

J. J. GRUENFELD, JR.
HOLLOW CONCRETE POLE MAKING APPARATUS.
APPLICATION FILED JUNE 18, 1918.

1,303,889.

Patented May 20, 1919.
11 SHEETS—SHEET 1.

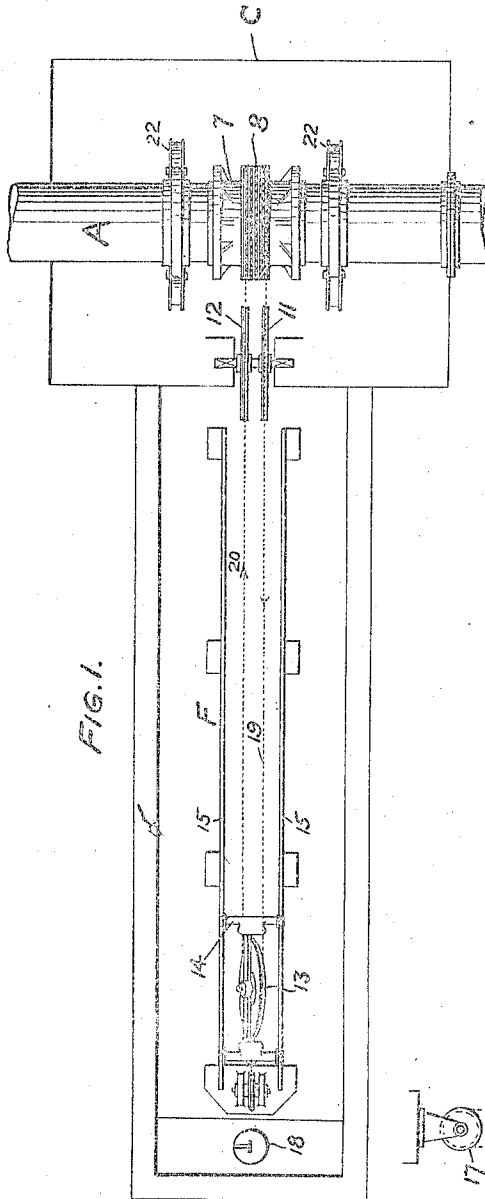


FIG. 1.

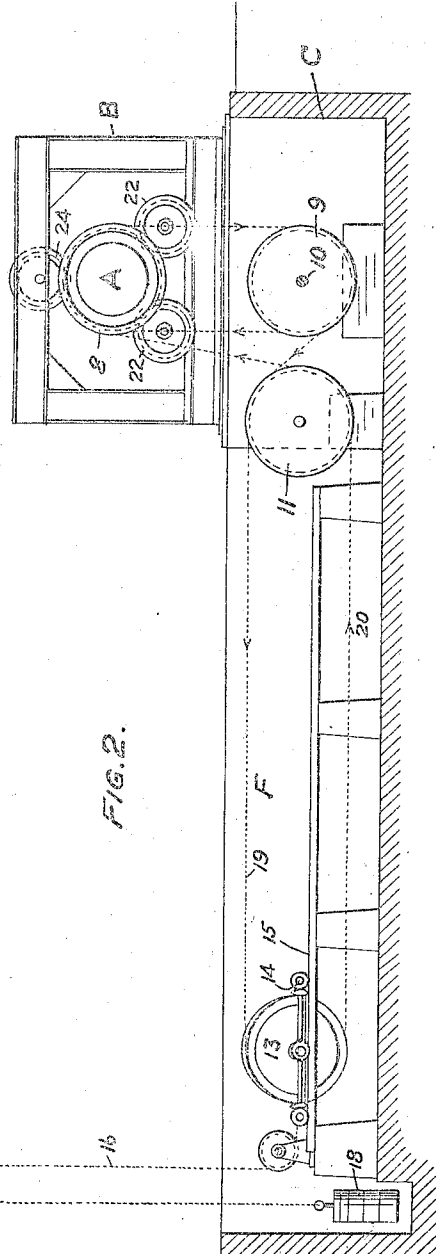


FIG. 2.

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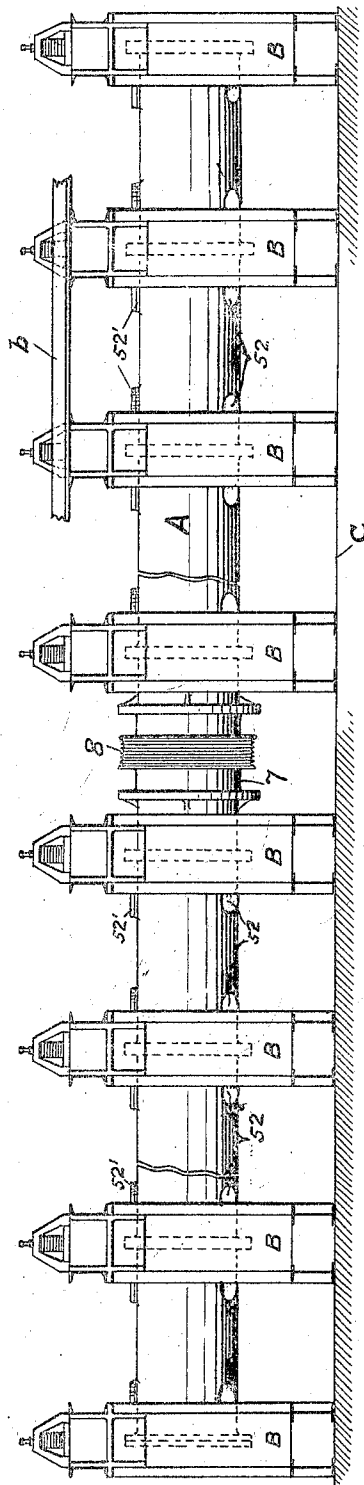
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11 SHEETS—SHEET 2.

FIG. 3.



WITNESS:
Robt. P. Litchel.

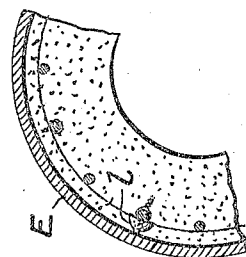


FIG. 5.

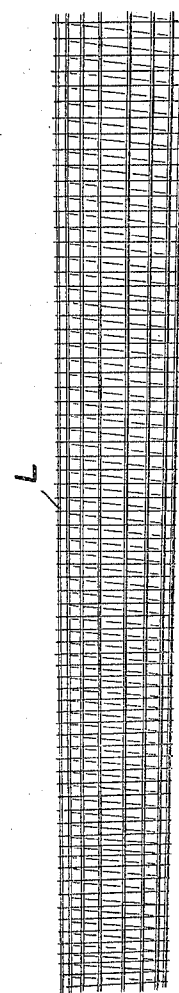


FIG. 4.

