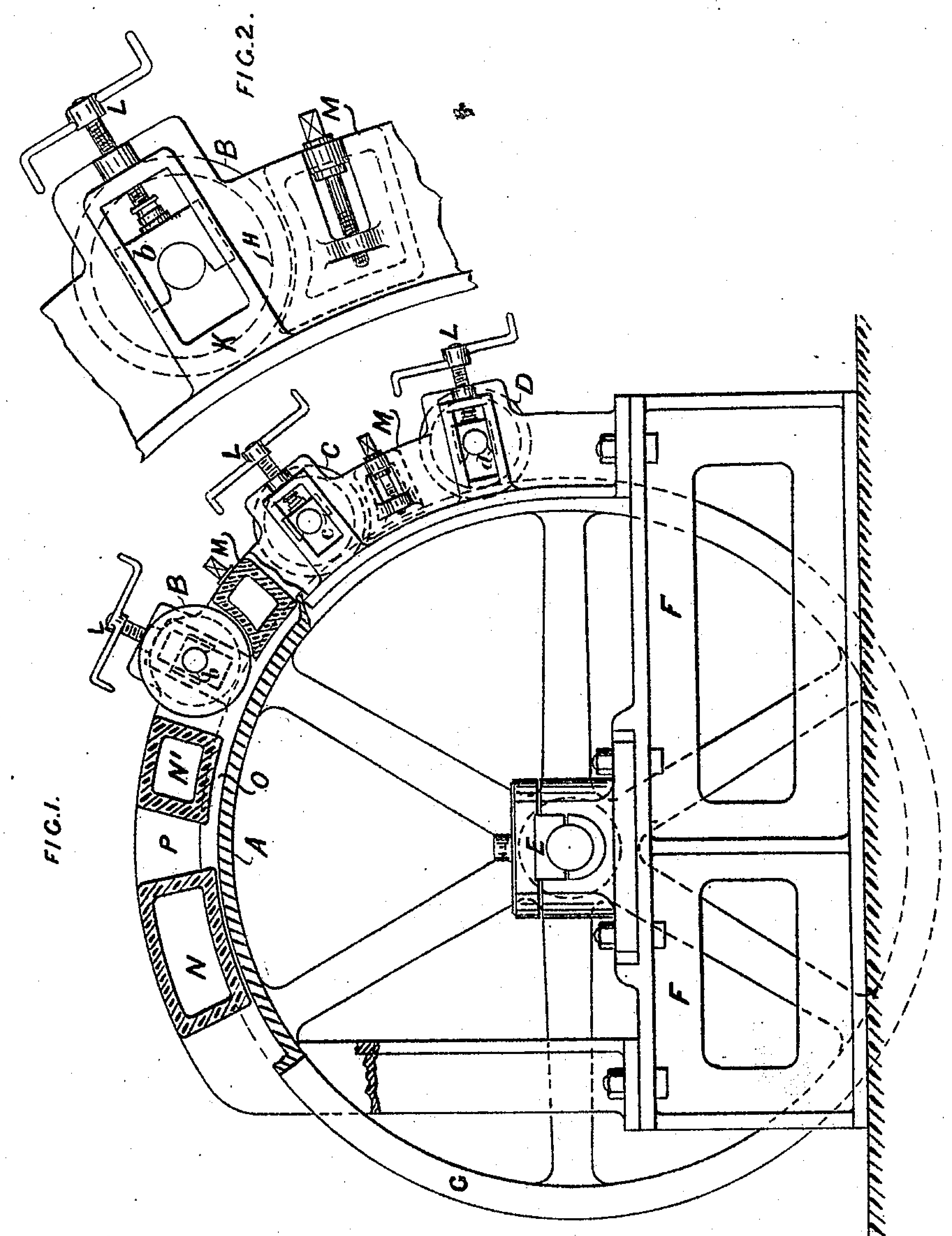
(No Model.) 5 Sheets—Sheet 1.

C. M. PIELSTICKER.

PRODUCING SHEETS DIRECT FROM MOLTEN METAL.

No. 437,509. Patented Sept. 30, 1890.



Witnesses
Jos. H. Blackwood
Chas. S. Sturtevant.

CARL M. PIELSTICKER
by ATTORNEY
Frankland Jannus

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

(No Model.)

