

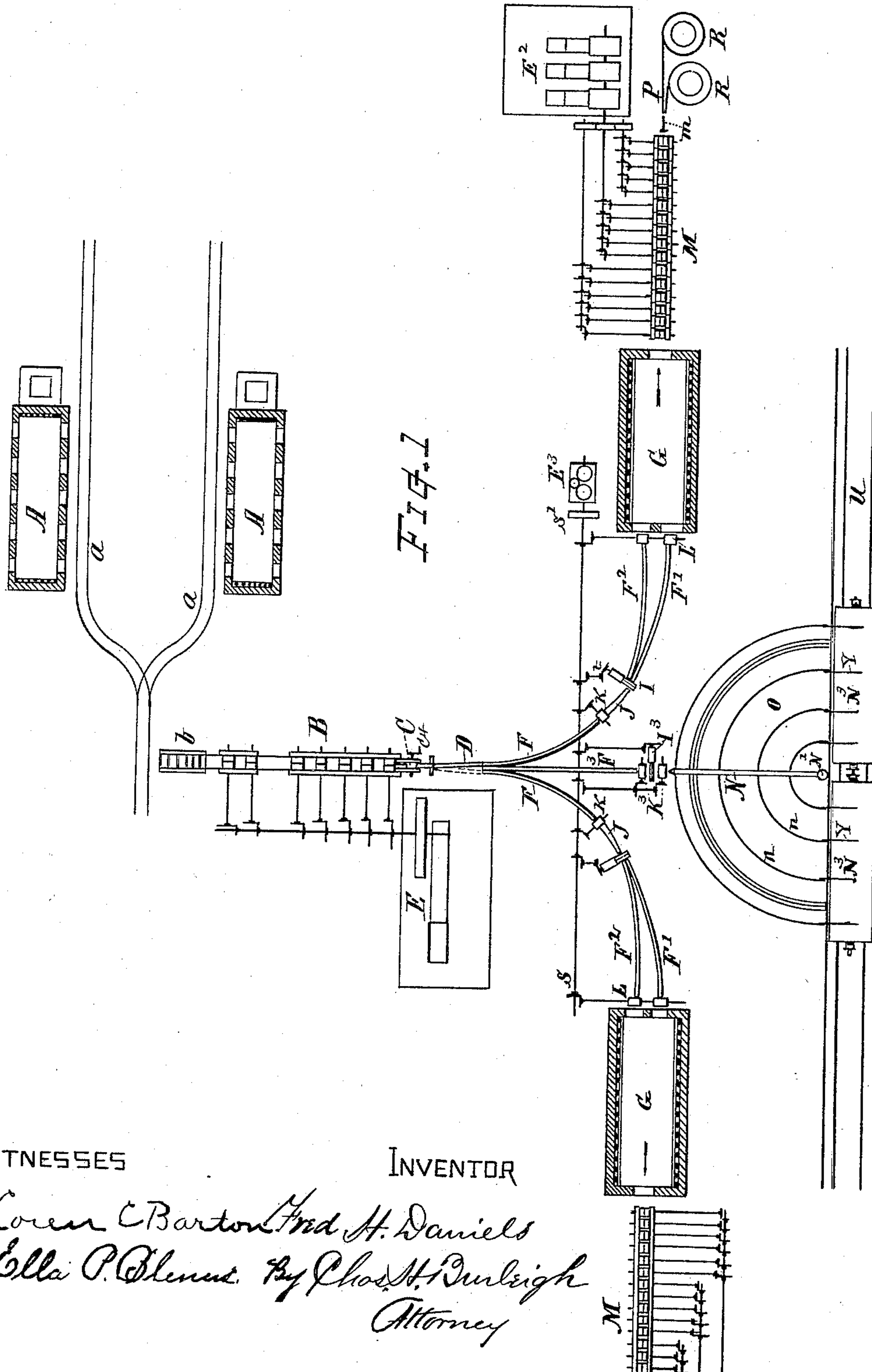
(No Model.)

5 Sheets—Sheet 1.

F. H. DANIELS.
ROLLING MILL.

No. 440,696.

Patented Nov. 18, 1890.



