(No Model.) 8 Sheets—Sheet 1.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

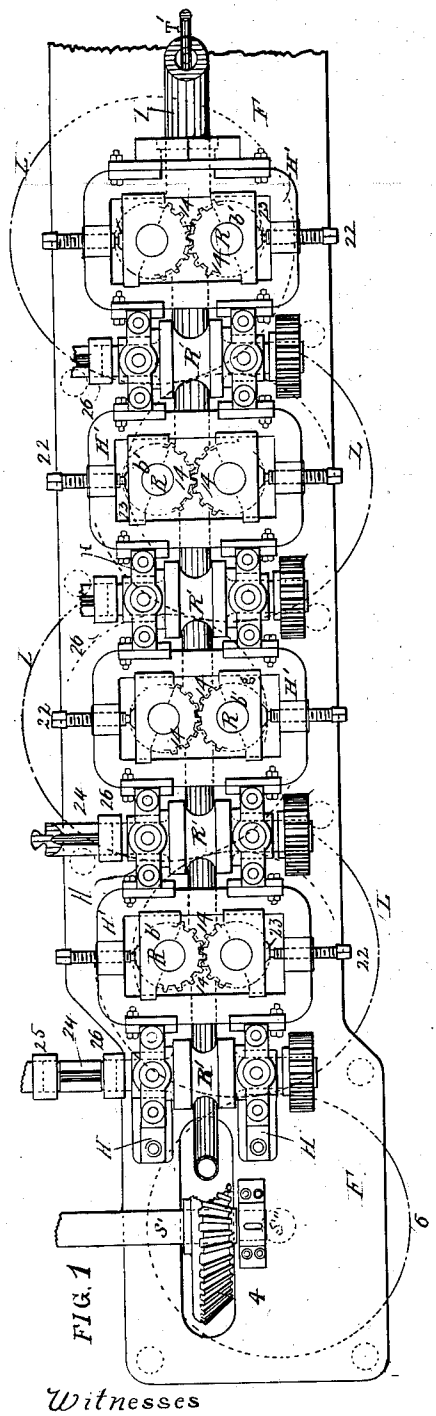


FIG. 1.

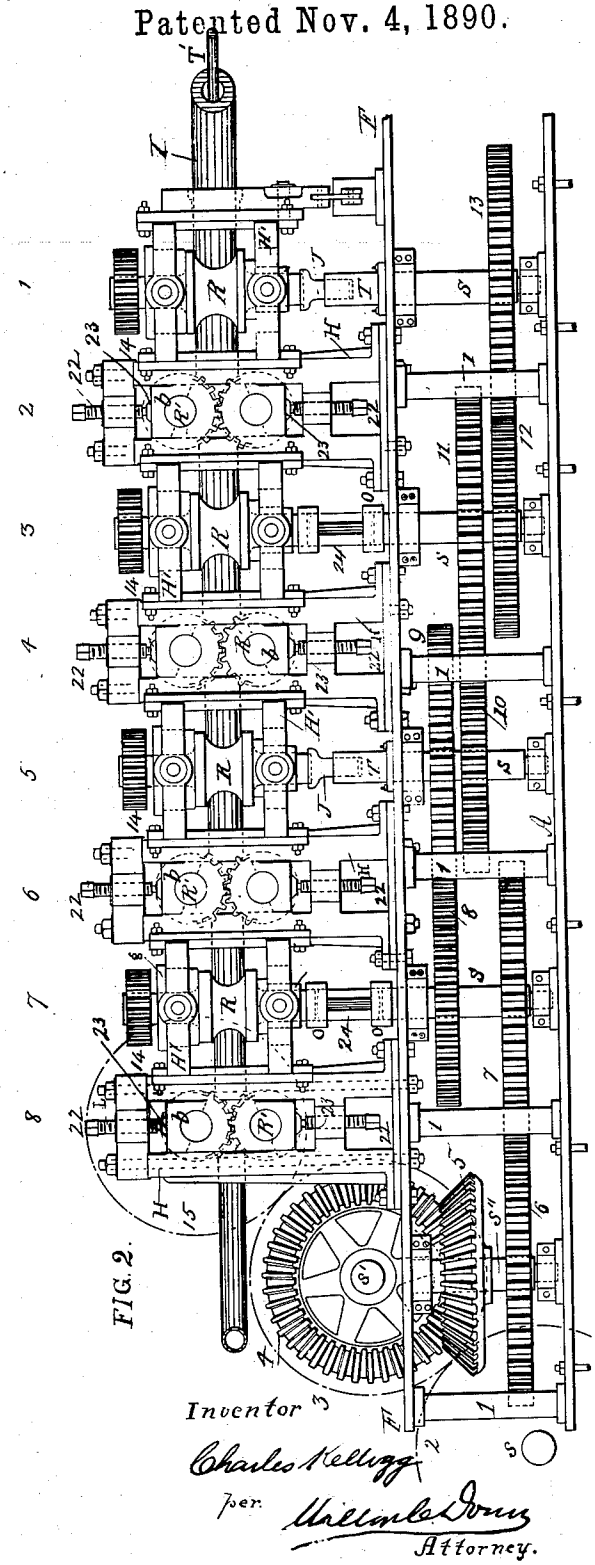


FIG. 2.

