(No Model.) 3 Sheets—Sheet 1.

A. S. ELMORE.

PROCESS OF AND APPARATUS FOR MANUFACTURING COPPER TUBES.

No. 464,351. Patented Dec. 1, 1891.

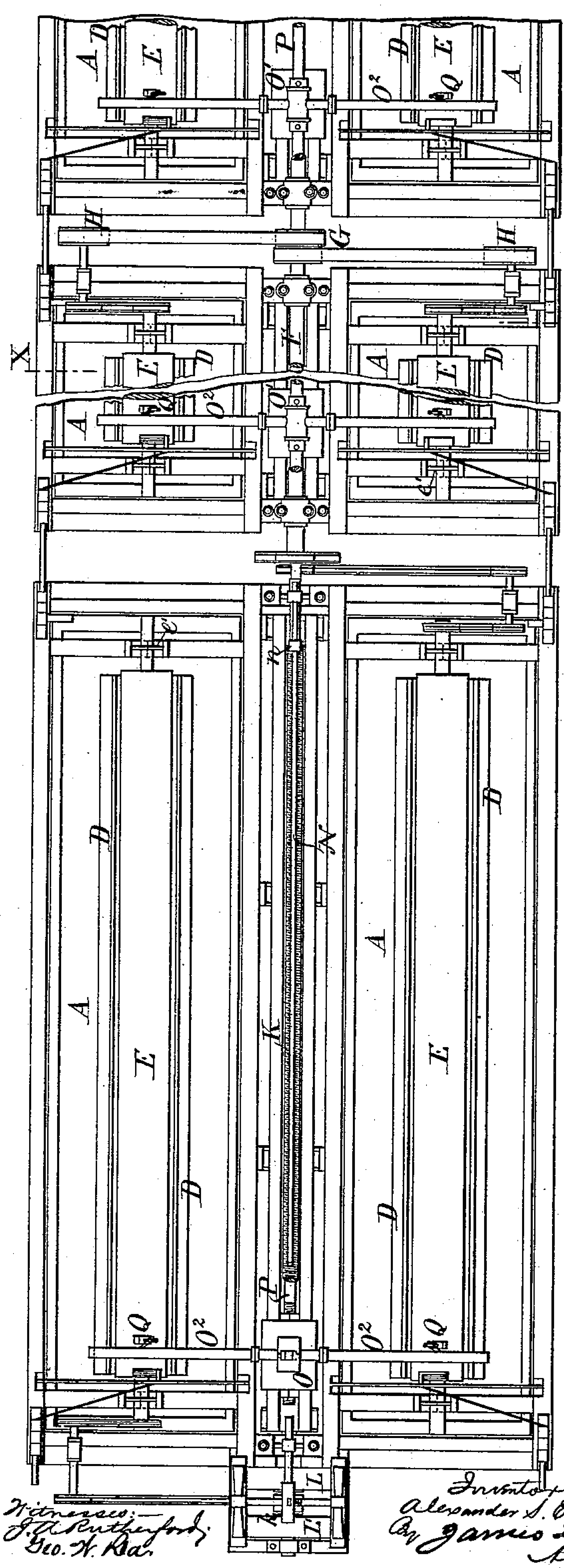

Fig. 1.