5 Sheets—Sheet 2.

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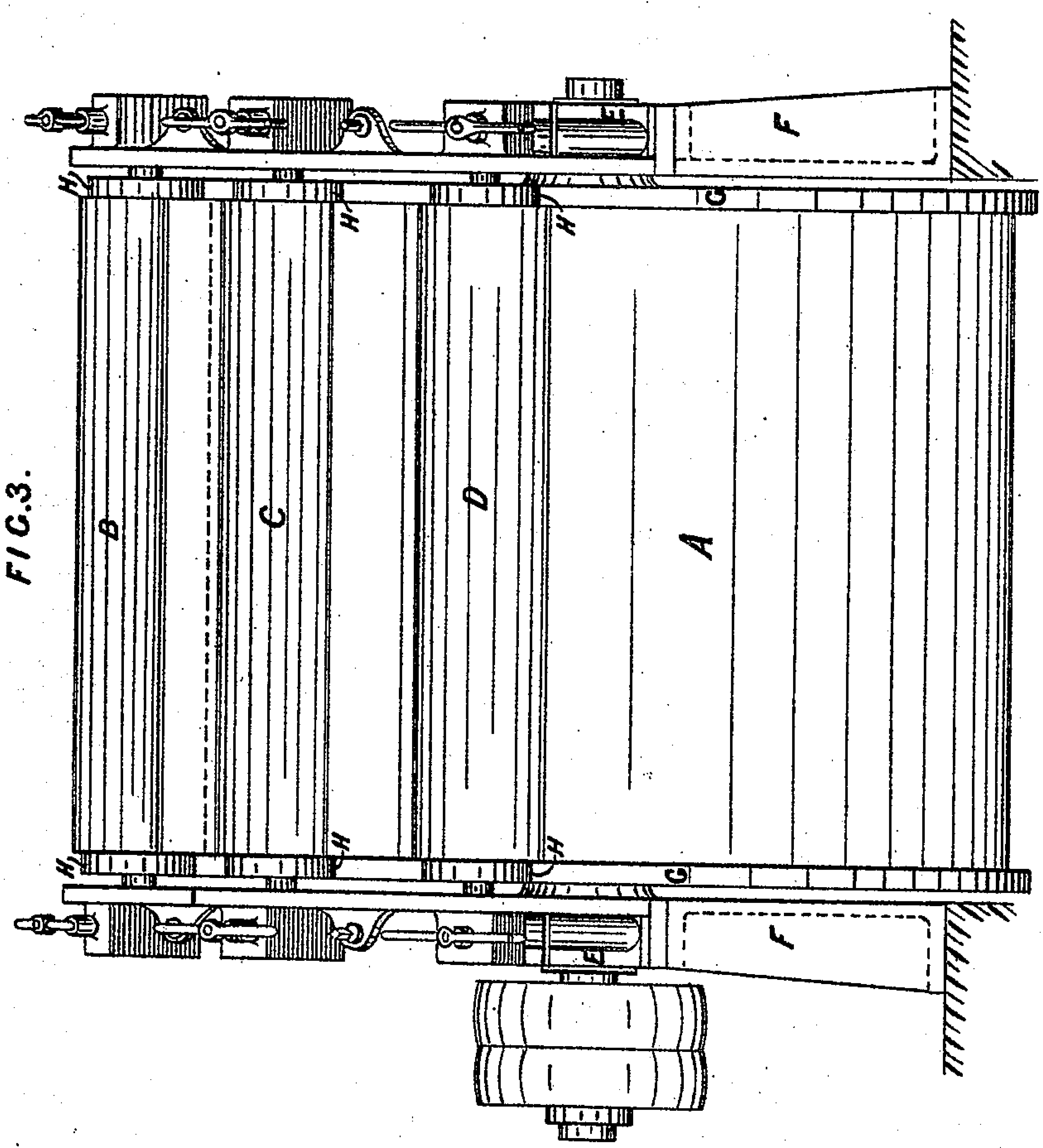
FIG.3.



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(No Model.)

5 Sheets—Sheet 3.

C. M. PIELSTICKER.

PRODUCING SHEETS DIRECT FROM MOLTEN METAL.

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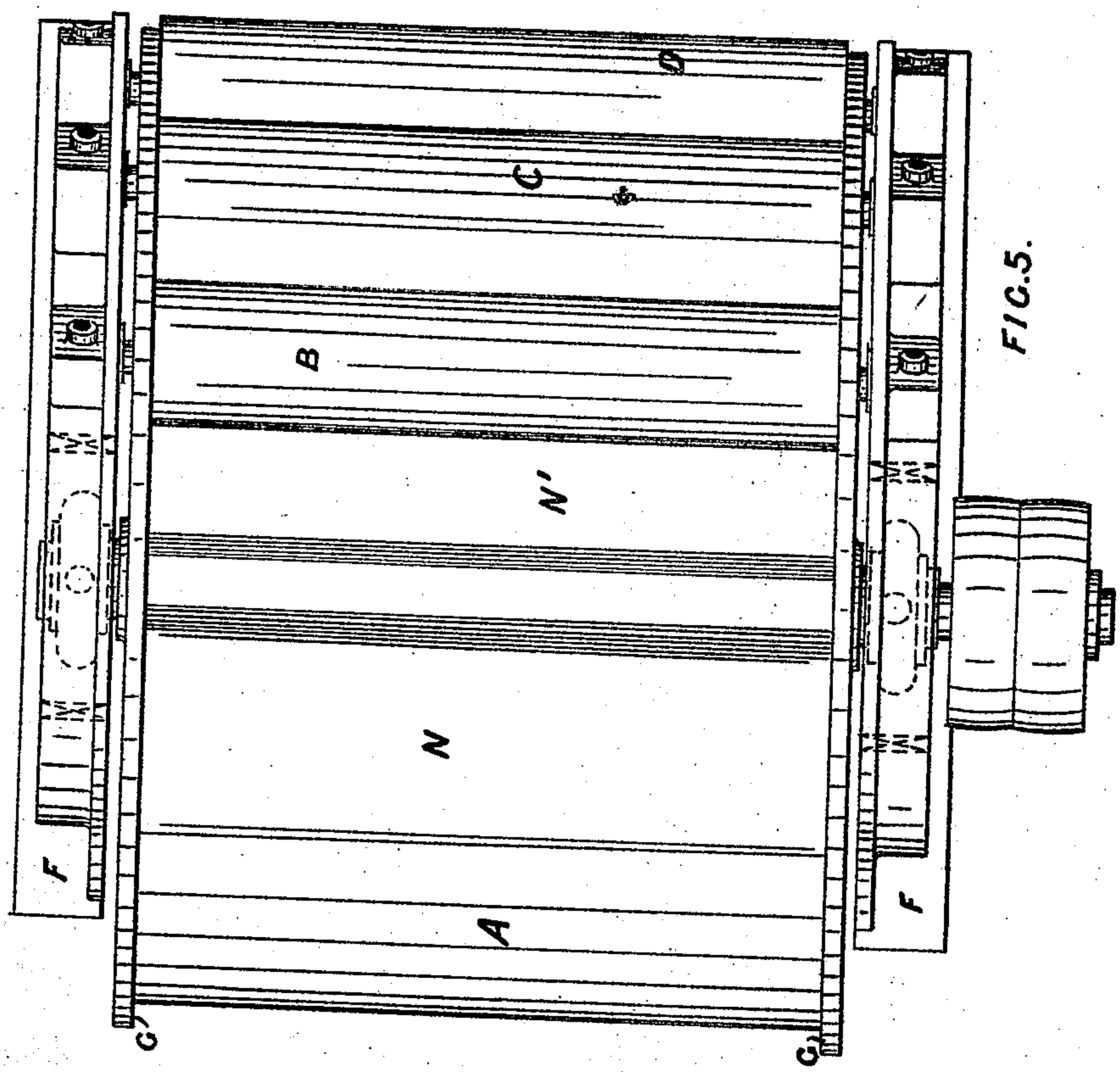