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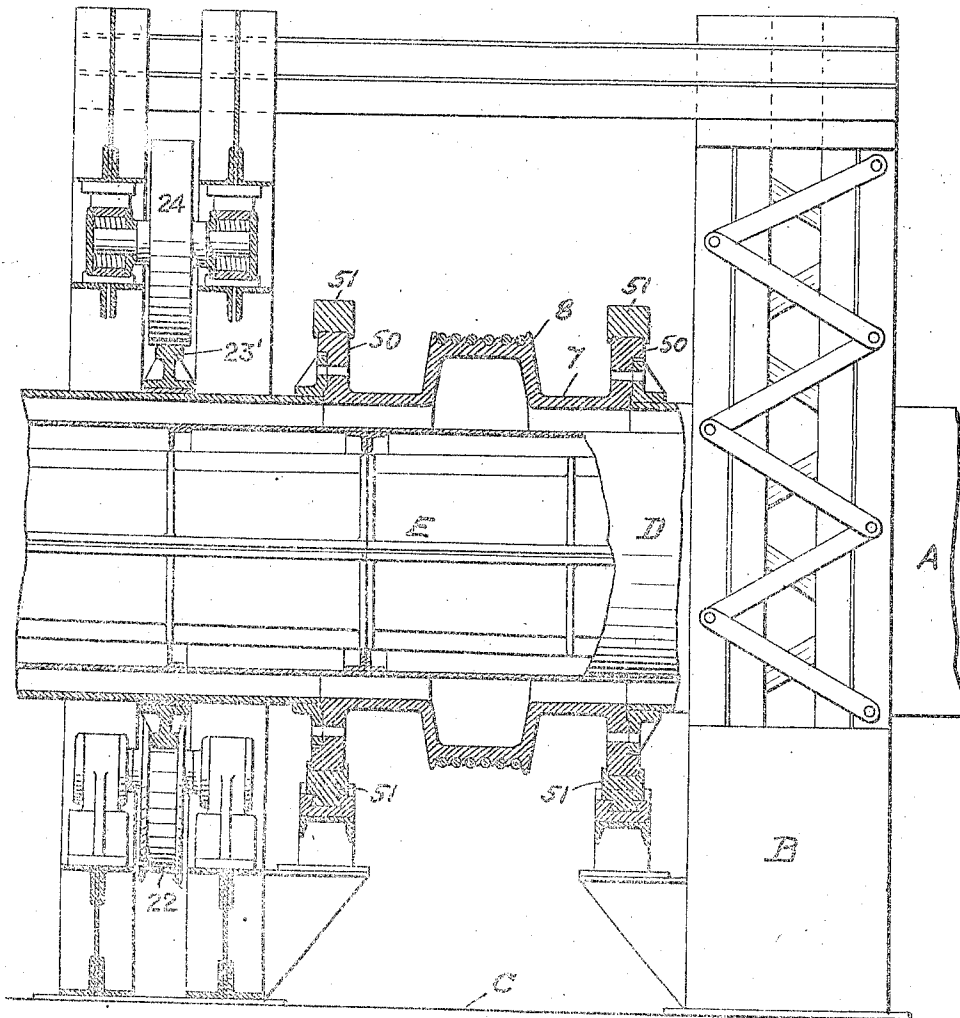


FIG. 6.

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11 SHEETS—SHEET 4.

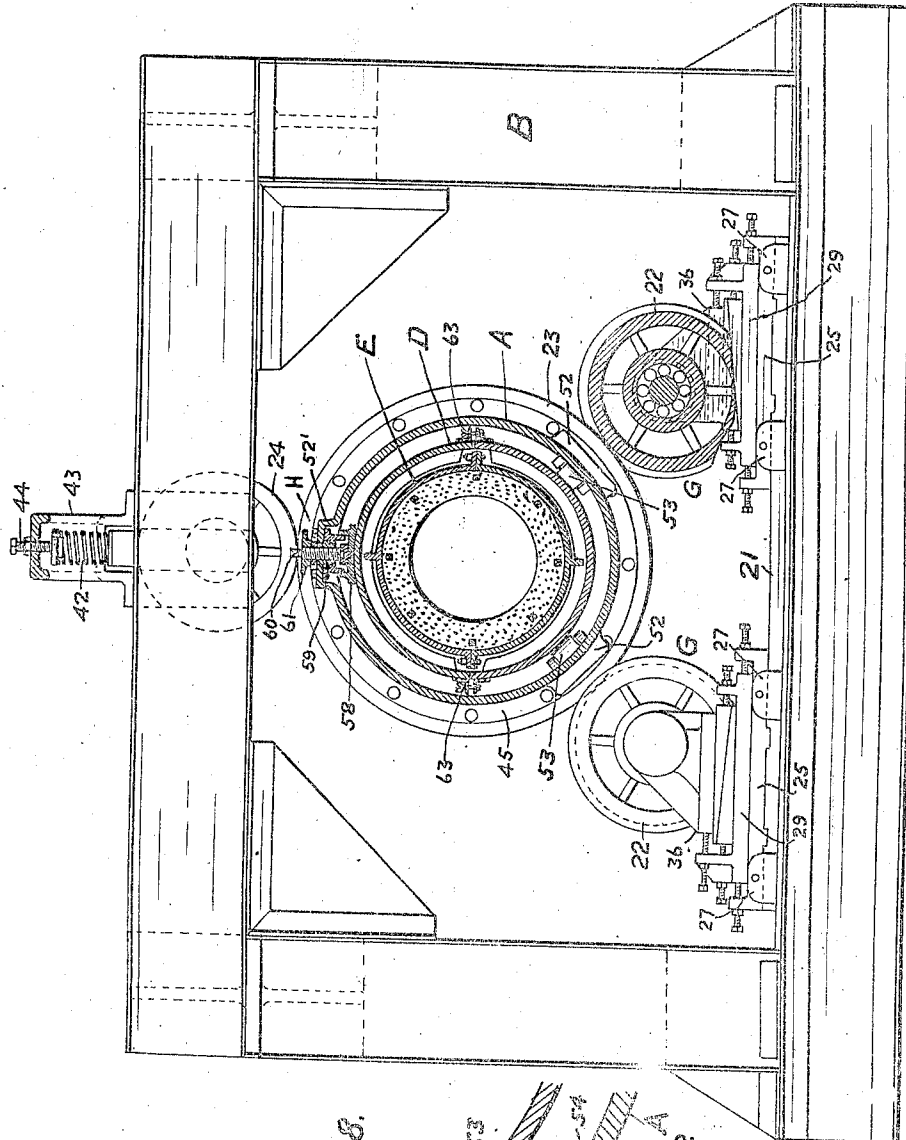


FIG. 7.

