

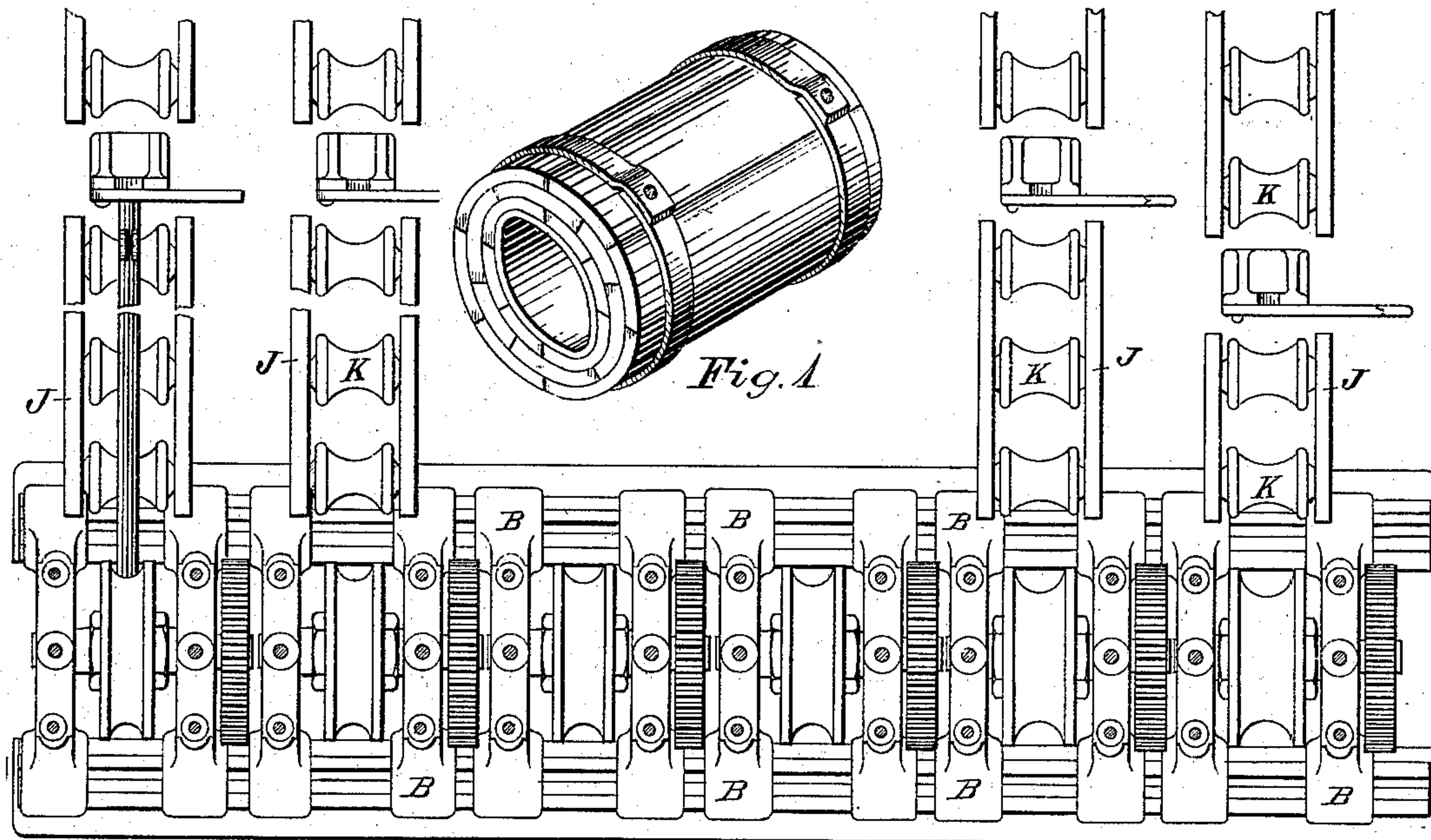
(No Model.)

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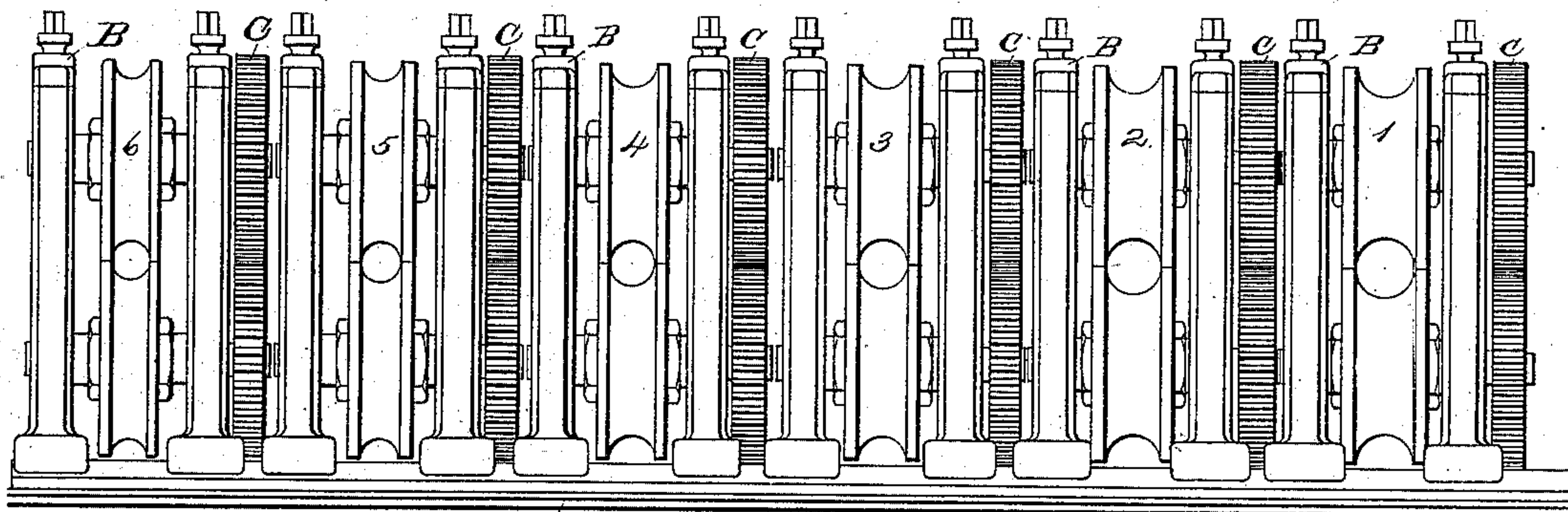
A. L. MURPHY.  
MANUFACTURE OF METAL TUBING.