Witnesses
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(No Model.) 8 Sheets—Sheet 2.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

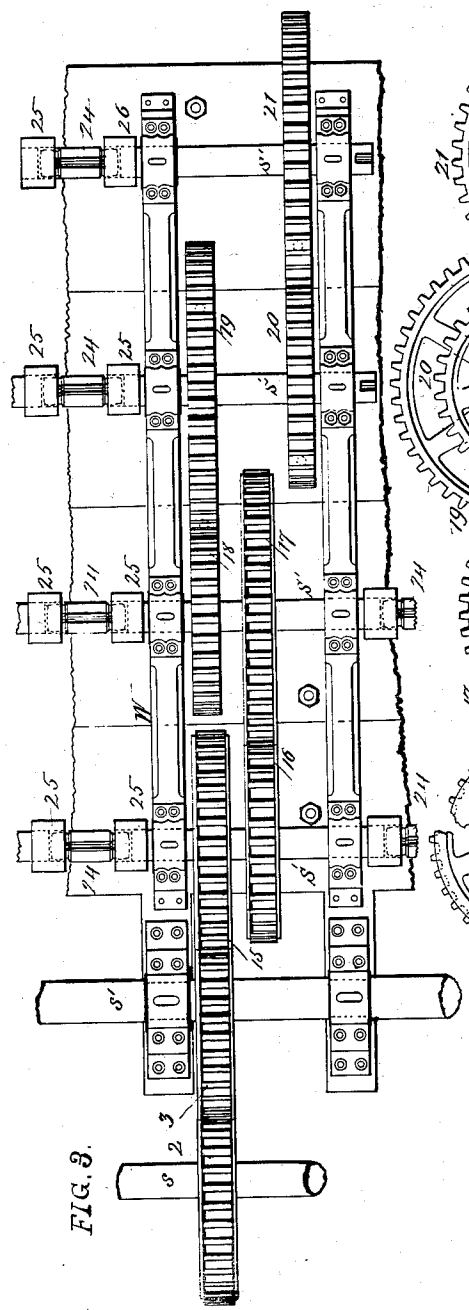


FIG. 3.

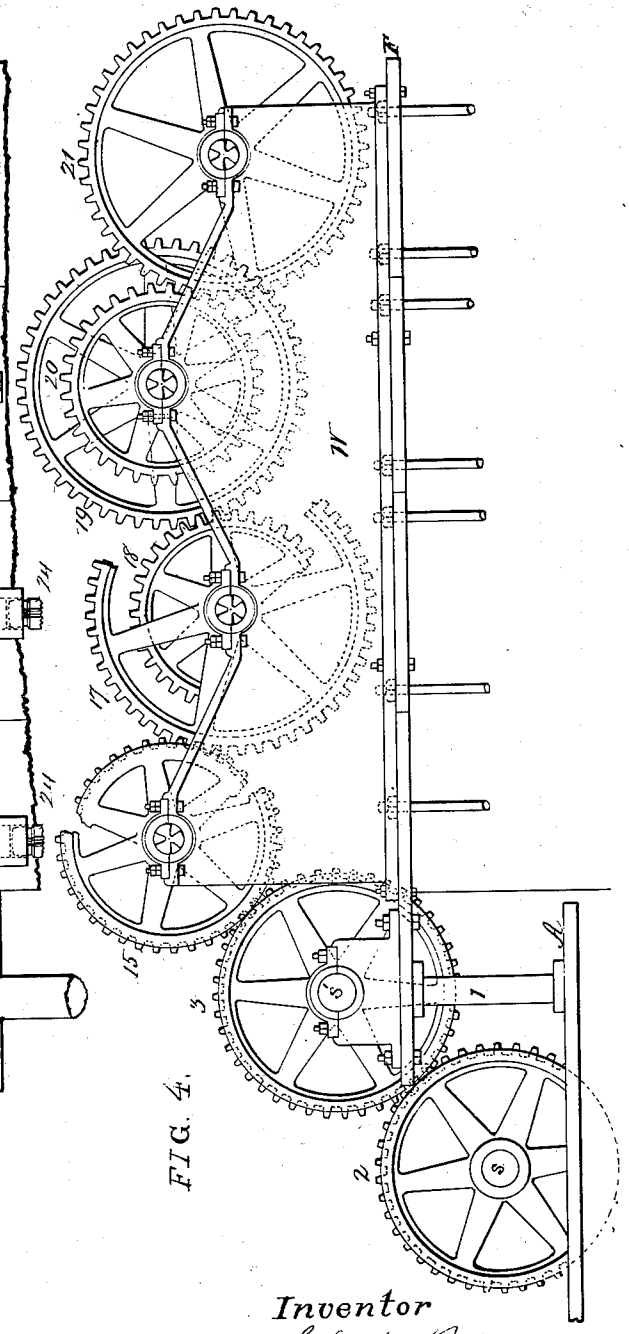


FIG. 4.

Witnesses
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(No Model.) 8 Sheets—Sheet 3.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

FIG. 6.

