(No Model.) 4 Sheets—Sheet 1.

F. H. J. WÜSTENHÖFER.

MACHINE FOR MAKING TUBES.

No. 452,909. Patented May 26, 1891.

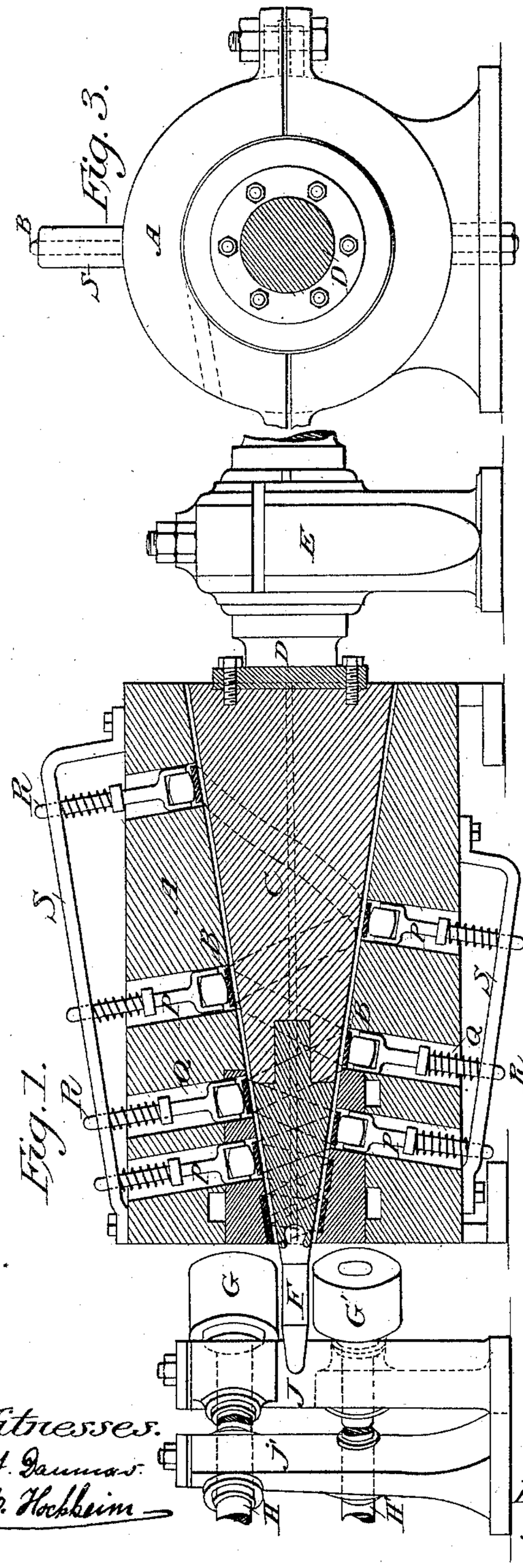

Fig. 3.

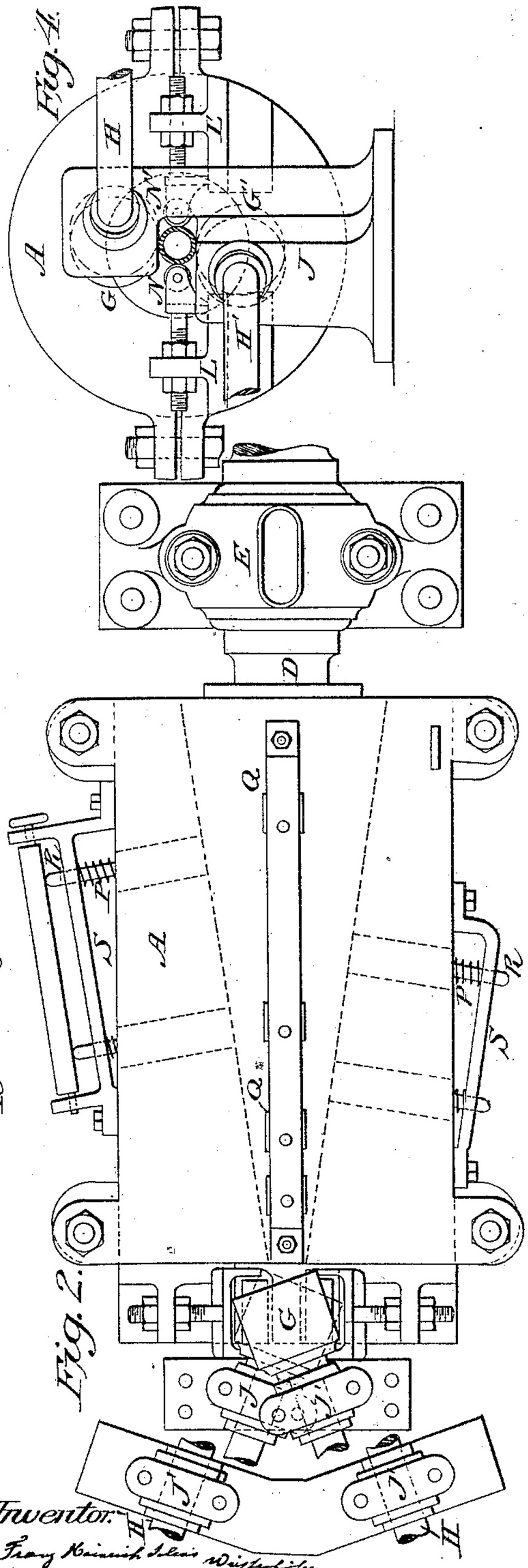

Fig. 4.

Fig. 1.

Fig. 2.

Witnesses.
A. Damm.
C. Hochheim

Inventor:
Franz Heinrich Ludwig Wüstenhöfer
per Karl J. Meyer
attorney

(No Model.) 4 Sheets—Sheet 2.

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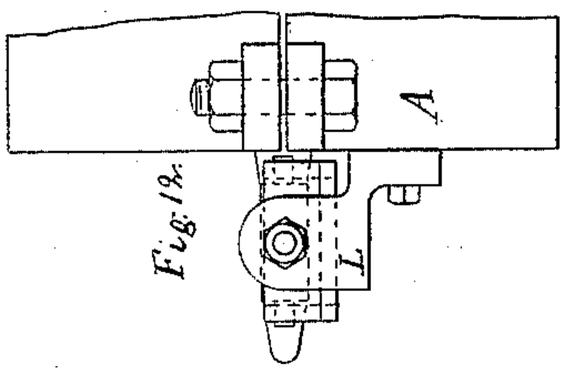


Fig: 12.