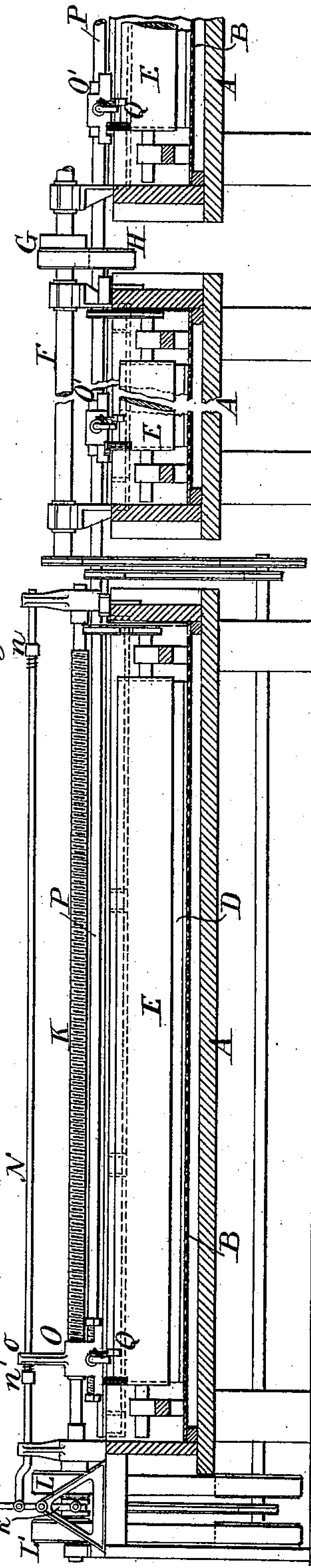

Fig. 2.

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

(No Model.) 3 Sheets—Sheet 2.

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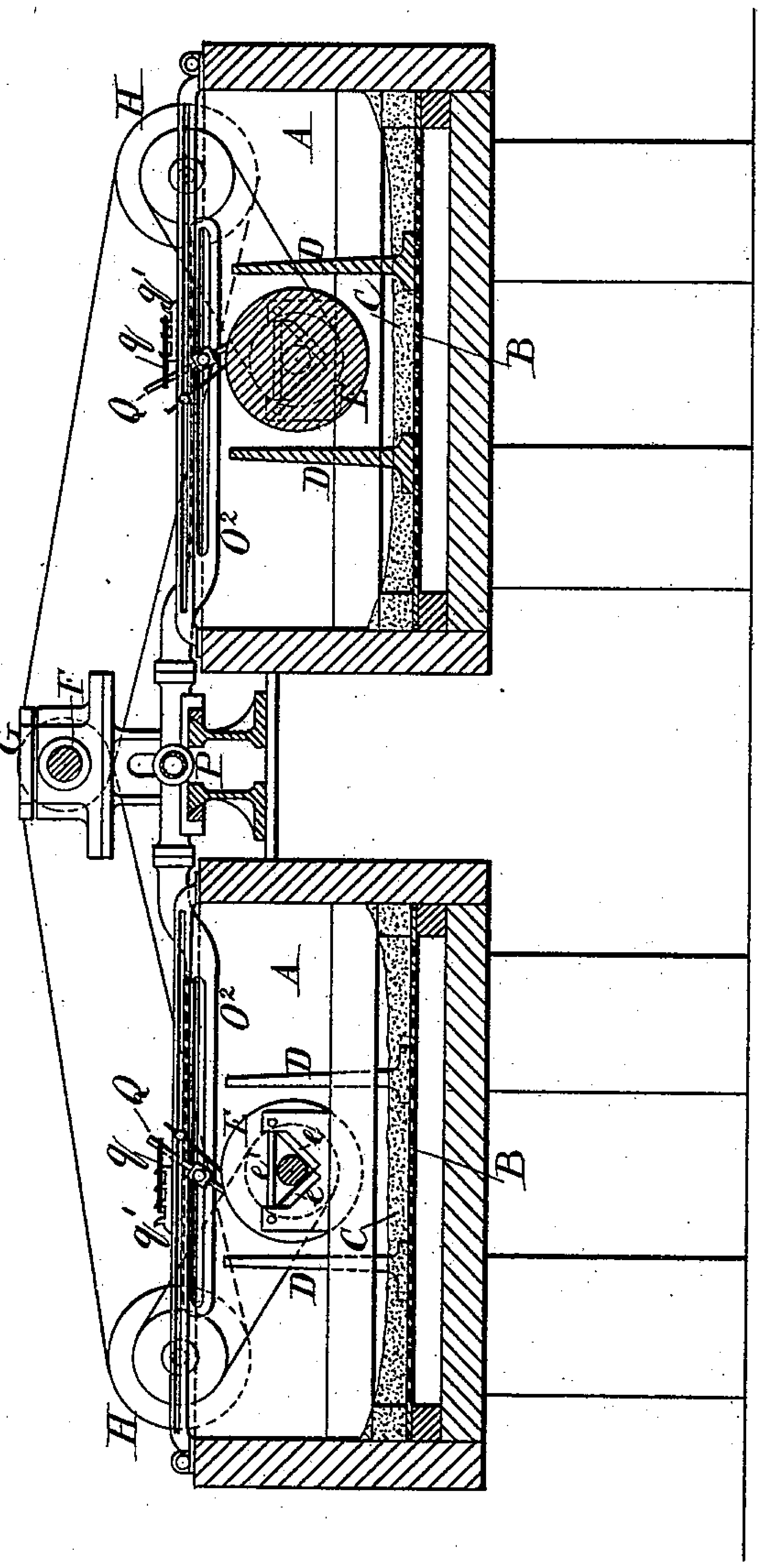

Fig. 3.

