(No Model.) 2 Sheets—Sheet 1.

A. F. E. DUPONT.

HOLLOW OR SOLID METAL BAR, WIRE, TUBE, &c.

No. 560,484. Patented May 19, 1896.

Fig. 1

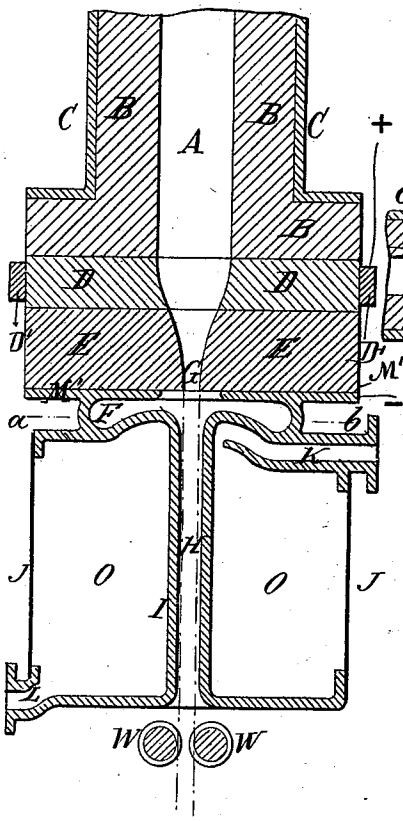


Fig. 2

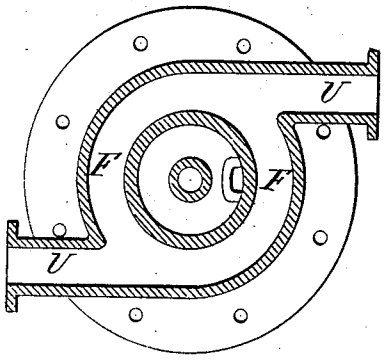


Fig. 3

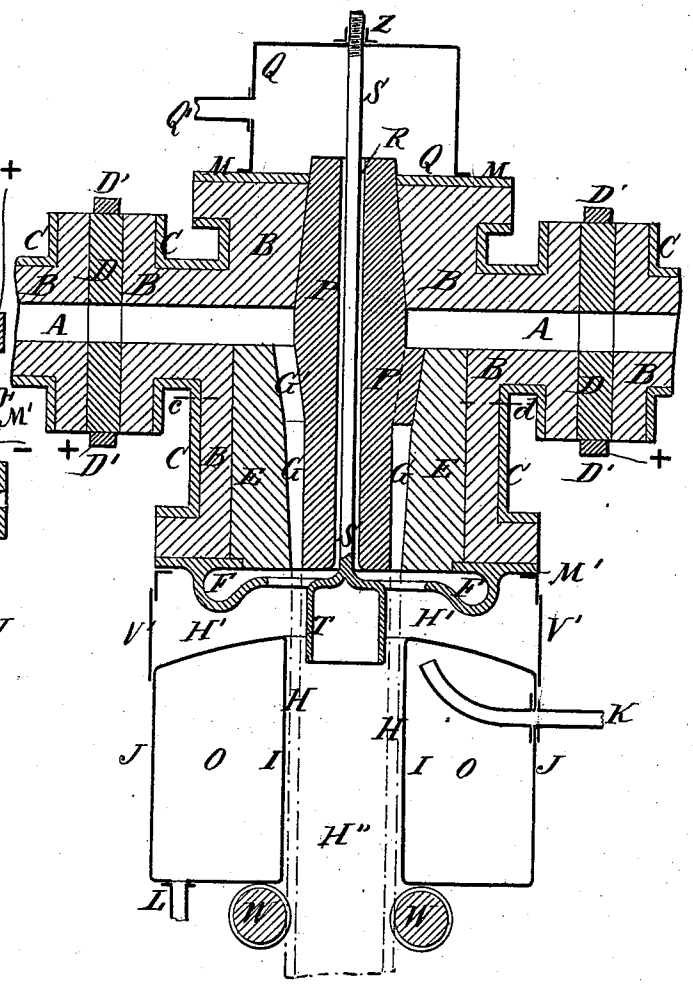
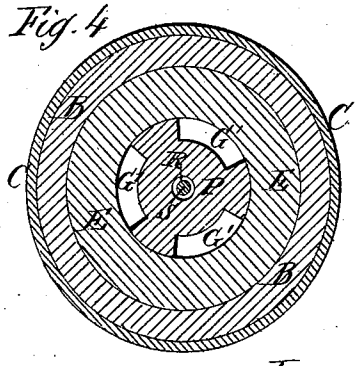


