(No Model.) 3 Sheets—Sheet 1.

G. H. CORLISS, Dec'd.

E. A. Corliss, Administratrix.

MACHINE FOR FINISHING THE ENDS OF CYLINDERS OF STEAM ENGINES.

No. 450,398. Patented Apr. 14, 1891.

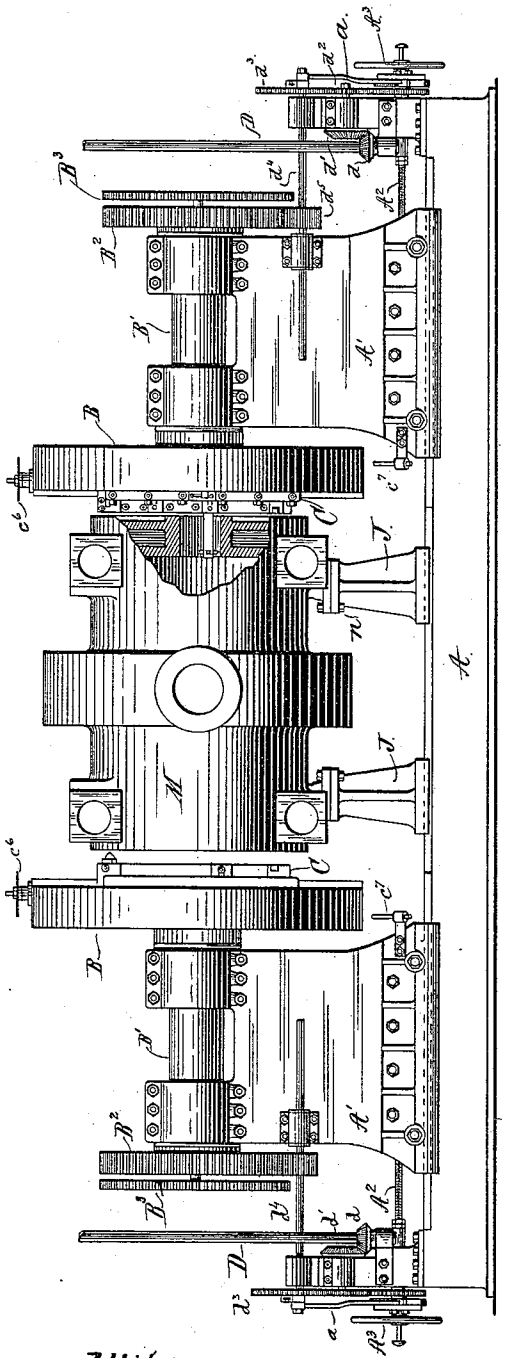

Fig. 1