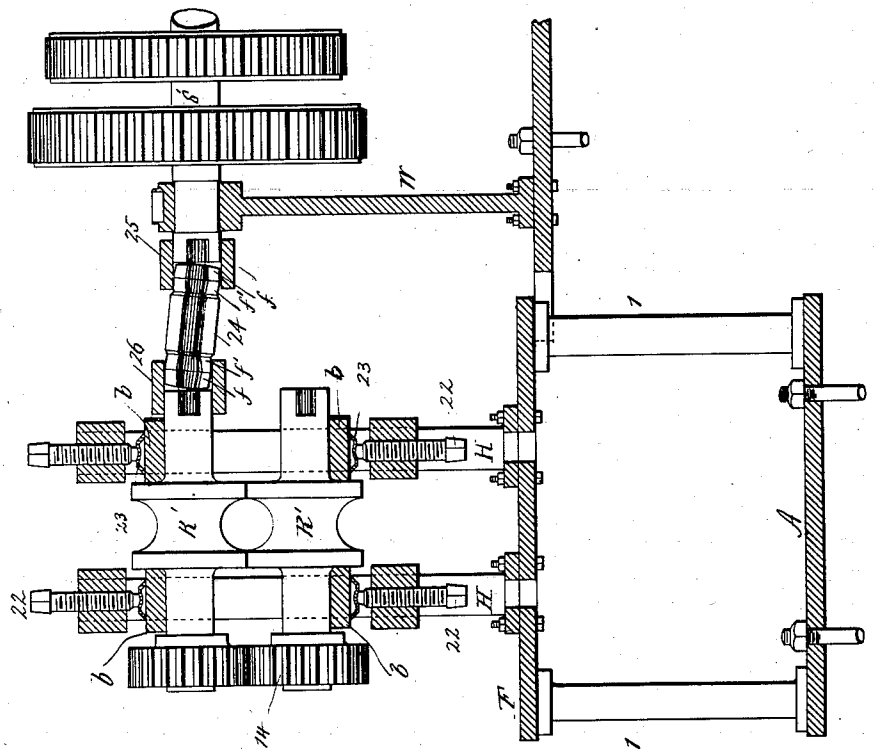
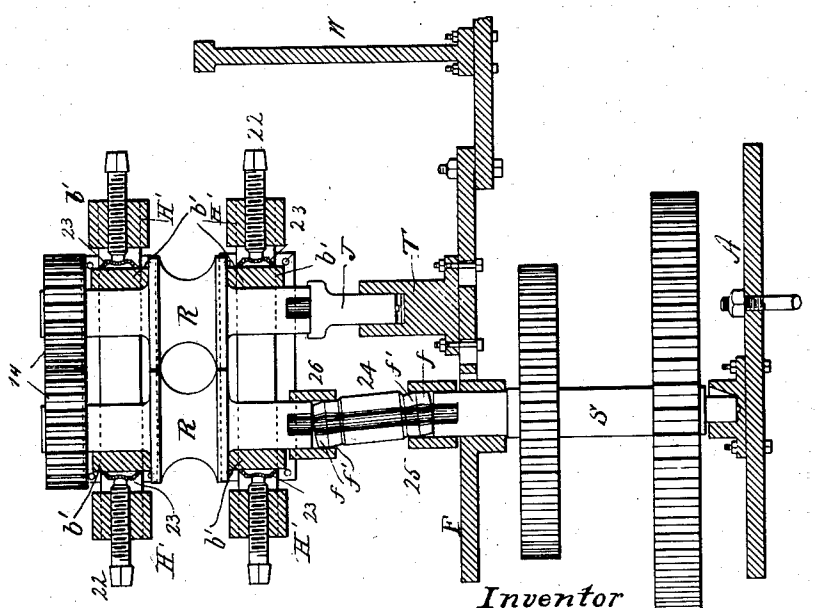


FIG. 5.



Witnesses
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(No Model.) 8 Sheets—Sheet 4.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

FIG. 6.

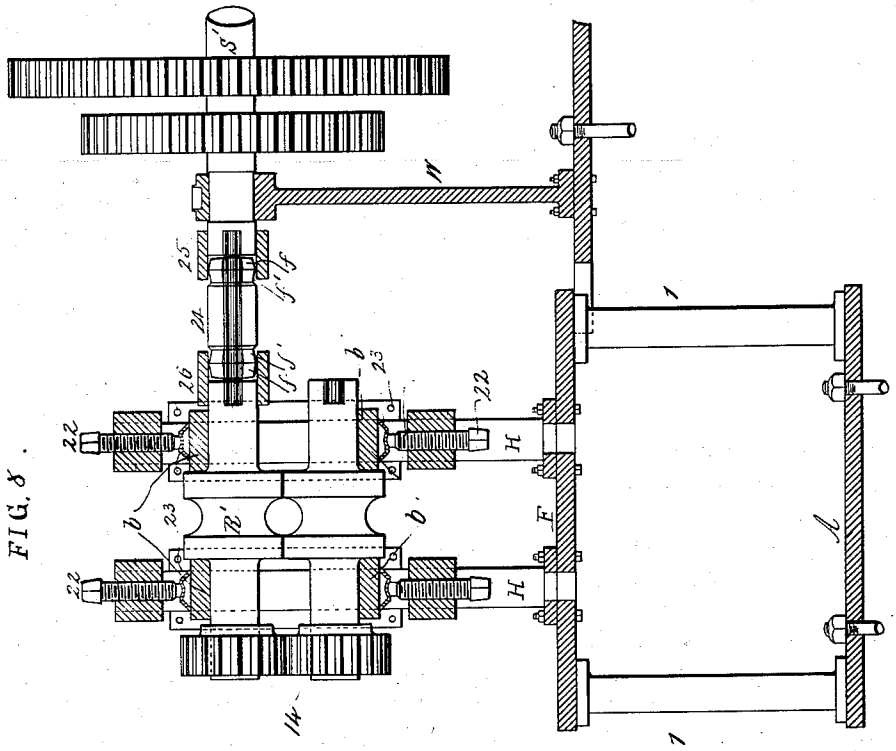
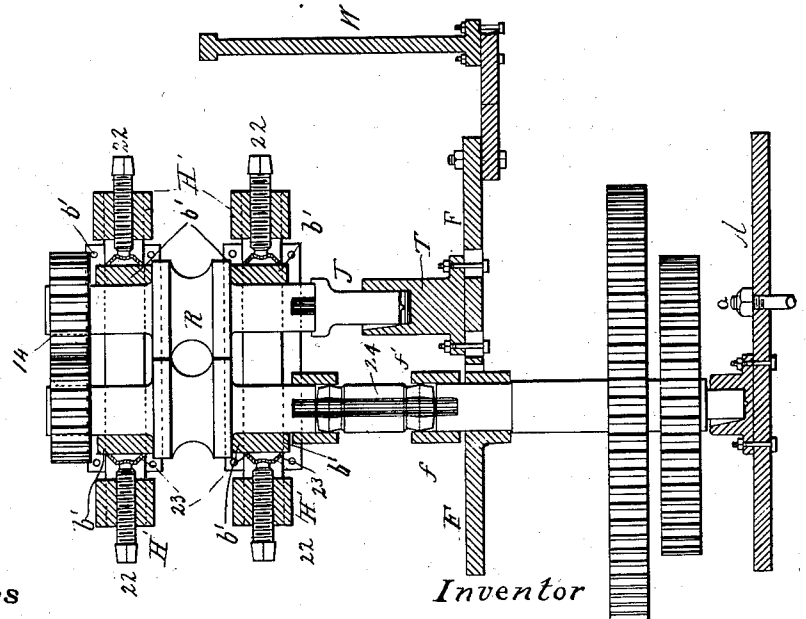


FIG. 7.