WITNESSES

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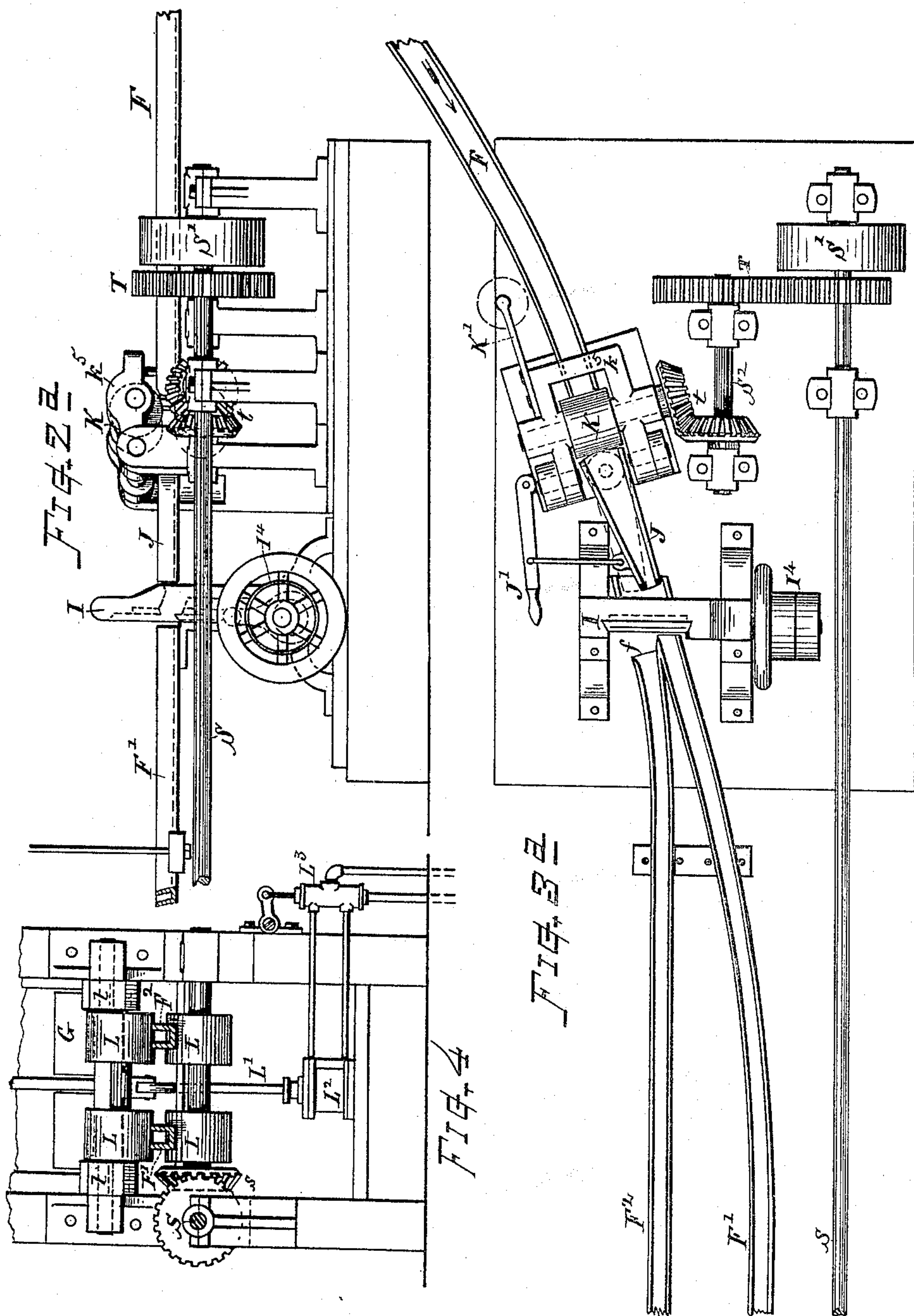
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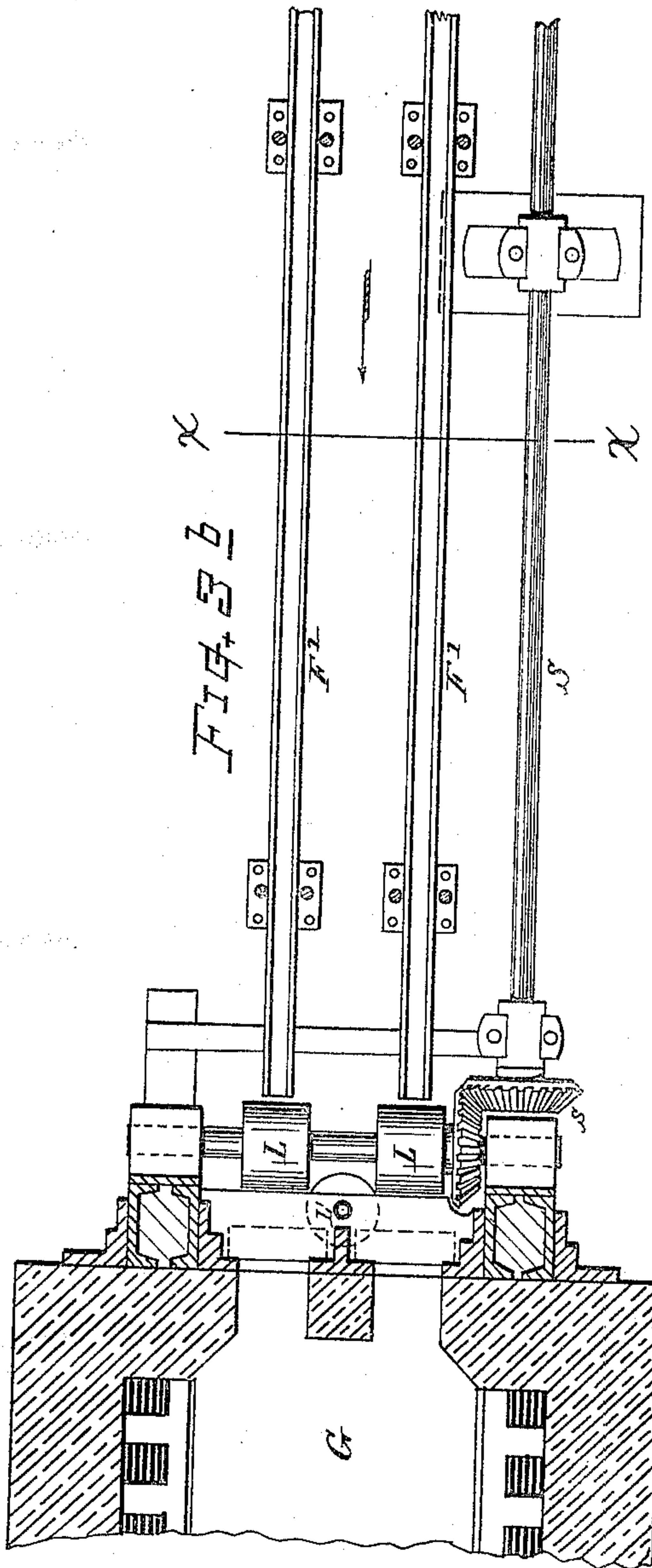