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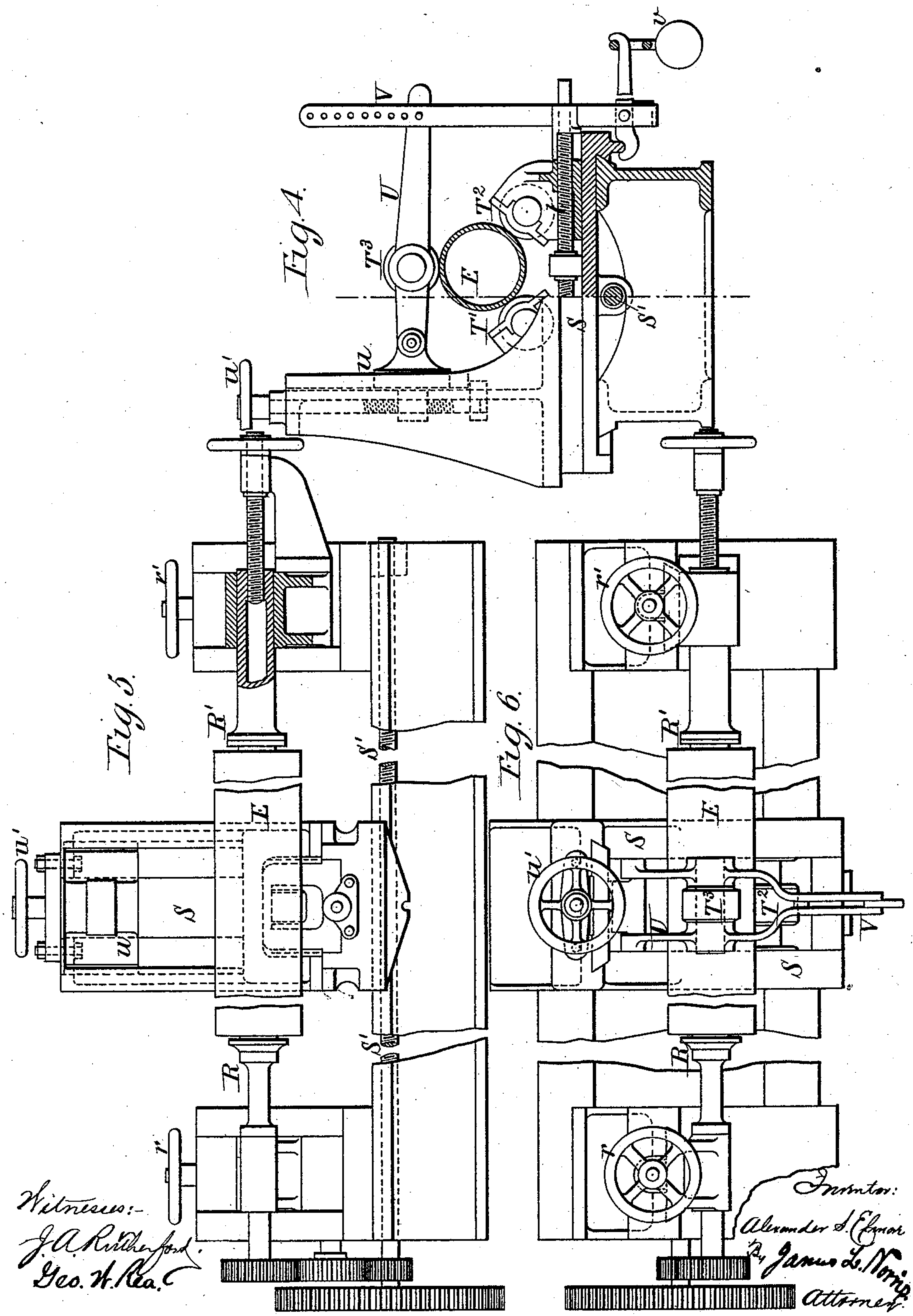

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Inventor:
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UNITED STATES PATENT OFFICE.