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(No Model.) 8 Sheets—Sheet 5.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

FIG. 10.

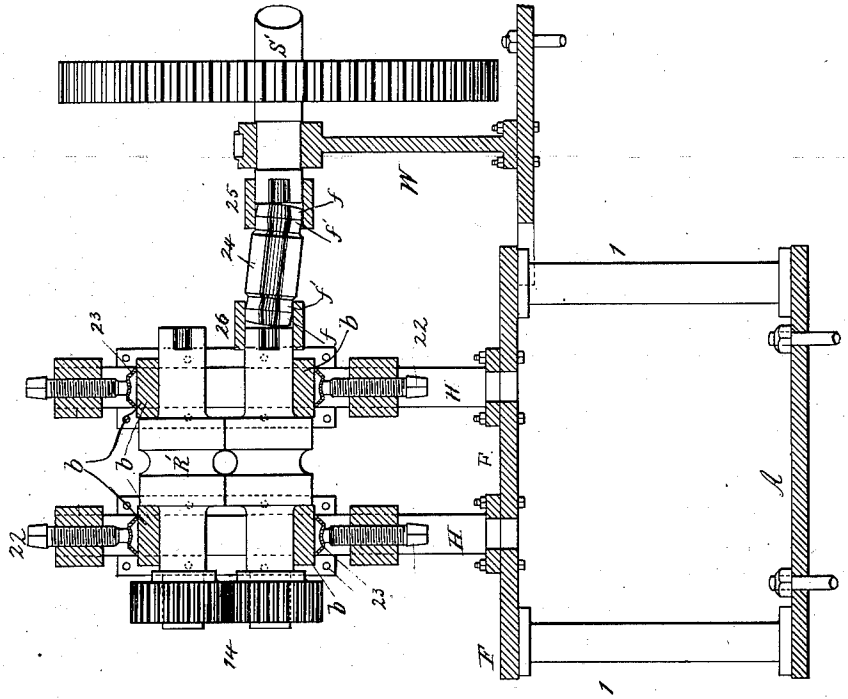


FIG. 9.

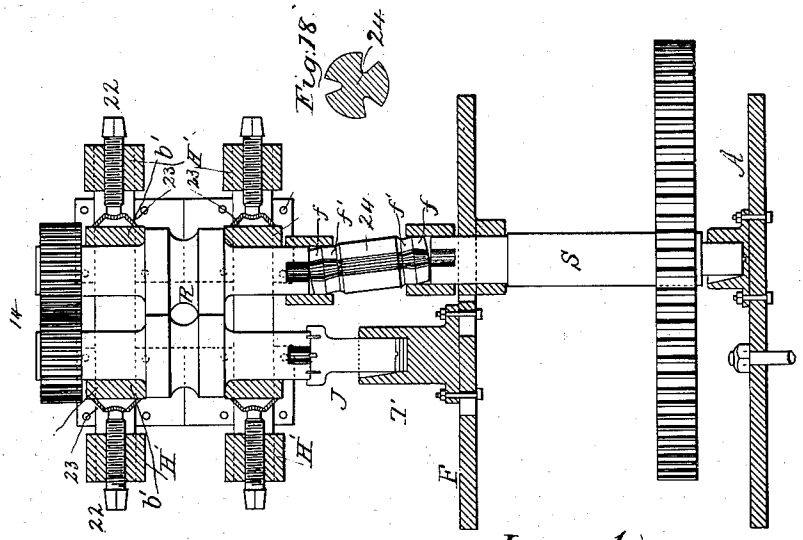


Fig. 18.

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(No Model.) 8 Sheets—Sheet 6.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

Fig. 11

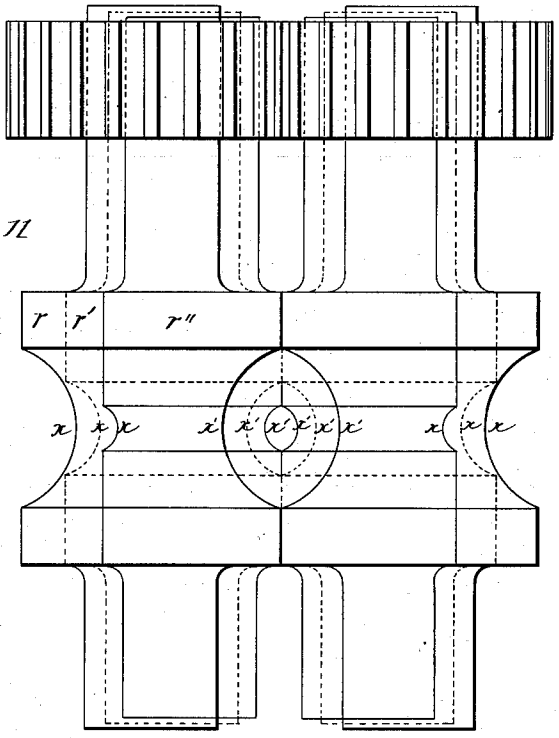
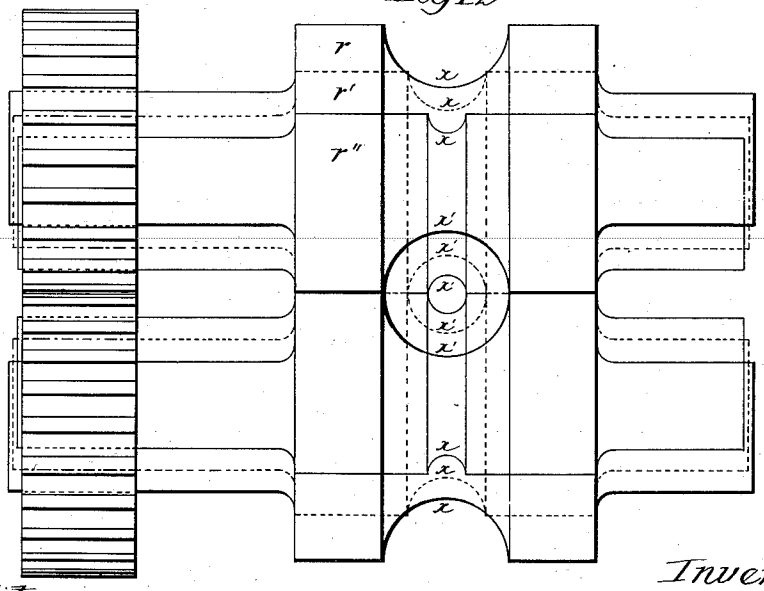