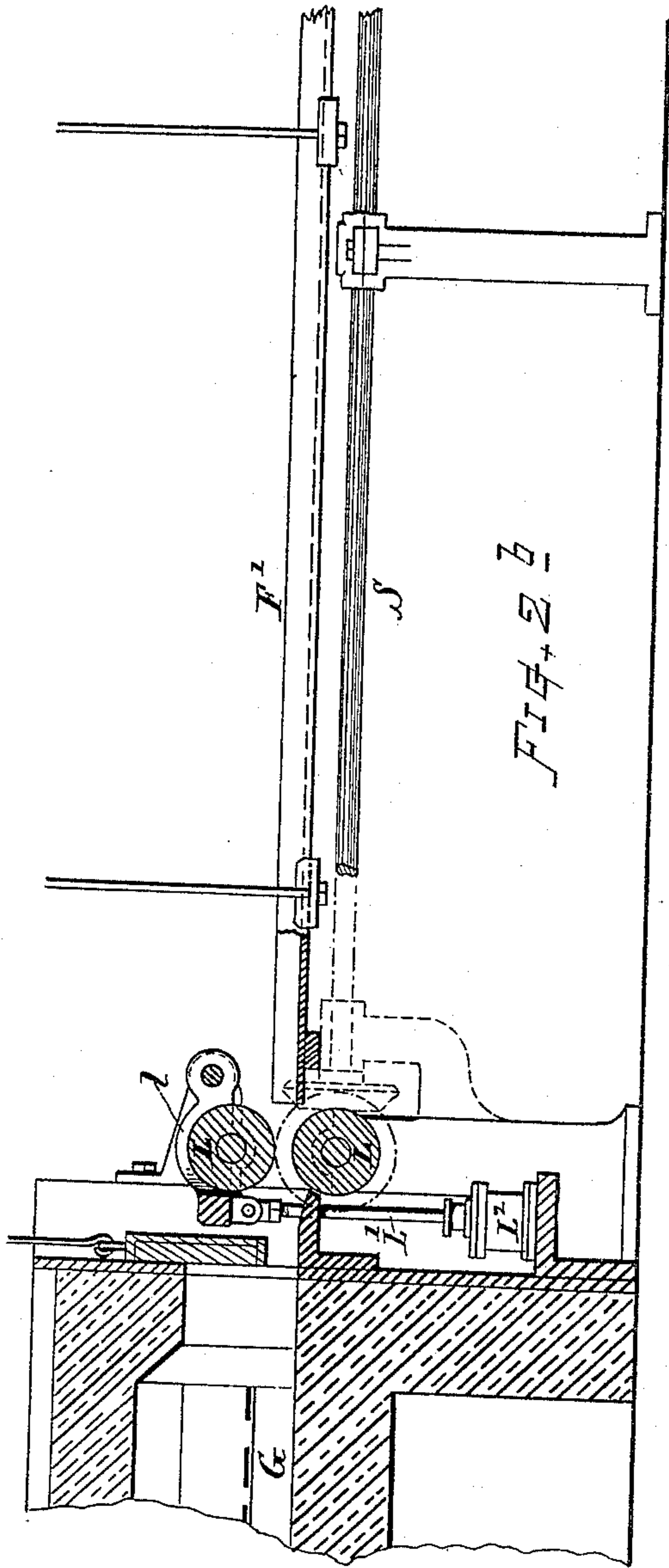
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F. H. DANIELS.
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5 Sheets—Sheet 3.

