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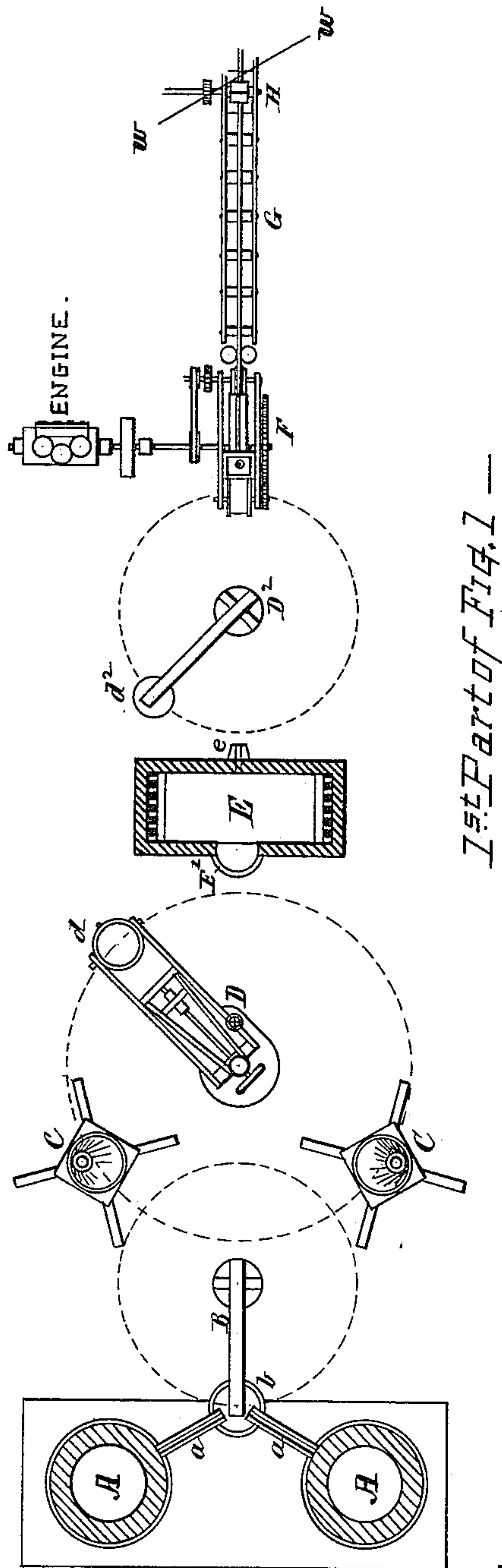
3 Sheets—Sheet 1.

C. F. WASHBURN & F. H. DANIELS.

PLANT FOR MAKING WIRE RODS FROM FLUID METAL.

No. 362,687.

Patented May 10, 1887.