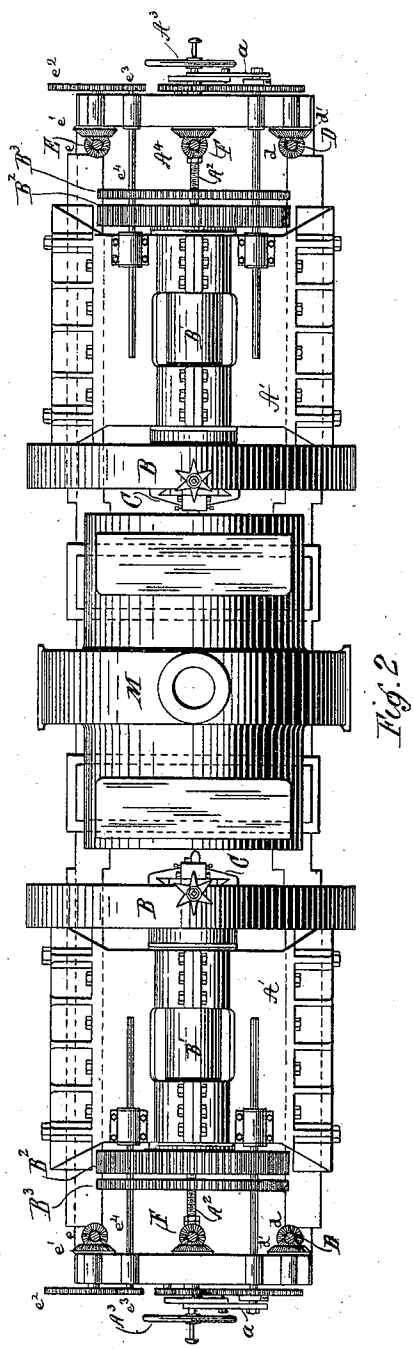

Fig. 2

Witnesses
Henry Marsh Jr.
Maria L. Corliss

Inventor
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

G. H. CORLISS, Dec'd.

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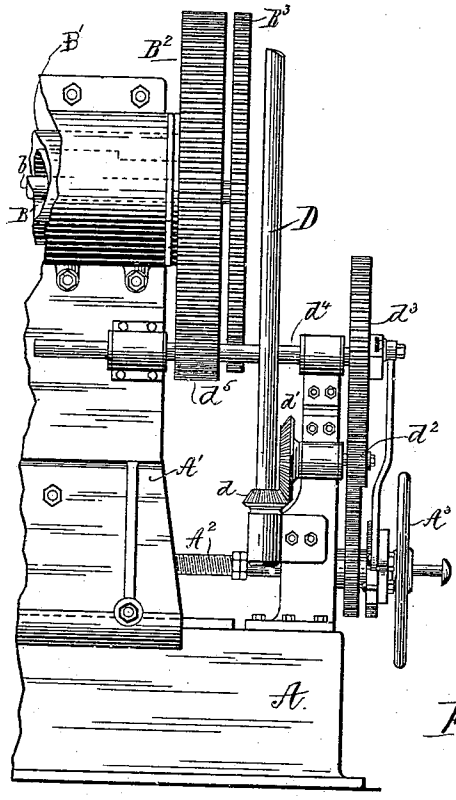