FIG. 5.

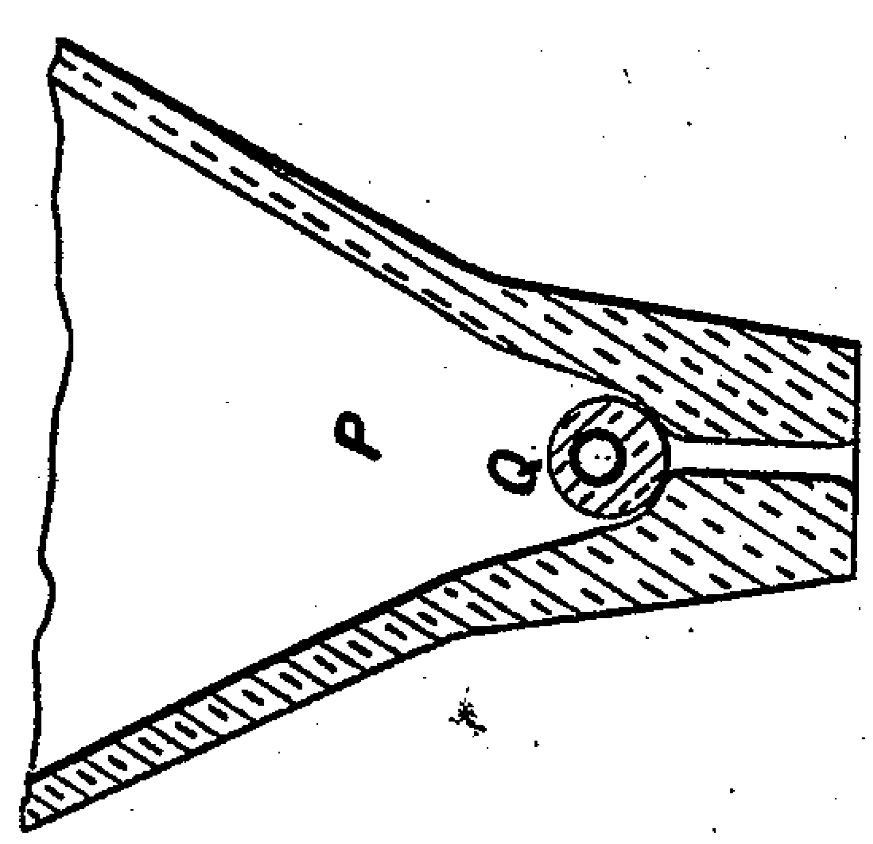

FIG. 4.

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(No Model.) 5 Sheets—Sheet 4

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FIG. 7.