WITNESSES

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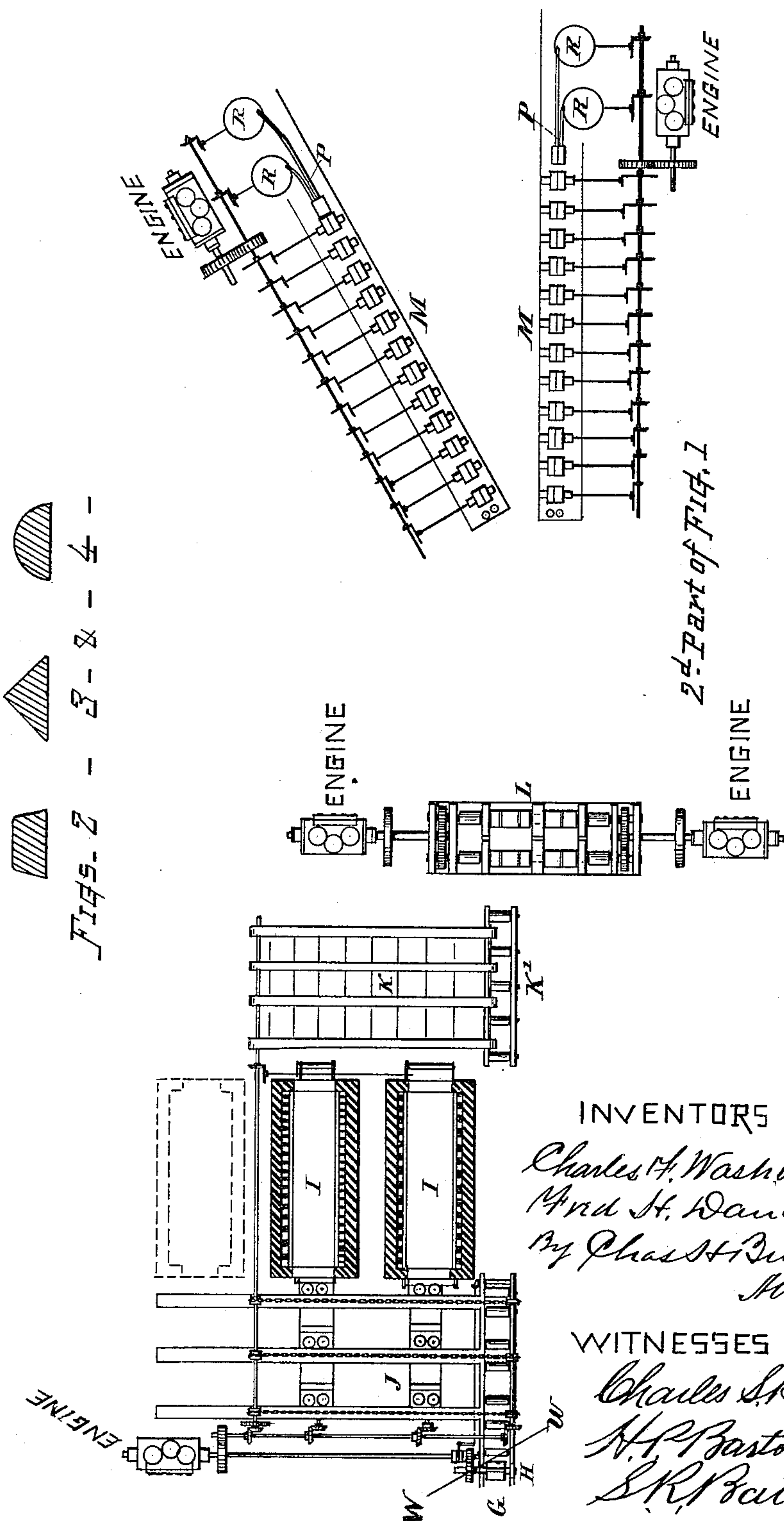
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