ALEXANDER STANLEY ELMORE, OF LEEDS, ENGLAND.

PROCESS OF AND APPARATUS FOR MANUFACTURING COPPER TUBES.

SPECIFICATION forming part of Letters Patent No. 464,351, dated December 1, 1891.

Application filed December 18, 1890. Serial No. 375,141. (No model.) Patented in France November 18, 1890, No. 209,602; in Belgium November 18, 1890, No. 92,771; in Switzerland November 18, 1890, No. 2,999; in Luxemburg November 18, 1890, No. 1,375; in Norway November 18, 1890, No. 2,082; in England November 21, 1890, No. 18,896; in Italy December 3, 1890, LVI, 157; in Turkey December 17, 1890, No. 215; in Cape of Good Hope January 6, 1891, No. 160/658; in Victoria January 12, 1891, No. 8,414; in New South Wales January 12, 1891, No. 2,731; in South Australia January 13, 1891, No. 1,822; in Spain January 13, 1891, No. 11,472; in Queensland January 15, 1891, No. 1,231; in Tasmania January 15, 1891, No. 844/10; in New Zealand January 23, 1891, No. 4,810; in Austria-Hungary April 22, 1891, No. 51,902 and No. 3,907; in Canada April 24, 1891, No. 36,468, and in Western Australia August 4, 1891, No. 279.

To all whom it may concern:

Be it known that I, ALEXANDER STANLEY ELMORE, a citizen of England, residing at Spring Grove, Hunslett, Leeds, in the county of York, England, have invented a new and useful Process of and Apparatus for Manufacturing Copper Tubes, Sheets, Strips, and Wires by Electrolysis, (for which I have obtained patents in Great Britain, No. 18,896, dated November 21, 1890; in France, No. 209,602, dated November 18, 1890; in Austria-Hungary, No. 51,902/3,907, dated April 22, 1891; in Belgium, No. 92,771, dated November 18, 1890; in Switzerland, No. 2,999, dated November 18, 1890; in Spain, No. 11,472, dated January 13, 1891; in Luxemburg, No. 1,375, dated November 18, 1890; in Italy, Vol. LVI, 157, dated December 3, 1890; in Norway, No. 2,082, dated November 18, 1890; in Victoria, No. 8,414, dated January 12, 1891; in New South Wales, No. 2,731, dated January 12, 1891; in New Zealand, No. 4,810, dated January 23, 1891; in Cape of Good Hope, C C 160, Folio 658, dated January 6, 1891; in South Australia, No. 1,822, dated January 13, 1891; in Queensland, No. 1,231, dated January 15, 1891; in Tasmania, No. 844/10, dated January 15, 1891; in Canada, No. 36,468, dated April 24, 1891; in Turkey, No. 215, dated December 17, 1890, and in Western Australia, No. 279, dated August 4, 1891,) of which the following is a specification.

It has been proposed to manufacture tubes by electrolytically depositing metal on revolving mandrels and rendering the deposited metal firm, sound, and compact by burnishing it as it is deposited by means of burnishers caused to travel to and fro along the surface as it revolves. The tubes thus electrolytically manufactured in their entire condition are available as strong and sound pipes or conduits for fluids, or, according to descriptions given in other patent specifications, they are divided by straight or helical cuts and unbent, so as to form sheets, strips, or wires of sound and homogeneous character.

The present invention consists in improvements in this process and in the apparatus by which it is conducted.