Fig. 3

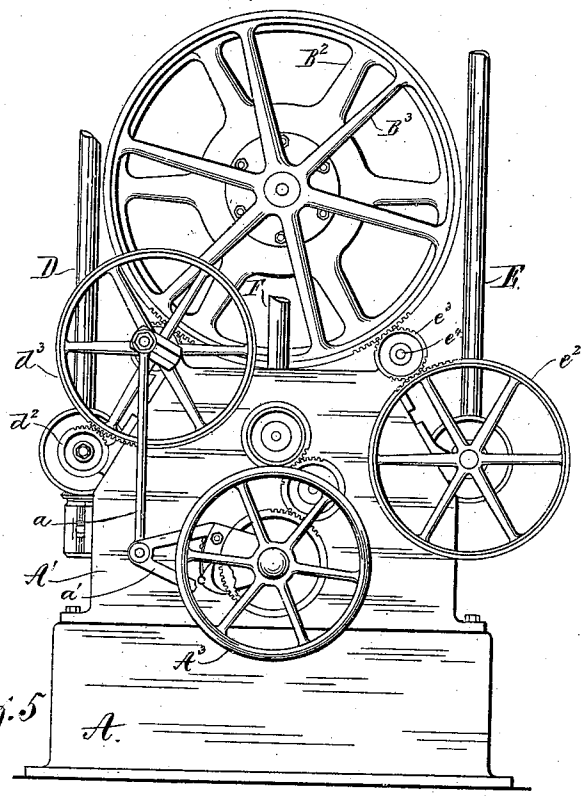

Fig. 5

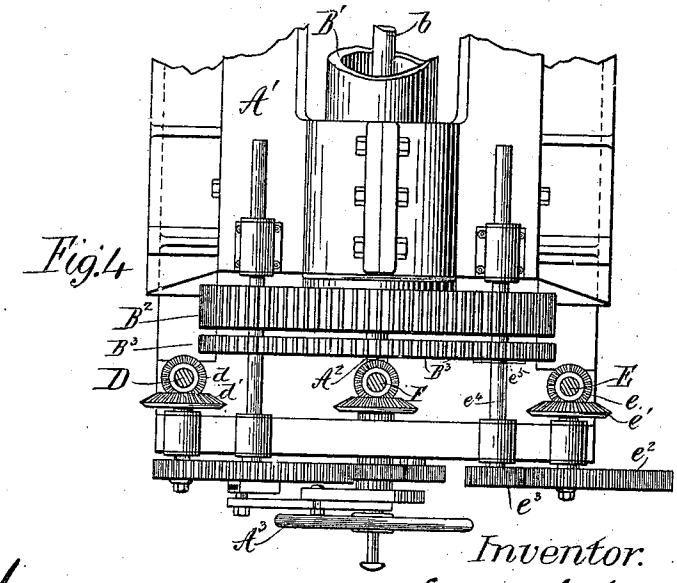

Fig. 4

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(No Model.) 3 Sheets—Sheet 3.

G. H. CORLISS, Dec'd.

E. A. CORLISS, Administratrix.

MACHINE FOR FINISHING THE ENDS OF CYLINDERS OF STEAM ENGINES.

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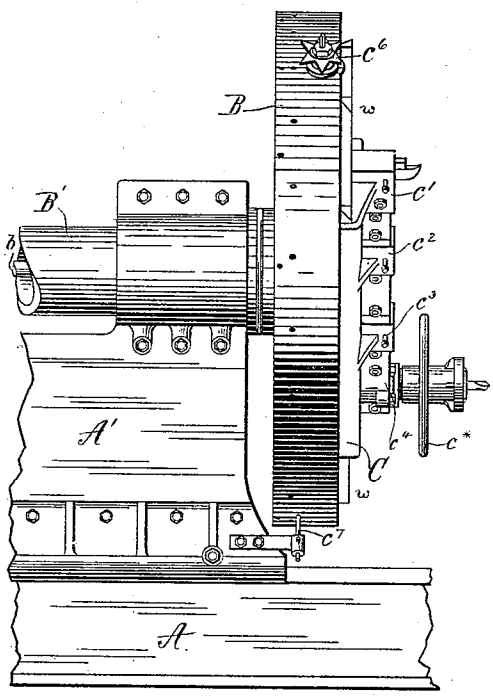

Fig. 6.

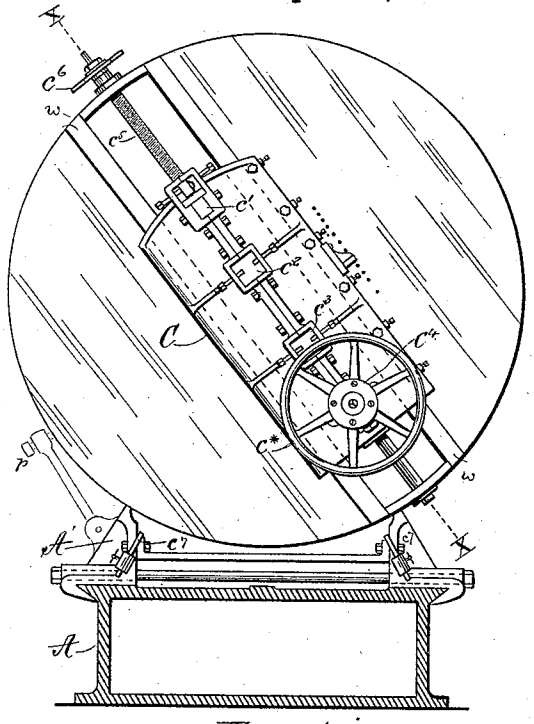

Fig. 7.