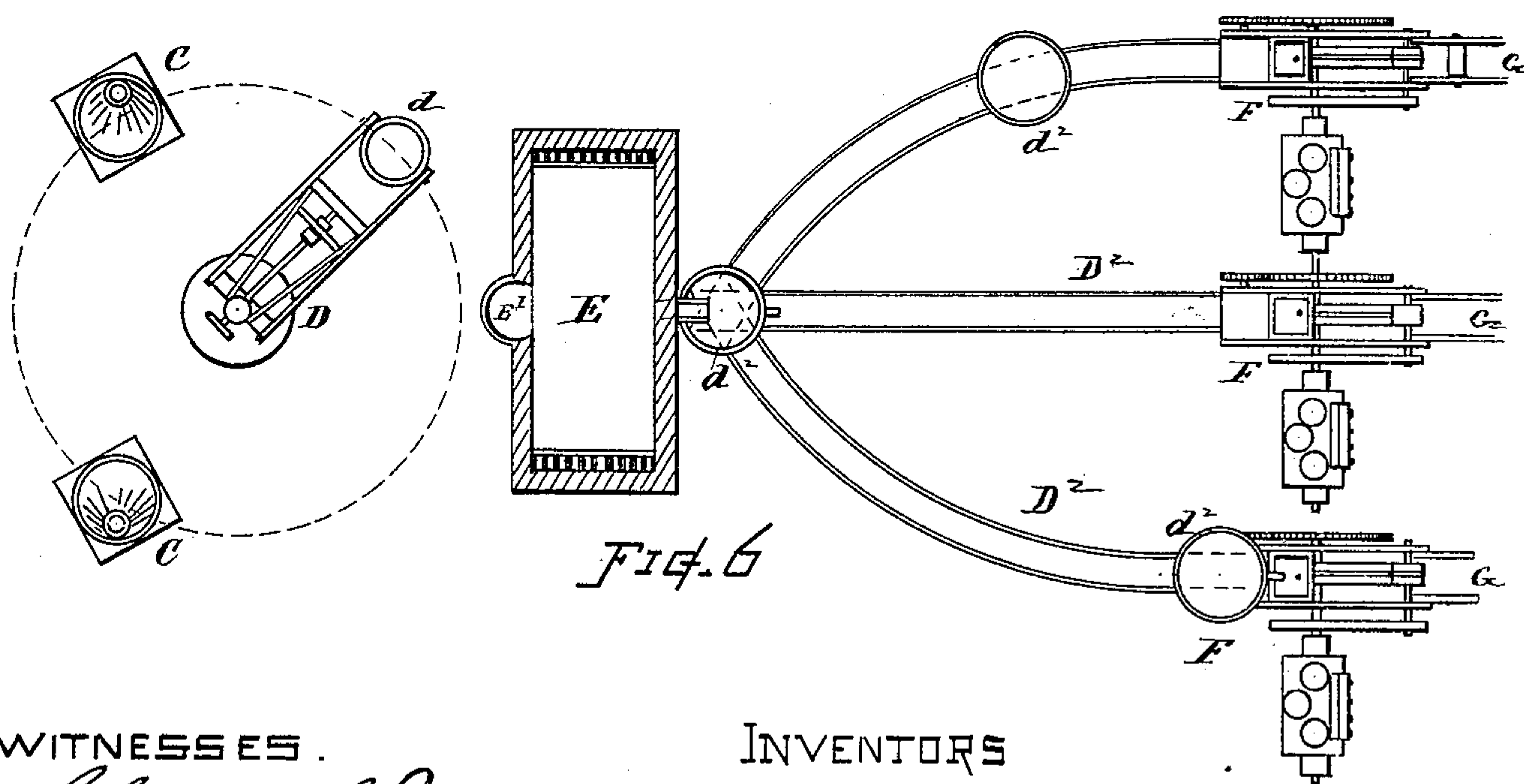
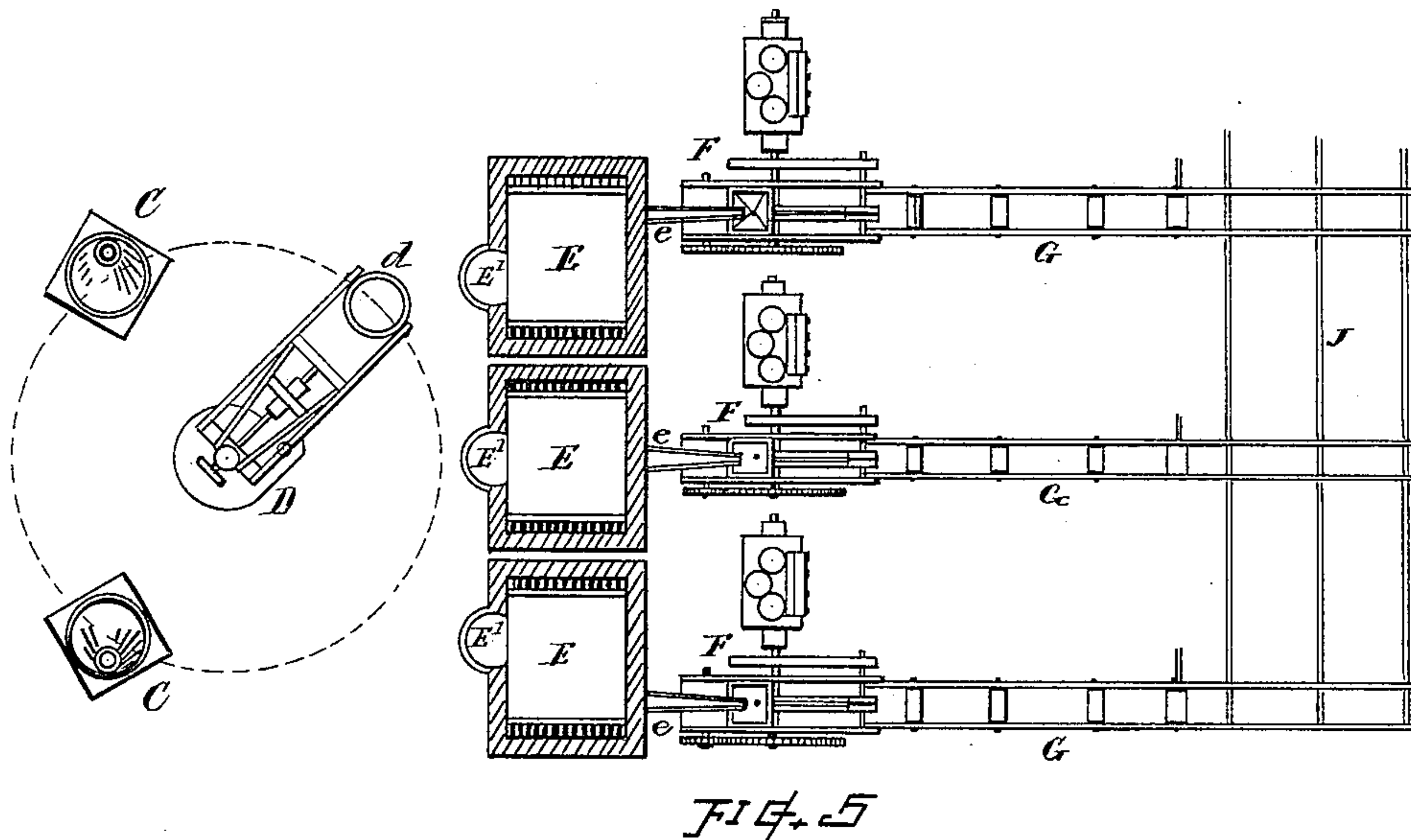
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UNITED STATES PATENT OFFICE.