The process according to my present invention for depositing copper is conducted as follows: I first prepare an externally turned and polished mandrel of iron or steel, preferably hollow for the sake of lightness, and I fix this on a non-conducting spindle, which may be of wood. I mount the mandrel-spindle in non-conducting bearings, which may be of glass, in an electrolytic bath, connecting the mandrel by a brush to one terminal of a voltaic battery, dynamo-electric machine, or other source of electricity, so as to form a cathode, and connecting a suitable anode to the other terminal. I form the anode of two sheets of copper, one on each side of the bath, and I charge the bath with a solution of double cyanide of copper and potassium, the solution containing about one part, by weight, of the salt to twenty parts of water, and the temperature being, preferably, about 55° to 60° centigrade. The mandrel, having been caused to revolve in this bath with the electrical action continued for about a quarter of an hour, becomes coated with a layer of copper, and then it is taken out and exposed for about the same time to the air, by which the surface becomes oxidized, so that another layer of copper deposited on it will not adhere to it. The mandrel thus prepared with an oxidized coating of copper is now placed in another bath, which has for its anode a perforated plate of copper supported at a little distance above the bottom of the bath and carrying a thick layer of granulated copper. In addition to this anode plates of copper may be placed on the bottom plate so as to stand upright on each side of the mandrel. The solution in this bath consists of sulphate of copper with a certain amount of free sulphuric acid. The proportions may be varied; but I find that in starting the bath about three parts, by weight, of sulphate-of-copper crystals and one part of acid to twenty parts of water make a good mixture, to which from time to time a little acid has to be added. The mandrel is caused to revolve in this bath, and the burnishing-tool is caused to travel to and fro along the surface of the deposited metal by apparatus which I shall hereinafter describe until the desired thickness of metal is deposited. When additional layers have to be deposited, the surface of each layer has to be heated to prevent adhesion of the next layer. This can be effected by running off the contents of the bath and exposing the metal for a short time to oxidation or by varnishing the surface of the deposited metal with a thin coating of solution of wax in alcohol. When no particular regard is to be had to the surface polish, a rapid and easy method of preventing adhesion is simply to reverse the electrical current for a very short time, thus producing a film of oxide on the surface of the metal. When the metal is deposited to sufficient thickness to form a tube or when a sufficient number of successive thicknesses have been deposited, the mandrel, with the metal on it, is removed from the bath and subjected in a machine, presently to be described, to pressing-rollers, which are made to travel along it longitudinally. These rollers by somewhat extending the periphery of the deposited metal loosen it from the mandrel, so that it can be readily removed therefrom. The tube thus removed from the mandrel may be used as a pipe, or it may be cut longitudinally and unbent to form a sheet or cut helically to form a long continuous strip or a rod which can be drawn to wire, and when several thicknesses have been deposited they can all be cut at one operation, producing a number of sheets, strips, or wire rods.

Figure 1 of the accompanying drawings is a plan, and Fig. 2 is a longitudinal section, showing the first, second, and part of the third of two continuous rows of electrolytic baths for the deposit of the copper on the revolving mandrels with the gearing for causing the mandrels to revolve and the burnishers to travel to and fro along the surface of the deposited metal. Fig. 3 is a transverse section on X X to an enlarged scale. The baths A may be made of wood made water-proof by a lining of resinous or like material.

A little above the bottom of each bath is supported a perforated plate B, of copper, covered with a thick layer C of granulated copper, and standing on the plate B are two upright plates D, of copper, one on each side of the mandrel E, on which the copper is deposited. A shaft F, driven by any suitable motor, is mounted between the two rows of baths and extends along them, having on it pulleys G, which by belts drive pulleys H, one for each bath, and from the spindles of these pulleys the mandrels E are driven by chain gearing. The spindle of each mandrel, which is of wood, turns in bearings, one at each end, consisting of two plates e, of glass, placed at an angle in a wooden block, and over the spindle is a bar e', of wood, to prevent it from being lifted out of its bearing. Over the central space, between the two end baths, is mounted a screwed spindle K, connected by a shifting-clutch k to either of two pulleys L L′, revolving in opposite directions. The clutch k is jointed to a lever M, which is surmounted by a tumbling weight and is linked to a rod N, that extends above the screw K and has on it two collars n n', fronted by springs. A cross-head O forms the nut of the screw K and has an arm o standing up from it and embracing the rod N. The cross-head O is fixed on a sliding rod P, which extends the whole length of the row of baths and has fixed on it cross-heads O′, one for each bath. These cross-heads O′, as well as the first cross-head O, have removable arms O^2 projecting from them, and on these are pivoted the burnishing-tools Q, which can be adjusted along slots in the arms O^2, so as to press obliquely on the surface of the mandrel E, their pressure being regulated by an elastic band q, which can be strained more or less to catch on one or other of a set of hooks q'. Assuming that the screw K is driven by the pulley L so as to turn in the one direction, causing the cross-head O to travel toward the right, and with it the rod P and all the other cross-heads O′ and their arms O^2, so that all the burnishing-tools Q move along the surfaces of their respective mandrels, which at the same time are caused to revolve by their connections to the shaft F, then when the arm o approaches the stop-collar n it first compresses the spring, then moves the rod N, causing the lever M to tumble over, disengaging the clutch k from the pulley L and engaging it with the oppositely-revolving pulley L′. The rotation of the screw K being thus reversed, the cross-head O, the rod P, and all the other cross-heads O′, arms O^2, and their burnishing-tools Q now travel back until the arm o, acting on the stop-collar n', again causes reversal of the screw K.