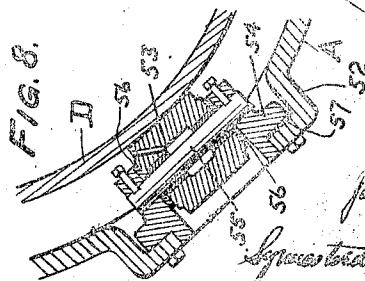


FIG. 8.

WITNESS:

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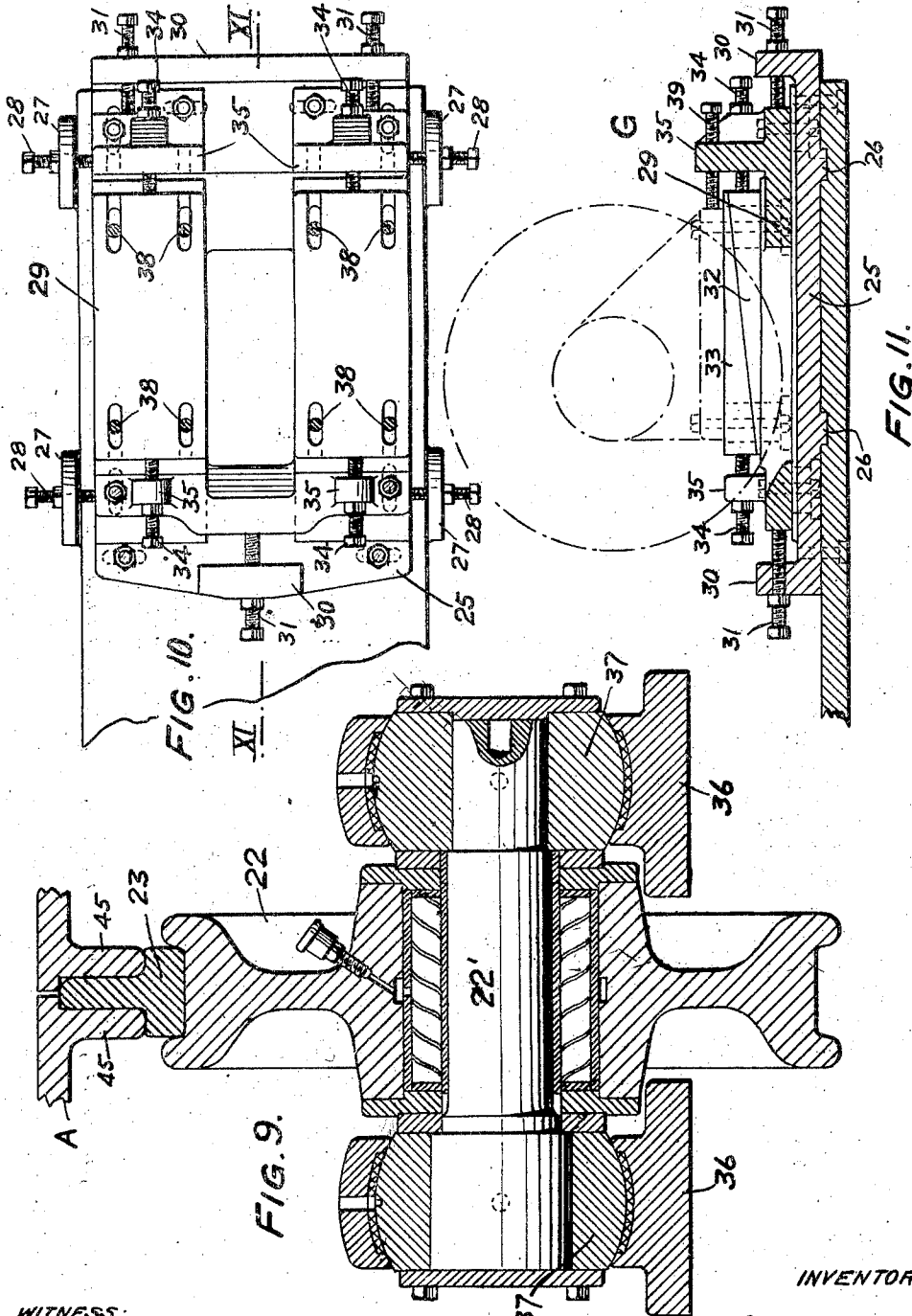
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11 SHEETS—SHEET 5.



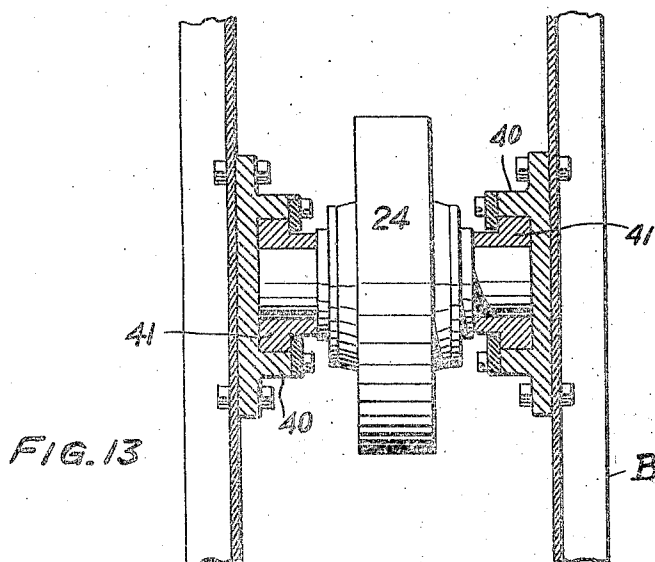
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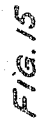
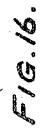
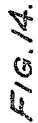
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11 SHEETS—SHEET 7.