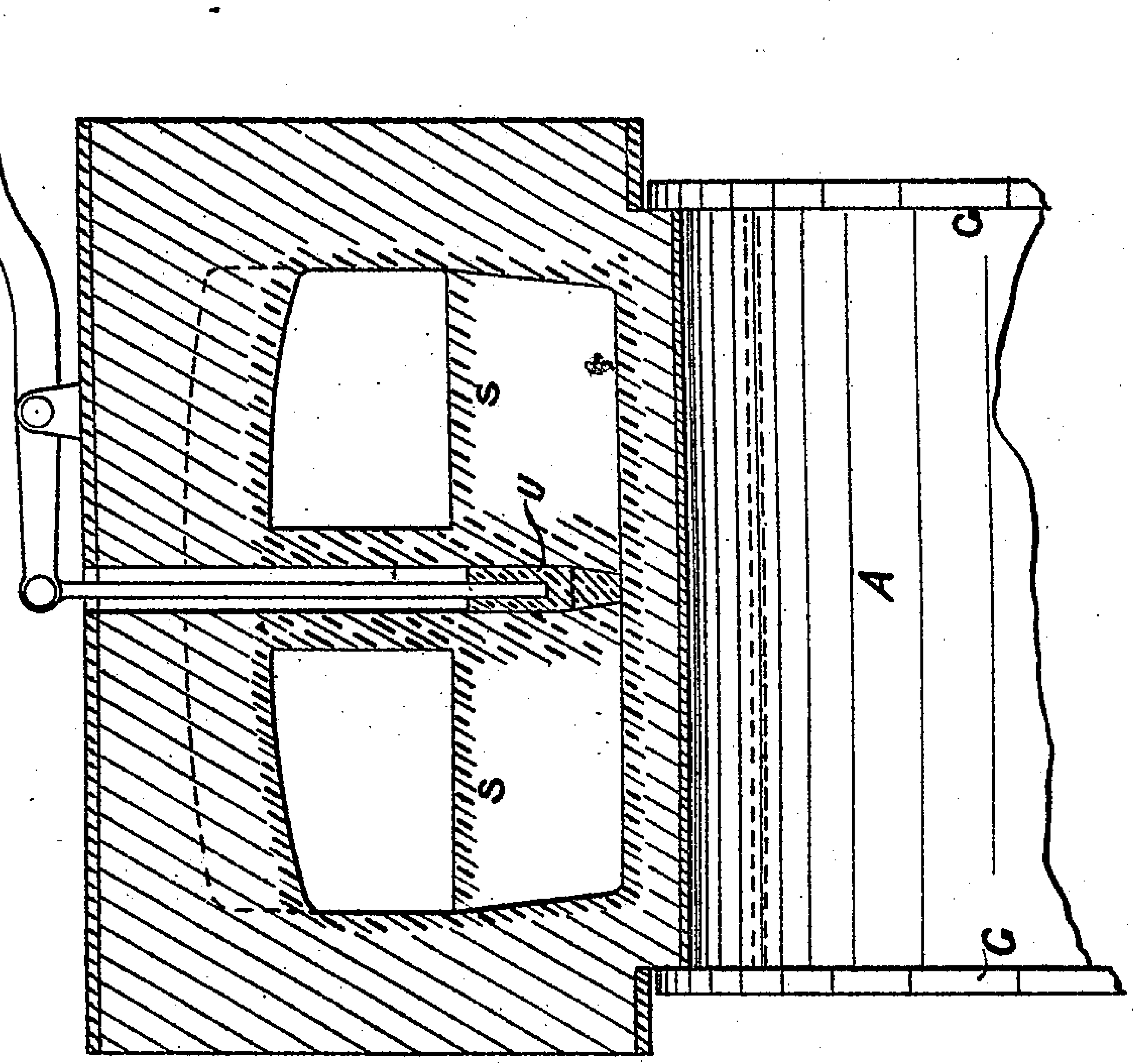
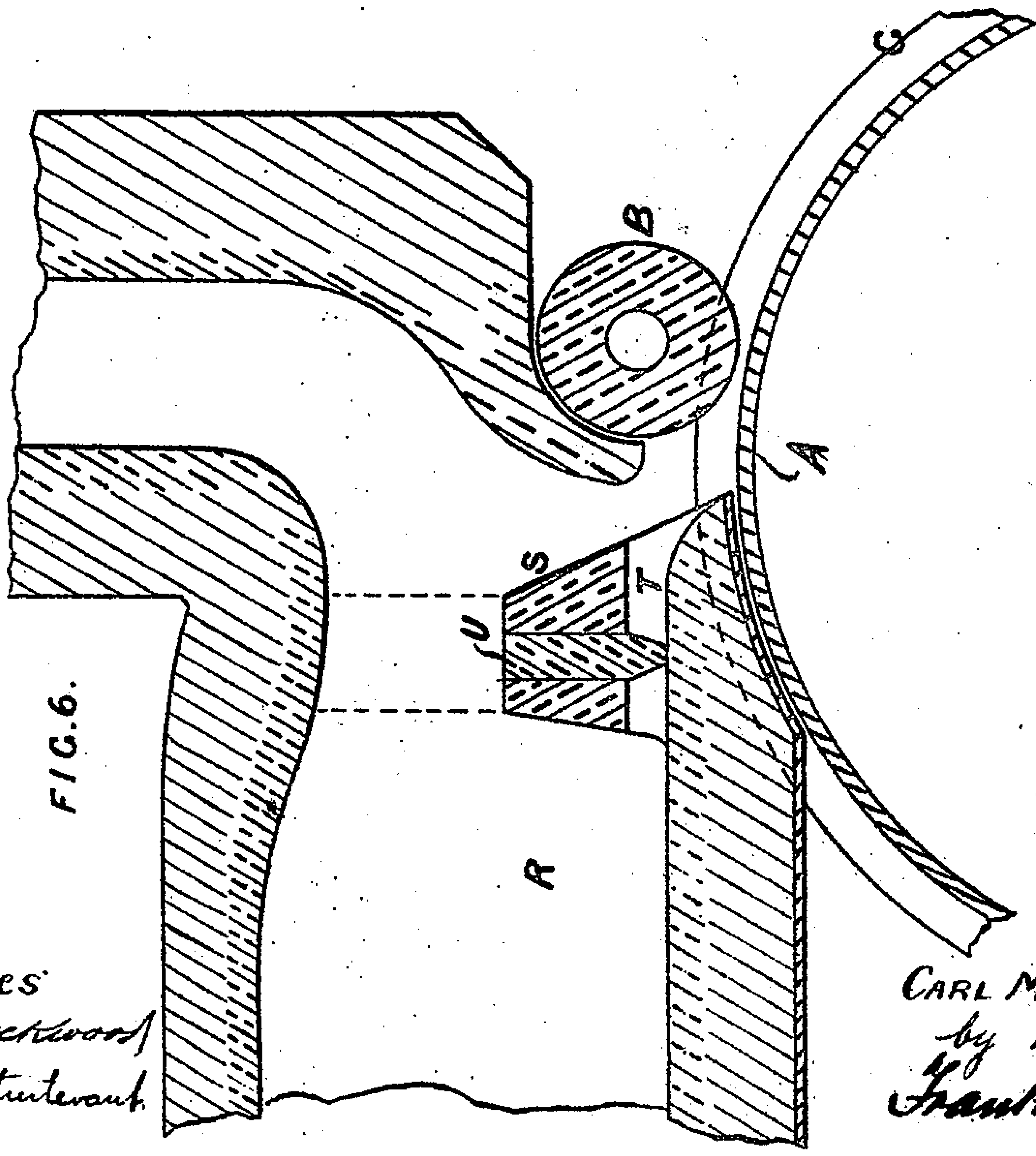