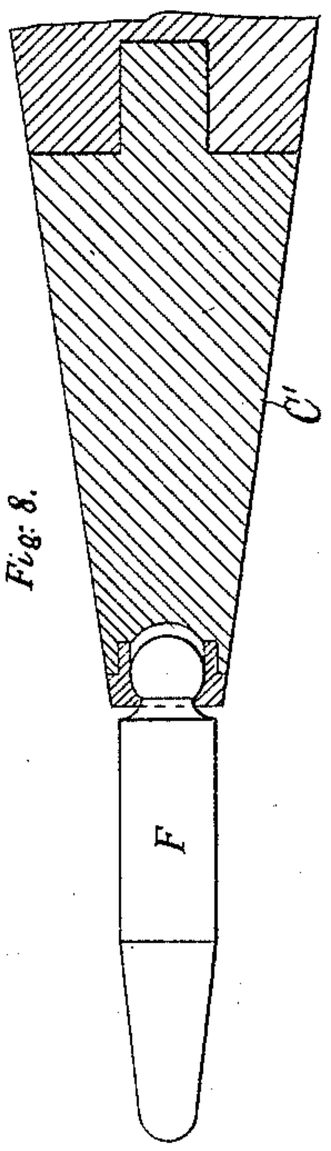


Fig: 8.

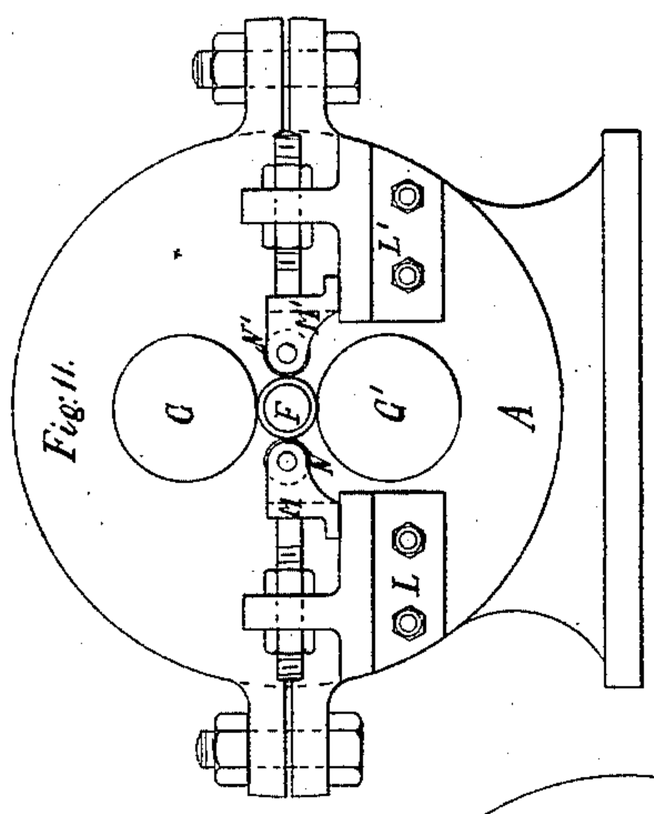
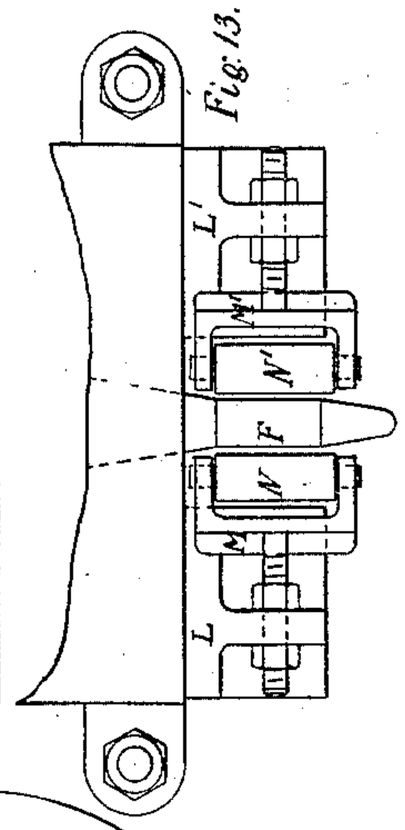


Fig: 11.



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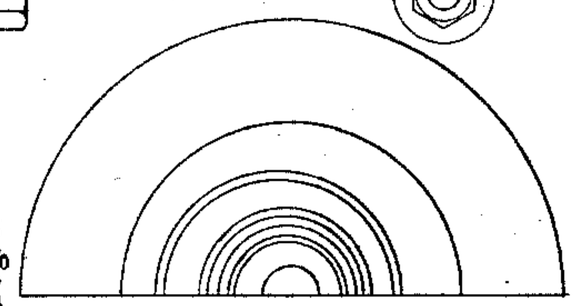

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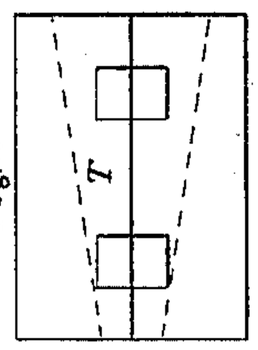

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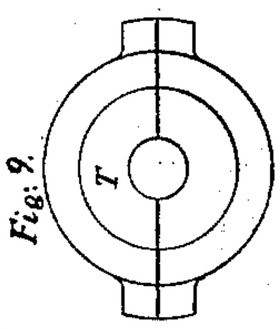
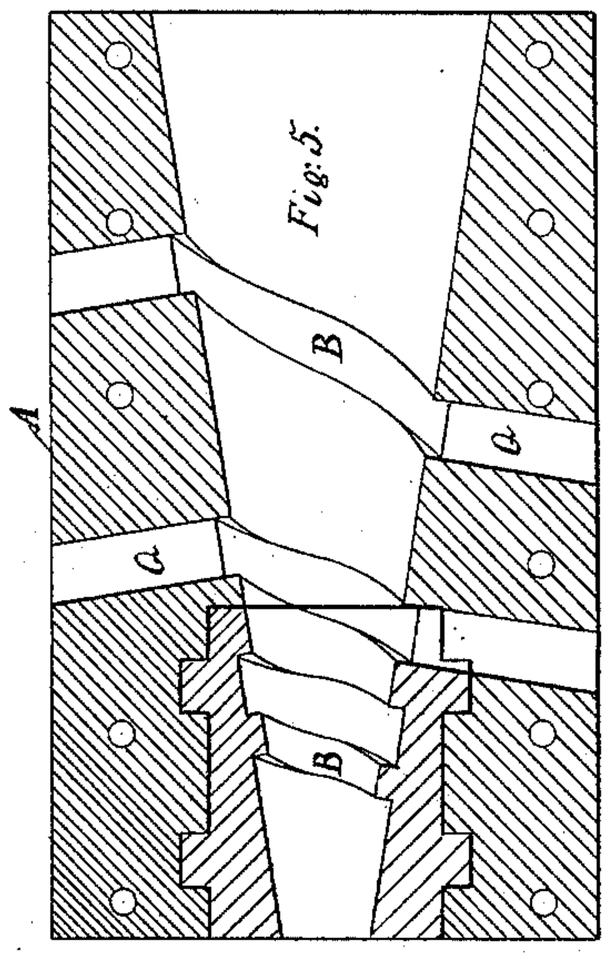