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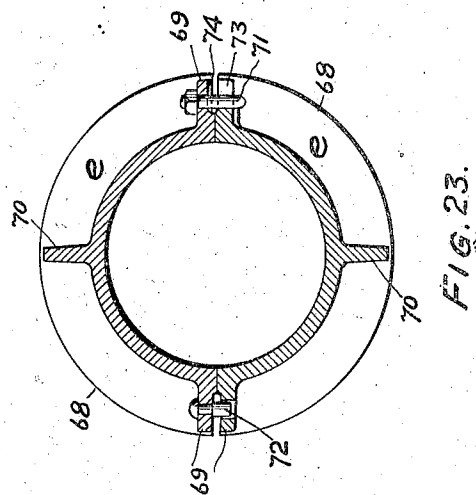
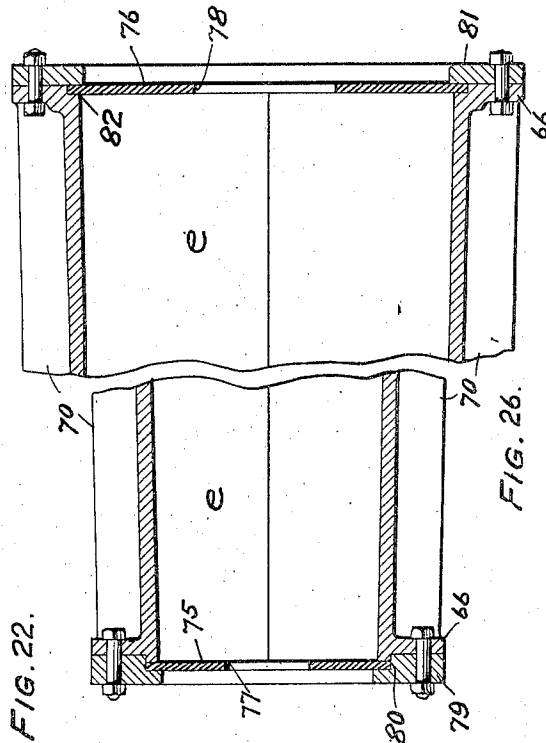
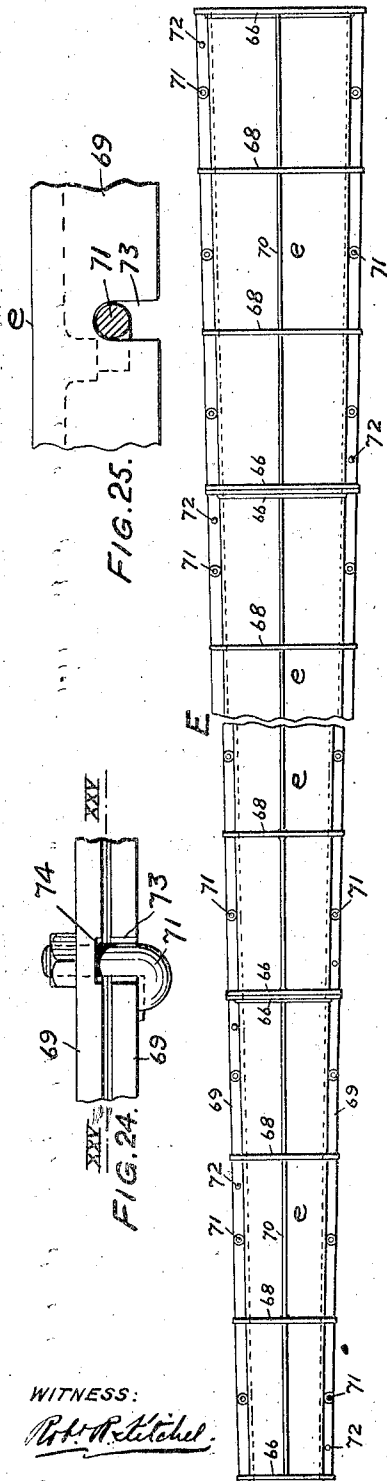
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HOLLOW CONCRETE POLE MAKING APPARATUS.
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11 SHEETS—SHEET 9.



WITNESS:
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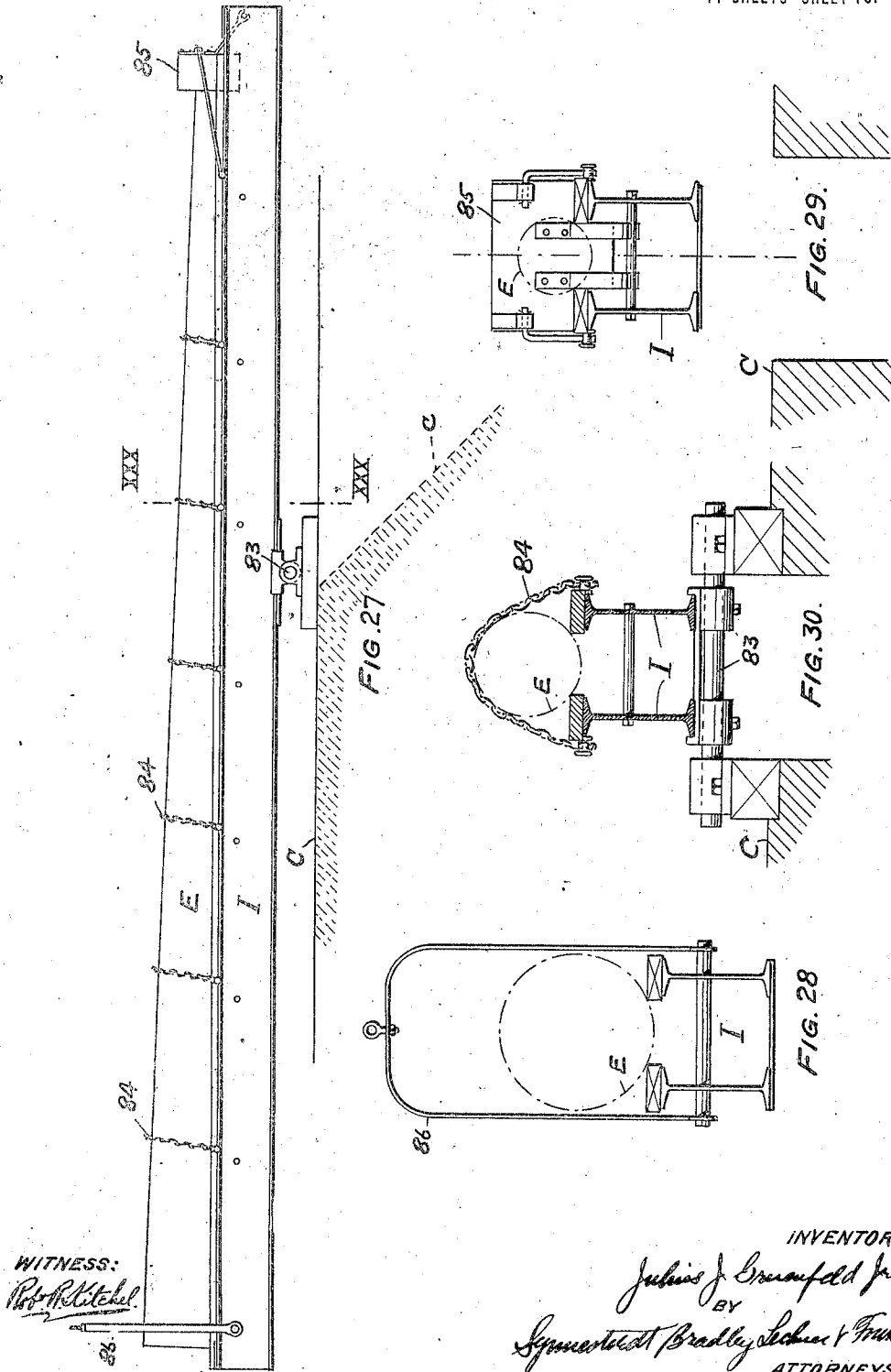
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HOLLOW CONCRETE POLE MAKING APPARATUS.
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J. J. GRUENFELD, JR.
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11 SHEETS—SHEET 11.