No. 255,804.

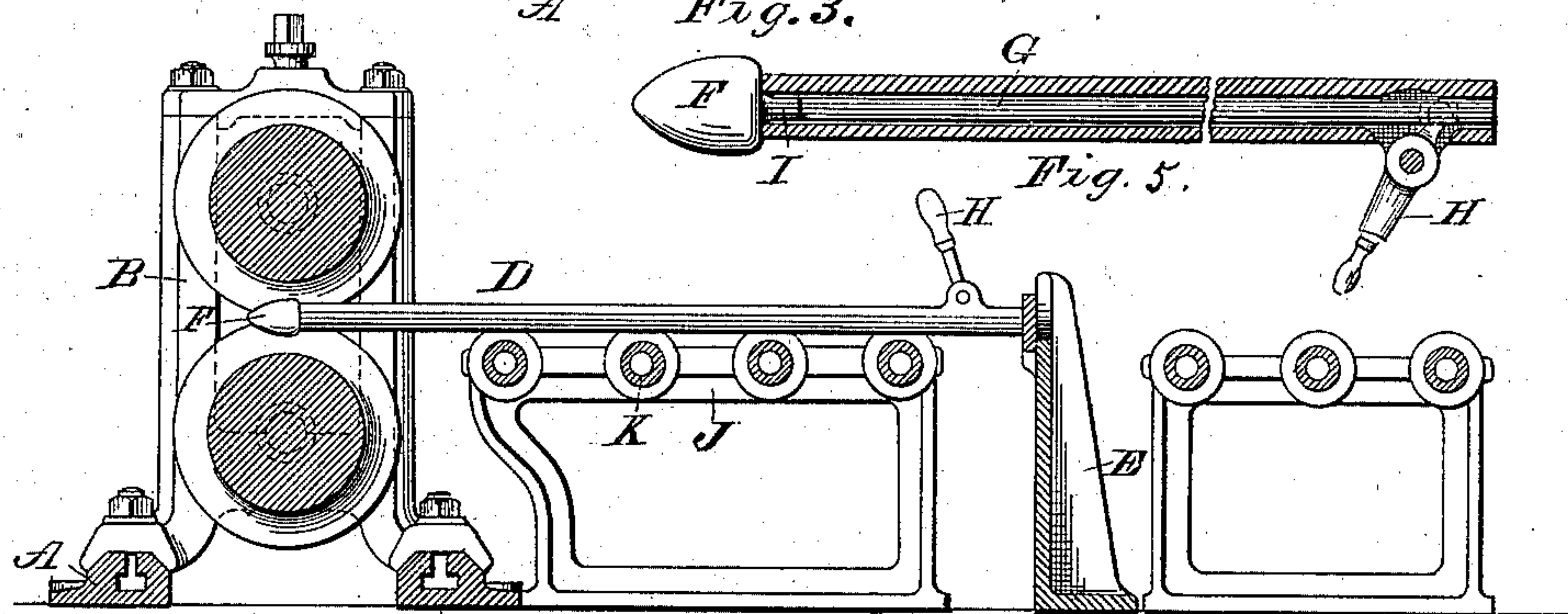
Patented Apr. 4, 1882.



A Fig. 2.



A Fig. 3.



Attests.

*John D. Sullivan*  
*J. H. Sampson*

Fig. 4.

Inventor.

*Albert L. Murphy*  
By his Attorneys,  
*W. C. Strawbridge*  
*Bonsall Taylor*



(No Model.)

2 Sheets—Sheet 2.

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Fig. 7.

