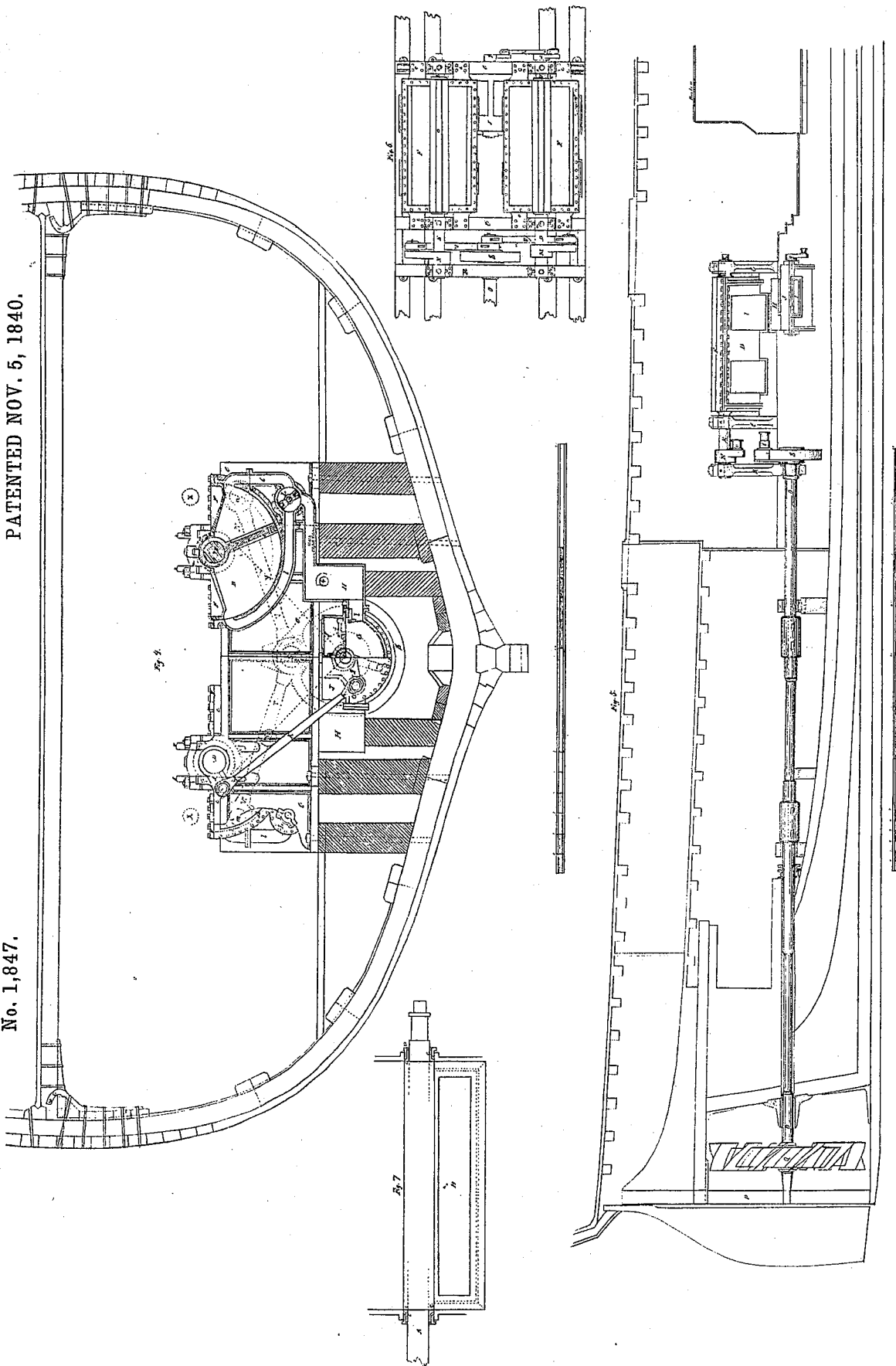


MODE OF APPLYING STEAM POWER TO LOCOMOTIVES, &c.

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UNITED STATES PATENT OFFICE.

JOHN ERICSSON, OF SWEDEN.

IMPROVEMENT IN THE MODE OF APPLYING STEAM-POWER TO LOCOMOTIVES, &c.

Specification forming part of Letters Patent No. 1,847, dated November 5, 1840.

To all whom it may concern:

Be it known that I, JOHN ERICSSON, a subject of the King of Sweden, have invented certain new and useful Improvements in the Application of Steam-Power to Locomotive Purposes and Steam Navigation; and I do hereby declare that the following is a full and exact description of the construction and operation of the said improvements in locomotive and steam navigation invented by me.