FIG. 31.

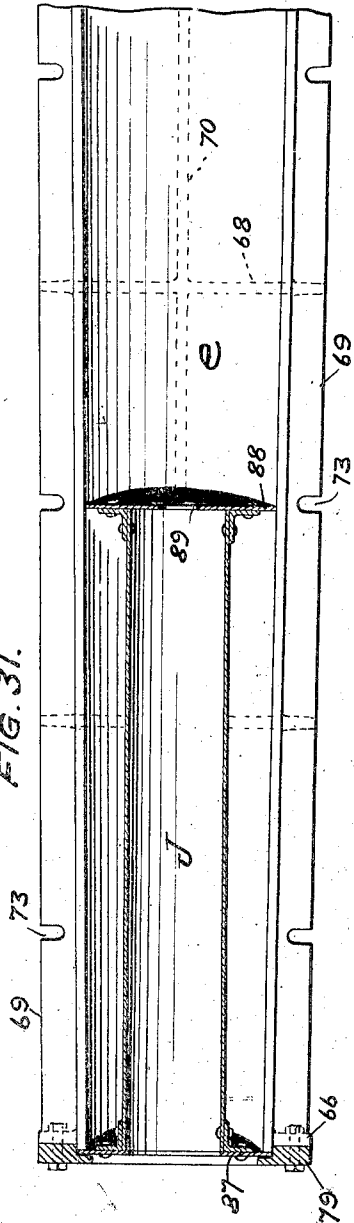
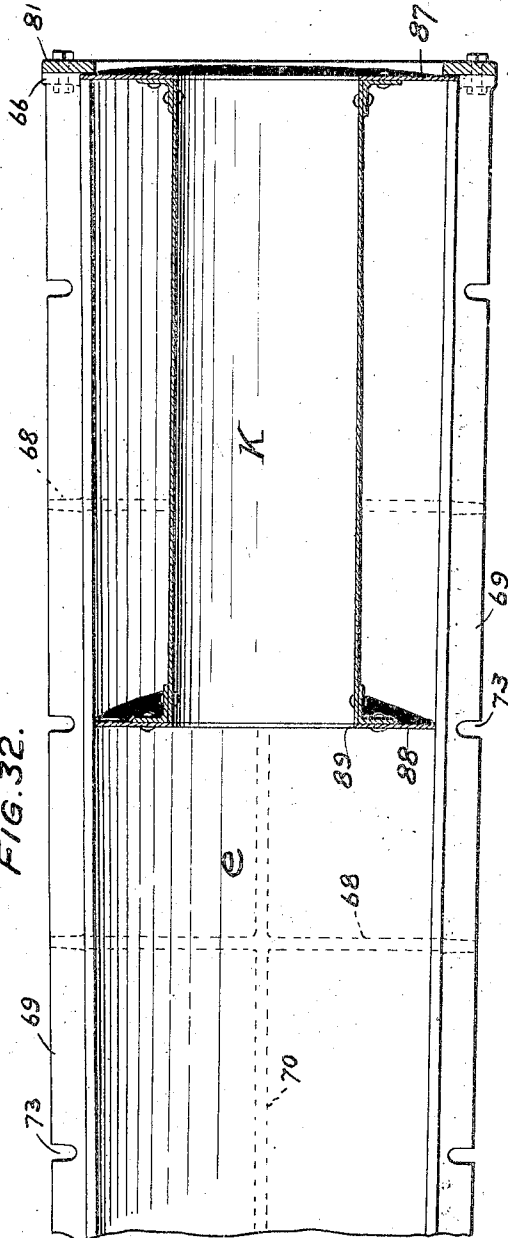


FIG. 32.



WITNESS:

Attest

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UNITED STATES PATENT OFFICE.

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HOLLOW-CONCRETE-POLE-MAKING APPARATUS.

1,303,889.

Specification of Letters Patent.

Patented May 20, 1919.

Application filed June 18, 1918. Serial No. 240,646.

To all whom it may concern:

Be it known that I, JULIUS J. GRUENFELD, Jr., a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hollow-Concrete-Pole-Making Apparatus, of which the following is a specification.

This invention relates to apparatus for making hollow concrete poles by the rotary process and it has for its primary object the provision of improved apparatus which is simple but rigid in construction, and in which wear of the parts and liability to breakage are reduced to a minimum. My invention also contemplates the provision of improved apparatus, the parts of which may be conveniently handled and manipulated in assemblage, and readily adjusted. A further object resides in the provision of means whereby the apparatus can be readily adapted to the production of poles of different lengths, and in an improved arrangement whereby the proper distribution of the concrete is obtained.

Other objects of the invention reside in the provision of improved driving means; the provision of improved means for supporting the rotating parts and supporting them against whipping or deflection during rotation; the provision of improved bearings permitting adjustment of the parts; the provision of an improved arrangement of sectional driving casing and wearing tires; the provision of improved means for preventing relative displacement of the interior parts of the apparatus, etc., as will further appear hereinafter.

I accomplish the foregoing by means of improvements illustrated in preferred form in the accompanying drawings, wherein:—

Figure 1 is a plan view of the driving mechanism for rotating the outer or driving casing and its associated parts; Fig. 2 is a side elevation of Fig. 1; Fig. 3 is an end elevation of the apparatus partially broken away showing the outer or driving casing and the supporting standards or box framework therefor; Fig. 4 is an elevation of a portion of the skeleton reinforcing which is supported in the mold proper and is adapted to be embedded in the concrete; Fig. 5 is a fragmentary sectional view, drawn on an enlarged scale and illustrating the method

of supporting the skeleton in the mold; Fig. 6 is an elevation and partial section illustrating a modified method of revolvably supporting the outer casing in the box-frames and also shows a portion of the brake mechanism; Fig. 7 is a section through the butt end of the apparatus showing the box-frames in side elevation and the means whereby the outer casing is adjustably supported in such frames for rotation; Fig. 8 is an enlarged section showing one of the rollers by means of which the intermediate casing carrying the mold proper is readily inserted in the outer or driving casing and supported therein; Fig. 9 is a cross-sectional view through one of the lower adjustable rollers which support the rotating parts through the medium of wearing tires, together with the preferred form of bearing for such rollers; Fig. 10 is an enlarged plan view of the adjusting support for the bearings shown in Fig. 9; Fig. 11 is a section taken on the line XI—XI of Fig. 10; Fig. 12 is a section through the upper portion of the box-frame illustrating one of the upper rollers which support the driving casing; Fig. 13 is a horizontal section taken on the line XIII—XIII of Fig. 12; Fig. 14 is a typical elevation partly in section of the preferred form of the outer casing, illustrating the manner in which the sections are joined with each other and with the wearing tires therebetween; Fig. 15 is an enlarged sectional view of the tire and the joint between the sections of the outer casing; Fig. 16 is a cross-section taken on the line XVI—XVI of Fig. 14; Fig. 17 is a longitudinal section through the halves of the intermediate casing in which the mold proper is carried and shows the various typical forms of intermediate stiffening bearing rings and the end plates or closure members for such intermediate casing; Fig. 18 is a section on the line XVIII—XVIII of Fig. 17, illustrating one typical stiffening ring for the intermediate casing, and illustrating the manner in which the mold is supported thereby; Fig. 19 is a cross-section taken on the line XIX—XIX of Fig. 17, and illustrates another typical form of stiffening ring, and the manner in which relative rotation of the mold with respect to the intermediate casing is prevented; Fig. 20 is a fragmentary section drawn on