Fig 12



Witnesses:
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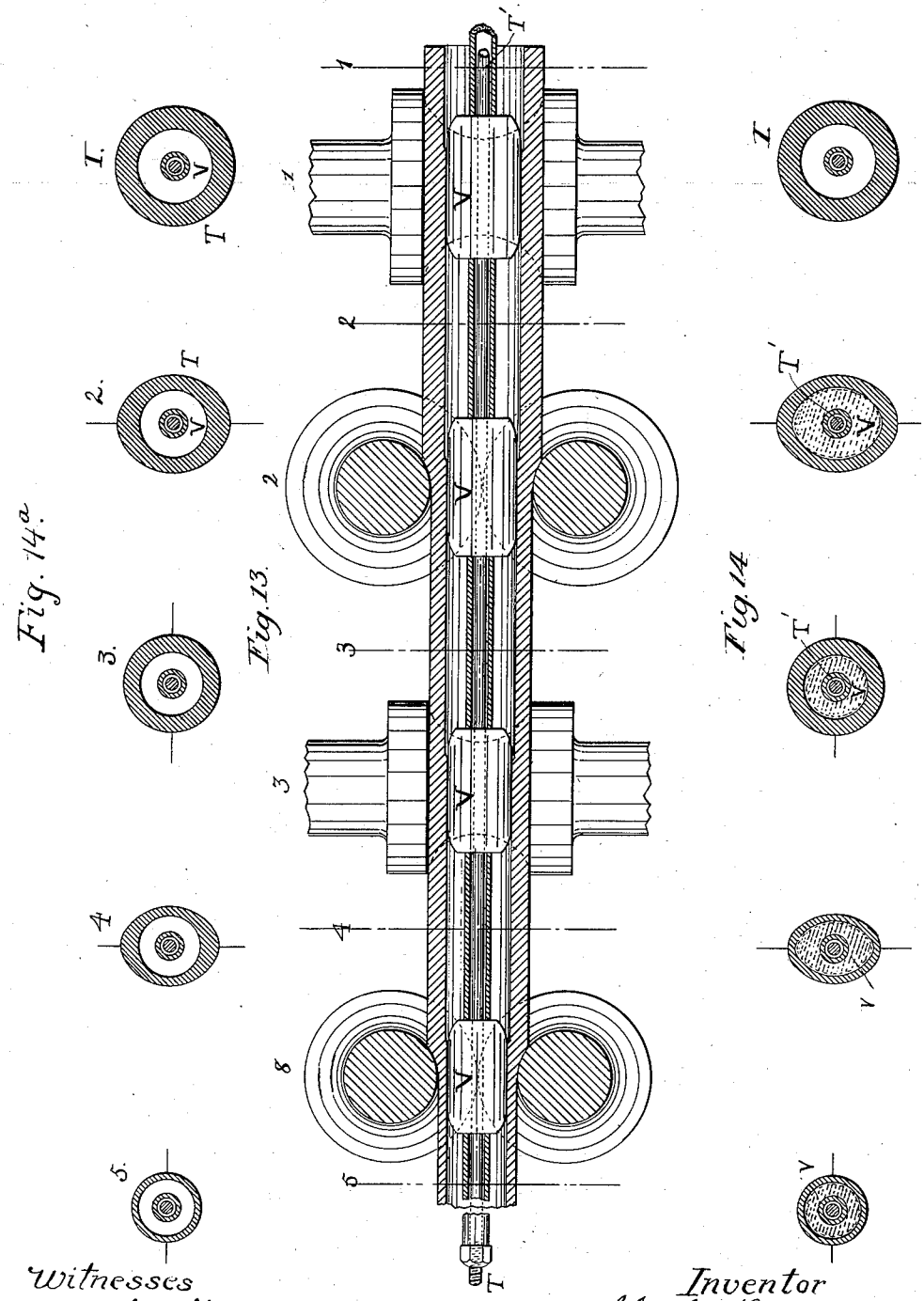
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Atty.

(No Model.) 8 Sheets—Sheet 7.

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MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.



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(No Model.) 8 Sheets—Sheet 8.

C. KELLOGG.

MACHINE FOR ROLLING TUBES.

No. 439,878. Patented Nov. 4, 1890.

FIG. 15.

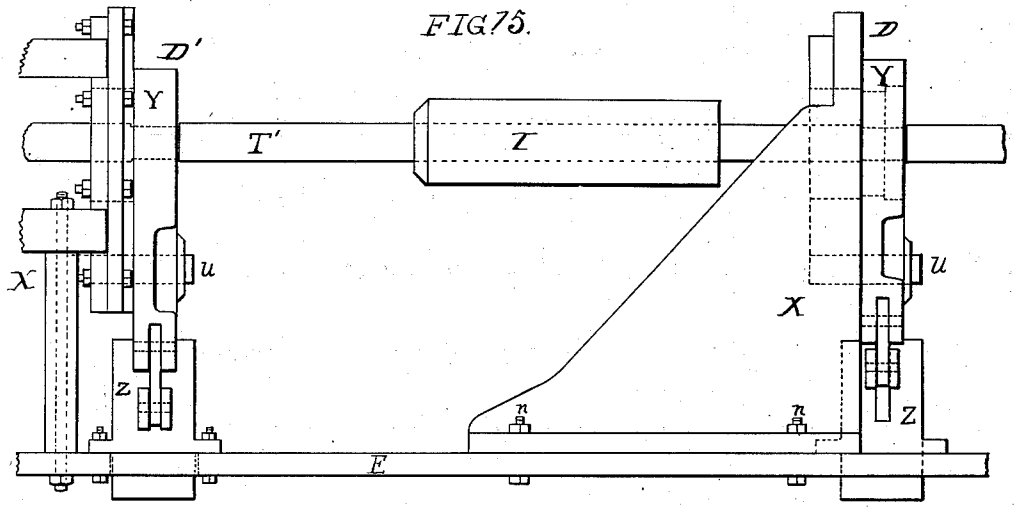


FIG. 16.