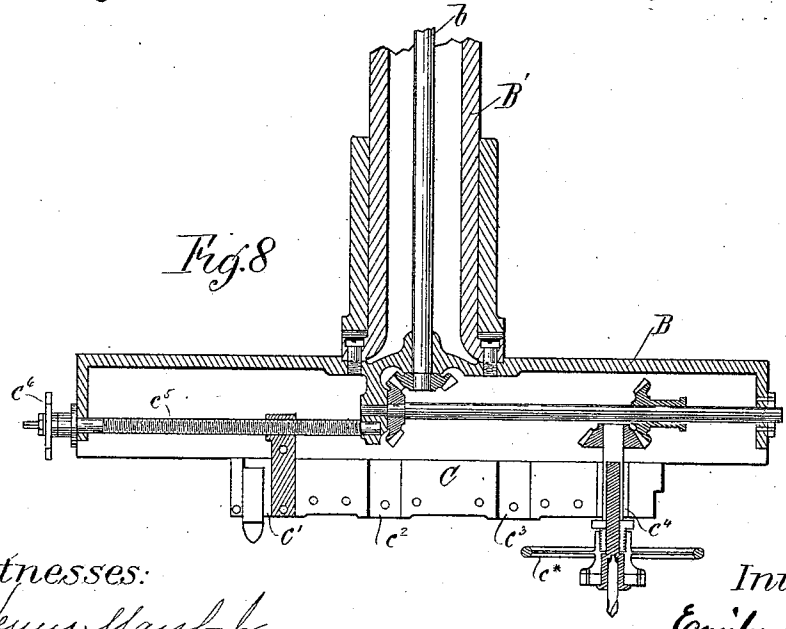

Fig. 8.

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UNITED STATES PATENT OFFICE.

EMILY A. CORLISS, OF PROVIDENCE, RHODE ISLAND, ADMINISTRATRIX OF GEORGE H. CORLISS, DECEASED.

MACHINE FOR FINISHING THE ENDS OF CYLINDERS OF STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 450,398, dated April 14, 1891.

Application filed December 18, 1889. Renewed November 6, 1890. Serial No. 370,449. (No model.)

To all whom it may concern:

Be it known that GEORGE H. CORLISS, deceased, late a citizen of the United States, resident in the city and county of Providence, in the State of Rhode Island, (represented by EMILY A. CORLISS, administratrix,) invented a new and useful Machine for Finishing the Ends of Cylinders of Steam-Engines by Facing, Boring, Counterboring, Drilling, and Tapping the Same, of which the following is a specification.

The said GEORGE H. CORLISS has embodied in one machine mechanisms for performing at a single setting and adjustment of the cylinder the several operations of facing, boring, counterboring, drilling, and tapping the ends of the cylinder, all arranged and adapted for contemporaneous or independent action relatively each to the other, with provision made for supporting the cylinder in the correct line and maintaining its adjustment during the several operations performed upon it, and other provision for varying the relative adjustment of parts of the machine, whereby it is adapted to operate upon cylinders of different dimensions.

Prior to this invention of said GEORGE H. CORLISS it had been customary to employ three machines in finishing the ends of cylinders of steam-engines, one of the machines facing the ends of the casting, another boring one end and counterboring the other end of the cylinder, and the third drilling and tapping the stud-holes in the ends of the cylinder. It was necessary to turn the cylinder end for end several times and to handle, set, and adjust the cylinder at least twice for each machine, and the greatest care was requisite to adjust the cylinder in the proper position for each machine. The size and weight of the cylinders involved labor in the moving, setting, and adjusting them for each machine, and their proper adjustment was a matter involving time and careful skill when the separate machines were employed in finishing the ends.