an enlarged scale of an intermediate bearing and stiffening ring showing the manner in which the mold is held against longitudinal displacement relative to the intermediate casing; Fig. 21 is an end elevation of the right hand end of Fig. 17; Fig. 22 is a plan view of the mold proper, with the intermediate portions broken away; Fig. 23 is an irregular cross-section through the mold shown in Fig. 22, illustrating the manner in which the halves of the mold are doweled and are secured together; Fig. 24 is an enlarged view showing the construction and arrangement of the hooks for locking the halves of the mold together; Fig. 25 is a section taken on the line XXV-XXV of Fig. 24; Fig. 26 is a section through the mold with the intermediate portions broken away to illustrate the means for closing the ends of the mold; Fig. 27 is a diagrammatic view of a tilting bridge or frame, on which the mold is supported during the charging operation; Fig. 28 is an end elevation of the left hand end of Fig. 27 drawn on an enlarged scale; Fig. 29 is an end elevation of the right hand end of Fig. 27 drawn on an enlarged scale; Fig. 30 is a cross-section taken on the line XXX-XXX of Fig. 27, drawn on an enlarged scale; Fig. 31 is an enlarged longitudinal section through the tip end of the mold illustrating the preferred means for varying the length of the pole to be formed in the apparatus; and Fig. 32 is a similar section of the butt end showing the shortening of the pole to be formed at such end.

Referring particularly to Figs. 1, 2, 3 and 7, it will be seen that the apparatus comprises, in general, a driving or outer casing or shell A which is rotatably mounted in a plurality of spaced box-frames B suitably anchored or supported in a foundation C; an inner shell or holder casing D mounted within the drive shell A and adapted to removably inclose and support the mold E in which the poles are to be made; and the driving mechanism indicated as a whole at F in Figs. 1 and 2. Before passing to a detailed description of the driving casing, the holder, the mold and associated parts, the driving mechanism will be described, attention being directed particularly to Figs. 1, 2 and 3.

The outer or driving shell A, which is of sectional construction, as will hereinafter be pointed out, is provided at a point intermediate its ends, and preferably nearer the butt end of the apparatus than the tip end thereof, with a cylindrical casting 7 having a sheave 8 below which is a driving sheave 9 mounted on the driving axle 10 (driven from a suitable motor, not shown). On a level with the sheave 9 and to the left thereof, are a pair of idler sheaves 11 and 12, and at the left hand end of the driving mechanism

is a tension sheave 13 mounted in a carriage 14 which runs on rails 15. A cable 16, passing over the suspended pulley 17 and carrying a weight 18, is connected to the carriage 14 and normally draws the tension sheave 13 to the left to place the driving rope 19 under tension. A single hempen driving rope or cable is employed, the path of travel of the rope being indicated in arrows. Starting at the lower horizontal row marked 20, the rope passes under the sheave 12 and over the sheave 8, and thence under sheave 9, being preferably wrapped ten times around the sheaves 8 and 9, and then it passes from below sheave 9 over sheave 11 and around tension sheave 13.

The framing in which the outer or drive shell A is rotatably mounted will now be described, attention being directed particularly to Figs. 3 and 7, upon inspection of which it will be seen that the box frames B comprise a rectangular structure composed of channels suitably secured together and braced. The box-frames are mounted on a suitable foundation C, as before pointed out, and are braced at the top by longitudinal angles 6. To the bottom member of each box-frame is bolted a base sole plate 21. At opposite ends, each base sole plate supports a carriage G, to be described, in which is revolvably mounted a trunnion wheel 22, such trunnion wheels being flanged to engage wearing tires or rails 23, carried on the outer shell, as will hereinafter be set forth. The weight of the outer shell and its contained parts is carried on the trunnion rollers 22, and each box-frame is provided with a third or idler roller 24 yieldingly held in engagement with its respective tire or rail 23. The rollers 22 and 24 thus constitute a three point support for the driving shell, the idler rollers being adapted to prevent the driving shell from climbing the trunnion wheels 22 on one side when the shell is revolving at high speed.

One of the reasons why the idler rollers 24 are yieldingly mounted is that it is necessary to provide a machine, the longitudinal axis of which may be slightly tilted at different angles for different lengths and tapers of poles in order that the proper distribution of concrete shall result, and a pole of uniform thickness of shell be produced. To the same end the trunnion rollers 22 are supported in their carriages in such manner that they may be raised and lowered. In order to facilitate the shifting of the longitudinal axis of the machine, a prefer to raise the machine at one end and lower it at the other by correspondingly raising the trunnion wheels in varying degrees on one side of the axis of tilting, and lowering the trunnion wheels in varying degrees on the other side of the axis of tilting. It will also be seen that the tilting of the machine, which

of course involves a tilting of the plane of rotation of the tires or rails 23, necessitates the canting of the trunnion rollers 22 so that they may rotate in the same plane as the rails. The construction of the carriages G, in which the trunnion rollers 22 are mounted, is designed to meet these ends and will now be described.

On the end of each base sole plate 21 is mounted a longitudinal sole plate 25 having parallel tongues 26 riding in corresponding grooves formed in the base sole plate and extending longitudinally of the machine. Each base sole plate carries upstanding lugs 27 at its sides and locking bolts 28 are threaded into these lugs for adjustably fixing the position for the longitudinal sole plates of the machine. Mounted on each longitudinal sole plate is a transversal sole plate 29, the inner and outer ends of the longitudinal sole plates carrying upstanding lugs 30 provided with locking bolts 31, adapted to abut against the inner and outer edges of the transversal sole plates and determine the position of the latter toward or from a vertical plane passing from the axis of the machine. Upon each transversal sole plate are mounted two sets of wedge plates spaced apart to permit the rotation of the trunnion wheel therebetween, the transversal sole plates also being centrally channelled for such purpose. Each set of wedge plates comprises a lower plate 32 and an upper plate 33, the positions of which are adapted to be shifted by the locking bolts 34 threaded in the lugs 35 on the ends of the transversal sole plates 29. Each end of the trunnion wheel axles 22' is supported in a housing 36, each of which is carried on an upper wedge plate 33.