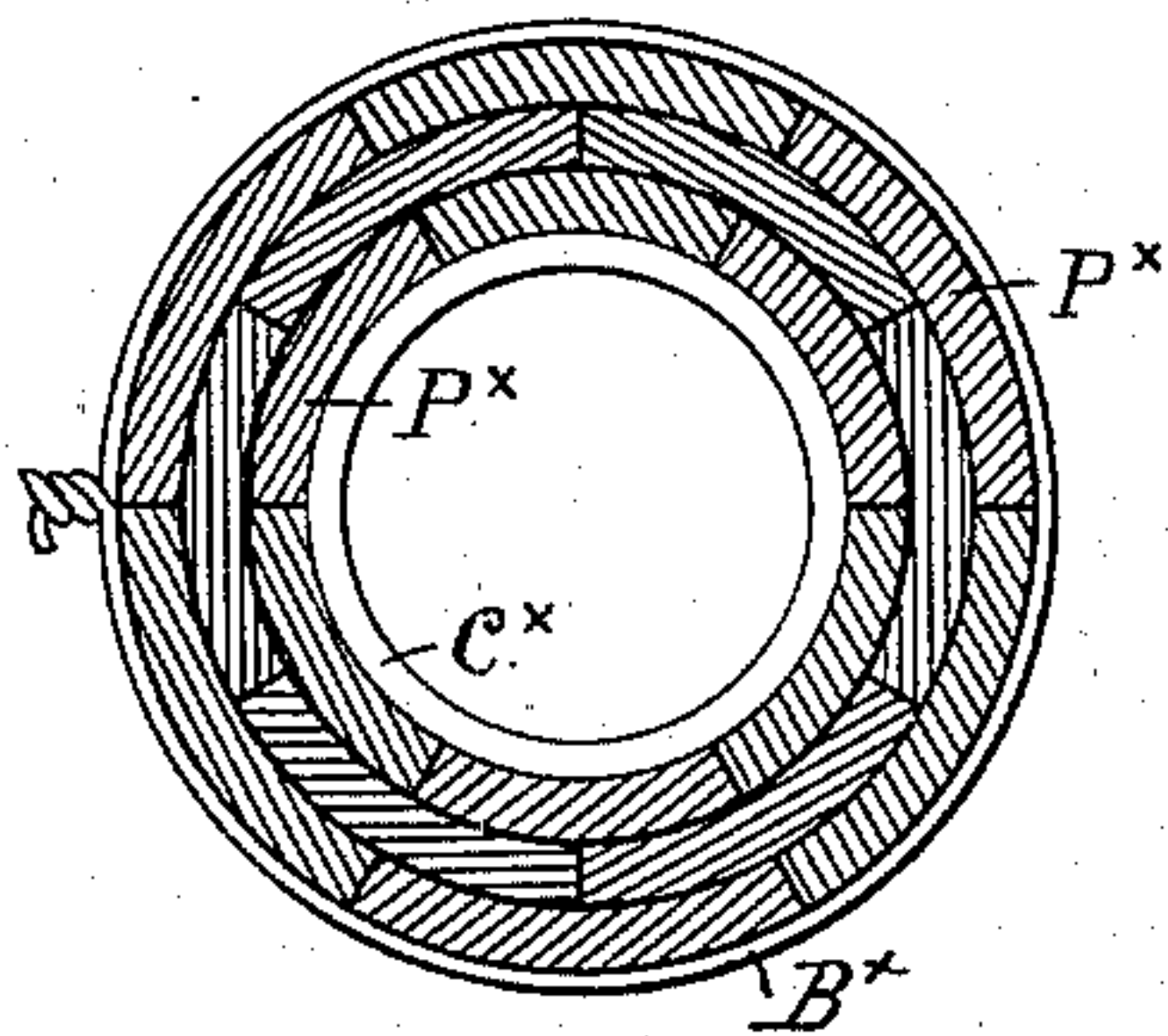


Fig. 8.

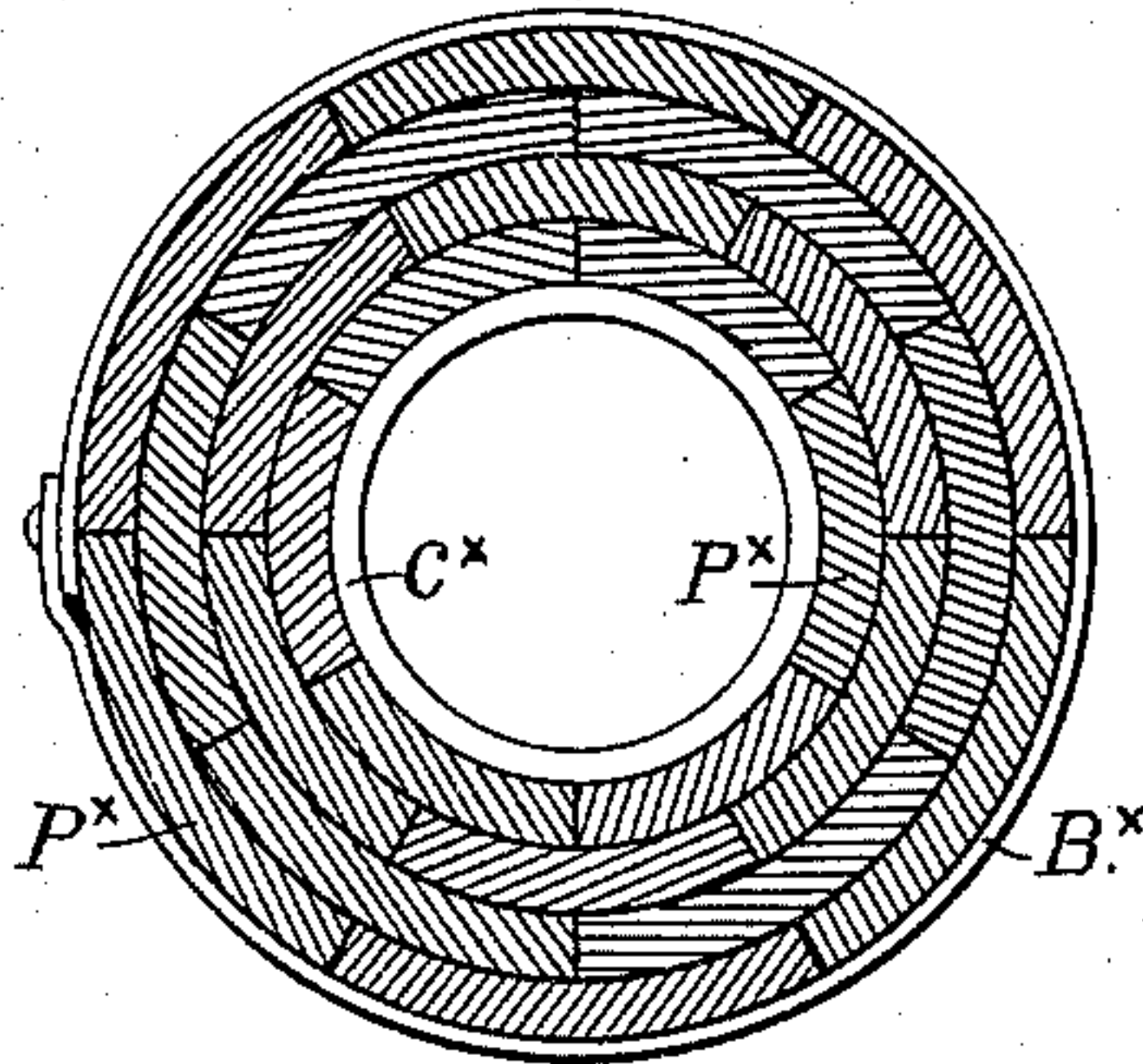


Fig. 9.