Fig: 9.



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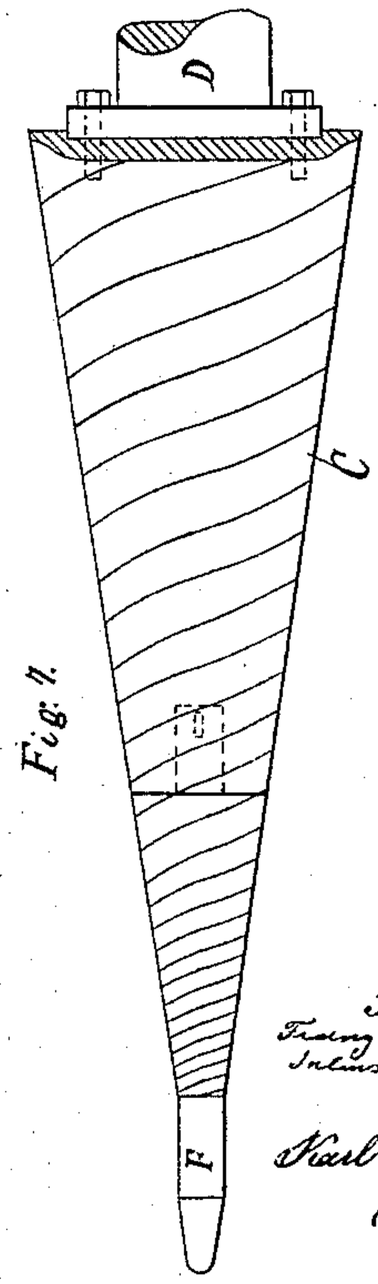

Fig: 7.

Witnesses
H. Bruchhausen
L. Bockmann

Inventor
Friedrich Heinrich
Julius Wüstenhöfer
per
Karl S. Mayo
Attorney

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F. H. J. WÜSTENHÖFER.

MACHINE FOR MAKING TUBES.

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Fig: 15.

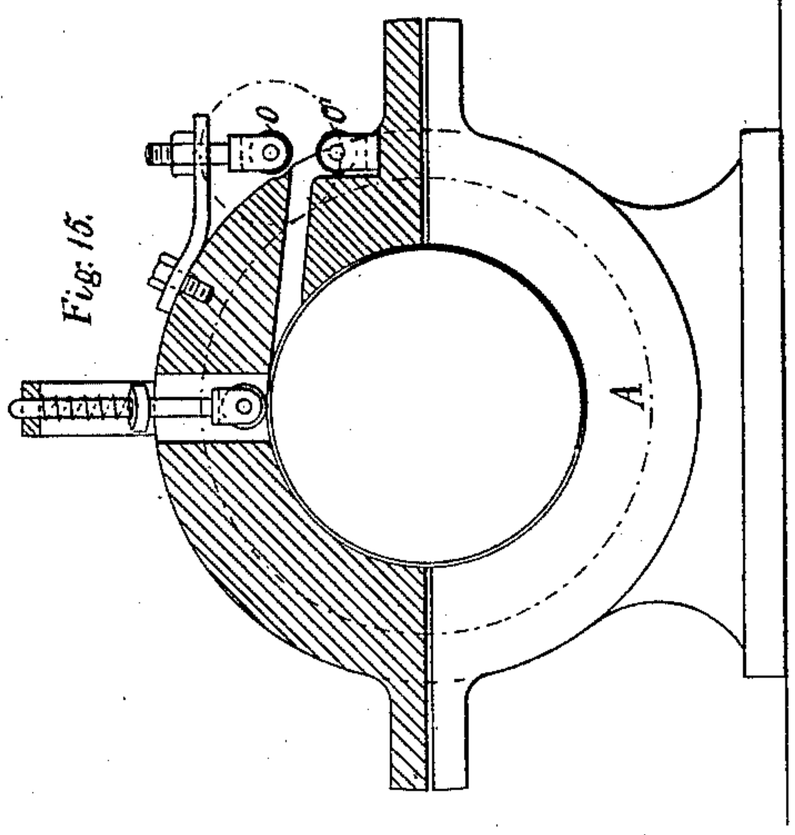


Fig: 18.