No. 440,696.

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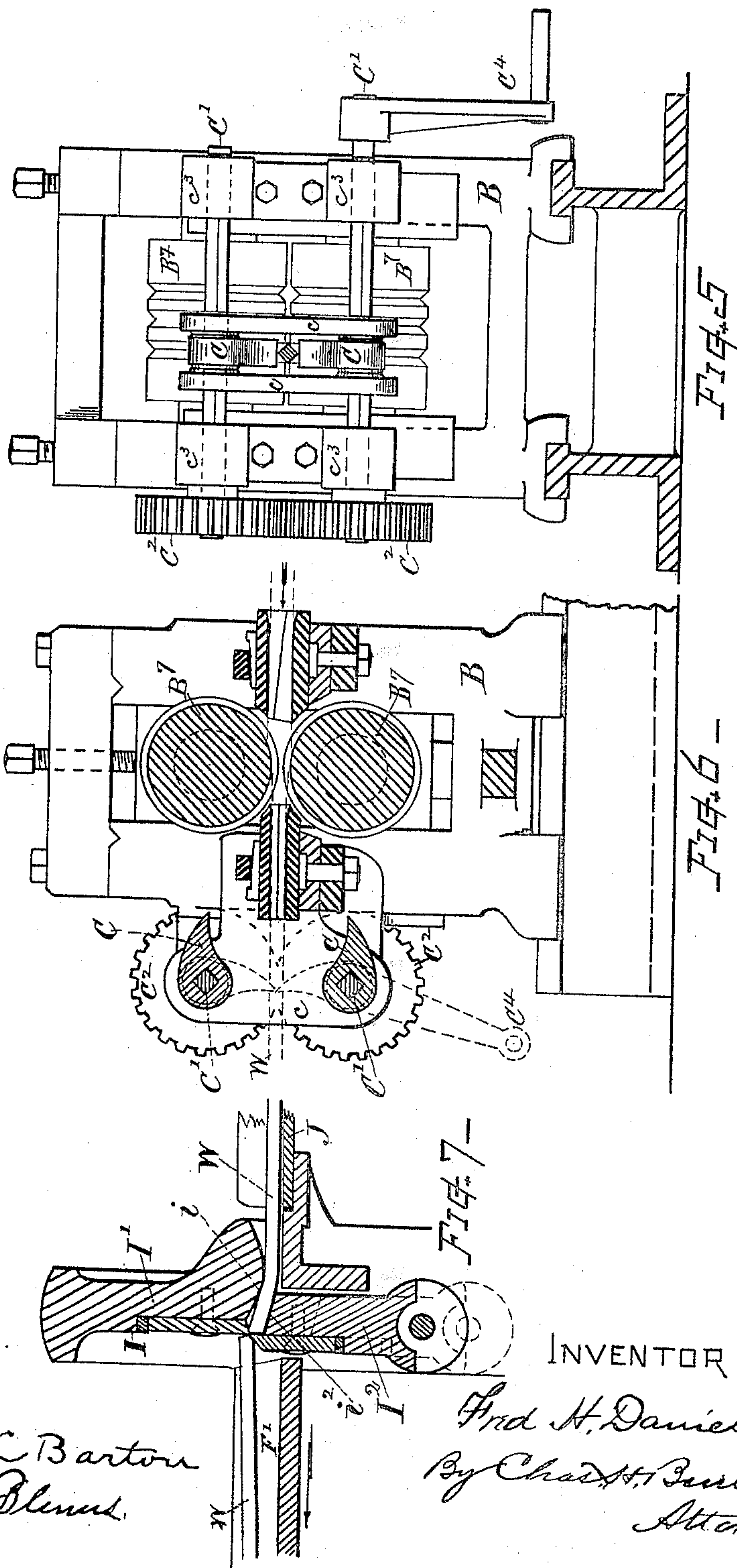
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F. H. DANIELS.
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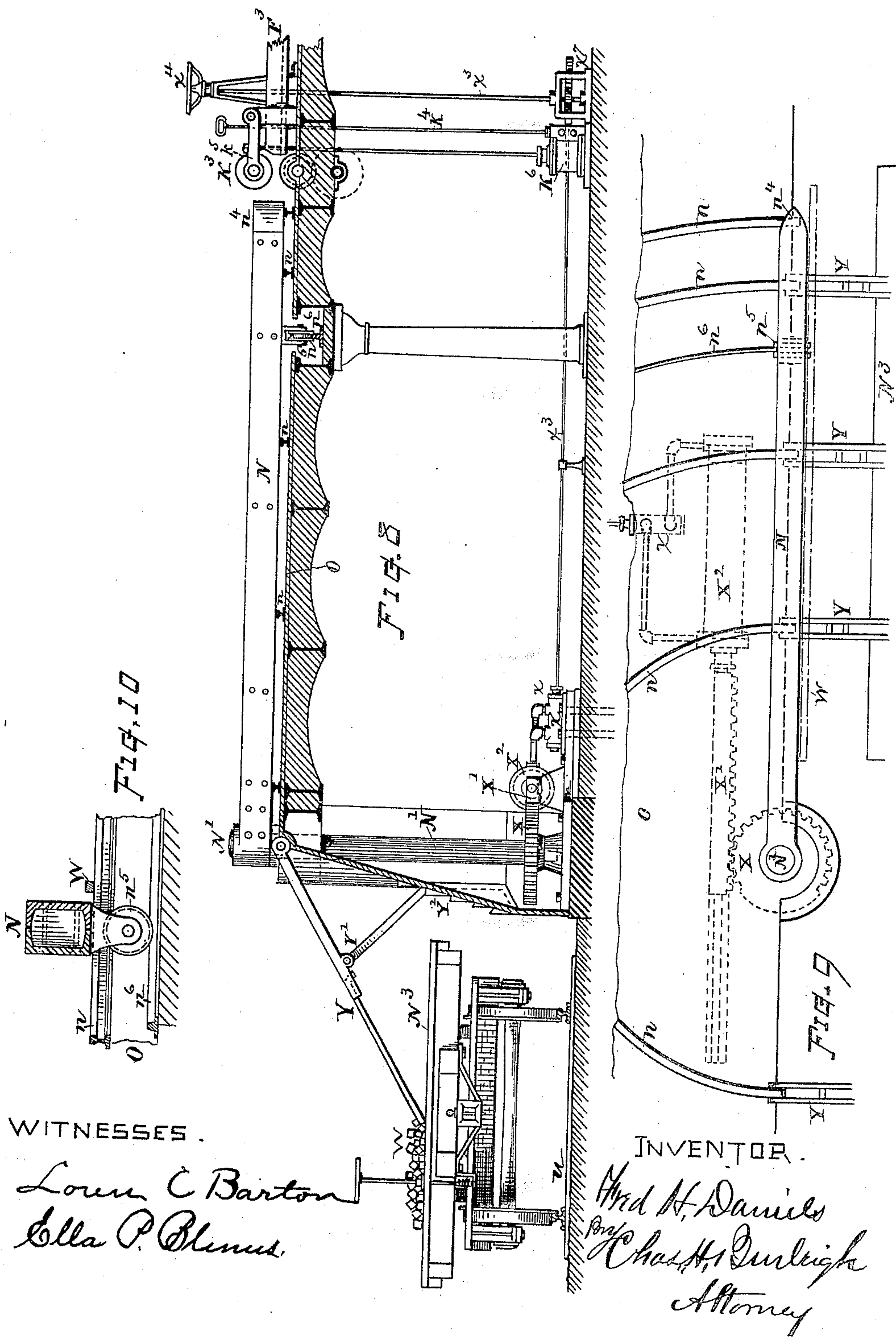
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F. H. DANIELS.
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No. 440,696.