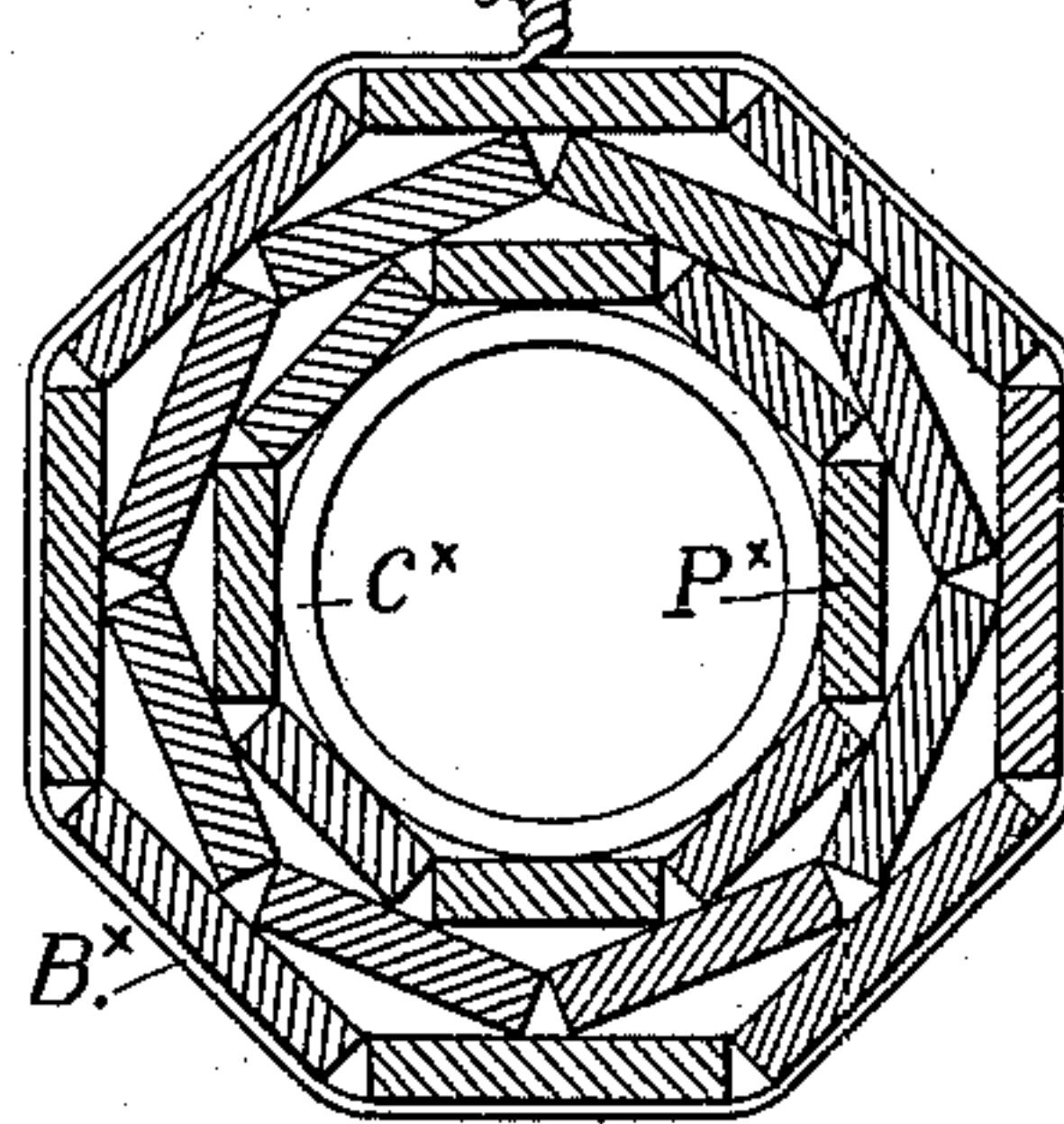


Fig. 6.