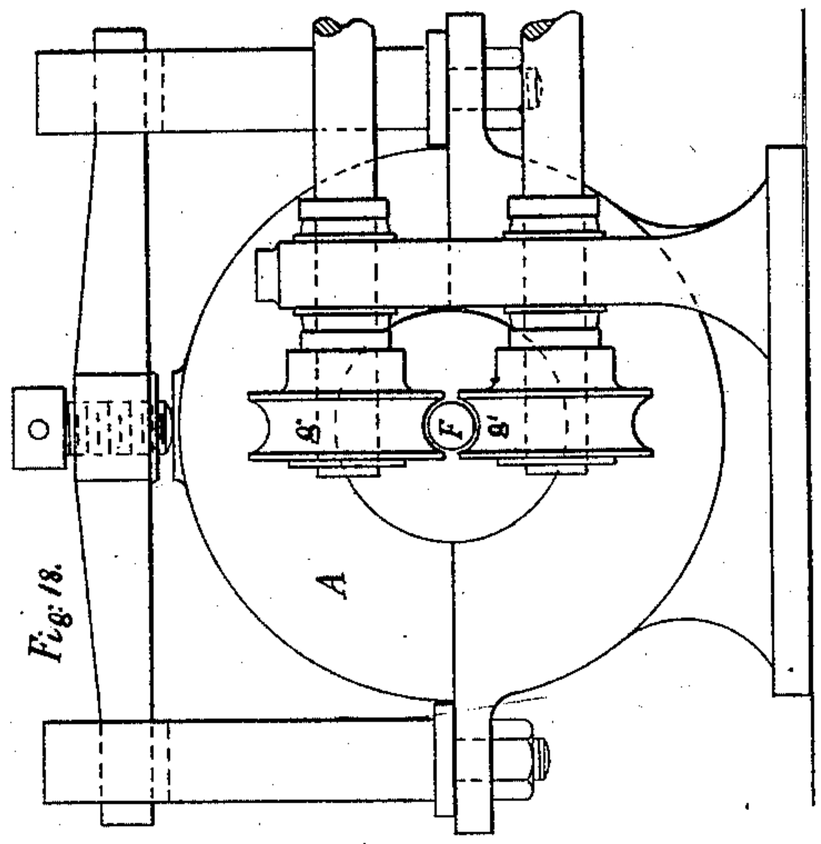


Fig: 14.

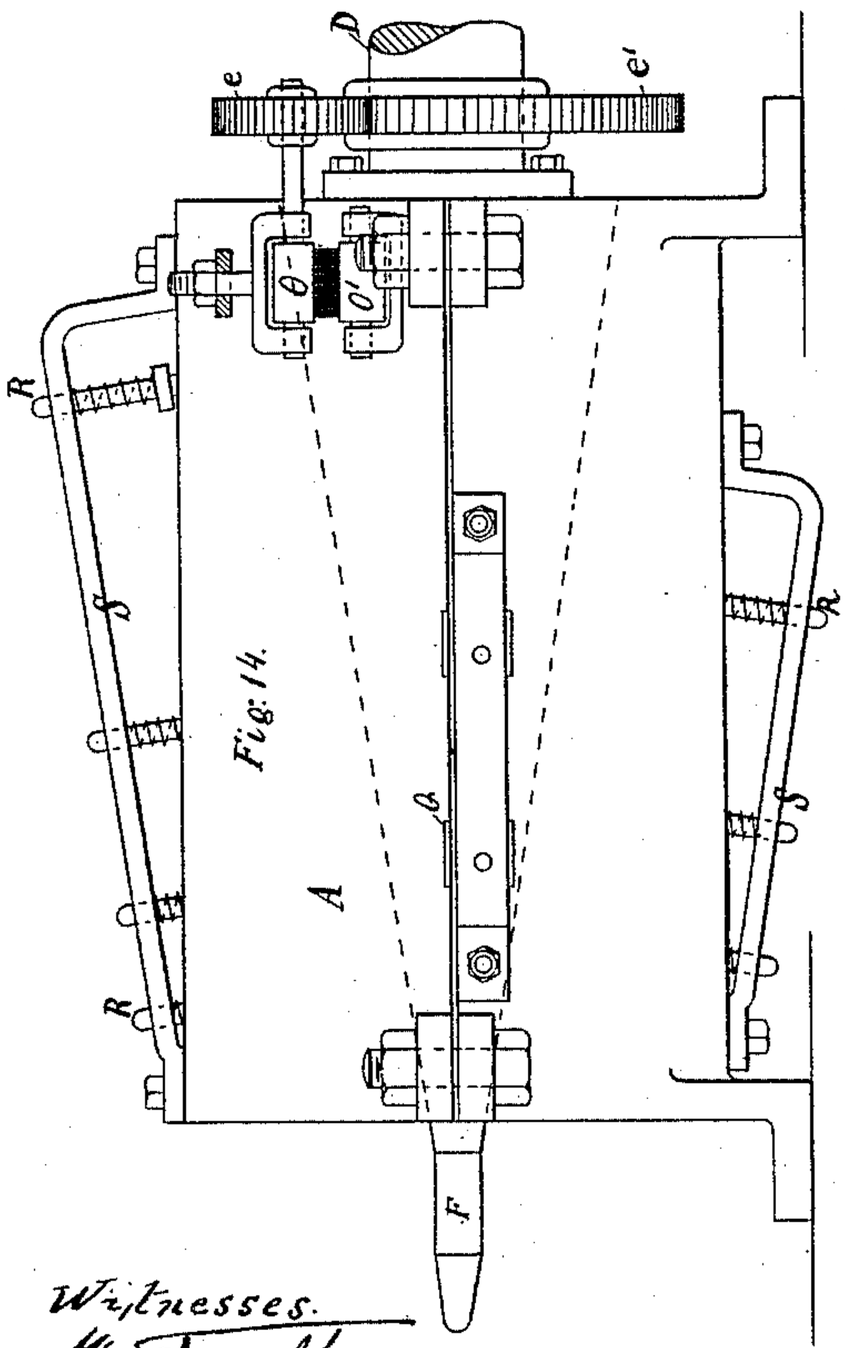
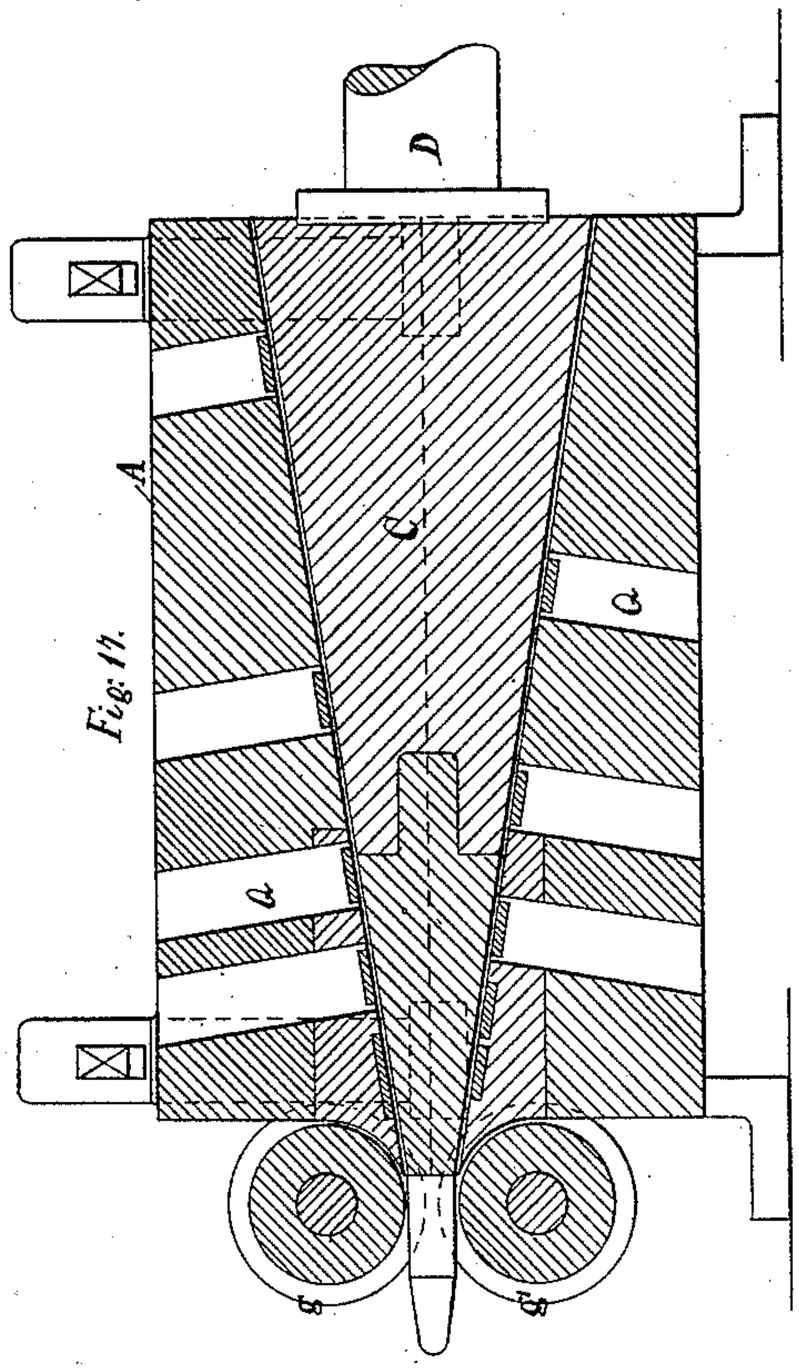