Fig. 4



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5

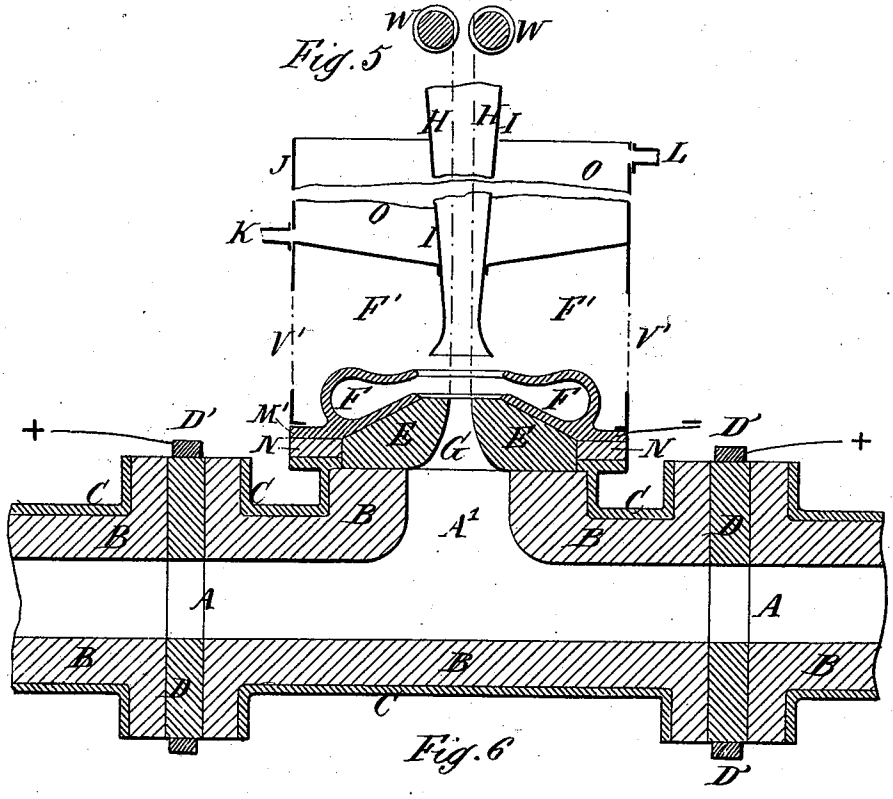
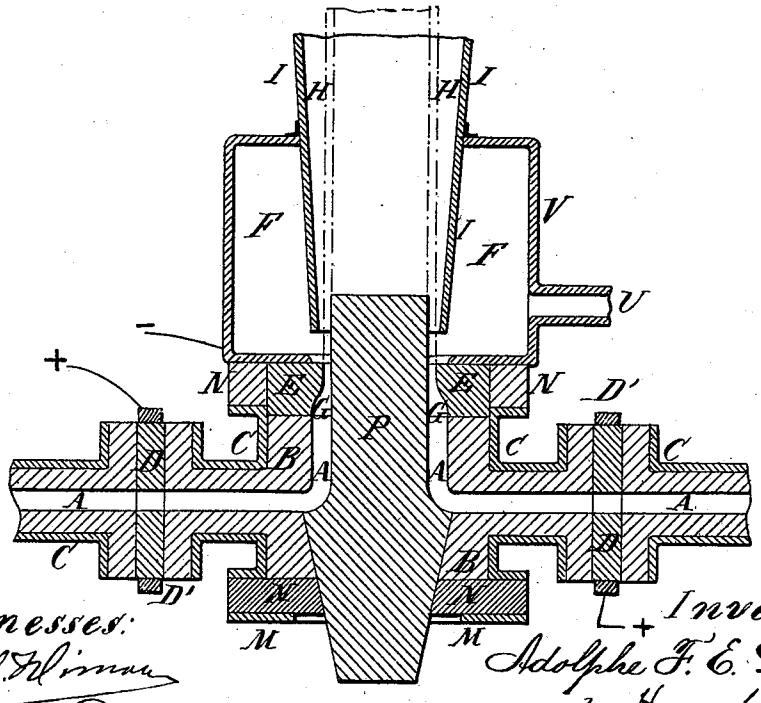


Fig. 6



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UNITED STATES PATENT OFFICE.

ADOLPHE FRANÇOIS EUGÈNE DUPONT, OF PARIS, FRANCE.

HOLLOW OR SOLID METAL BAR, WIRE, TUBE, &c.

SPECIFICATION forming part of Letters Patent No. 560,484, dated May 19, 1896.

Application filed September 12, 1894. Serial No. 522,845. (No model.) Patented in France January 25, 1894, No. 235,798, and in England July 21, 1894, No. 14,078.