FIG. 6.



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(No Model.) 5 Sheets—Sheet 5.

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FIG.9.

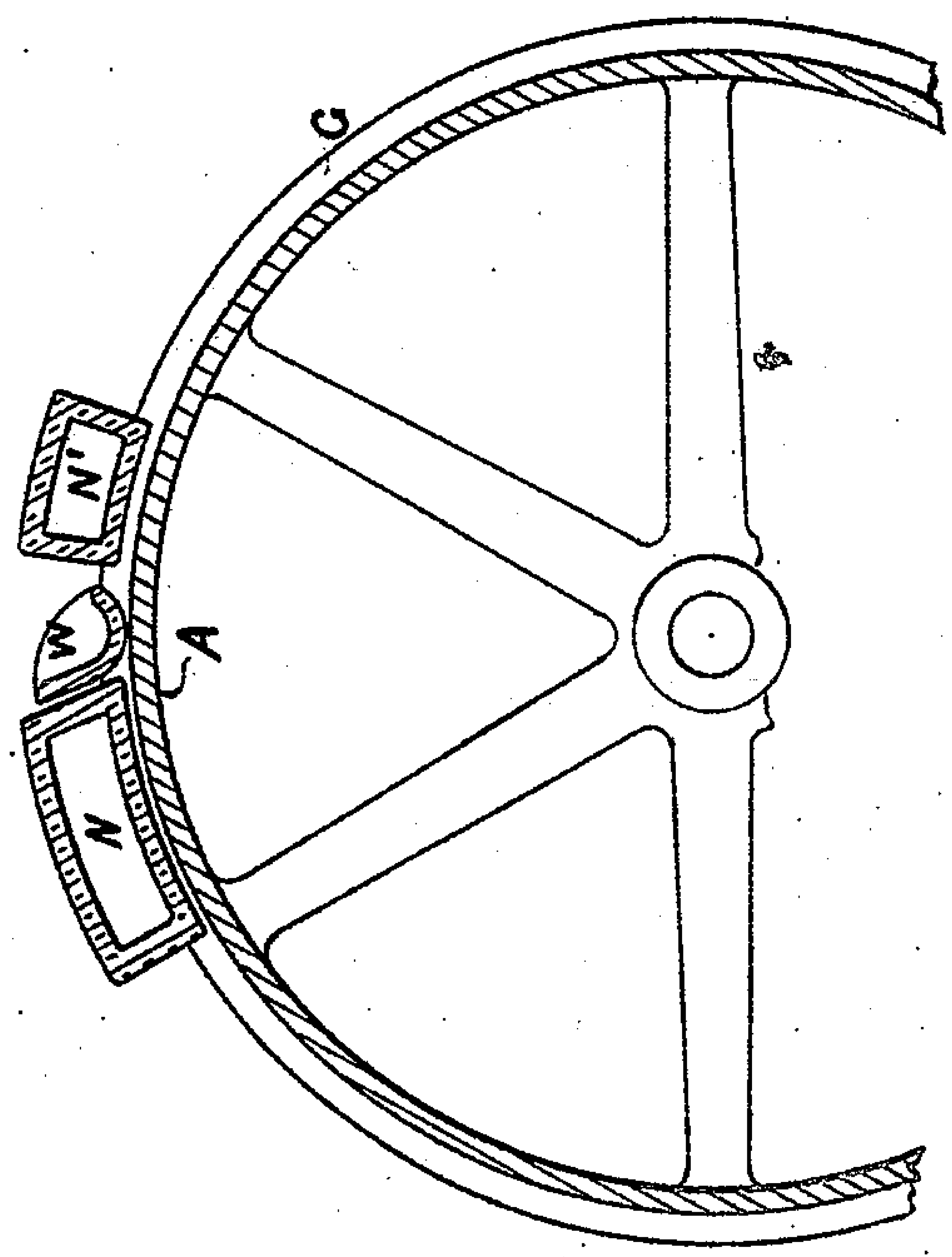
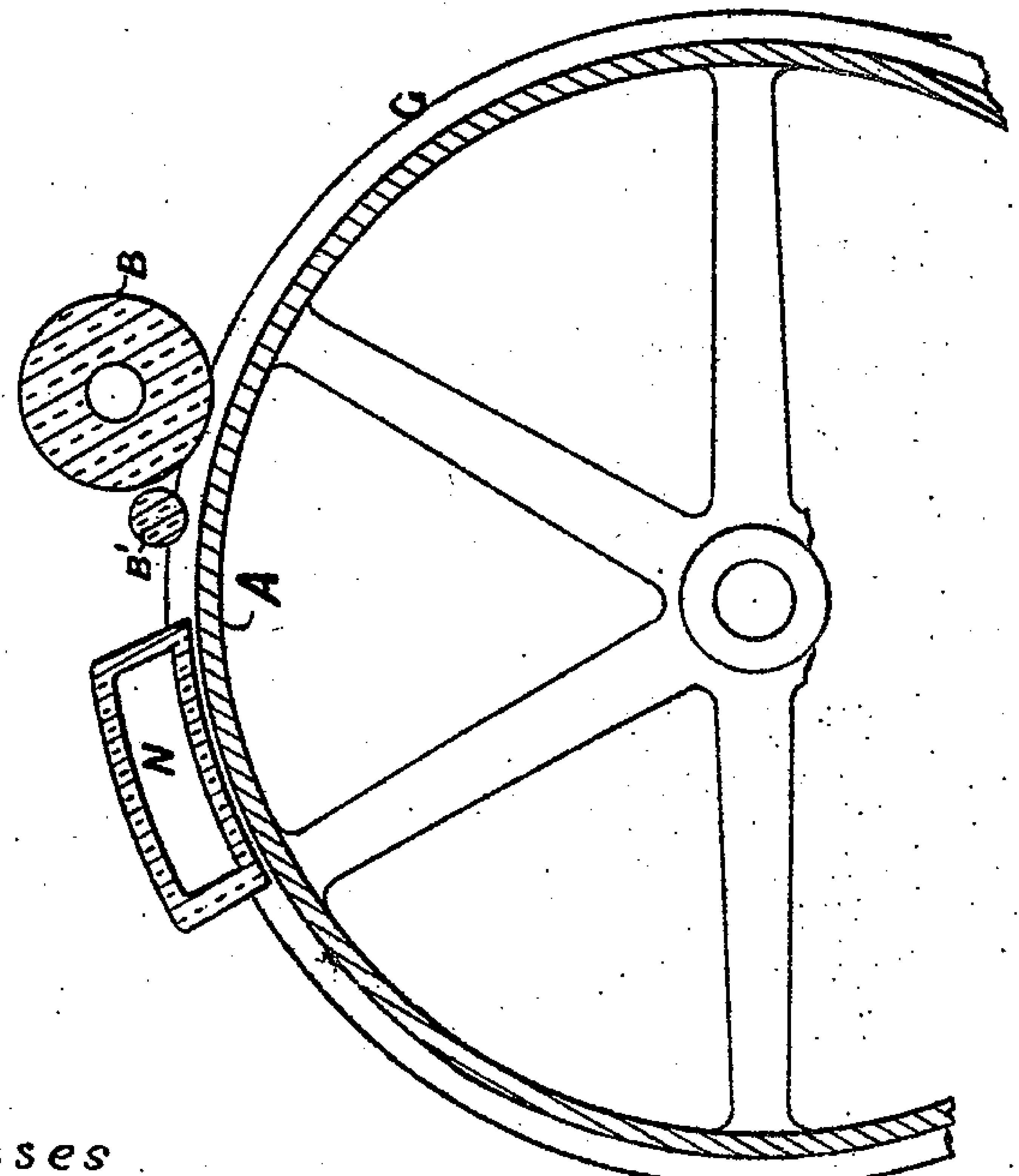