Fig: 17.



Witnesses.
H. Brucht.
L. Goepmann

Inventor
Franz Heinrich Julius Wüstenhöfer
per
Karl F. Mayer
attorney

(No Model.) 4 Sheets—Sheet 4.

F. H. J. WÜSTENHÖFER.

MACHINE FOR MAKING TUBES.

No. 452,909. Patented May 26, 1891.

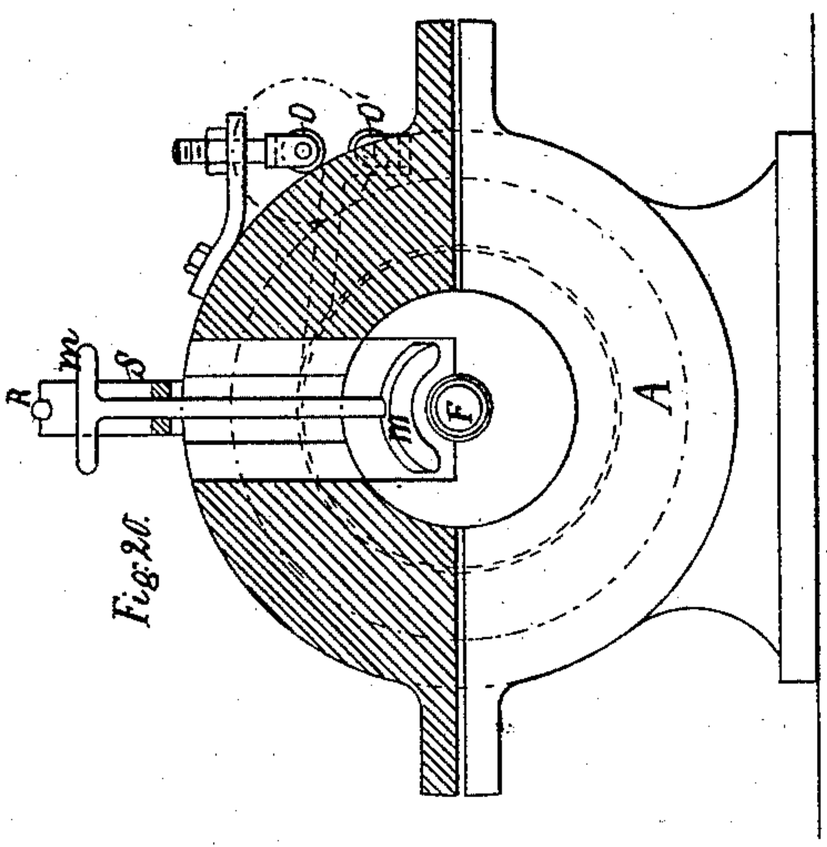


Fig: 20.

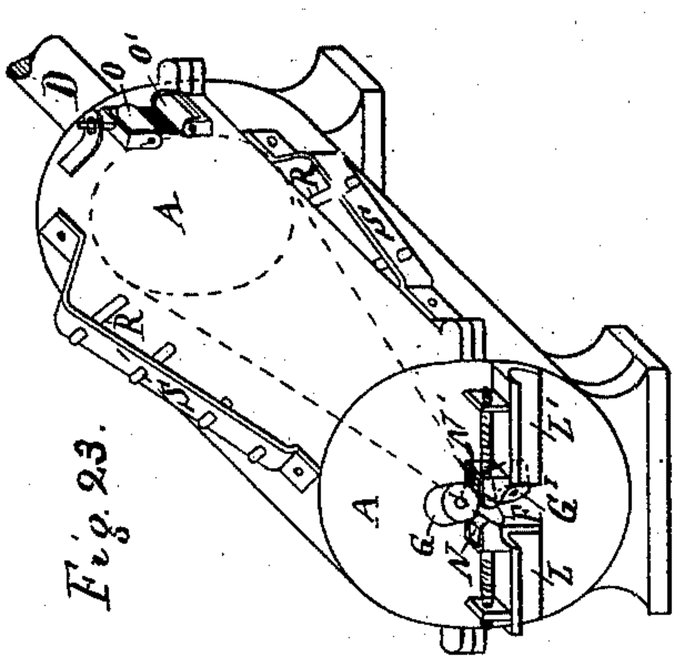


Fig: 23.