CHARLES F. WASHBURN AND FRED H. DANIELS, OF WORCESTER, MASS.

PLANT FOR MAKING WIRE RODS FROM FLUID METAL.

SPECIFICATION forming part of Letters Patent No. 362,687, dated May 10, 1887.

Application filed May 24, 1886. Serial No. 203,071. (No model.)

To all whom it may concern:

Be it known that we, CHARLES F. WASHBURN and FRED H. DANIELS, both citizens of the United States, residing at Worcester, 5 in the county of Worcester, and State of Massachusetts, have invented certain new and useful Improvements in the Production of Billets and Wire Rods from Fluid Metal, of which the following, together with the accompanying 10 drawings, is a specification sufficiently full, clear, and exact to enable persons skilled in the art to which this invention appertains to make and use the same.

The object of our present invention is to 15 provide a practical method and apparatus for making billets or rolled bars direct from melted or fluid metal, and for reducing the same into rods, wire, bands, or shapes by a continuous process, or without permitting the 20 metal to become cold at any intermediate stage between the melting of the metal and the reeling of the finished rod; also, to provide means for the proper treatment and manipulation of the metal, while undergoing the process of 25 manufacture into billets or rods, at the various stages of its reduction.

To this end our invention consists in the method of making and reducing bars and rods, as explained, and in the apparatus therefor, 30 as hereafter described and claimed.

In the drawings, Figure 1, Sheets 1 and 2, is a plan diagram illustrating the nature of a working plant or apparatus adapted for carrying out our invention in practice. Figs. 2, 35 3, and 4 are sectional views illustrating shapes in which the ingots may be formed. Figs. 5 and 6 show modifications in the arrangement of the ingot-forming plant.

In our improved process of making billets, 40 bands, wire rods, &c., direct from fluid metal, the metal is melted and then subjected to the Bessemer or other suitable process, whereby it is converted into steel. It is then tempered to the proper consistency or corrected as to con- 45 dition and temperature in a receiving and storage furnace, from which it is conveyed to an ingot forming and solidifying mill. When solidified and sufficiently hard it is separated into sections or bars of any required length, 50 which bars are immediately transferred into a soaking heat maintaining or augmenting

furnace to give them uniform temperature throughout. They are next taken out and subjected to a roughing, preparatory rolling, or breaking-down operation by back and forth 55 passes or by continuous rolling in suitable rolls, and then reduced and finished in a rod-rolling train, and finally coiled in convenient form for transporting, coating, or drawing.