FIG.8.



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

UNITED STATES PATENT OFFICE.

CARL MARIA PIELSTICKER, OF LONDON, ENGLAND.

PRODUCING SHEETS DIRECT FROM MOLTEN METAL.

SPECIFICATION forming part of Letters Patent No. 437,509, dated September 30, 1890.

Application filed February 17, 1890. Serial No. 340,731. (No model.) Patented in England April 28, 1890, No. 6,464.

To all whom it may concern:

Be it known that I, CARL MARIA PIELSTICKER, a subject of the Queen of England, residing at Suffolk House, Cannon Street, in the city and county of London and Kingdom of England, have invented Improvements in Machinery for the Production of Sheets Direct from Molten Metal, (for which I have obtained Letters Patent in Great Britain, No. 6,464, dated April 28, 1890,) of which the following is a specification.

My invention relates to improved machinery and process for producing sheets direct from the molten metal instead of, as is now usually practiced, first casting large ingots or slabs and then reducing these by repeated rolling and reheating. Various attempts have been made to attain this object, among others by pouring molten metal between two revolving rollers. In this process the molten metal, collecting on the top and between the two rollers, rapidly chilled and rendered it impossible for the rollers to take hold of the mass of solidified metal and pass it through the small space left between them. In a modified method the molten metal was poured in a thin stream directly between the two rollers, the latter being run at a sufficiently high speed to prevent the accumulation of any molten metal on the top of them. By this process only very thin sheets could be produced, owing to the stream of molten metal coming into contact only tangentially with the periphery of the rollers, such instantaneous contact not being sufficient to solidify the center of any but a very thin plate. Moreover, there exists great difficulty in so regulating the speed of the revolving rollers as to prevent the molten metal from collecting between the rollers when they are running at two slow a speed, or to avoid the tearing or breaking of the plate when running at two high a speed, and, further, since the nozzle of the crucible can only be carried down for a certain distance between the two rollers, the molten metal has to fall through some distance before it reaches the rollers, whereby objectionable oxidation of the molten metal takes place. Another method consists in pouring the molten metal between the peripheral surface of a revolving wheel and the surface of an inclosing fixed semicircular segment. Here it was found that since the plate while solidifying did not receive any compression numerous faults appeared on the surface on account of the gases occluded in the molten metal which formed blow-holes after solidification, and that the surface of the plate in contact with the fixed segment was of an uneven and rough appearance. The friction between the face of the wheel and the fixed segment being excessive, it entailed an undue wear and tear between them, and necessitated considerable motive power to rotate the wheel.