This invention, which I name as above, consists for locomotive purposes, in giving motion to the driving-wheels of the locomotive-carriage by means of two pistons performing partial rotary and reciprocating movements within two half-cylinders placed horizontally side by side, the axes or shafts to which the said pistons are attached and which form their center of motion being made to pass through stuffing-boxes in the covers of the said half-cylinders and extending in opposite directions beyond the outside frame of the carriage, the ends of these shafts being provided with crank-levers, which, by means of connecting-rods and pins, are connected to circular disks or cranks fixed on the outer ends of the shaft or axis of the driving-wheels; and for steam navigation my said invention consists in applying, in the manner hereinafter described, pistons of a reciprocating and partial rotary movement working within half-cylinders for the purpose of giving motion either to ordinary paddle-wheels or to spiral stern-propellers.

In the drawings hereto attached, Figure 1 represents a side elevation, and Fig. 2 plan, of a locomotive-carriage on my improved construction, drawn to a scale of half an inch to a foot. Fig. 3, which is drawn to a scale of two inches to a foot, represents a transverse section of the two half-cylinders and pistons. I will first proceed to describe this figure. A and B are two half-cylinders secured by screws to a bridge or abutment piece C, made of cast-iron. D *d* are axes or shafts passing through stuffing-boxes in the covers of the cylinders, and to which shafts square pistons E E are attached. The said stuffing-boxes, as well as the packings of the pistons, will be hereinafter described. F F are square metallic rods inserted into grooves made in the abutment-piece. These rods are made to

press against the piston-shaft by means of springs, in order to prevent any steam from escaping round the same. G is an ordinary slide-valve for admitting the steam through the passages *a a* alternately on opposite sides of the piston of the cylinder A. Behind the valve G is a similar valve placed within the common slide-box H, which slide, through passages similar to *a a*, admits the steam alternately on opposite sides of the piston of the cylinder B. I is a cavity made in the abutment-piece, into which and through the eduction-pipe J the steam escapes into the atmosphere. K is the induction-pipe admitting steam into the slide-box. L is a spindle and lever for giving motion to the slide-valve in the usual manner.

I will now proceed to describe Figs. 1 and 2, in which similar letters of reference denote similar parts as in Fig. 3. A and B are the half-cylinders, and M M the stuffing-boxes in the cylinder-covers, through which the piston shafts or axes D and *d* pass. N and O are crank-levers placed at right angles to the pistons and firmly fixed at the opposite ends of the piston-shafts D and *d*. *n o* are crank-pins fixed in the said levers. P and Q are circular plates or disks firmly fixed to the ends of the axle of the driving-wheels R R. *p* and *q* are what is commonly called "crank-pins," of a globular form, fixed at right angles to each other in the circular plates. The crank-pins *n* and *p* and the crank-pins *o* and *q* are connected by means of ordinary connecting-rods, the center lines of which are marked in red lines. SS are bearing-brasses, fixed in the outside framing of the carriage for supporting the piston-shafts D and *d*. *s* are keys for adjusting the same. T T are eccentric circular bosses on the inside of the circular plates, to which ordinary straps and slide-gear is attached for giving motion to the two slide-valve spindles. One of these spindles L is shown on the elevation. U is a lever, attached to the piston-shaft D, for working a force-pump for supplying the boiler. I have now to state that the position of the eccentric bosses T T with regard to the crank-pins *p q* should be similar to the eccentrics of ordinary steam-engines and likewise the gear-work for communicating the motion of the eccentric bosses to the slide-valves G; and I

have also to observe that the relative position of the driving-shaft and the cylinders should be such that a straight line drawn through the extreme points of motion of the centers X and Y, Fig. 3, of the crank-pins *n* and *o* should pass through the center of the driving-shaft Z. With regard to the operation or motion of the machinery it becomes evident that when steam is admitted into the slide-box H and the alternate movement given to the slide-valves a reciprocating and partly rotary motion will be given to the pistons and their shafts, and thereby a vibrating motion to the crank-levers N and O. The extent of vibration is marked by red dotted lines in Fig. 3. These crank-levers being connected to the pins *p* and *q*, which are placed at right angles to each other, it follows that a continuous rotary motion will be given to the driving-wheels of the carriage.

Having thus described the nature of my improvements in the application of steam-power to locomotive purposes, I will now proceed to describe my improvement in the application of that power to steam navigation.

Fig. 4, which is drawn to a scale of one-half inch to a foot, represents part of the transverse section of a steamship with a front view of my improved machinery, and Fig. 5, which is drawn to a scale of one-fourth inch to a foot, represents part of the longitudinal section of a steamship, with a side elevation of the machinery of my improved construction.

In order more clearly to exhibit the various parts, it will be seen that in Fig. 4 the exterior view of one half of the machinery is shown, while the other half is shown in section. A and B are two half-cylinders supported by strong cast-iron frames C C by means of strong lugs *c c* projecting from the end covers of the cylinders and firmly bolted to the frames. D and E are the piston-shafts, to which radial vibrating pistons, as before described, are attached, *e* being the piston attached to the shaft E. *a a* are plummer-blocks or bearings attached to the frames C C for carrying the piston-shafts, and *k k* are keys for adjusting the bearings. F F are the top covers of the cylinders, and *f* is one of the metallic rods for preventing any escape of steam round the shaft. G is an air-pump constructed upon the same principle as the steam-cylinders, with a similar vibrating piston. (Shown by dotted lines on the drawings.) H is a condenser with a rose-jet *h*, similar to those used in common condensing-engines. I is the suction-valve, and *i* the valve communicating to the hot-well J. *g* is a crank-lever attached to the piston-shaft of the air-pump, and *d* is another crank-lever attached to the end of the piston-shaft D. These crank-levers give motion to the piston of the air-pump by means of a connecting-rod K. *ll* are the steam-passages, and L the eduction-valve by which the steam is alter-