From the foregoing it will be seen that the carriages G are constructed to have movement longitudinally of the machine and transversely of the machine, and that the axis of the rollers is not only capable of vertical adjustment but may be canted to correspond with the tilt of the longitudinal axis of the machine.

In this connection it is to be observed that the housings 36 are provided with spherical bearing portions to fit the balls 37 in which the ends of the trunnion roller axles 22' are supported. These bearings constitute a ball and socket joint which will permit of one of the housings 36 being shifted vertically with respect to the other housing, whereby the axis of the trunnion wheel axles may be canted.

When all of the parts just described have been finally adjusted for a particular type of mold, they are held in fixed position by the locking bolts 33 (see Figs. 10 and 11). The bolts 39 and the bolts 34, respectively, serve to position the housings 36 and the wedge members. The yielding mounting of the

idlers permits of the making of the various adjustments.

Another reason for providing a yielding mounting for the idler rollers 24 is to permit obstructions to pass between the rails or tires and the trunnion wheels. To these ends, the idler rollers are mounted as follows: (See particularly Figs. 12 and 13). In the upper reach of each box-frame B, I have provided a vertical slotted guideway 40, in which is mounted a slide or cross-head 41, the ends of the axles of the idlers being journaled in such cross-head. The stout compression spring 42 normally serves to press the cross-head and its contained roller downwardly against the respective rail and maintains the driving shell A in proper position in the box-frames in the manner hereinbefore pointed out, such spring being topped by a pressure plate 43, and the tension of the spring being adjustable by a locking bolt 44. The spring is centered by bosses 41' and 42'. If a small obstruction falls between the trunnion rollers and the rails, the spring 42 will yield and the rails will ride over the obstruction. If an obstruction should fall between the trunnion rollers and the rails of a size too great to pass therebetween, the cross-head will come against the stop 43', as a result of which the particular trunnion wheel affected will be broken, the trunnion wheels being constructed of such material and in such manner as to collapse under such strain before any damage occurs to the rails and the shell.

Attention is now directed to Figs. 14, 15 and 16, which are views showing typical sections of the outer or driving shell and the manner of mounting the wearing tires or rails between the joint sections. It will be noted, from inspection of these figures, that the shell A is composed of a plurality of sections *a*, such sections being provided with an annular flange 45 at each end, such flanges having their outer faces turned down as indicated at 46 to receive the inwardly projecting shank of the tires or rails 23. The thickness of the shank is such that the ends of the sections do not abut. The bolts 49 serve to connect the flanges 45 with the rail therebetween, the construction being simple and economical. In Fig. 6 a modified arrangement for supporting the tires or rails 23' is shown.

The sections *a* of the shell may be of varying length, as required. Thus, for example, the sections immediately adjacent the driving sheave casting 7 are very short in order that the shell may be supported at points adjacent the application of power. The casting 7 is provided with annular brake hubs 50 which carry brake bands 51 such as shown, for example, in Fig. 6, the brake bands being operated in any preferred manner. Such braking mechanism is necessary

to stop the machine which may be rotated so rapidly as to have a peripheral speed of the rails of a mile a minute.

The sections A of the outer casing are provided with bosses 52 arranged in pairs at the bottom and with other bosses 52' at the top, oppositely located with respect to the bosses 52. The lower bosses 52 are adapted to receive casing rollers 53 carried in a suitable housing 54 bolted to the frame. In the upper bosses 52' are mounted clamping devices H. The clamping devices H and the casing rollers 53 form a three point support for the intermediate casing or holder D, each holder, with its contained mold E, being adapted to be slid longitudinally into the outer shell over the rollers 53, and when once positioned to be clamped into position by the clamping devices H.

In Fig. 3 I have shown the construction and mounting of the casing rollers 53, from inspection of which it will be seen that the roller shafts 55 are fixedly supported in the housing or casing 54, the thrust washers or shims 56 being interposed between the roller and the housing and being provided for purposes of adjustment in order to insure proper centering of the casing within the outer shell. It will be noted in this connection that the surface of the rollers 53 is tangential to the surface of the intermediate casing or holder so that wearing of the casing rollers theoretically takes place at one point. By interchanging the washers 56 or by inserting washers of a different size, a fresh point of contact between the rollers and the holder may be secured. Similarly the lower end of the housing 54 may be shimmed up as indicated at 57. By this arrangement it will be seen that the intermediate casing can be centrally located through the medium of the casing rollers and the clamps H.

The clamps H are shown in section in Fig. 4 and comprises a shoe 58 slidably mounted on a collar or sleeve 59 carried in the boss 52', the shoe being forced into engagement with the periphery of the casing D by means of a screw 60 locked in position by the locking wheel 61.

The intermediate casing or holder D will now be described, attention being directed particularly to Figs. 17 to 21. This casing is preferably composed of two halves or semi-cylinders, each preferably integral and of the desired length for the particular machine. At meeting edges the halves are each provided with longitudinal stiffening angles 62 which are adapted to be secured together by means of the adjustable hook bolts shown diagrammatically at 63 in Fig. 17. The interior of the casing is supported at intervals by various forms of annular stiffening rings which are likewise formed in halves, each half being secured to its respec-

tive half of the casing. The rings, for reasons which will be clear from the description of the mold parts, differ in configuration, but typical forms of such rings are shown in Figs. 18 to 21. Thus, in Fig. 18, which is a section taken on the line XVIII—XVIII of Fig. 17, I have shown an intermediate stiffening ring d having a plurality of inwardly projecting fingers 64, the ends of which are curved to conform with the curvature of the mold E and are adapted to support the wall of the mold intermediate its stiffening flanges and thus prevent warping or distortion of such portions under the heavy pressures developed during the rotation. In Fig. 19 I have shown another form of intermediate stiffening ring d' the fingers 64 of which are slotted at 65 to receive and embrace the longitudinal braces or ribs of the mold, and thus causing the mold to rotate with the intermediate casing which is caused to rotate with the outer or driving shell by the pressure of the clamps H. Fig. 20 illustrates one form of intermediate stiffening or bearing ring d'' which may be employed singly or in pairs, and comprises a plain angular angle with which the annular flange rings 66 of the mold are adapted to be brought into alignment. Such rings serve to centrally position the mold, as do the rings d. The rings d'', however, are provided with inwardly projecting lugs or fingers 67 which embrace the annular reinforcing rings or ribs 68 of the mold and prevent the mold from shifting longitudinally with respect to the intermediate casing. In Fig. 21, I have shown a typical form of closing ring d''' for closing the ends of the intermediate casing.