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UNITED STATES PATENT OFFICE.

FRED H. DANIELS, OF WORCESTER, MASSACHUSETTS.

ROLLING-MILL.

SPECIFICATION forming part of Letters Patent No. 440,696, dated November 18, 1890.

Application filed September 8, 1887. Serial No. 249,114. (No model.)

To all whom it may concern:

Be it known that I, FRED H. DANIELS, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Rolling-Mill Apparatus, of which the following, together with the accompanying 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 my present invention is to provide an efficient and practical method of and apparatus for the production of wire rods, band-iron, or similar rolling-mill product from steel, iron, copper, or other metal blooms of large size reduced directly or without permitting the metal to become cold at an intermediate stage of the operation.

Another object of my invention is to provide a plant for reducing blooms to billets and wire rods by a continuous system comprising a billet-forming mill, one or more rod-forming trains with mechanism for automatically reeling finished rods, and intermediate reheating furnaces and guides for directing the metal for continuous reduction.

Another object of my invention is to provide, in connection with a billet-forming mill, an auxiliary mechanism for receiving and taking care of billets at an intermediate stage of the reduction process, thus providing for the care of the surplus product of the billet-mill when from any cause the rod-reducing train or trains fail to take the entire output of said billet-mill.

Another object is to provide, in combination with the billet and rod-rolling trains and the intermediate guiding devices, cutting mechanism, as hereinafter described, for removing "crop ends" and dividing the billets into sections of convenient length and feed-rolls for advancing and charging the same into the furnaces or delivering them, as required.

Another object is to provide facilities for bending or offsetting the billet, so that its advance end will slide freely along the furnace-bottom without liability of catching or scratching thereon.

These objects I attain by rolling-mill apparatus such as illustrated in the drawings and explained in the following description, the

particular subject-matter claimed being hereinafter definitely specified.

In the drawings, Figure 1 is a plan diagram illustrating the arrangement of my improved apparatus for making wire rods from blooms by direct or continuous process and for cutting up, charging into furnaces, or at intermediate stage delivering the product of the billet-mill. Fig. 2^a is an elevation on a larger scale, showing the mechanism for cutting, guiding, and feeding the billets. Fig. 2^b, a continuation of Fig. 2^a, shows in section that part of the apparatus adjacent to the mouth of the rod-mill furnace. Figs. 3^a and 3^b show the plan of the cutting, guiding, and feeding mechanism in detail. Fig. 4 is a transverse vertical section at line *xx*, Fig. 3^b, looking toward the furnace. Figs. 5 and 6 are respectively an end view and section showing the last pair of rolls of the billet-rolling mill and the cutters or shears for severing the billets. Fig. 7 is a sectional view showing the cutter jaw or shears as adapted for bending the advance end of the billet to facilitate sliding on the furnace-bottom. Fig. 8 is a vertical sectional view showing the construction of mechanism for delivering billets from the intermediate guide and loading them upon cars. Fig. 9 is a partial plan view of the same, and Fig. 10 is a cross-section of the carrier-arm and a portion of the floor.

Referring to parts, A A denote bloom-heating furnaces, which are made to accommodate blooms of, say, four by four inches diameter, more or less, and four or five feet, more or less, in length. Said furnaces may be fired by gas on the Siemens-Martin plan or in other suitable or well-known manner.

B indicates the billet-forming mill, wherein the blooms are reduced by rolling from their original size to long billets having a section of about one inch to one and one-fourth inch, more or less, in diameter. Said billet-mill consists of seven pairs of rolls, more or less, arranged to operate in continuous order, with suitable guides between the pairs and driven by suitable gearing from the engine E.

C denotes cutters or shears near the end of the billet-mill for cutting off or severing the billets, as hereinafter described. The details of said shears are shown in Figs. 5 and 6.

Tracks *a*, overhead or otherwise, and trans-

ferring trucks or tongs of ordinary or suitable construction can be employed for conveying the blooms from the furnaces A to the supporting and carrying rods that form the feed-table *b* of the billet-rolling mill B.

D indicates a switch, and F indicates guides, troughs, or conductors whereby the billets are directed to the rod-mill furnaces G. Said guides F are preferably divided as they approach the furnace, two conductor branches F' and F^2 being employed, as indicated, with a switch J at their junction for directing the billets into either of said branches F' or F^2 . More than two conductor branches might be employed, if desired; or in some instances only a single conductor may be used.

I indicates shears or cutters adjacent to the switch J, and K indicates feed-rollers disposed in the line of the guides for advancing the billets.

L indicates feed-rollers adjacent to the mouth of the furnace for projecting or charging the billets from the guides F' into the furnace-chamber. Said rolls are shown in detail in Figs. 2^b and 3^b.