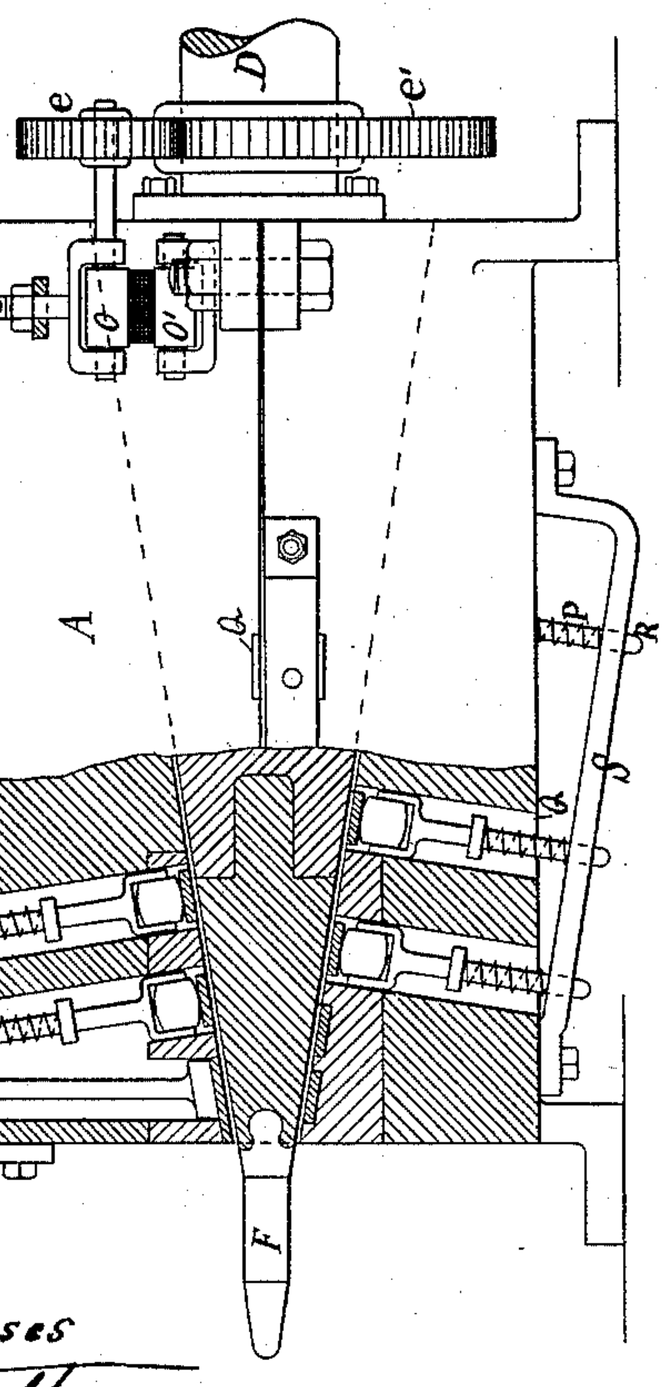


Fig: 19.

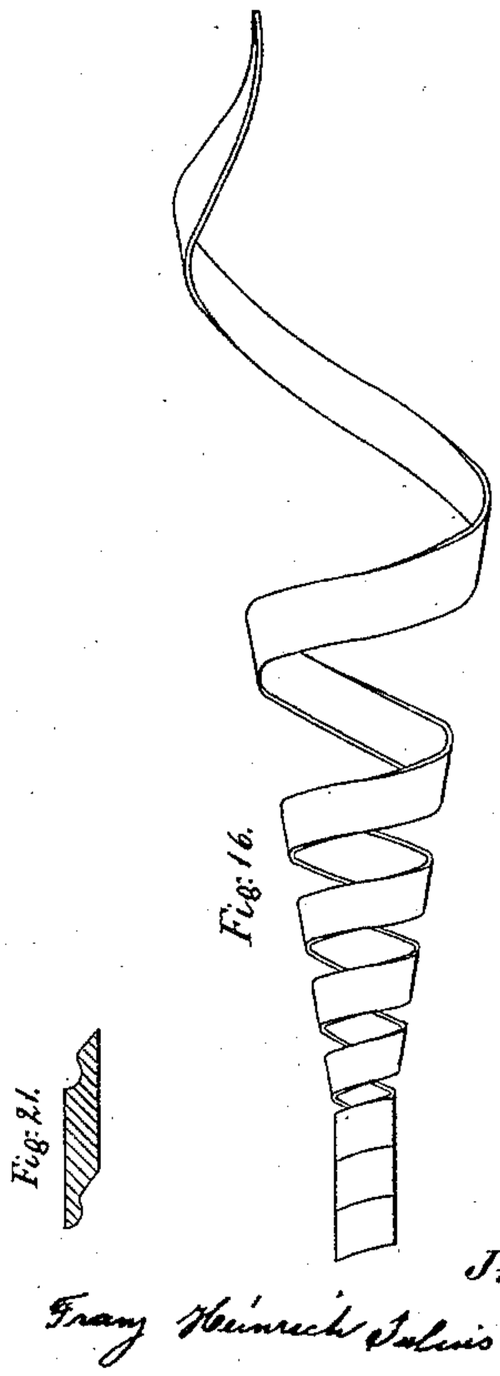


Fig: 21.

Fig: 16.

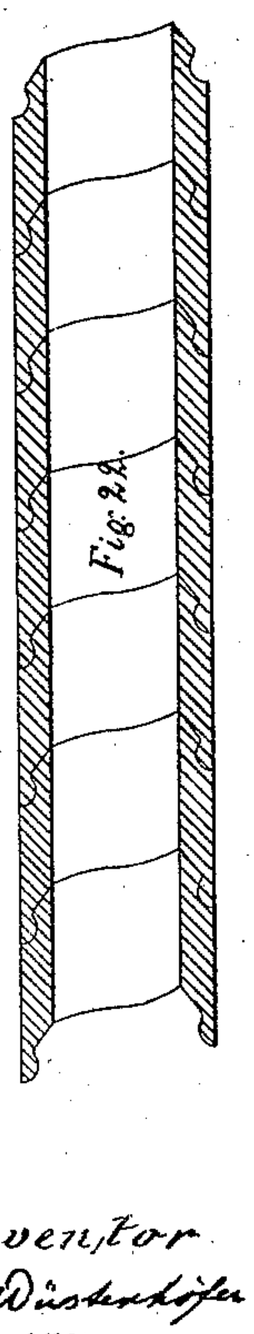


Fig: 22.