Referring to the different parts of the appara- 60 tus, as shown in the drawings, A A denote cupola-furnaces for melting the iron, which is drawn therefrom through the spouts *a* into a suitable ladle, *b*, suspended from a crane, B, and thence transferred into Bessemer convert- 65 ers C, or other steel-producing furnaces, wherein the metal is treated in the usual manner for the production of steel of the desired quality to be used in making the billets and wire rods.

D denotes a crane carrying the ladle *d* for 70 receiving the metal from the converters C.

E indicates a storing and tempering furnace, into which the converted metal is deposited when the converters C are discharged of their contents. Said furnace is preferably a basin- 75 shaped reverberatory heating-furnace, fired by gas on the regenerative plan, and serves for maintaining the proper chemical constituents of the metal, or for varying the chemical conditions thereof, if required, and for correcting 80 or bringing the fluid metal into the best conditions and consistency for flowing, working, and delivering.

The furnace being fired by gas on the re- 85 generative plan the temperature can be conveniently controlled for rendering the metal more or less fluid, by allowing a greater or less supply of air and gas to enter the furnace, thereby giving greater or less heat, and the chemical constituents of the metal within the 90 furnace can be changed, and consequently the temper of the metal varied, by introducing to the mass, through suitable openings in the furnace top or walls, well-known substances, such as ferro-manganese or spiegeleisen; or an- 95 other way in which the tempering and varying of condition of the metal may be brought about is by introducing different charges of varied constituents from the converters, and also serves as a reservoir for relieving the con- 100 verters of their charge of converted steel at the proper time for their discharge, and for

containing a supply of fluid metal maintained at a desired and uniform degree of heat and in proper quantity to be drawn upon for the continuous supply of the ingot forming and reducing mechanisms. Said furnace E is provided with a suitable funnel or mouth, E', into which the metal can be poured from the ladle which receives the charge of the converters C, and with a delivery-spout, e, from which the metal can be drawn out.

D² indicates a crane or carrier supporting the ladle d², whereby the prepared and tempered fluid metal is conveyed from the storage-furnace E to the ingot-forming mill.

F indicates the ingot-forming mill, consisting of mechanism which is adapted for receiving the metal in a molten or liquid state, confining and holding it in shape until it has congealed or cooled sufficiently to become solid or so as to retain its shape, and then delivering it in the form of a continuous ingot or bar of, say, two inches diameter, more or less, and at indefinitely increasing length, or in consecutive sections moving forward as formed. Said ingot-mill preferably consists of a revolvable wheel having a matrix, groove, or continuous mold formed in its face or periphery, combined with a traveling band or cover, which closes over said matrix-groove for a distance sufficient for allowing the metal which is poured into said groove to become congealed as the periphery of the wheel moves forward, and having a plow-guide or device for discharging the ingot from the mold. The mill is geared or connected with a suitable motor, whereby the matrix-wheel is revolved at a slow speed, and the fluid metal is supplied to the mold as it advances, so that the ingot is continuously forming and being discharged at a speed corresponding to the speed at which the periphery of the wheel moves forward.

The particular construction of an apparatus or machine for making continuous ingots or bars from fluid metal and suitable to be employed in this connection forms the subject-matter of a separate application for Letters Patent by Mr. F. H. Daniels. (See Serial Nos. 204,115 and 205,086.)

G indicates a roller table or platform for supporting the ingot or bars coming from the forming-mill F. Said table is preferably composed of a series of horizontal rolls supported in a frame in a manner to run freely, and having guides arranged in the intervals, so that the ingot can be run out from the ingot-mill without undue friction and in a straight condition.

H denotes a shearing or cut-off apparatus for cutting the continuous ingot into bars of required length convenient for use in subsequent reducing operations.