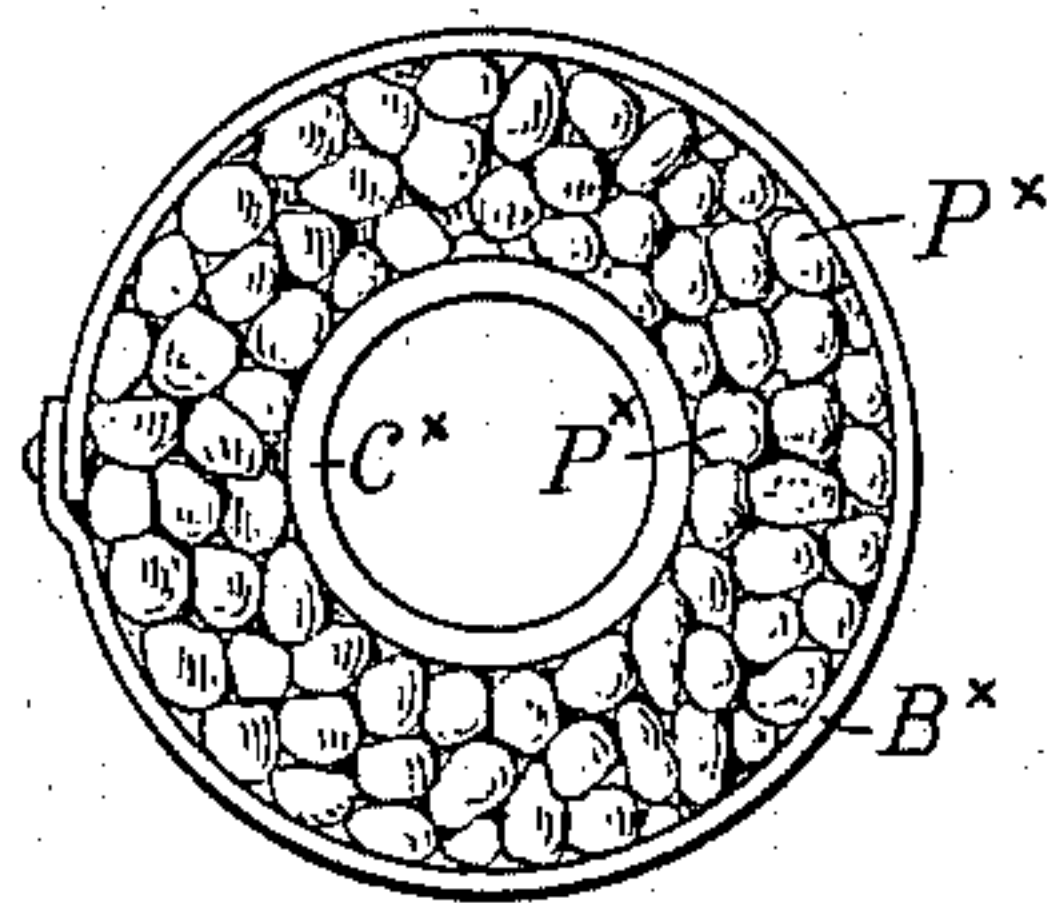


Fig. 10.

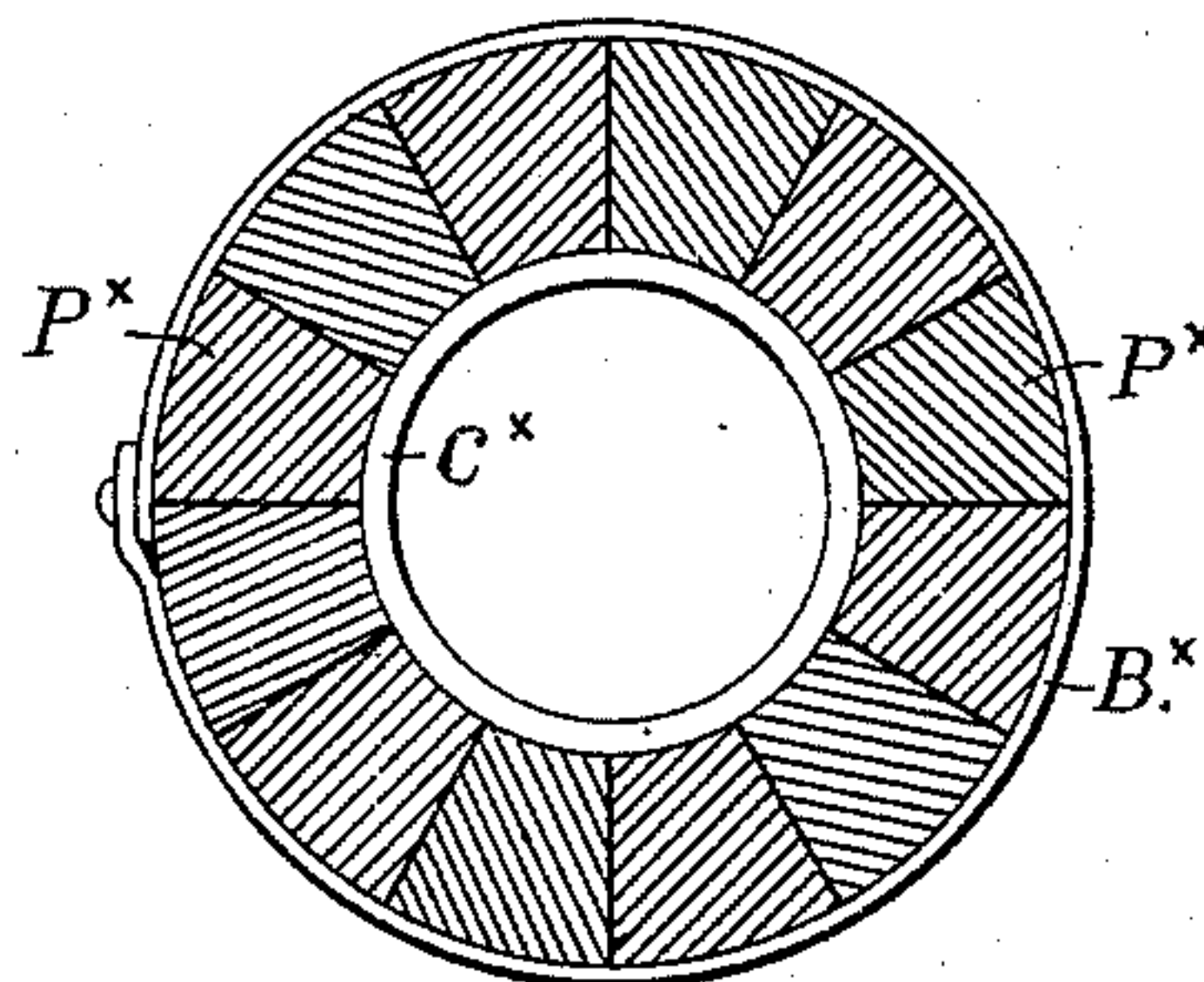


Fig. 11.