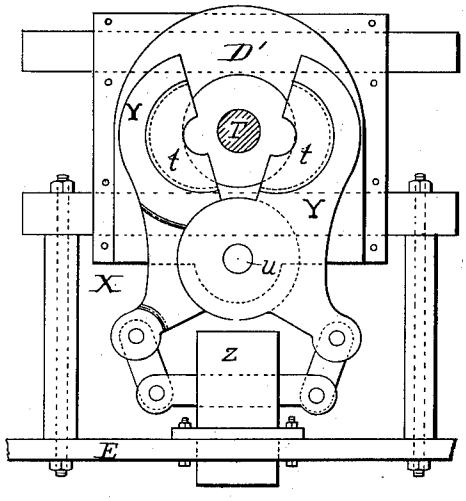
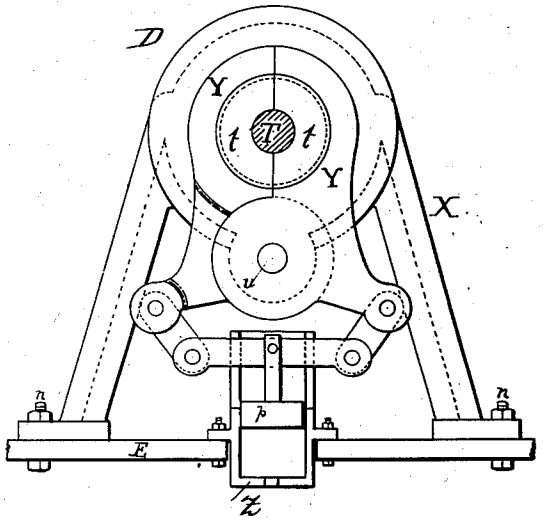


FIG. 17.



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UNITED STATES PATENT OFFICE.

CHARLES KELLOGG, OF FINDLAY, OHIO.

MACHINE FOR ROLLING TUBES.

SPECIFICATION forming part of Letters Patent No. 439,878, dated November 4, 1890.

Application filed May 1, 1890. Serial No. 350,220. (No model.)

To all whom it may concern:

Be it known that I, CHARLES KELLOGG, of Findlay, in the county of Hancock and State of Ohio, have invented a new and useful Improvement in Machines for Rolling Seamless Tubes, Pipes, Columns, and other Hollow Cylindrical or Tubular Articles, of which the following is a specification.

This invention relates to the manufacture of seamless tubes, pipes, &c., from hollow ingots, by means of a machine consisting of a series of pairs of grooved rolls operating in conjunction with a mandrel located in the passes of the said rolls.

In Letters Patent No. 397,724, granted to me February 12, 1889, for "machine for rolling seamless tubing," &c., I have shown and described a machine for making tubes, pipes, &c., by rolling, reducing, and elongating a hollow ingot, consisting of a series of pairs of alternate vertical and horizontal grooved rolls, driven at gradually-accelerating speed, a tapering mandrel placed between the rolls and centered in the passes formed by the grooves, and separately-operated grips which hold the mandrel and which can be independently released in order that an ingot may be passed into the mandrel and fed to the rolls without releasing or decentering the mandrel. The construction of the said patented machine is such that tubular articles of but one size can be manufactured by it. Hence a special machine is required for every size of pipe it is desired to make. As the pipes in common use vary greatly in size, to supply the market a factory would have to be equipped with a separate machine for every size of pipe produced, which would be very expensive, as well as inconvenient on account of the space required for the machines. To obviate these objectionable features of the patented machine is the object of my present invention; and it consists in the construction and adaptation to the driving mechanism of a rolling-mill of several series of pairs of rolls, each of said series being adapted to produce tubes of a different size from the other series, and said several series being interchangeable one with another or either of the other series, whereby a single rolling-mill plant is adapted to produce different sizes of tubes by merely changing the rolls.

In the accompanying drawings, Figure 1 represents a plan of the machine for rolling seamless pipe, &c.; Fig. 2, a side elevation of the same; Fig. 3, a top view, and Fig. 4 a side elevation, of the pinion-gearing for the horizontal rolls. Figs. 5 and 6 represent the two last pairs of a series of rolls for making large pipe; Figs. 7 and 8, the same for making medium pipe; and Figs. 9 and 10, the same for making small pipe, these figures also illustrating the mechanism for transmitting the motion of the gearing to the rolls. Fig. 11 represents vertical rolls for making large, medium, and small pipe, the three sets being placed together, and illustrating the novel construction by which the several sets of rolls may be used with the same system of gearing. Fig. 12 represents horizontal rolls, illustrating the same principle. Fig. 13 represents several pairs of rolls and a mandrel in sectional side elevation in connection with an ingot undergoing reduction. Figs. 14 and 14ª represent the several forms given to the ingot by the rolls 1, 2, 3, and 8, the former representing the forms given by alternately round and elliptical cavities or grooves and mandrel-balls, and the latter the forms given by round cavities or grooves and mandrel-balls. Fig. 15 represents a side elevation, and Figs. 16 and 17 end elevations of the grips for holding the mandrel. Fig. 18, Sheet V, a cross-section of one of the wabblers, showing the grooves therein.