Witnesses
H. Tiecht.
L. Boekmann

Inventor
Franz Heinrich Julius Wüstenhöfer
per
Paul J. Mayer
Attorney

UNITED STATES PATENT OFFICE.

FRANZ HEINRICH JULIUS WÜSTENHÖFER, OF ARNSBERG, GERMANY.

MACHINE FOR MAKING TUBES.

SPECIFICATION forming part of Letters Patent No. 452,909, dated May 26, 1891.

Application filed December 23, 1889. Serial No. 334,769. (No model.) Patented in Austria-Hungary January 8, 1889, No. 41,742 and No. 64,570; in Germany June 22, 1889, No. 51,069, and August 22, 1889, No. 53,532; in France July 22, 1889, No. 199,718; in Belgium July 22, 1889, No. 87,087; in Sweden January 8, 1890, No. 2,240, and in England September 14, 1890, No. 14,532.

To all whom it may concern:

Be it known that I, FRANZ HEINRICH JULIUS WÜSTENHÖFER, a subject of His Majesty the Emperor of Germany, and residing at Arnsberg, in the Province of Westphalia, Germany, have invented new and useful Machinery for Making Welded Iron and Steel Tubes, (for which I have obtained patents in Germany, No. 51,069, bearing date June 22, 1889; Germany, No. 53,532, bearing date August 22, 1889; France, No. 199,718, bearing date July 22, 1889; France, No. 199,718, bearing date September 10, 1889, patent of addition to the first; Belgium, No. 87,087, bearing date July 22, 1889; Belgium, No. 87,087, bearing date September 7, 1889, patent of addition to the first; Austria-Hungary, No. 41,742 and No. 64,570, bearing date January 8, 1889; Great Britain, No. 14,532, bearing date September 14, 1890; Sweden, No. 2,240, bearing date January 8, 1890,) of which the following is a specification.

My invention relates to the manufacture of welded iron and steel tubes having the joint not in a straight line parallel to the geometrical axis, as is the case with the tubes hitherto made, but in a spiral line. The tubes made with a longitudinal joint cannot be relied upon and do not give the necessary security of resistance in a great many cases—for instance, with hydraulic presses, tubular boilers, &c. This drawback is essentially due to the mode of manufacture with a longitudinal seam.

In making my invention I started from two fundamental ideas, the practical realization of which excludes the deficiencies named—*i. e.*, first, the welded joint or seam must not go in a straight line in longitudinal direction or parallel to the axis of the tube, because by this mode of manufacture the weakest part of the tube is accumulated all along one side of the same; second, the material of which the tube is made must be so distributed and used that the direction of the strain to which it is exposed runs as much as possible in the direction of the fiber of the material and that its tensile strength has to resist the internal pressure. These two fundamental ideas gave the direction how I had to proceed to obtain my object in view. I must make the welded joint in a spiral line winding round the tube.

By means of the annexed drawings and the following description my invention will be fully explained and understood.

Figure 1 a longitudinal section of the machine. Fig. 2 is a plan of Fig. 1. Fig. 3 is a vertical view seen from the right. Fig. 4 is a vertical view seen from the left of Fig. 1. Fig. 5 shows the inside of the lower half of the machine. Fig. 6 is a side view of this part of the machine. Fig. 7 shows the conical rolling-mandrel. Fig. 8 shows the exchangeable pointed end of the same in an enlarged scale. Figs. 9 and 10 show an end view and a side view, respectively, of the exchangeable nut. Figs. 11, 12, and 13 show the arrangement of the pressure and guide rollers at the outlet of the machine. Fig. 14 shows the arrangement of the entrance guide-rollers and the entrance-channel. Fig. 15 is a cross-section through the machine at the entrance-channel. Fig. 16 shows the gradual formation of the straight bar into a tube. Fig. 17 is a modified arrangement with ordinary straight acting rollers, instead of the oblique rollers at the end of the machine. Fig. 18 is a front view of Fig. 17. Fig. 19 shows the arrangement of the retarding or brake bolt. Fig. 20 is a cross-section of the machine through the brake-bolt. Fig. 21 shows a section of the bar used for making the tubes. Fig. 22 shows in longitudinal section how the joints are made. Fig. 23 is a perspective view of the machine, showing its outside with the principal fittings.

By my new method and with the new machine I can make tubes quite finished, ready for use, and tubes half-finished, which require reheating and are then welded complete and finished on a mandrel, as usual. A bar of iron or steel, which when of very great length may be wound up in a ring, is made white hot and is then pushed into the machine and into the spiral groove cut in the hollow cone surface surrounding the mandrel. The pitch of this spiral groove or its angle of inclination being at first very steep, diminishes

gradually toward the outlet until it is equal to the breadth of the bar itself, when the spiral groove in the cone surface will disappear; or, in other words, the windings following each other will be quite close to and touch each other, and no partition will be between them. The bar of iron or steel pushed into the machine is forced to follow the groove in the hollow cone by the action of the conical rolling mandrel, which fits closely in the hollow cone, and which is provided with close windings or riflings of same inclination as the spiral groove. From place to place guide-rollers and pressure-rollers are arranged, which cause the bar to remain in continuous contact with the rolling mandrel.

At the end of the machine the mandrel projecting out of it is made cylindrical and of the same diameter as the inside width of the tube to be made. Here I expose the tube to the action of obliquely-working rollers, by which the welding is completed. The speed of these oblique rollers must be so that the linear advance of the tube, caused by their rotation, shall be equal to the linear advance given to the tube by the conical mandrel. By no means are they allowed to be driven faster. They may go slightly slower to cause a certain upsetting action upon the material by retarding the advance in front of the tube.