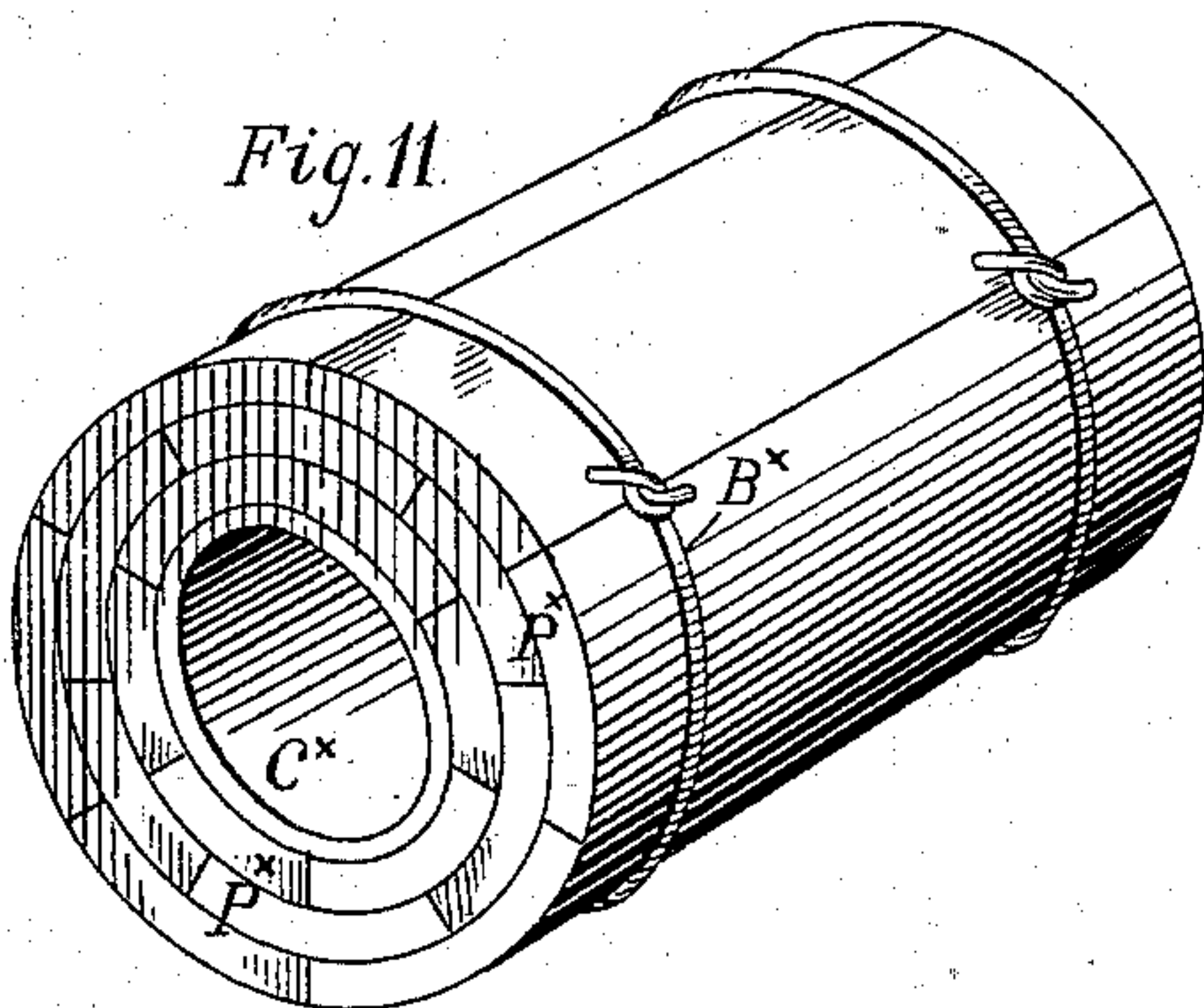
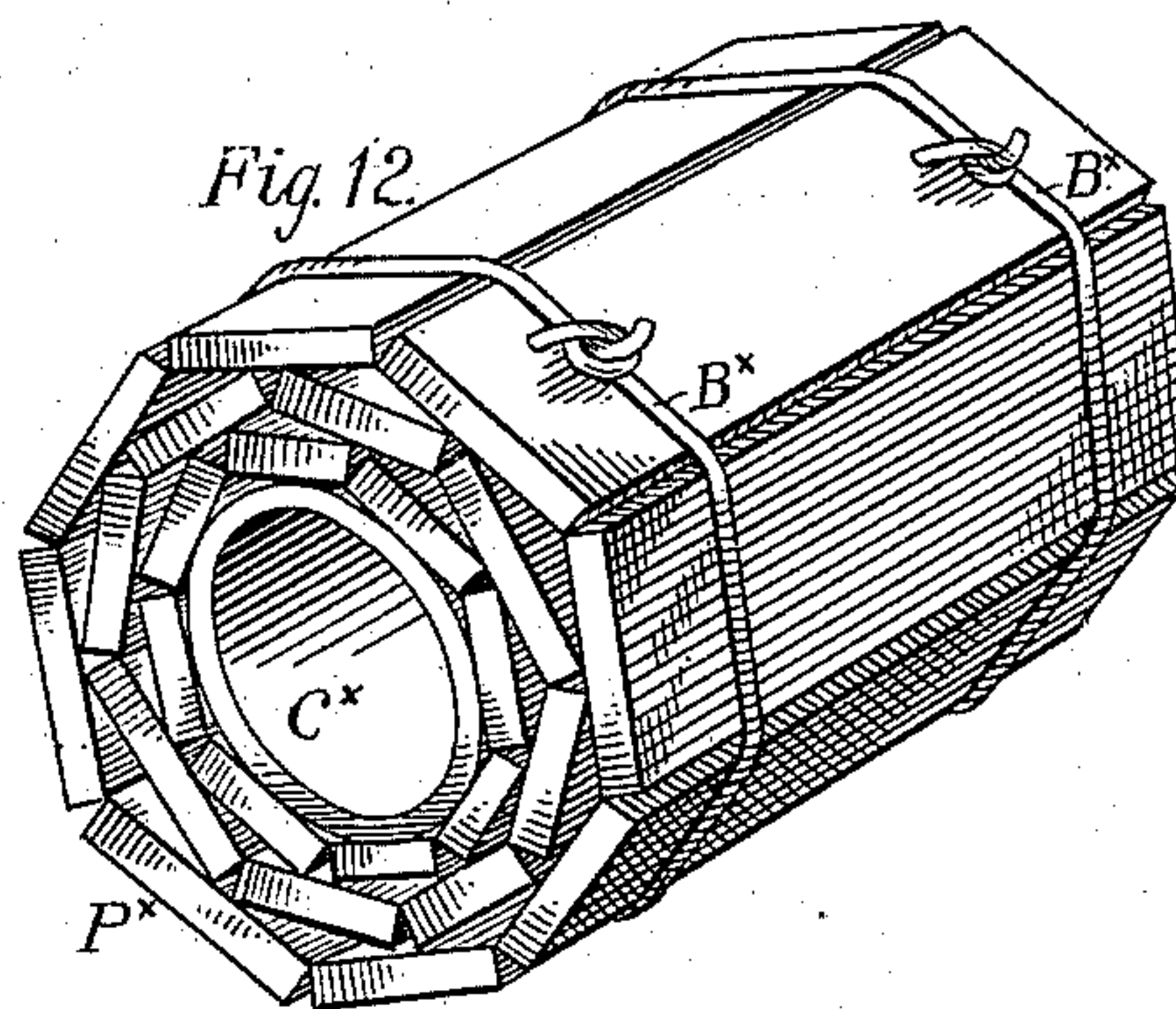