To all whom it may concern:

Be it known that I, ADOLPHE FRANÇOIS EUGÈNE DUPONT, a citizen of the French Republic, residing at Paris, France, have invented certain Improvements in the Manufacture of Hollow or Solid Metal Bars, Wires, Tubes, &c., (for which patents have been granted in France, No. 235,798, dated January 25, 1894, and in England, dated July 21, 1894, No. 14,078,) of which the following is a specification.

The object of my invention is the manufacture of bars, tubes, rods, &c., in continuous lengths, like lead pipe, from metals and alloys. This problem presents two principal obstacles, which are, first, the cooling of the metal in the molding-nozzle, and, second, the friction which is produced between the stream or current of gradually-cooling metal and the cooler walls of the channel and nozzle and those of the refrigerator exterior to the latter. My mode and apparatus overcome both of these obstacles at once.

It consists in the combination, with an electric current, which keeps the metal passing through the molding-nozzle at a temperature most suitable for conforming to the contour of the mold, of a current of water or other fluid which envelops all parts of the moving molded article as it issues from the molding-nozzle in a hot and still plastic state, this fluid playing the double roll of a refrigerant and a conductor for the electric current.

Electric heating-currents have before been employed for maintaining metals at the melting-point, and currents of fluid have also been before employed to cool articles continuously molded; but the combined use of these agents in the manner stated above has not been before employed so far as I am aware; and my invention, on the other hand, presents another peculiarity—namely, that the electric current, which has become useless, or indeed hurtful, when it shall have traversed and reheated the metal at the molding-nozzle is then derived outside of the moving mass of metal passing through the nozzle—and I utilize for effecting this derivation the fluid employed for refrigeration of the molded article in such a manner that the cooling agent fills in my apparatus the double function above explained.

In order to carry out this invention, I give to the channel which leads the metal to the nozzle a much greater cross-section than the nozzle itself and give to its profile an accentuated curve. The electric current enters the metal in the channel and flows through the metal up to the nozzle. In its passage it encounters a resistance which begins at the point where the channel commences to diminish, and attains its maximum where it enters the nozzle, which is the most contracted part of the channel occupied by the molten metal. The metal is thus reheated progressively and gradually as it approaches the nozzle, and it attains its maximum temperature precisely at the point where it receives its definite form. The intensity of the electric current is regulated in such a manner as to obtain the temperature most suitable for molding or giving form to the metal in the molding-nozzle.

The metal passes out from the nozzle in a more or less plastic state. After it passes out from the nozzle it traverses an annular orifice, through which flows a current or stream of water or other cooling fluid, which envelops the hot metal completely and moves more rapidly than the latter. This fluid, to which I give, ordinarily, a large cross-section, does not offer the resistance to the flow of the electric current that is offered in the channel, and said fluid serves to materially reduce the temperature of the molded article and diverts the electric current from the metal, said current being then returned to its source or grounded by means of a suitable conductor. At the same time the fluid absorbs the heat from the molded article it envelops, and with which it is in direct contact, and the latter becomes firm and solid. When the quantity of water employed is not great, I place about the jacket or cylindrical envelop through which the refrigerating water flows an annular water jacket or holder adapted to contain a moderate amount of water. This construction enables me to reduce in a notable degree the whole amount of water used.

In the accompanying drawings I have illus-

trated an embodiment of the apparatus employed in carrying out my invention.

Figures 1 and 2 show an apparatus for making bars in which the flow of the metal is vertically downward, the former being a vertical axial section and the latter a transverse section in the plane indicated by line *a b* in Fig. 1. Figs. 3 and 4 show a form of the apparatus adapted for producing tubes and solid bars of cross-shaped transverse section, the flow of the metal being vertical. Fig. 3 is a vertical axial section, and Fig. 4 is a transverse section in the plane indicated by line *c d* in Fig. 3. Fig. 5 is a sectional view of a form of the apparatus adapted for producing bars, rods, or wires, the flow of the metal being vertically upward. Fig. 6 is a sectional view of the apparatus in which the metal flows vertically upward. This form of the apparatus is adapted for producing tubes.

Referring to Figs. 1 and 2, A is the channel which brings the molten metal to the molding nozzle or die E. This nozzle is a sort of die or draw-plate, which imparts to the bar its proper dimensions and cross-sectional contour. B is the refractory material forming the wall of the channel A, and C is the metal casing or armor inclosing and reinforcing the material B. D is a ring of graphite arranged between the material B and the nozzle E and having formed in it a part of the channel A where it contracts to unite with the molding-passage G in the nozzle. This ring D serves as an electrode, and it is tightly embraced by a metal clamping-ring D′. I is the tubular jacket or wall of the cooling device. The cooling fluid arrives by pipes connecting with the opposite tangential inlets U of the cooling device or refrigerator, which leads the fluid into an annular or circular chamber F at the upper end of the jacket I and open to the passage G, with which the channel H in the jacket I is axially alined. From the chamber F the fluid passes down through the channel H about the hot bar, which moves down through the jacket, as indicated by the dotted lines in Fig. 1. The jacket I is inclosed within a chamber O, formed by an inclosing casing J, and into this chamber O water is introduced at the inlet K and drawn off at the outlet L, or vice versa. The object of this device is to cool the jacket I. The chamber or reservoir O will not always be needed.