With the invention herein described the entire work can be performed on a single machine with a single handling and adjustment of the cylinder-casting with ease and exactness. The tools being true, all the operations are performed so exactly as to insure perfect interchangeability of all cylinders of the same size operated upon and finished in this machine. Upon a stationary plane bed are gibbed two housings arranged in line with each other and movable longitudinally of said bed for purposes of adjustment and also for automatic endwise feed of the boring and counterboring tools, which latter, in common with the facing and drilling and tapping tools, are held in rests arranged in a tool-carriage radially movable in the face of a head secured upon a horizontal hollow shaft which has its bearings in the housing above mentioned. Automatic radial movement of the tool-carriage in the head is secured, to feed the facing-tool radially, by a star-wheel arranged to actuate a threaded shaft contained within the head by striking at each revolution of the head against a spring pin or stop attached to the housing in the orbit of the star-wheel. The facing, boring, and counterboring tools, seated in their respective tool-rests, are operated by the revolution of the head. The facing-tool is fed automatically, as already described, and endwise feed of the boring and counterboring tools is attained by automatically moving the housing longitudinally along the bed. The drill and tapping tools are operated by power conveyed through a shaft located axially of the head and its hollow shaft and connected by a train of shafts and bevel-gears, all contained within the head, with the drill-spindle, which is located parallel to the axial line of the head and may be operated at any distance therefrom and in any part of the circle. The drill and taps are fed by the common hand-wheel attached to their spindle.

In the operations of drilling and tapping the stud-holes in the end of the cylinder, the head is held stationary by means of a pawl, which is caused to engage the appropriate index-hole in the peripheral face of the head. There are a number of these index-holes arranged in the peripheral face of the head in a predetermined position and order. After a stud-hole has been drilled and tapped the pawl is disengaged and the head then partially revolved to bring the tools into the proper position to drill and tap the next stud-

hole in the end of the cylinder. The pawl is then caused to engage the proper index-hole, and the stud-hole is then drilled and tapped. These operations are repeated until all the stud-holes have been drilled and tapped.

The cylinder is supported and centered in this machine by jigs secured removably upon the plane-bed of the machine between the heads of which there are two located in line with each other. The jigs are also bolted to the bottoms of the exhaust-valve boxes of the cylinder, which latter have been previously prepared in another machine. The jigs are of a height suitable to properly center a corresponding size of cylinder. For a small cylinder they would be higher than for a large cylinder. In other words, every size of cylinder has its appropriate jigs.

In the accompanying drawings, Figure 1 is a side elevation of the machine with a cylinder in position, a portion of the latter being broken away. Fig. 2 is a top plan of the same. Fig. 3 is a side elevation of one end of the machine. Fig. 4 is a top plan, and Fig. 5 an end elevation, of same. Fig. 6 is a side elevation of one of the revolving heads, with its tool-carriage, a portion of the bed, housing, hollow shaft, and internal shaft being also shown. Fig. 7 is a face elevation of the head and tool-carriage, a portion of the housing and a transverse section of the bed being shown. Fig. 8 is a sectional view of the head, tool-carriage, and hollow shaft, on line $x\ x$ of Fig. 7, showing also the internal shafts which operate the drill-spindle and the star feed device for radially moving the carriage.

Similar letters of reference indicate like parts where they occur in the drawings.

A represents the stationary bed, and A′ A′ the housings gibbed thereon and movable longitudinally along the same for purposes of adjustment and for endwise feed of the boring and counterboring tools by the feed-screw A^2, actuated by the hand wheel A^3, or automatically by power applied to said feed-screw through a system of gears and shafting.

B B are the heads mounted on hollow shafts B′ B′, journaled in the housings A′ A′.

C is the tool-carriage, with tool-rests c' c^2 c^3, and drill-chuck c^4.

The threaded shaft c^5, star-wheel c^6, and spring-pin c^7 serve to move the carriage C radially in the head B, and thereby automatically feed the facing-tool as the head B revolves. The carriage C is also movable radially in the head for purposes of adjustment by turning the threaded shaft c^5 by means of a crank-handle or wrench applied to the outer end of said shaft, which is suitably squared or otherwise fitted to receive the wrench.

The head B is secured upon the hollow shaft B′ and revolves therewith during the operations of facing, boring, and counterboring the ends of the cylinder M, as driven by power conveyed from the vertical driving-shaft D, through the bevel-gears d d', pinion d^2, gear d^3, counter-shaft d^4, and pinion d^5, meshed into the gear B^3, keyed upon the hollow shaft B′.