Fig. 12.



Witnesses:

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John D. Kelley

Inventor:

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By his Attorneys,  
W. C. Strawbridge,  
Bosman Taylor



# UNITED STATES PATENT OFFICE.

ALBERT L. MURPHY, OF PHILADELPHIA, PENNSYLVANIA.

## MANUFACTURE OF METAL TUBING.

SPECIFICATION forming part of Letters Patent No. 255,804, dated April 4, 1882.

Application filed October 13, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT L. MURPHY, of Philadelphia, Pennsylvania, have invented an improvement in tubing and a new and useful method of manufacturing the same from piles composed partly of unrefined puddled or muck iron and partly of refined iron, of which the following is a specification.

My invention relates in general to the manufacture of tubing, shafting, columns, axles, and kindred hollow articles in metal from hollow piles, but more specifically from such hollow piles as are formed of separate pieces of metal piled upon a central hollow core.

The object of the invention is the production, from a pile composed of pieces of unrefined puddled or muck iron arranged and secured upon or about a hollow core of refined iron, as a new article of manufacture, of a seamless homogeneous tube the exterior substance of which is fabricated from puddled or muck iron, and the interior lining or bore of which is fabricated from refined iron.

My invention consists in the making of a tube or kindred hollow article partly from unrefined puddled iron (which is known in the trade as "muck-iron," and is rolled direct from the puddle-ball to a bar of desired configuration, and not reheated and rerolled) and partly from refined iron by the reduction and condensation over mandrels of a heated pile formed of bars of muck-iron arranged upon a hollow core of refined iron approximately co-extensive in length with the piled bars, which successive reduction and condensation over the mandrels cause the conversion of the piled pieces or bars of unrefined puddled iron into refined iron and their consolidation and extension with the core, and, further, cause the conversion of the refined iron of the core into an iron doubly or to a greater extent refined and its consolidation and extension with the pieces, so that there results a tube of predetermined dimensions, the substance of which is of iron once refined, and in which there is an inner lining or bore of highly-refined iron, constituting an integral portion of the tube and formed from the reduced and extended core.

My invention further consists in a new article of manufacture—an iron tube the outer

substance or portion of which is formed from muck or unrefined puddled iron, and the inner portion of which is formed from refined iron, the muck-iron becoming refined and the refined iron re-refined in the process of making the tube; and my invention lastly consists in a pile from which to make tubing, composed of pieces of unrefined puddled or muck iron arranged and secured upon or about a hollow core of refined iron. The reduction of the pile to a tube, column, shaft, axle, flue, or the like is effectually carried out by the apparatus hereinbelow described, although other forms of apparatus employing a series of mandrels will effectuate the successive reduction and condensation over mandrels, in which such method consists.

The following is a description of a convenient form of rolls for accomplishing the above consolidation and reduction, although many other forms of apparatus may be employed. It is to be understood that the pile is first heated to the proper welding-heat.

A represents a foundation or bed-plate, upon which are erected a series of housings, B, which support a series of sets of reducing-rolls. The apparatus illustrated is a six-set series, each set two high, being numbered from 1 to 6, and the pass of each succeeding set being smaller than that of the set immediately preceding, so that whereas the pass of set number one (1) is adapted to take the pile as first heated and impart to it its first reduction, the pass of set number six (6) is of such size as to impart the desired dimensions to the finished tubing made from the successively-reduced pile. The rolls are driven by means of toothed wheels C, to which motion is imparted from underground shafting or the like in the usual manner.

D are mandrels supported upon mandrel-brackets E in such manner that their balls F are properly placed and retained centrally within the passes of the sets to which the mandrels are respectively applied.

G are shifter-bars, Fig. 6, inclosed within the stems of the mandrels, which latter are made hollow. The shifter-bars are controlled by hand-levers H, so that they can be shifted after the passage of the tube to project or



throw the balls, which simply rest in place by means of stems I from off the mandrels. The pile is manipulated to the successive passes in any manner well known to rolling-mill men, and not therefore requiring description here. Each set of rolls is of course driven independently of every other, and at different rates of speed.

J are benches arranged back of each set of rolls, and provided with carrier-rolls K. These benches vary in length proportionately with the diameter of the pass of the set with which they are respectively connected, that of the first set being, for instance, five feet, while that of the finishing-set is, for instance, twenty feet. The carrier-rolls K are so arranged as to carry the pile as the latter emerges upon the mandrels in its successively-reduced condition. The mandrel-brackets E are of such resisting power as to hold the mandrels rigidly against the pile as it is forced upon them.