W W are delivery-rollers for supporting and delivering the bar or article as it emerges from the passage H. In order to pass the electric current, it will suffice to connect the positive terminal + of the circuit-conductor with the metal ring D′, and the negative terminal − with the flange or plate M′, or with any other metallic part of the cooling device below the nozzle E, as this device is, as a whole, a negative electrode.

The above-described apparatus is adapted for the use of any fluid refrigerant whatever, as gas, vapor, spray, liquid, &c.

Referring to Figs. 3 and 4, A is the channel which leads the molten metal to the die. B is the refractory material about said channel, and C the metallic casing or armor. D D are two electrodes of graphite and D′ D′ the metal bands thereon. E is the nozzle, of refractory material. P is the mandrel which serves to form the bore in the tube which is being formed or cast. The metal arriving by the horizontal channels A flows down through passages G′ into the annular passage G in the nozzle E about the mandrel or core P. The several passages G′ merge into the single passage G, which contracts progressively down to the molding-outlet, as clearly shown. The molded article—a tube in this case—passes down from the outlet of the nozzle into the cooling or refrigerating device below, which is somewhat different from that shown in Fig. 1. The molded tube first passes down through an annular chamber H′, above the chamber O, and about a hollow cylinder T, secured to the lower end of a rod S, which extends up through an axial bore R in the mandrel P and screws, at Z, into the upper plate of a chamber Q, which surmounts the apparatus and has an inlet Q′ to supply a refrigerant fluid. This fluid flows from the chamber Q down through the passage or bore R, about the rod S, and thence down about the cylinder T and through the annular space between it and the tube being cast, which latter is indicated in dotted lines in Fig. 3. Thus the tube is brought into contact with the refrigerant fluid both internally and externally. The refrigerant fluid from the chamber F flows down exterior to the tube and that from chamber Q down through the tube. The chamber H′ is furnished with inspection-apertures covered by plates V′.

The apparatus seen in Fig. 5 is adapted for an upward delivery and for the employment of gas or liquid spray as a refrigerant. This form of the apparatus also shows a horizontal channel A, connecting at its side with the nozzle E. This construction differs from that of Fig. 1 in the employment of two electrodes D, placed at opposite sides of the lateral outlet A′, leading to the nozzle E. It differs also in that the cooling device has a chamber F′ to relax the cooling-gas, for regulating the pressure, access to this chamber being provided by apertures V′, which permit of the inspection of the molding operation as the article emerges from the nozzle. It also permits the attendant to get at the emerging molded article to remove scale due to superficial oxidation. N is an insulating-washer about the nozzle E.

Fig. 6 shows a form of the apparatus for making tubes wherein the flow is upward in a vertical direction. In this form of the apparatus the mandrel or core P is solid and not hollow, as that in Fig. 3. The cooling reservoir or chamber O is omitted from this form of the apparatus. V represents the shell or wall about the chamber F, into which the

cooling fluid is admitted at the inlet U. N N are insulating-washers.

Having thus described my invention, I claim—

1. The herein-described method of making by a continuous molding operation, bars, wires, tubes and the like from molten metal, which consists in passing the molten metal in a continuous manner through a shaping-nozzle to impart to it the proper cross-section, reducing the temperature of the molded article as it issues from the nozzle by enveloping it with a flowing fluid refrigerant, and simultaneously passing through the metal on its way to the molding-nozzle and in the said nozzle a current of electricity which keeps the metal passing through the nozzle at the proper temperature for molding, said current of electricity finally escaping to the fluid refrigerant about the molded article and thence returning to the source or the ground, thus providing a free and good conductor exterior to the nozzle whereby the metal after leaving the nozzle is relieved from the heating effect of the current, substantially as set forth.

2. In an apparatus for the continuous molding from molten metal, of bars, rods, tubes and the like, of uniform cross-section, the combination with the contracted molding nozzle or die and means for passing a current of electricity through the molten metal in said nozzle for reheating said metal at that point, of a refrigerating device for cooling the molded article as it emerges from said nozzle, said refrigerating device being situated at the point where the molded article emerges and comprising a casing about the path of the article furnished with an inlet and an outlet for the cooling fluid, whereby the latter is made to flow in the manner of a sheath about the moving article to be cooled and forms a part of the electric circuit, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ADOLPHE FRANÇOIS EUGÈNE DUPONT.

Witnesses:
CLYDE SHROPSHIRE,
AUGUSTE MATHIEU.