Tubes of any size and length may be made in this way. The ends of the bars may be welded together to receive any desired length, and they may be wound up and heated in rings. The machine designed by me for the purpose consists of a solid block or body A, made in two pieces—the upper and lower one—both held firmly together by bolts and keys in any suitable manner, as shown by Figs. 2 to 4, 11 to 15, and 17 and 18 in two different manners. In the center this block is bored out conically and in the cone surface is cut a spiral groove B, Figs. 1 and 5. Near the end of the cone (near its base) the groove runs out in a straight tangential direction toward the circumference of the block A to form the entrance into the machine. The pitch or inclination of the spiral B is, as was said above, very steep at the beginning, and it diminishes toward the point of the mandrel until the pitch is equal to the width of the bar, and here the grooves, or rather the solid partition between two following windings or threads, disappear, Figs. 5 and 17, making but a recess in the cone surface. In that part of the machine is placed the nut T, Figs. 9 and 10. This is made exchangeable and of hardened steel. It is held in place by ears cast at each side of the same and embedded in cavities provided for it in the upper and lower part of the block A. Into the hollow cone of the block A is fitted the conical rolling mandrel C, Figs. 1, 7, and 8. This is the positive-acting and movable and motion-giving element of the machine. It is turned at a very high speed and has a pulling or pushing effect upon the heated bar between it and the block A in the groove B. It is also provided with riflings of same pitch as the groove B in the hollow cone, and it ends in a small cylinder, where it projects out of the block. Its thin end is made in a separate piece and exchangeable. At the thick or base end the mandrel is coupled to a driving-shaft D, carried in plumber-blocks E, and being provided with a driving-pulley or a spur-wheel to receive its rotary motion from any suitable shafting. The exchangeable part of the mandrel is made of hardened steel because it is exposed to the greatest wear and tear. According to the diameter of the tubes to be made it is exchanged, as well as the nut. Outside of the block A the mandrel is made cylindrical F, ending in a short cone. This little cylinder F is coupled to the other part by a universal or ball joint, so that it can be adjusted and move a little in any direction, Fig. 8. When small tubes are being made, this ball-coupling may be dispensed with and the cylinder F may be made in one piece with the other part of the end of the mandrel.

With the apparatus so far described are combined the oblique-acting rollers G G′, which are adjustable and press upon the cylindrical mandrel. The shafts H H′ of the rollers G G′ are carried in standards I I and I′ I′. They of course rotate in the same direction, and not, as ordinary rollers, in opposite directions. In place of this, little oblique rolling-mill rollers *g g′*, with parallel axes of usual design and turning in opposite directions, may be used, Figs. 17 and 18, when it is intended to make half-finished fabrics only.

In order to prevent the movable end of the mandrel from shifting right and left too much, I use the pressure-rollers N N′, Figs. 2, 4, 11, 12, and 13, mounted in the brackets L and L′, which are fixed to the face of the lower part of the block A in such a manner that they can be adjusted conveniently and pressed against the tube being formed. The spindle of the upper entrance guide-roller O, Figs. 14, 15, 19, and 20, may be fitted with a little spur-wheel *e*, being in gear with a wheel *e′* of the shaft D. By this means the rollers act positively to push or draw the bar into the machine, and not to only guide it; and the movement or speed of the bar does not depend upon and is not caused exclusively by the action of the mandrel alone.

Fig. 21 shows in section the shape of the bar, which I prefer using in making tubes according to my method and with my machine, and Fig. 22 shows how the spiral lap-welded joint represents itself by using such a bar, and that the half-round bead is allowed or caused to rise upon the adjoining edge and to enter into the corresponding groove of this edge, thus making a perfect joint. In order to aid the formation of this joint, I place into one or two of the pits or holes Q of the block A, nearest the outlet side of it, instead of the guide-rollers P′, the retarding or brake bolts *m*. By their means the workman re-

tards the advance of the bar by pressing the bolt down upon it when it first passes that place, and so assists the part of the metal following to mount upon the preceding winding, and thus to form the perfect lap-joint, with the half-round bead lying on or in the corresponding groove of the other edge of the bar. The downward pressure of the retarding-bolts can be made automatically, and working constantly by the use of springs or an eccentric, (indicated at the upper side of Fig. 2,) or by screwing them down.

The working of the machine described is as follows: The oblique rollers G G′ and the pressure-rollers N N′, as well as the guide-rollers P′, having been properly adjusted, the mandrel is made to rotate very fast, and now the white-hot bar is pushed into the machine between the entrance guide-rollers into the groove B. As soon as it reaches the circumference of the mandrel this will pull it into the machine and force it along the spiral groove B, the guide-rollers P′ in the pits Q assisting the bar to keep in contact with the mandrel. The guide-rollers P′ are carried in brackets S by the bolts P, which are adjustable, to exert a smaller or greater pressure upon the bars passing below them. Between the rollers and the sides of the holes Q in the lower part of the block A sufficient space is left for the outlet of scales of iron formed, in order to prevent choking of the passage and stopping the advance of the bar. The bar enters nearly in a straight line gradually, but in a short time takes the screw form, changing its angle of inclination as it advances until both edges of the bar touch each other, Fig. 16, and nearly at the end of the block A the brake-bolt *m* causes the foremost winding to be retarded in advancing axially and the edge of the following winding to mount upon the preceding one, thus forming the lap-joint, and when coming out of the block A the bar already forms a regular tube, requiring only the necessary pressure to be finished, and this is done by the oblique rollers G G′, as described before. A box containing welding-powder may be placed above the outlet of the machine, from which a continuous stream of that material falls upon the heated bar, thus aiding the welding. If it should happen or if desirable that the heat of the tube, or rather the bar at the outlet from the block A, should not be sufficient to make a good welded joint, or if it is so desired, a half-finished fabric may be turned out, and this is then reheated and welded in a separate operation by means of a mandrel, as usual.

Having now explained my manner of working and the machine employed, what I claim as my invention, and desire to secure by Letters Patent, is—

1. In a machine for making welded tubes with a spirally-running lap-joint, the combination of the block A, having a spiral groove B in its hollow conical boring, the holes or pits Q, the exchangeable nut T, the entrance-rollers O O′, and the guide and pressure rollers P′, with the rolling mandrel C.

2. The combination of the block A, having a spiral groove B in its conical boring, the holes Q, the exchangeable nut T, the entrance-rollers O O′, the guide and pressure rollers P′, the rolling mandrel C, the exchangeable mandrel end C′, the cylindrical end F, being made adjustable by a ball-joint with the oblique rollers G G′, and the pressure-rollers N N′, as set forth and specified.

3. The combination of the block A, having a spiral groove B in its conical boring, the holes Q, the nut T, the mandrel C C′ F, the entrance-rollers O O′, the guide and pressure rollers P′, with ordinary rollers *g g′*, as set forth and specified.

4. The combination of the block A, having a spiral groove in its hollow cone, the holes Q, the exchangeable nut T, the mandrel C C′ F, with the shaft D, the geared entrance-rollers O O′, and the guide-rollers P, with the brake or retarding bolts *m*, as set forth and specified.

FRANZ HEINRICH JULIUS WÜSTENHÖFER.

Witnesses:

CARL KRUGER,

LUDWIG BOCKMANN.