Referring to the drawings, A designates the bed-plate of the machine, which should be laid on a foundation of solid masonry and secured thereto by anchor-bolts in the usual manner. Columns 1 rest on the bed-plate and support the housings-floor F. Between the bed-plate and housings-floor is placed the gearing for driving the vertical rolls, while the gearing that drives the horizontal rolls is placed in a frame-work W built on the housings-floor. The gearing of the vertical rolls R is connected with vertical shafts S, that are supported in suitable bearings on the bed-plate and floor, and the shafts S′, for the gearing of the horizontal rolls R′, are held in suitable bearings in the frame-work W. The vertical rolls are driven from the engine-shaft *s* by means of a spur-wheel 2, (indicated by

dotted lines only,) that engages a pinion 3 (also indicated by dotted lines only) on the counter-shaft *s'*. This shaft also carries a beveled wheel 4, that engages a beveled pinion 5 on a vertical shaft *s''*, which latter also carries a spur-wheel 6, that engages a pinion 7 on the shaft S of the last pair of vertical rolls in the machine. The several shafts S of the vertical rolls are thus connected together by a series of wheels and pinions 7 to 13. The shafts S are coupled alternately with the right and left hand rolls of the vertical series, this arrangement being indicated in Fig. 1 by the dotted lines L, that represent the wheels and pinions on the said shafts, and thus the said rolls are driven directly by the said shafts, while the uncoupled rolls are geared to the coupled rolls by toothed wheels 14 14, and thus the rolls of each pair are driven positively and at uniform speed. The successive pairs of rolls commencing with the first pair 1 are driven at gradually-increasing speed to compensate for the increasing length of the ingot as it is reduced in its progress through the rolls. The proportion the gearing of the several pairs of rolls bears to each other is approximately illustrated in Fig. 4 of the drawings of the Letters Patent above referred to.

The horizontal rolls are driven from the pinion 3 on the counter-shaft, the said pinion transmitting its motion through a series of spur-wheels and pinions 15 16 17 18 19 20 21 to the shafts S', coupled to the horizontal rolls in the same manner as the vertical rolls, the said shafts being coupled alternately to upper and lower rolls, counting from the front of the machine, and the rolls of each pair being geared together by toothed wheels. The gearing of the horizontal rolls is likewise arranged and proportioned to give a gradually-increasing speed to the successive pairs of rolls, the proportion of the gearing being also shown in Fig. 5 of the drawings of the said patent.

The horizontal rolls R' are mounted in upright housings H, and the journal-boxes *b* are constructed to slide vertically on suitable guides in the housings, adjusting-screws 22, bearing against suitable bearers 23 on the upper and lower boxes, being provided to move, adjust, and sustain the said rolls. The vertical rolls R are mounted in housing-frames H', bolted or otherwise fixed to the housings H, and the boxes *b'* of said vertical rolls are arranged to slide laterally on suitable guides in the said frames, lateral adjusting-screws 22, bearing on suitable bearers 23, being provided to move, adjust, and sustain the said rolls laterally.

By the above-described construction and arrangement of the two sets of rolls the several pairs are readily adjustable relatively to each other. Consequently the axis of the pass in each and every pair may be made to coincide with the axis of the passes in the remaining pairs, so that a line drawn through the center of the passes of the first and last pairs of rolls will be the center of the pass of every pair of rolls in the series.

The vertical rolls that are not coupled with the gearing-shafts S are coupled underneath to upright journals J, which are held in suitable bearings in standards T, bolted to the floor F, the journals turning freely in said bearings.

The rolls of both the vertical and horizontal series that are driven directly from the shafts S S' are connected with said shafts by means that permit the axis of rotation of said rolls to be changed at will, so that rolls of different diameters may be operated in the same machine and by the same gearing and shafts, and also be adjusted readily to the rolling positions. The means used for this purpose are contrivances that connect by means of coupling-sleeves, the gearing-shafts S S', &c., with the roll-shafts, and in such a manner that whether or not the axes of the rolls coincide with those of the shafts these contrivances will communicate the rotary motion of the shafts to the rolls. These contrivances are the wabblers 24, which have one end held in a sleeve-coupling 25 on shafts S S' and their opposite ends in couplings 26 on the roll-shafts. These wabblers should have their ends formed in such a manner that whatever their angular position with respect to the shafts and the rolls they will continue in engagement with the couplings and will transmit the motion of the shafts to the rolls. For this purpose the ends of the wabblers are provided with oppositely-beveled faces *f f'*, and they are also grooved, as shown by the cross-sectional view, Fig. 18, in the usual manner of the coupling ends of roll-shafts, by which they are adapted to connect with the sleeve-couplings. It will be observed that the grooves at the ends of the wabblers are also beveled to correspond to the beveled faces of the ends. By this construction the wabblers transmit the rotary motion of the shafts S S' to the rolls with which they are coupled, whether the rolls are centered with the shafts or decentered in any direction that does not destroy the parallelism of the axes of the rolls and the shafts.

Each of the sets of two pairs of vertical and horizontal rolls represented on Sheets III, IV, V, may be taken to represent the two last pairs of rolls of a machine adapted to make but one size of pipe, so that if used in the ordinary manner three distinct machines would be necessary to employ the said sets of rolls, but as this invention contemplates a machine that may be used to make many sizes of pipes, the said sets of rolls are intended to form parts of three series of pairs of rolls that are to be used in the same machine to make three sizes of pipes. For example, Figs. 5 and 6 are the final rolls of a series for making large pipe; Figs. 7 and 8, the same of a series for making medium pipe, and Figs. 9 and 10 the same for making small pipe. The series of rolls consist of alternate

vertical and horizontal rolls, as heretofore described, geared to move with increasing velocity. Thus understood the positions of the wabblers 24 with respect to the different sizes of rolls and the gearing-shafts may be readily understood from said figures. Thus in Figs. 5 and 6, representing the final vertical and horizontal rolls for making large pipe, the wabblers are turned outward in the vertical set and upward in the horizontal. In Figs. 7 and 8, representing rolls for medium pipe, the wabblers are centered with the gearing-shaft and the rolls, and in Figs. 9 and 10, representing rolls for making small pipe, the wabblers are directed inward and downward, respectively. Thus it will be seen that the wabblers can assume various positions with respect to the axes of the rolls and the gearing-shafts for the purpose of accommodating rolls of different diameters, and in these positions they transmit the power and motion of the gearing-shafts to the rolls. The rolls of both the vertical and horizontal sets that are not connected with the gearing-shafts are also adjustable, the first by means of the standards T, the fastening-bolts of which are passed through slots in the floor which permit the standards to be moved laterally, and the second by means of their adjustable boxes.