Fig. 4 is an end view, partly in section. Fig. 5 is a side view, and Fig. 6 is a plan, of the roller apparatus whereby the shell of deposited metal is released from the mandrel. The mandrel E, with the shell of metal on it, is mounted between centers R R′, which are on slides adjustable in height by screws r r'. A slide S, which by means of a screw S′ can be moved along the bed of the machine, carries three rollers T′ T^2 T^3. The two lower rollers T′ T^2 can be adjusted to or from the central line of the bed by a right and left handed screw t. The upper roller T^3 is carried by a lever U, which is pivoted to a vertical slide u, capable of being raised or lowered by a screw u', and the other end of this lever is adjustably linked to another lever V, carrying an adjustable weight v. The mandrel E, with its coating of deposited metal, being caused to revolve, the slide S, with its rollers, is at the same time caused to travel along the bed of the machine, and the pressure of the rollers, by extending the periphery of the metallic shell, loosens it from the mandrel.

Having thus described the nature of my invention and in what manner the same is to be performed, I claim—

1. The process herein described for manufacturing copper tubes by electrolysis, which consists in coating a mandrel by moistening it with a solution of cyanide of copper, mounting the mandrel as a cathode in an electrolytic bath charged with an acidulated solution of sulphate of copper and having granulated copper and copper plates arranged as anodes connecting the cathode and anodes to a source of electricity, causing the mandrel to revolve, moving burnishing-tools to and fro along the surface of the revolving mandrel, and finally, when the deposit is of the desired thickness, removing the mandrel and its coating from the bath and subjecting it to roller-pressure along its length to loosen and release the deposited tube, substantially as set forth.

2. The process herein described for manufacturing copper tubes by electrolysis, which consists in subjecting mandrels to the action of a bath of cyanide of copper, placing the mandrels in electrolytic baths charged with acidulated solution of sulphate of copper and having granulated copper and copper plates arranged as anodes and the mandrels as cathodes connected to a source of electricity, revolving the mandrels, depositing successive layers of copper on the mandrels, coating each deposited layer of copper with a substance to prevent adhesion, causing burnishing-tools to travel to and fro along the mandrels, and finally, when the deposit is of the desired thickness, removing the mandrels and their coating from the bath and subjecting them to the pressure of rollers traveling along their length to loosen and release the deposited layers, substantially as set forth.

3. The combination, with a series of electrolytic baths A, arranged in two parallel rows, of the mandrels E, supported and arranged to revolve in the baths, the shaft F, arranged centrally between the two rows of baths and provided with the pulleys G, the pulleys H, the chain gearing between the latter and the mandrels, and connections between the pulleys, substantially as described.

4. The combination, with a series of electrolytic baths A, arranged in two parallel rows, of the rotary mandrels E, supported and arranged to revolve in the baths, the driving-shaft F, connections between the driving-shaft and the mandrels for rotating the latter, a screw-spindle K, arranged centrally between the two rows of baths, a cross-head O, arranged in screw-threaded engagement with the screw-spindle and having the arm *o*, the horizontal rod N, having collars *n n′* and extending through the arm of the cross-head, the longitudinally-sliding rod P, secured to the cross-head which engages the screw-spindle and having cross-heads O′, the arms O^2, secured to the respective cross-heads and provided with burnishing-tools Q, arranged, respectively, in proper relation to the mandrels, the reversing-pulleys L L′ for rotating the screw-spindle, the clutch *k* between the reversing-pulleys, and the tumbling-lever M, connected with the clutch and with the horizontal rod, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 4th day of December, A. D. 1890.

ALEXANDER STANLEY ELMORE.

Witnesses:
WILLIAM VEVERS,
HENRY S. LENTY,
Clerks to T. and H. Greenwood Teale, Solrs. and Notaries Public, Leeds, England.