinder the attendant will turn on the injection-water by means of the handle R′, operating the equilibrium-valve R, thereby admitting water through the nozzle C, when condensation will be effected, as described in the first modification, and the combined products of condensation will be discharged into the hot-well Q and thence through the branch pipe Q′.

While I prefer to use the hollow spindle F or connection with any condenser when applied to low-pressure marine engines, it may be omitted if desired; and I do not here claim it in combination with the other parts of my invention.

What I claim is—

1. The combination, with the outer casing of a condenser, of the bell-mouthed nozzle C and the spindle F, having the enlarged or flaring lower end or top, M, whereby the injection-water is guided into the form of an annular jet, substantially as and for the purpose set forth.

2. In a condenser for steam-engines, the combination of the nozzle provided with the internal tapered spiral grooves and the conoidal discharge-chamber having similar grooves, whereby a rapid gyratory motion is imparted to the injection-jet, the exhaust-steam rapidly condensed, and the water of condensation speedily carried off, substantially as described.

3. The combination of the bell-mouthed nozzle having the tapered internal spiral grooves and the spindle having the enlarged or flaring lower end or tip, the upper inclined surface of which is provided with spiral grooves, substantially as and for the purpose set forth.

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