The feed-rolls K and L and cutting mechanism I are operated by suitable shafting S and gearing T s t, power being applied thereto by the engine E³ or by driving-belts on pulleys S' and I⁴ from any convenient motor.

In the present illustrated plant I show two rod-rolling trains M M and furnaces G for receiving billets from the billet-mill B. Said rod-mills M M may be of similar construction and for rolling wire rods of similar size and shape; or, if preferred, the respective mills may be fitted for making rods of different sizes or product of different shapes.

The rod-rolling trains M preferably consist of sixteen pairs of rolls, more or less, arranged to operate in continuous order, with intermediate guides and driving mechanism constructed and arranged in the ordinary well-known manner and driven by a suitable engine E². The rod-rolling trains are disposed for drawing the billets from the furnaces G, and at the foot of said trains automatic reels R R are provided for winding up or coiling the finished rods, which are alternately guided to the respective reels by the pipes P and switch *m*. The conducting-guides F from the switch D are deflected or curved, respectively, to the right and left, so as to lead to the respective rod-rolling trains or their furnaces G. Between said conductors F there is arranged an auxiliary conductor F^3 , which leads to a delivery mechanism, hereinafter described: A shear I³ and feed-rolls K³ are provided at the foot of said conductor for severing the billets into convenient lengths and for advancing them onto a series of receiving-ways, where a carrier N is arranged to deposit them upon cars N³ on tracks U for conveying the billets to any desired destination.

The switch D can be of any construction suitable to direct the billets into either of the

conductors F F or F^3 , as required. The feed-rolls L are arranged in pairs. The top roll is journaled in an adjustable hanger *l*, so that said roll can be raised and depressed for releasing and gripping the billet. Said hanger is connected by a rod L' with the piston fitted in a cylinder L², adapted to be operated by hydraulic, steam, or pneumatic pressure under control of the valve L³ (see Figs. 2^b and 4) for manipulating the hot billets, as desired. In like manner the pairs of feed-rolls K and K³ have their top rolls hung in an adjustable hanger K⁵, which can be raised and depressed either by a handle, as K', or, if preferred, by means of a hydraulic cylinder and pistons, as at K⁶, Fig. 8. Thus while the bottom feed-rolls are constantly in motion the billet will not be moved forward except the top rolls are depressed to give grip or friction.

The arrangement of the feed-rolls K and the switch J and cutting devices I intermediate of the conductors F and branches F' F^2 are illustrated in Figs. 2^a and 3^a. A suitable connection and handle J' is provided for moving the switch, so as to deliver the rod to either of the conductor branches F' or F^2 . The cutter or shear I is preferably disposed between said switch and conductor branches. A space is allowed between the cutters and the end of one of the said conductor branches, as at *f*, to allow crop ends cut from the billets to drop out of the way. The cutters I are preferably constructed as indicated in Fig. 7, the jaw I' on the stationary frame being provided with a lug, incline, or rounded bearing-surface at *i*, past which the billet is guided, while the movable jaw or blade carrier I² is fitted with an opposite lug or incline surface *i*², which is brought in contact with the end of the billet W to force it upward when the cutters are closed together, thereby offsetting or bending the end of the billet slightly, as shown in Fig. 7, so that when charged into the furnace it will slide upon the furnace-bottom without liability of its end catching or scratching thereon.

While I have here illustrated and described cutters or shears which bend the end of the billet, it will be understood that I do not confine my invention to such construction, as the bending devices may in some instances be omitted, the operation of working the product being in all respects substantially the same whether the end of the billet is bent or otherwise, except in the liability of its scraping on the bottom of the furnace.

The shears or cutters C at the foot of the billet-rolling mill are preferably constructed as illustrated in Figs. 5 and 6, and consist of two pointed blades mounted opposite to each other on rotatable shafts C', that are connected by gears C² to rotate in unison. One of said shafts is provided with a crank C⁴.

To operate the shears an attendant swings said crank to bring the points of the cutters C into contact with the metal of the billet W. Then the forward movement of the billet,

tending to rotate the cutters, forces the edges thereof into the metal so that the billet is severed. (See dotted lines, Fig. 6.) If preferred, power mechanism can be connected to rotate the cutters C, when desired, in lieu of operating them by the hand-crank. The cutters C are for the purpose of severing the billet in case it is desired for any reason to change its direction from one of the conductors F to the other or to switch it into the conductor F³ while it is issuing from the billet-rolling train B. Said cutters can also be used for cutting off crop ends from the billets, although in general practice it may be more convenient to cut off said crop ends with the cutters I.

The mechanism for delivering the billets upon cars from the end of the conductor F³ is constructed as follows: The floor O at the foot of said conductor is provided with a series of semicircular ways or tracks *n*, arranged on a level with each other and concentric with a center near the side of the tramway U. The carrier N consists of a beam or sweep connected to a rotatable or oscillating upright standard N' at the center of the circular track and disposed in a manner to swing to the right and left and sweep along the top surfaces of said tracks. The carrier-arm is formed of metal beams, preferably two channel-iron beams bolted together to present their flat faces outward, and firmly attached at one end to the rotating standard, its other end being provided with a pointed terminal casting, as indicated at *n*⁴. Upon the lower end of the standard N' there is fixed a gear X, which meshes with a reciprocating rack X', connected with and operated by a piston that works in a cylinder X² to be operated by hydraulic, steam, or pneumatic pressure under control of the valve *x*, which may be provided with connections *x*³ and handling devices *x*⁴ at any convenient location, or as indicated. The outer end of the carrier-arm N is supported by a wheel or truck *n*⁵, that runs on a track *n*⁶, disposed somewhat lower than the surface of the billet-receiving tracks *n*. The tramway U for the transporting-cars N³ is arranged at a level sufficiently below the floor O to permit the bars or billets to slide down from said floor onto the cars N³, and a series of adjustable skid-bars Y are connected with the ends of the semicircular tracks *n* for supporting the billets in their descent.