The construction of the rolls to adapt those of different diameters to be used in the same machine will best be understood by reference to Figs. 11 and 12, where three sets of horizontal and vertical rolls are represented. The three sets are drawn together, so that the differences in their size can be clearly seen. The rolls marked r, drawn in solid lines, are for rolling the largest-size pipe, those marked r' in broken lines are for the medium sized, and those marked r'' in solid lines are for the smallest-size pipe. The grooves, it will be observed, vary greatly in area, but the diameter of the rolls at the deepest part of the grooves, (the point $x\,x'$,) which may be designated the "pitch-line" of the rolls, for all three rolls is the same, and therefore the surface-speed of all the rolls at this point with the same system of driving-gear is the same. Hence either of the three sets of rolls $r\,r'\,r''$ may be used interchangeably in the same machine, and at the pitch-line $x\,x'$ their speed will be uniform. The pitch-lines $x\,x'$ are the points in the pass between the rolls, where the greatest resistance to the passage of the ingot is met with, and the gearing is adjusted to the action of the rolls at this point of their surface. Therefore when the gearing is adjusted to give a pair of rolls of a given diameter at their pitch-line a certain speed, other rolls having the same, or approximately the same, diameter at the point may be used in the same machine with the same system of gearing, notwithstanding that they may be of greater or less diameter at other points outside of the pitch-line, and their action on the ingot undergoing reduction and elongation will be the same.

By reference to Fig. 2, it will be seen that the pairs of rolls are numbered 1 to 8, consecutively, commencing at the front end of the machine, and these numbers indicate the position of the rolls in the machine or the order of their action on the ingot.

Where rolls of various sizes are to be used with the same machine to make different sizes of pipe, all those intended for the same position in the machine must have the same diameter on the pitch-line.

The shape of the passes in the rolls and of the mandrel-balls is illustrated in Figs. 11, 12, 13, and 14. The passes of the vertical rolls are elliptical and of the horizontal circular; but these latter may also be elliptical with their longer axes at right angles to the longer axes of the passes in the vertical rolls. The mandrel-balls V are longer than their transverse diameter and are preferably of uniform diameter except that their ends are beveled or chamfered off. These features of my invention are not claimed here, as they will form the subject of another application for Letters Patent.

The ingot I, Fig. 14, is approximately cylindrical. The first pair of rolls 1 gives it an elliptical form, pair 2 brings it back to a cylindrical form, and pair 3 again gives it an elliptical form. The following pairs 4 5 6 7 (not shown) roll it alternately to cylindrical and elliptical forms until the last pair 8 is reached, where the final form is given to it, and it passes from the machine. This final form is represented to be cylindrical, but it is evident that it may be of other forms in cross-section. It is preferred that the reduction of the walls of the ingot shall be uniform in the pass of each pair of rolls. For this purpose the perimeter of the mandrel-balls in cross-section should be parallel to the walls of the passes in which they are placed, so that the cylindrical or elliptical space between the mandrel-ball and the walls of the pass should be uniform, so that when the reduction takes place the walls of the ingot shall be reduced uniformly and in cross-section shall be of uniform thickness, as shown in Fig. 14. The alternate arrangement of rolls with elliptical and cylindrical passes may be departed from, and all of the rolls may have elliptical passes except the last, and adjacent pairs in that case should have their longer axes at right angles to each other, or approximately so.

The grips represented in Figs. 15, 16, and 17 consist of jaws Y Y, pivoted to standards X X, secured to the bed-plate in front of the first pair of rolls. These jaws are connected with steam-pistons in cylinders Z, which are arranged to receive steam from suitable boilers, (not shown,) and by a system of valves steam is admitted to and exhausted from under the said cylinders. The construction and operation of these grips are fully described in my Letters Patent above referred to, and no further description of their construction is necessary here. In their operation the man-

drel-rod T′ is held by the grips, and when an ingot is to be rolled the first pair of grips D is opened, as in Fig. 16, the other pair D′ remaining closed and holding the mandrel. The ingot I is then placed on the rear end of the mandrel and shoved through the grips D to the position shown in Fig. 15. Strips D are then closed and grips D′ opened, (the mandrel being now held by grips D,) the ingot is shoved through grip D′, and thence fed to the first pair of rolls. Thus the ingots are passed through to the rolls without releasing the mandrel from the control of the grips at any time.

I claim—

1. In a machine for rolling tubes, pipes, and other hollow cylindrical articles, the combination of driving-gears and shafts adjusted to drive rolls of a given diameter at a determined speed, with several series of pairs of grooved rolls, each of said series being interchangeable with another or either of the other series, substantially as specified.

2. The combination, in a rolling-mill, of several series of pairs of grooved rolls, the rolls of the corresponding pairs of the several series having the same diameter at the point of greatest resistance, and the series of pairs of rolls being interchangeable, substantially as specified.

3. The combination, in a rolling-mill, of several series of pairs of grooved rolls, the rolls of the corresponding pairs of the several series having the same diameter on the pitch-line, and each series of pairs of rolls being interchangeable with the other series, substantially as specified.

In testimony that I claim the foregoing as my invention I have hereunto subscribed my name this 11th day of March, 1890.

CHARLES KELLOGG.

In presence of—
FREDK. HAYNES,
WILTON C. DONN.