In this my improved apparatus and process I obviate all these difficulties. The molten metal can neither collect between the rollers should they be running slow, nor can the continuity of the plate be broken in the event of their running fast. The apparatus can be run at any degree of speed desirable, and a thick or a thin plate be produced, presenting on both sides a smooth and finished surface. Further, as the machine can be run at any desired speed, and as the molten metal remains in contact with the peripheral surface of the roller for a distance of nearly one-quarter of its circumference, plates of considerable thickness can be produced, the molten metal having sufficient time to solidify right to the center.

I will now describe my invention by reference to the accompanying sheets of drawings, on which—

Figure 1 represents a sectional elevation of my apparatus. Fig. 2 is an enlarged view of the adjustable bearing for the small rolls. Fig. 3 is an end elevation of my apparatus, as seen from the back. Fig. 4 shows in detail the eccentric roller for closing the mouth of the crucible; Fig. 5, a plan as seen from above; Fig. 6, a section showing the arrangement of my apparatus constructed so as to be fed direct from a furnace, Fig. 7 being a front view of the bridge across the furnace. Fig. 8 is a transverse section through the upper portion of large roller A, showing the arrangement of the small rollers B B′. Fig. 9 is a transverse section showing the arrangement of shallow ladle W and crucible.

It will be seen that my machinery consists of one large or receiving roller A of, say, five feet diameter (more or less) and of a width equal to the plate to be produced, and one or more small or forming rollers B C D—say of about nine inches in diameter, more or less—the latter being arranged to revolve in suitable bearings *b c d* and on the upper surface of the large roller A. These rollers may be constructed of iron or other suitable material and are preferably made hollow. A stream of water circulates through each roller, entering at one end and issuing at the other. The large roller A is supported in bearings E, placed in vertical housings or side frames F, and is provided with flanges G at each end. These flanges G are of such a width apart as to embrace the small rollers B C D, and of a depth greater than the thickest plate which it is proposed to roll, and are constructed so as to run in contact with corresponding loose collars H, arranged to revolve freely on the axis of the small rollers B C D. By this construction the molten metal flowing onto the surface of the large roller A is prevented from escaping sidewise by the flanges G, and at the same time the surface velocity of the small rolls is maintained at the same uniform rate as that of the large roller. I may, instead, arrange for the loose collars H to revolve on the axis of the large roller A and the flanges G to be on the small rollers B C D. The bearings *b c d* of the smaller rollers are fitted within corresponding slides K and furnished with screws L for the purpose of adjustment. By varying the diameter of the loose collars H the small rolls can be run nearer to or farther from the large roller A, the diameters of the loose collars being determined according to the thickness of plate to be made. The first small roll B may have a coating of refractory material.

Between the first and second and the second and third of the small rollers, and parallel to the axis of the large roller A, a refractory or metal shield M may be placed, arranged so as to be capable of being adjusted nearer to or farther from the large roller in a similar manner to the small rolls. When these shields M are made of iron, they are preferably constructed hollow, and kept cool by the circulation of water inside of them, the water entering at one end and issuing at the other.

I have found it preferable in some instances, especially when dealing with metals of high melting-point, to construct the first of the small hollow rollers B of a refractory material, and, instead of cooling this roller, to heat the same by means of a blow-pipe flame introduced at one end of the cylinder, the products of combustion finding an outlet at the other end of the same.

Immediately opposite to the first of the small rollers B is a guard-block N, of refractory material, extending right across and parallel to the axis of the larger roller A and resting on the surface of same, the object of which is to prevent any molten metal escaping in the wrong direction, and to afford the possibility of running the machine at a slow speed when making thicker plates, and also of accumulating a head of metal to evenly feed the machine. This refractory block N may be provided with a tubular perforation along its whole width for the purpose of heating it by means of a blow-pipe or otherwise. A similar refractory block N′ may be placed immediately in front of the first small roller B, which may likewise be similarly heated as the first block. This block is so constructed as to leave a space O equal to the thickness of the plate to be made between its under surface and the periphery of the large roller A.

In order to prevent the adhesion of molten metal to the rolls, I preferably coat them with oil, plumbago, powdered lime, or other similar material while the machine is in operation; or I may oxidize the surfaces.

Between the two refractory blocks N N′, or between the first refractory block M and the first one of the small rollers B, a space P is left for the insertion of the nozzle of a crucible, the nozzle extending in a direction parallel to the axle of the large roller, and so close to the peripheral surface of the roller A that only a space equal to the thickness of the plate to be formed is left between the end of the nozzle and the roller A. The space P between the two refractory blocks N N′ or the opening of the nozzle of the crucible may be closed or regulated by an eccentric roller Q, or a wedge-shaped refractory stopper, so arranged as to be operated by suitable levers or otherwise by the attendant.