I I indicate furnaces for "soaking" or mellowing the bars, or for equalizing or augmenting the heat thereof and bringing all parts of the bar to uniform heat, consistency, or condition. Said furnaces are preferably of the ordinary construction of reverberatory gas-

furnaces, such as are now used for heating billets for the manufacture of wire rods, fired on the regenerative plan, and provided with the usual means for regulating the supply of gas and controlling the temperature. For transferring the bars into these furnaces I, we prefer to employ an automatic mechanism, J, consisting of a row of tracks and a series of endless chains running on suitable guiding and driving wheels and provided with dependent arms or hooks that drag the bars along the tracks and deposit them at positions to be projected into the respective furnaces by feed-rolls, the chains and feed-rolls being driven by means of suitably-arranged gearing operated from an engine located at a convenient position, as indicated, said transfer mechanism J being arranged to act in concert with the shears H or cutting-off devices for receiving the lengths of ingot as they are delivered and transferring them to and feeding them into either one of the furnaces automatically in regular order and as fast as they are formed. The particular construction of mechanism for thus transferring and feeding the billets forms the subject of a separate application for patent.

We do not wish to confine ourselves to the particular method described for transferring the billets into and from the furnace or furnaces I, as any suitable method of transfer will answer the purposes of our process of making billets, wire, or other product.

K indicates a transfer mechanism or facilities, preferably consisting of a series of endless traveling bands or chains for receiving the bars as they are withdrawn from the furnace I and for delivering them upon a roller bed or platform, K', in front of and in position to be fed into and run through the preparatory rolling-sets or breaking-down mill L, in which the bars are reduced from a rough and porous cast ingot of uneven section to a homogeneous billet of uniform section and density and to a condition particularly adapted to be rolled and further reduced in a continuous mill.

It will be understood that the condition of the rough cast ingot as it comes from the forming mechanism is such that it would be impractical to attempt its direct reduction in a rolling-mill operating on the "continuous" order, on account of the lack of uniformity in texture and bulk, since the continuous rolling-train requires the strain to be substantially uniform and the texture regular and constant, and its successful operation depends in a great degree on these points; hence we introduce and employ the roughing or preparatory sets of rolls, as described, for condensing the rough bar or ingot to a uniform and homogeneous billet at this stage of the operation.

The bar is passed through the roughing-set three or more times, to condense and shape it to a size of about one inch (more or less) in diameter and of a square or other uniform section, as desired.

The roughing-sets L may be an ordinary three-high set of rolls or other suitable form

of mill adapted to this class of work. We prefer, however, a double form of mill, such as indicated on the drawings. The particular construction of said double mill, however, forms the subject of a separate application for Letters Patent by Mr. Daniels.

M M indicate rolling-trains consisting of sets of rolls arranged for operating in continuous order, and in which the passes are formed in the usual shapes for reducing the billet into a wire rod of the desired size and for rounding it up into a finished rod, which is delivered through a suitable guide, P, and automatically coiled up as it comes from the rolls by the reeling or coiling mechanism R. Two or more reels are employed for each of the rolling-trains, so as to allow time for the discharge of one reel while filling the other. The continuous rolling-trains, M and M may be constructed to operate as described in Letters Patent No. 292,794, or in other suitable manner, as heretofore employed; and the reeling apparatus R may be either of the ordinary kinds or such as described in Letters Patent No. 290,216. In some instances it may be desirable to employ several receiving or storage furnaces E, and also several ingot-forming mills, or a sufficient number of said mills to permit of the proper cooling of the metal in each of them, while giving total production of ingots, with the desired degree of rapidity. Said ingot-mills may, if desired, be located so that the metal can be drawn directly out from either one of the said furnaces E into the corresponding ingot-forming mill, and we include such an arrangement as within the scope of our present invention. This arrangement of several storage-furnaces admits of a portion of the contents of each of the several converters being deposited into each of the furnaces, thus keeping the chemical constituents of the various charges of the fluid metal in a more uniform and desirable condition, owing to the shorter time required in drawing the charges.

In Fig. 5 we show a diagram illustrating three receivers or storage-furnaces adapted for receiving the contents of the converters, to be distributed equally among said several receiving-furnaces, and a series of ingot-mills severally arranged in connection therewith in a manner so that the metal can be drawn direct from said furnaces into the hoppers or ladles of the respective mills.