Although the nomenclature employed might indicate otherwise, the balls F are the mandrels proper, the devices employed to sustain and operate the balls being merely auxiliary thereto.

The last pass of the set is adapted to produce a tube of the desired length, diameter, and thickness.

By my invention a merchantable refined-iron tube, flue, axle, column, or shaft of superior strength, quality, and cheapness can be made almost wholly from unrefined puddled or muck iron, thereby saving the cost of and dispensing wholly with the heretofore essential intermediate step of finishing or converting unrefined puddled iron into sheets or skelp prior to its manufacture by any known practical means into tubing.

The class of piles which, when in substance constructed of muck-iron, as first practiced by me, I convert direct into tubes are those in which pieces of metal are arranged about and connected to a continuous hollow central metal core, and which are formed by first taking preferably a tube or some other suitable hollow metallic body, of the desired length of the pile, as a core, and by then building around and upon said core a series of pieces of metal to form the substance or body proper.

Heretofore piles of this class have been formed of pieces of refined iron, worked or shaped, arranged upon a refined-iron core.

I have discovered that the cost and delay incident to the previous refining of the pieces constituting the substance or body proper of the pile may be obviated and a tube of refined metal be directly produced by making the substance of the pile of pieces of unrefined or muck iron, which becomes refined under the very process of heating and reduction which converts the pile into a tube and converts the core into re-refined metal.

Heretofore, also, in piles of this class the tubular or other hollow core has been employed solely because such core has formed a convenient and permanent basis upon which to build

the pieces composing the pile; and after the pile has been reduced, when a smooth bore has been required the core has been bored wholly or partially out, so as to provide such smooth bore to the resultant tube. My invention aims to obviate this boring out of the core, and, while retaining the extended core entire, to obtain a smooth interior thereto or bore to the tube without boring. When, therefore, the pile as constructed by me has been converted and reduced over mandrels to its ultimate dimensions, the hollow core forms an inside lining to the resulting finished tube, said core being, during the rolling operations, not only re-refined, but gradually reduced, extended, and smoothed by compression upon the mandrels, (although existing at every stage of the reduction as an inner lining,) until it is formed into a smooth interior lining to the tube, coextensive in length therewith, and forming the bore thereof.

In the accompanying drawings, Figure 1 represents in perspective a pile of curved bars of muck-iron bound with metal bands upon a hollow core of refined iron. Fig. 2 represents in top plan view a convenient form of apparatus for the rolling out of my pile into tubing, the benches being shown shorter than in practice. Fig. 3 is a front elevation of the same. Fig. 4 is a side sectional elevation through one set of rolls. Fig. 5 is an inverted detail, showing the construction of the mandrels. Fig. 6 represents in end view a pile composed of many irregularly-shaped pieces of unrefined puddled iron arranged as they happen to come about a central hollow core of refined iron, and bound thereto by a band. Figs. 7 and 8 represent in end view piles composed respectively of three and of four layers of curved muck-bars, the curvature of each bar corresponding to that of every other bar, so that when arranged about the hollow refined core they lie snugly upon the latter and upon each other, and form a compact or solid pile without interior interstices. The bars in these last arrangements are piled in such manner that they break joint, as is very clearly shown in the drawings. Fig. 11 is a perspective view of the pile of Fig. 7, the bars being tied by wires. Fig. 10 represents in end view a pile composed of a single layer of muck-bars which have been rolled to the section of a keystone or skewback. They are shown arranged about a central hollow refined-iron core and bound thereto by bands of sheet metal. Fig. 9 represents in end view a pile composed of many variously-sized straight muck-bars arranged to break joints, and bound by iron rope about a central hollow refined-iron core. Fig. 12 represents in perspective the pile of Fig. 9.

Similar letters of reference indicate corresponding parts.

All the foregoing piles are illustrative merely of good forms of a given type of pile formed of muck-bars upon a hollow core of refined iron.

In the drawings depicting the piles, B\* rep-



resents the binding devices, C<sup>x</sup> the core, and P<sup>x</sup> the muck-bars of which the substance of the pile is composed. In practice the hollow central cores of these piles are best made of a section of ordinary iron tubing, which is of necessity refined metal. The re-refining of this core incident to the practice of my invention renders the bore of the tube of superior quality and strength.

10 The proportions of the core may be varied according to the thickness of re-refined metal which is desired for the resultant bore of the tube—a consideration governed by the proposed use of the latter.

15 Bands of metal are conveniently used to secure the pile together; but wire, wire rope, or other binding material is sometimes employed. The bars are simply arranged to the desired depth and bound together. When curved bars are employed they are previously rolled from the puddled ball to the desired curvature.

20 It will of course be understood that the passes of puddling-rolls vary in contour, so that puddled or muck bars, as an article of commerce, are of various sectional shapes. There are added around the core as many bars as are necessary to make the pile of the size and weight required.

My invention renders practicable the making of tubing from any hollow pile formed of muck-bars upon a central hollow refined-iron core, whatever be the specific formation or arrangement of the piled bars constituting the substance or body proper of the pile upon the core.

Having thus described my invention, I claim 35 and desire to secure by Letters Patent of the United States—

1. As a new article of manufacture, a refined-iron tube the outer substance or portion of which consists of refined iron, and the inner portion or bore of which consists of re-refined iron, or iron of a degree of refinement superior to that of the iron constituting the outer substance of the tube. 40

2. As a new article of manufacture, a pile 45 for the manufacture of tubing, consisting of pieces of unrefined puddled or muck iron arranged and secured upon or about a hollow core of refined iron, substantially as and for the purposes set forth.

In testimony whereof I have hereunto signed my name this 11th day of October, A. D. 1880. 50

ALBERT L. MURPHY.

In presence of—

J. BONNALL TAYLOR,  
W. C. STRAWBRIDGE.