When very thin plates are to be manufactured and the metal is fed between the refractory block N and the roller B, I may place a small roller B′ of, say two inches in diameter immediately in front of the roller B, to lessen the angle formed between the rollers A and B; or, in lieu of the above, the metal may be fed from a furnace R direct, either between the two blocks or between one block and the first small roller. In order to prevent the possibility of the metal chilling in the inlet, the space between the two blocks may previously be heated by means of a blow-pipe introduced temporarily from either end.

When dealing with metals of high melting-point—as, for instance, steel—I prefer to feed my machine direct from a furnace, in which the metal may be kept for any length of time in a molten condition, the furnace being divided into two parts by a wall or bridge S extending across it, in the middle of which wall or bridge is an opening T, which may be closed by means of a stopper U, operated in any convenient manner from the exterior of the furnace, whereby the flow of molten metal onto the machine can be regulated as desired. The heat from the furnace serves likewise to keep the inlet of the machine in a highly-heated state. If steel is to be fed on the machine from a crucible, I may allow the steel to run in a thick stream onto a shallow ladle W, provided with a wide lip and placed across the large roller and parallel to its axis. By tilting this trough-like ladle the metal will flow over its lip onto the roller A without the danger of clogging the outflow, which would exist if a crucible with a narrow slit in the nozzle were employed for steel.

In operating my machine, after heating the inlet and causing the water to circulate through the rollers and the shields, or by heating the small roller B, I cause the large roller A to rotate by means of a belt or other suitable driving mechanism, and this in revolving causes the small rollers B C D, with which it is in contact by means of the loose collars on its axis, to revolve in a similar manner. I then pour the molten metal into the inlet P between the two refractory blocks N N′, or between the first block and small roller B, whence it flows onto the surface of the large roller A in a continuous stream, the depth of which is regulated to the thickness of the required plate to be produced by the space or opening O, provided between the peripheral surface of the large roller A and that of the under surface of the refractory block N′ or that of the end of the nozzle of a crucible or the surface of the first small roller B. The plate, after having passed between the large flanged roller A and the small roller B, is then further solidified by passing under the rollers C D, where it may receive compression. The small rollers C D may be caused to rotate by the passage of the plate between them and the large roller A, instead of their loose collars running in contact with the flange G. The plate may be still further finished and reduced in thickness by other rollers placed in close proximity underneath of or on the same level with the large roller A, and also by placing one or more pairs of rollers in advance of the large roller A. This is an obvious arrangement and it is not deemed necessary to illustrate the same. It will be also understood that the edges of the plate may be sheared off by means of a pair of circular shears of ordinary construction, and similar shears may cut the sheet in strips of the desired width. If the sheet is very thin, it may at once be reeled off onto a reeler placed in advance of the circular shears.

When it is desired to manufacture sheets of shorter lengths, one or more ribs may be raised on the surface of one of the pair of rollers, between which the finished and still red-hot plate passes and parallel to its axis, the rib being high enough to touch the under surface of the second roller forming the pair.

My machine may be applied to the manufacture of sheets of glass as well as sheets of metal, in which case the rollers should be warmed and the sheet of glass stretched and annealed as it leaves the last roller.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An apparatus for the production of sheets directly from molten metal, consisting of a revolving receiving-roller and one or more forming-rollers arranged around the periphery thereof, and means for delivering material to said rollers, substantially as described.

2. The herein-described apparatus for manufacturing sheet metal, embracing a revolving receiving-roller, one or more forming-rollers arranged in succession and set at a distance from the receiving-roller regulated by the thickness of the sheet to be produced, and means for delivering the metal from the furnace or crucible, the whole being so arranged that the molten metal delivered onto the receiving-roller is thereby conveyed beneath the forming-rollers, substantially as described.

3. The combination, with a receiving-roller, one or more successive forming-rollers, and means of delivery of molten metal from a furnace or crucible onto the receiving-roller, of a refractory guard-block keeping the metal from flowing in an opposite direction to the rotation of the receiving-roller, substantially as described.

4. The combination, with a receiving-roller, one or more successive forming-rollers, means of delivery of molten metal from a furnace or crucible onto the receiving-roller, and a refractory guard-block, of a refractory block placed between the guard-block and the first forming-roller, a space equal to the thickness of sheet desired being left between the under surface of this block and the periphery of the receiving-roller, substantially as described.

5. The combination, with a receiving-roller, one or more successive forming-rollers, and a refractory-guard-block, of a crucible, the end of the nozzle of which leaves a space equal to the thickness of the plate desired between itself and the periphery of the receiving-roller, substantially as described.

6. The combination, with the machinery for the manufacture of sheet metal hereinbefore described, of a furnace divided by an inner transverse wall with opening therein for the insertion of a stopper by which the flow of metal to the receiving-roller may be regulated, substantially as described.

7. The combination of the shields M with the forming-rollers B C D, substantially as described.

8. The loose collars H on the forming-rollers B C D, in combination with the flanges G of the receiving-roller A, substantially as described, for the purposes set forth.

9. In combination with the receiving-roller A, a first forming-roller B, made of refractory material, and means for heating the same internally.

10. In combination with the receiving-roller A, the ladle W, arranged to operate substantially as and for the purpose specified.

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