In Fig. 6 we illustrate an arrangement of several ingot-mills in connection with a single receiving or storage furnace and means for transferring said metal from said storage-furnaces to the several ingot-mills.

When making wire rods or other metal product from iron, or when other metal than steel is used, the converters or steel-producing mechanism may be omitted and the metal taken direct from a melting furnace or furnaces, the melting and treating of the fluid metal being adapted to the particular kind of metal or alloy used in any particular case.

What we claim as of our invention, and desire to secure by Letters Patent, is—

1. The improved method herein described of making small bars or wire rods direct from fluid metal, which consists in depositing the fluid metal from Bessemer converters, for equalizing its temperature and condition, in a temporary storage-furnace, then delivering and casting the fluid metal into a constantly-advancing forming-mold, which delivers the same congealed in a continuously-extending ingot, automatically separating said ingot and transferring its sections into a heating-furnace, where they are subjected to an equalizing or mellowing action, then conducting the bars as they come from said furnace through a set or sets of preparatory condensing or roughing rolls, and then immediately through a final rod-rolling train, whereby the metal is reduced to the desired finished size, said operation being effected without intermission or cooling of the metal from the melting to the finished rod or product, substantially as set forth.

2. A plant for producing wire rods and other small shapes direct from fluid metal, comprising apparatus for melting and producing the steel or fluid metal, a temporary storage-furnace to receive and maintain the metal fluid, a forming apparatus for casting, congealing, and delivering the metal in a continuously-extending ingot, an automatic shearing device and transferring mechanism for dividing the ingot into sections and automatically transferring the same into mellowing-furnaces as fast as formed, the intermediate heating or mellowing furnaces, sets of roughing-rolls disposed for receiving and condensing the bars into homogeneous billets as they come from said furnaces, and a reducing train or trains into which the billets are fed direct from the roughing-sets, said mechanisms being arranged, substantially as set forth, for completing the production in continuous order and at single heat.

3. A plant for making wire rods direct from fluid metal, having, in combination, mechanism for producing a continuous ingot and a roller-table whereon said ingot is delivered, a shear or cut-off devices connected with said table, an intermediate furnace, mechanism for automatically transferring sections of the ingot as they are cut off from said roller-table to the furnace, a set of roughing-rolls having a feed-table onto which the bars are delivered from the furnace, a final rolling-train for reducing and finishing the rod as it comes from the roughing-rolls, and reeling mechanism for automatically coiling the finished rod as fast as produced, substantially as set forth.

4. A plant for making wire rods direct from fluid metal, having, in combination, mechanism for producing a continuous ingot and a receiving-table whereon said ingot is delivered in a continuously-increasing length, a shear or cut-off devices for severing the ingot at determined intervals, a plurality of furnaces for receiving

the sections of ingot as they are cut off, transfer mechanism adapted for automatically carrying the sections of ingot from the receiving-table to either of the respective furnaces, a
5 preparatory set of breaking-down rolls, mechanism for conveying the bars from the furnaces to the feed-table of the breaking-down rolls, and a plurality of trains of reducing and finishing rolls adapted for receiving and finishing the product direct from said breaking down
10 sets, substantially as set forth.

5. In a plant for producing ingots, bars, or wire rods direct from fluid metal, the combination, with mechanism for forming continuously-delivered ingots and a system of reducing-rolls, of an intermediately-located furnace or furnaces and automatic transferring mechanism adapted for receiving the ingot-sections from the forming mechanism and automatically depositing them within said furnace or
15 furnaces, substantially as set forth.
20

6. In a plant for the production of bars and rods direct from fluid metal, the combination, as described, with a plurality of Bessemer converters or steel-producing apparatus, C, 25 and a system of continuous ingot-casting mechanism, of the intermediate furnace, E, adapted for receiving the contents of the several converters and temporarily maintaining the same in heat and condition for delivery to continuously-operating casting mechanism, and means
30 for conveying the metal to and from said furnace.

Witness our hands this 21st day of May, A. D. 1886.

CHAS. F. WASHBURN.
FRED H. DANIELS.

Witnesses:

CHAS. H. BURLEIGH,
HERBERT P. BARTON.