In lieu of the rack X' and operating-piston and cylinder X², the carrier-arm might be moved by a rotating shaft having a screw or worm working in mesh with the teeth of the gear-wheel X, said shaft being actuated by any suitably arranged gearing or by belts and pulleys.

In the operation of my improved apparatus the bloom, properly heated in the furnace A, is fed into the billet-rolling mill and by passage through its several pairs of rolls is reduced into a long billet, which reaches from the foot of said billet-mill to the cutters I, the disposition of said cutters preferably

being such that when the rear end of the billet leaves the last rolls B⁷ of the billet-mill B its forward end will just pass the cutters I, so that said cutters may be brought into operation to sever said crop end at the head of the billet. The feed-rolls K are then brought into action to move forward the billet into one of the conductor branches F', accordingly as the switch J is turned, and to advance said billet until its end has entered between the feed-rolls L adjacent to the mouth of the furnace, the distance from the cutters I to the furnace G being such as will give a billet of the length required for the furnace. The cutters I are then again brought into action to sever the billet at its center. Pressure is then let into the cylinder L², depressing the upper feed-roll L to grip the billet between the pair, when the action of said rolls charges the billet forward into the furnace, projecting its forward end to a position where it can be conveniently entered to the rod-rolling train M, by means of which train its reduction to a finished wire rod is accomplished, and as it issues therefrom the finished rod is automatically reeled up upon the reel R by a manner of reeling which has been described and claimed in previous applications for patents for improvements in reeling apparatus. The first section of the billet having been started forward into the furnace G, the switch J is shifted and the rolls K are again brought into action, whereby the second section is advanced into the other conductor branches F² and projected into the furnace in a similar manner to the first by the rolls L. If for any reason the rod-trains M cease work or fail to take the entire product of the billet-train B, then the billets are directed by the conductor F³ to the discharging-carrier N.

In the operation of the discharging mechanism the billets are projected from the guide F³ by means of the rolls K³ and run out across the semicircular tracks *n* at either the right or left of the carrier N. The hydraulic cylinder X² is brought into action by turning the hand-wheel *x*⁴, and thereby opening the valve *x*, and the piston forced in one direction moves the rack X' and actuates the gear X, causing the carrier-beam N to swing around and sweep the billet or billets W along the circles and onto the inclined skid-bars Y, so that they will slide down upon the car N³. The valve is then reversed, causing the carrier-beam N to sweep in the opposite direction, carrying any billets that have been projected onto the tracks during its former movement around to the opposite side and onto the second car placed for their reception. In this way by swinging the carrier-arm N back and forth while the billets are delivered from the billet-rolling mill B and guide F³ the billets are loaded upon the cars N³. If preferred, in lieu of the cars N³, the billets might be piled upon the ground or floor at the foot of the skid-bars Y, the operation of the car-

rier mechanism being the same. As the hot billets pass around the curve of the conductor F they become set to the circle, and in order that they may charge into the furnace straight the curved set must be taken out. To accomplish this I make the latter end of the conductor straight for some little distance (see Fig. 3^b) and with sides that embrace the billet quite closely, so that as the billet is forced or drawn through said conductor the curve or bend in the billet is straightened by the opposite sides of the conductor pressing against the sides of the billet, thus insuring the advance of the billet into the furnace straight and in a direct line. In some instances it may be desirable to form a slight reverse curve in the conductor just before the straight portion for more forcibly counteracting the curved set of the billet.

If desired, anti-friction rolls can be used at the sides of the conductor to embrace and straighten the billet as it approaches the furnace, and said roll may be adjustable or otherwise, the object being to overcome the curved set of the hot metal without increase of friction to an extent that would cause liability of choking the guide or cause the billet to buckle.

The main feature of my present invention may be regarded as an improvement upon the apparatus described in my Patent No. 292,794, dated February 5, 1884; but that apparatus was designed for the manufacture of rolled products which when they passed from the primary train of rolls to the finishing-rolls were so small in cross-section as to be very flexible, so that they could be laid in loops upon a distributing-table, while my present invention relates to the manufacture of rolled products which as they come from the primary train of rolls are so large in cross-section that they cannot be practically looped upon a table or the like, but must be extended at full length substantially in a guiding-conductor, through which they pass endwise. I therefore disclaim in this application everything shown in my Patent No. 292,794, and especially all combinations of a train of rolls with a distributing-table, whether this table be grooved or not, the conductors of my present apparatus being radically unlike the distributing-table of my Patent No. 292,794 in that the latter was a table with a plurality of grooves in its surface, each groove being especially adapted to permit the escape of the rolled product from the grooves and its distribution in loops upon the table, while in my present invention the conductors are especially adapted to prevent the escape of the rolled product and compel it to travel endwise until it is extended at full length in the conductor and under the control of the feed-rolls by which the rolled product is carried endwise through its conductor.