The boring and counterboring tools are automatically fed endwise by power applied to the vertical driving-shaft F and through a train of gearing to the feed-screw A^2 to move the housing A′ along the bed A. Automatic endwise movement of the housing A′ along the bed A may also be attained by means of a pawl a', which can be made to engage a ratchet on the outer end of the feed-screw A^2 and operated by a toggle arm or link a, eccentrically secured upon the outer end of the counter-shaft d^4, the power being in that case taken from the vertical driving-shaft D and not from the shaft F.

Within the hollow shaft B′ and in the axial line thereof is a shaft b, on the outer end of which is keyed a gear B^3 and connected at its other end by a system of bevel-gears and shafting, all contained within the head B, with a drill-spindle held parallel with the axial line of the head and at any distance therefrom and in any part of the circle.

During the operations of drilling and tapping a stud-hole in the end of the cylinder the head B and carriage C are prevented from revolving by a pawl p, which is made to engage one of a number of index-holes arranged in predetermined positions in the peripheral face of the head B. The drill and taps are rotated by power conveyed from the vertical driving-shaft E, through bevel-gears e e', gear e^2, pinion e^3, counter-shaft e^4, and a pinion e^5 to the gear B^3, keyed upon the shaft b. Endwise feed of the drill and taps is attained by the well-known hand-wheel c^*. After a stud-hole in the end of the cylinder has been drilled and tapped the pawl is disengaged and the head revolved sufficiently to bring the tool into the proper position to drill the next hole, when the pawl is made to engage the proper index-hole in the head to hold the latter immovable during the operations of drilling and tapping the hole in the end of the cylinder. These operations are repeated until all the holes in the end of the cylinder have been drilled and threaded.

The facing, boring, and counterboring tools are carried, respectively, in the tool-rests c' c^2 c^3 in the carriage C and the drill and tapping tools in the spindle or chuck seated in the rest c^4 in said carriage. Each of the vertical driving-shafts D, E, and F is connected at its upper end to its appropriate system of gears and pulleys, from which it receives the power, and which are each provided with its appropriate means for starting and stopping it at will.

The parts which have been described herein are duplicated and arranged on a common bed whereby the several operations are performed simultaneously upon each end of the cylinder, except in the case of the boring and counterboring. The open end of the cylin-

der is counterbored and the closed or piston-rod packing-box end is bored. The cylinder is supported and centered by the jigs J J, which rest upon the plane table or bed A, and are held in the correct line laterally by bolts inserted through holes in the jigs into previously-determined holes in said table. Other bolts inserted through previously-fitted holes in the bottoms of the exhaust-valve boxes, which have been previously prepared and fitted upon another machine, (described and claimed in another application for Letters Patent, filed December 16, 1889, Serial No. 333,858,) serve to accurately center the cylinder. One of these bolts is shown at *n* in Fig. 1. These jigs J are of a height corresponding to the diameter of the cylinder being treated, so as to bring the center line of the cylinder in line with the axes of the revolving heads B B. The cylinder once centered in this machine is not removed nor its adjustment changed in any manner until the two ends have been entirely finished. Without counting repetitions, there are four distinct and separate operations performed by this machine upon each end of the cylinder at a single adjustment of the latter.

Any of the tool-rests c', c^2, or c^3 may be used at will to hold a suitable tool for facing or boring or counterboring; but there is an advantage in having the three arranged as shown, as it avoids the necessity for moving the carriage C, in changing from one jib to the other, the tool-rest c' being used for counterboring the large end of the cylinder, the tool-rest c^3 being used for boring the small hole in the "closed" end of the cylinder, and the intermediate tool-rest c^2 being used when convenient for facing.