nately let into the condenser. This valve, as well as the induction-valve, may be constructed upon the usual plan adopted in condensing-engines and worked by ordinary gear communicating with the main shaft. M and N (shown by dotted lines in Fig. 4) are crank-levers fixed to the ends of the piston-shafts. The extent of the motion of these crank-levers is marked by red lines in Fig. 4. O is the main or paddle shaft, which passes through the stern of the ship, its outer end being supported by a vertical post P of wrought-iron, which also carries the rudder. This post is fixed at the top to the upper part of the projecting stern, its lower end being secured to the keel by means of projecting timbers and iron plates firmly bolted thereto. Q is a spiral propeller or series of spiral planes attached to the main shaft. R is a strong cast-iron frame attached to the frame C, firmly bolted to longitudinal timbers at the bottom of the ship. This frame carries the outer ends of the piston-shafts D and E, as well as the main shaft O. S is a circular plate of cast-iron firmly attached to the main shaft. *s* is a crank-pin fixed in this circular plate, and which pin, by means of connecting-rods U and V, is connected to the pins *m* and *n* of the crank-levers M and N. I have here to observe that the relative position of the cylinders and the center of the main shaft should be such that straight lines drawn through the extreme points of motion of the centers X and Y of the crank-pins *m* and *n* should intersect each other at right angles in the center of the main shaft, as shown by the red lines in Fig. 4.

Fig. 6, drawn to a scale of one-fourth inch to a foot, represents a plan or top view of the engines. All the parts shown in this view have been before described. I have therefore only to observe that similar letters of reference denote similar parts as in the foregoing Figs. 4 and 5.

Fig. 7 represents the side view of one of the pistons, and shows the mode in which they are made to form steam-tight joints with the cylinders, as well as the mode of preventing the steam from escaping at the places where the piston-shafts pass through the end covers. A is the piston-shaft, and B the piston. The dotted lines marked round it show the form of metallic rods and angle-pieces inserted between the side plates of the piston. (Better seen at Z in Fig. 4). These angle-pieces are pressed toward the side of the cylinder by springs similar to those used in ordinary metallic pistons. C is a ring of gun-metal, which, by means of common hemp-packing and a packing ring or gland D, is pressed against the shoulder of the shaft at *c c*, thereby preventing any escape of steam.

With regard to the operation or motion of the engine, I have only to state that steam being admitted alternately on opposite sides of the piston and alternately let into the con-

denser in the usual manner, a continuous rotary motion will be given to the circular plate S by means of the crank-levers, pins, and connecting-rods before described, for it is evident that when one connecting-rod is in a direct line with the center of the crank-pin s and the center of the main shaft the other connecting-rod will be placed nearly at right angles to the crank-pin and the center of the main shaft.

Now, it is evident that by changing the position of the crank-levers on the piston-shaft the main shaft may be placed above the center of the steam-cylinders as much as it is placed below the same in Fig. 4, and it is evident that by placing the cylinders transversely in the vessel instead of longitudinally, motion may be given to a common paddle-shaft in the manner before described, whether the cylinders are placed above the shaft, as in Fig. 4, or below the same to an equal degree, or in such position with regard to the shaft as shown in Fig. 3.

Having thus fully described the nature of my invention, and shown the manner in which I carry the same into operation, I do hereby declare that I do not claim to be the inventor of steam-engines having radial pistons which vibrate or perform partial rotary movements within semi-cylinders or other segments of cylinders, such engines having been before known and used; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. The propelling of a locomotive-carriage by the combining of two semi-cylinders, each

furnished with radial pistons, which pistons vibrate within them, said semi-cylinders being placed on a level with each other, and the shafts or axes of their radial pistons extending through the cylindrical covers in opposite directions beyond the sides of a locomotive-carriage, and having crank-levers attached to their outer ends, which crank-levers are connected by suitable rods to crank-pins on the driving-wheels, the respective parts being combined and arranged substantially in the manner herein set forth.

2. The employment of the same apparatus for the driving of the propelling or paddle wheels of such vessels as are propelled by the power of steam, the general arrangement and operation of the respective parts being substantially the same with those by which said combined semi-cylinders are adapted to the propelling of locomotives, with such variations of arrangement only as are required by the nature of the case, and as herein fully pointed out and made known.

3. The combining of the double-acting semi-cylindrical air-pump with my double semi-cylinder steam-engine, constructed and arranged as herein set forth, said air-pump having a radial vibrating piston, and the self-acting valves I and i, and being arranged and connected with the other operating parts of the engine, substantially as herein described.

J. ERICSSON.

Witnesses:

THOS. P. JONES,

W. THOMPSON.