What I claim as of my invention to be secured by Letters Patent is—

1. In a rolling-mill plant, a train of rolls,

a switch-guide, and a plurality of conductors, each having feed-rolls and each having confining and controlling walls, all arranged and co-operating substantially as described, the switch-guide switching the product to either one of the conductors from the train of rolls, and the conductors and their feed-rolls constructed and arranged, as described, not only to carry the hot product through the conductor, but also to prevent its escape sidewise from and its buckling in the conductor.

2. In a plant for making rods from blooms, the combination, with the billet-rolling train, the rod-rolling train, and the intermediately-disposed furnace, of a guiding-conductor leading to said furnace from said billet-train and feed-rolls disposed in the line of said conductor between said billet-train and furnace for advancing the product through said conductor and charging the same into the furnace after it is released from the rolls of the billet-rolling train, substantially as set forth.

3. In a rolling-mill plant, a train of rolls, a switch-guide, a plurality of guiding-conductors, each having feed-rolls and also confining and controlling walls, and shears disposed in the line of said conductors, all arranged and co-operating, substantially as set forth, to carry the hot product from the rolls through either of the conductors to prevent its escape and to prevent its buckling and to present it to the shears.

4. A plant for making billets and wire rods direct from blooms, consisting of the billet-rolling train, a plurality of rod-rolling trains provided with furnaces, guiding-conductors that lead the billets directly from the billet-rolling train to the respective furnaces, a switch in said conductor adjacent to the billet train, a billet-cutting mechanism, and feed-rolls adjacent to the furnace-doors, whereby hot billets directly from the billet-rolling train are charged into the furnaces, as set forth.

5. In combination, heating-furnaces, a primary train of rolls, a switch-guide, a plurality of conductors, each having feed-rolls, storage-receptacles, a secondary train of rolls, and its reel, the furnaces being arranged to supply hot billets to the primary train, the switch-guide being arranged to direct the partially-rolled product from the primary train to either of the conductors, the conductors being arranged to deliver the partially-rolled product to the storage-receptacles, and one of the receptacles being arranged in close proximity to the secondary train, the whole being and operating substantially as described.

6. In combination, substantially as described, the furnace G, the main conductor F, a plurality of branch conductors F' F², the feed-rolls K, switch J, cutters I, disposed intermediate of said main and branch conductors, and the feed-rolls L, for the purposes set forth.

7. In combination, substantially as described, the furnace G, the guiding-conductors F F', the cutters I, the feed-rolls L, and the

pressure-cylinder L^2 and connections, for the purpose set forth.

8. In combination with the billet-rolling train B, furnace G, and feed-rolls L, the curved conductor F, having its latter end or portions F^1 F^2 formed straight and provided with side guards that embrace the sides of the billet, substantially as and for the purpose set forth.

9. In combination, substantially as described, the billet-rolling train B, two rod-rolling trains M M, with heating-furnaces G G, right and left guiding-conductors for directing billets from said billet-rolling train to the respective rod-mill furnaces, an auxiliary conductor F^3 , with cut-off shears I^3 and feed-rolls K^3 at the foot of said conductor, and the switch D, for the purposes set forth.

10. In a rolling-mill plant, the combination of a billet-rolling train, two rod-rolling trains with heating-furnaces at the heads thereof, guiding-conductors from said billet-train to the respective furnaces of said rod-rolling train, an auxiliary or intermediate guiding-conductor leading to a billet-receiving bed, a switch common to the several conductors, billet-cutting shears, and a traversing carrier at the foot of said auxiliary conductor that sweeps the surface of said bed, substantially as and for the purposes set forth.

11. An apparatus for handling billets or bars of metal, comprising a semicircular bed or way onto which the billets are delivered, a swinging beam-carrier pivoted substantially in line with the straight side of said bed to traverse the surface thereof, and means for imparting power and motion to said carrier for sliding the billets from the edge of said bed, substantially as described.

12. In a rolling-mill plant, the combination, with a primary rolling-train, the furnace, and the conducting-way through which the product passes from said primary rolling-train to the furnace, of a cropping-shear provided with lugs or inclined surfaces upon its jaws

that bend the extremity of the billet as the crop end is severed by the shearing-cutters, substantially as and for the purpose set forth.

13. The cutting-shear I, having its cutter-supporting jaws adjacent to the cutting-plates provided with inclined lugs or surfaces i and i^2 for bending the end of the billet, in combination with the conducting-guide F in a rolling-mill, substantially as set forth.

14. In combination with the final rolls B^7 of the billet-rolling train B, the cut-off shears consisting of the intermeshingly-gearcd rotating shafts C^7 and the oppositely-acting blades C, for the purposes set forth.

15. In combination, substantially as described, the semicircular supporting-ways n , the swinging carrier-beam N, its axial standard N^1 , having gear X, the rack X^1 , the operating piston and cylinder X^2 , the valve x , and valve-controlling mechanism, substantially as and for the purpose set forth.

16. The combination, with the billet-rolling mill, of the guiding-conductor F^3 , cutters I^3 , feed-rolls K^3 , the semicircular supporting-ways or receiving-bed, the swinging beam-carrier N, and adjustable skid-bars Y, substantially as described, and for the purpose set forth.

17. In combination, a train of rolls, a switch-guide, a plurality of conductors, each having feed-rolls, and a plurality of receptacles for the product of the train, the product of the train being switched to either one of the conductors and carried through that conductor by its feed-rolls to one or the other of the receptacles, all combined and operating substantially as described.

Witness my hand this 6th day of September, A. D. 1887.

FRED H. DANIELS.

Witnesses:

CHAS. H. BURLEIGH,
ELLA P. BLENTS.