I claim as the invention of said GEORGE H. CORLISS and desire to secure by these Letters Patent—

1. In a machine for finishing the ends of steam-engine cylinders and analogous castings, a head B, hollow shaft B′, and a tool-post and a drill-chuck, each movable radially in such head, and gearing independently operated by a shaft *b* within the hollow shaft B′ for rotating such drill-chuck, in combination with each other and with mechanism for automatically traversing the whole longitudinally to provide for boring and counterboring, substantially as herein specified.

2. In a machine for finishing steam-engine cylinders and analogous castings, the single tool-carriage C, having one or more tool-rests and a drill-chuck mounted therein, carried on a head B, fixed on a hollow shaft B′, in combination therewith and with the feed-screw A^2 and means for operating it to give a feed movement to the carriage, and with a threaded shaft c^5 and means for operating it to move such carriage radially on the head, as herein specified.

3. The hollow shaft B′, head B, mounted thereon, and mechanism for rotating the two, a tool-carriage C, equipped with two or more tool-rests c' c^2 c^3, and a drill-chuck c^4, each carrying tools arranged for alternate action, means for traversing such carriage radially in such head automatically and at will, and other means for operating such drill-chuck at any distance from the axis of the head B and in any part of the circle by mechanism contained within such head and connecting with the shaft *b*, contained within the hollow shaft B′, all combined with each other and with a housing A′, and mechanism for feeding such housing and its connections longitudinally at will and automatically, and all arranged to serve substantially as specified.

4. In a machine for finishing steam-engine cylinders and analogous castings, the housing A′ and mechanism for feeding it longitudinally, the hollow shaft B′ and head B, carried on such housing, the head having a radial way *w w*, the carriage C, carrying one or more tool-rests c' c^2 c^3 and also a drill-chuck c^4, mechanism for automatically feeding such carriage radially on the head, mechanism for revolving the shaft B′, mechanism for revolving the drill-chuck c^4, held parallel to the axis of the head and at any distance therefrom and in any part of the circle, and shafts D and E, extending up and down, connecting the shaft B′ and the drill-chuck c^4, respectively, with gears arranged overhead and driven by power and provided with means for controlling their action at will, all combined and arranged for joint operation substantially as herein specified.

5. In a machine for finishing steam-engine cylinders and analogous castings, having the housing A′ and mechanism for feeding it longitudinally, a hollow shaft B′ and a head B, carried on such housing, a carriage C, carrying the tool-rests and also a drill-chuck, and mechanism for operating either at will and for feeding each automatically at will, in combination with each other and with three vertical shafts D, E, and F, with separately-controlled driving-gears mounted overhead and separate trains of gears below for each, connected as shown, so that one shaft shall at will revolve the hollow shaft B′ and its connections, another shaft shall at will revolve the drill-chuck, and a third shall at will move the housing A′, carrying such hollow shaft B′ and its connections longitudinally, all substantially as herein specified.

6. A machine for finishing the ends of cylinders of steam-engines and analogous castings, the same consisting of the following elements in combination: two heads B, fixed upon hollow shafts B′, mounted in housings A′, all arranged in line with each other, carriages C, carried on such heads, each carriage being equipped with means, as the threaded shaft c^5, for moving it radially on such head, and also with one or more tool-rests carrying tools, respectively, for facing, boring, and counterboring, and with a drill-chuck carrying in alternation drills and taps, all said tools being arranged for successive operation

and said drill-chuck and its tool being held parallel with the axis of such head and combined with means for operating the tool at any distance from such axis and in any part of the circle, means for revolving the drill-chuck at will, means for revolving the hollow shaft B′ and its connections at will, and other means for moving each housing and its connections longitudinally at will and automatically, and jigs adapted to serve, as described, to center and hold the cylinder in the correct line, all arranged substantially as shown and described, and adapted to serve, as specified, to accurately finish both ends of a cylinder at a single setting and adjustment of the latter.

In testimony whereof I hereunto set my hand in presence of two subscribing witnesses.

EMILY A. CORLISS,
Administratrix of the estate of George H. Corliss, deceased.

Witnesses:
HENRY MARSH, Jr.,
MARIA L. CORLISS.