Referring now to the mold E, which is shown in Figs. 22 to 26 inclusive, unlike the intermediate casing, it is comprised of a plurality of sections e which are formed in halves and are each provided with annular and ribs 69, intermediate annular ribs 68, longitudinal ribs 69 at the meeting edges, and with intermediate longitudinal ribs 70. The mold is given a taper such as is required for the particular type of pole to be formed.

The halves of the sections are secured together by means of the hooks 71, and at intervals intermediate the hooks, dowels 72 are provided in order to secure an accurate fitting. In order to facilitate the assembling of the halves of the mold, a novel arrangement of the hooks 71 is provided. The hooks constitute bent bolts which are carried by the ribs 69 of the upper sections, the hook ends being adapted to be passed through the slots 73 formed in the flanges 69 of the lower halves of the sections when the hook ends are turned at right angles to the longitudinal axis of the mold, the hooks being adapted to engage the flanges when turned through 90° as shown in Fig. 24. It will be apparent

that in the absence of means for properly maintaining the hooks in position to be passed through the slots 73, difficulty would be encountered in assembling the parts. To overcome this difficulty I provide slots 74 in the lower faces of the ribs 69 of the upper section, such slots being of a size adapted to receive the ends of the hooks and prevent the same from turning. In assembling the upper half of a section is positioned with a concave side up and the hooks dropped into the slot 74, in which position the lower half of a section can be readily dropped into place and hooked.

In Fig. 26, I have illustrated a plate 75 adapted to close the small or tip end of the mold and a plate 76 adapted to close off the large or butt end of the mold. It will be noted that these plates have central apertures 77 and 78. These apertures are given a size to conform with the diameter of the opening within the hollow pole. The closure plates, although formed in this fashion, retain the grout or fresh concrete during rotation. The tip end closure plate 75 is secured in position by means of an annular ring or collar 79 having a seat 80 turned on the face thereof. A plain ring or collar 81 retains the plate 76 in position, the end of the butt end section in this case being provided with a groove or seat 82 to receive the closure plate.

After the mold has been assembled it is placed upon a tilting bridge or frame I trunnioned as at 83, and is held in position thereon by a plurality of fastening means such as the chains 84, the tip end of the mold abutting against a block 85. The butt end of the bridge I is provided with a yoke 86 by means of which the butt end is lifted and the bridge rocked on its trunnion until the mold has been shifted to an angle of about 45°, the foundation C being provided with a pit *c* into which the tip end of the bridge and mold freely pass.

After the mold has been tilted on its bridge it is filled with the concrete until it is about half full, after which it is rolled or transferred into the lower half of the intermediate casing or holder *d* which is suitably supported on any preferred type of conveyer mechanism (not shown.) After this the upper half of the intermediate casing or holder is placed in position and the two halves locked together. When the mold is thus assembled in the intermediate casing, it is centrally positioned by the engagement of the end flanges or ribs 66 with the bearing rings *d''* and by the engagement of the body of the mold with the fingers 64 of the rings *d'*; it is held against rotation by the engagement of the slotted fingers 65 of the rings *d'* with the longitudinal ribs 70; and it is prevented from shifting longitudinally with respect to the holder or casing by the fingers 67; as hereinbefore pointed out.

The holder and its contained mold are transferred by the conveyer mechanism, into the outer shell, the intermediate casing riding upon the casing rollers 63 in the manner hereinbefore described. After having been slipped into the outer shell, the intermediate casing is centrally clamped by means of the clamps H and rollers 53, after which the outer shell is rotated through the medium of the driving mechanism hereinbefore described, at first slowly in order to secure proper distribution of the fresh concrete throughout the mold, and afterward very rapidly,—500 revolutions per minute, more or less, as may be required. This rapid rotation of the parts is continued for about ten minutes after which the casing and mold are retracted from the outer shell and the upper halves of the intermediate casing and mold are removed and the concrete allowed to set for a proper period of time.

When the mold is charged all of the fresh concrete works toward the tip end of the mold, but previous to rotation a bar or rod is thrust through the aperture 77 in the closure plate 75 and worked through the concrete to make an initial central opening therein. This suffices to cause the concrete, under the initial slow rotation, to work from the tip end lengthwise to the butt end, and when the parts are rapidly rotated an absolutely uniform distribution of the concrete takes place so that the resultant pole has a wall of uniform thickness throughout.

As previously indicated, it is essential to shift the horizontal axis of the mold in varying degrees, dependent upon the length and taper of the mold being made in order to secure proper distribution of the concrete. If the parts were maintained truly horizontal, the concrete would all work toward one end. For this purpose the adjustable carriages for the trunnion rollers 22 are provided as hereinbefore set forth.

In case it is desired to use the same mold for forming poles of different lengths, this can be conveniently done by providing stop-off devices as shown in Figs. 31 and 32, one of such devices J being adapted to be used at the tip end of the mold and the other device K at the butt end of the mold. These devices may be used singly or together dependent upon the circumstances of each particular case, and the lengths thereof may be varied as required. Each device comprises a tube having at one end a plate 87 adapted to fit between the end section of the mold and its respective end collar, and having at the other end a plate 88 the diameter of which corresponds to the internal diameter of the mold. Thus, the plate 87 of the stop-off member J is secured between the end of the tip end section of the mold and the collar 79 in the same manner that the end plate 75, shown in Fig. 26, is secured,

Similarly the plate 87 of the stop-off K is secured between the butt end section of the mold and the collar 81. It will be noted that the plates 88 have central apertures 89 of a diameter corresponding to that of the hollow or opening within the pole.

As hereinbefore indicated, the various intermediate stiffening rings carried on the interior of the mold B vary in conformation, the reason for which will be readily understood when the tapered form of the mold B is kept in mind. With the decreasing diameter of the mold and its bearing and stiffening ribs, it will at once be seen that the internal diameters of the stiffening rings must be correspondingly increased from the tip to the butt end. Thus, for example, the stiffening ring d', shown in Fig. 19, has an internal diameter much less than that of the stiffening ring d' shown in Fig. 7, the latter stiffening ring being located near the butt end of the machine while the former is located at some intermediate point.

It is to be understood that the reinforcing skeleton L, shown in Fig. 4, is inserted in the mold B before charging. The manner of centrally suspending the skeleton within the mold is shown in Fig. 5, from inspection of which it will be seen that the skeleton is provided with a plurality of buttons 7 which are secured to the skeleton in any preferred manner, said buttons being constructed to have an extended seat on the skeleton and to have a pointed end adapted to engage the inner surface of the mold so that in the finished article the buttons will be substantially entirely covered by the concrete. Any number of buttons necessary to suitably center the skeleton with reference to the mold are provided.

One of the most important advantages obtained by my improvements is the fact that I am enabled to tilt the longitudinal axis of rotation. While the degree of inclination from the horizontal is relatively slight, nevertheless I have found that in order to secure uniform and proper distribution of the fresh concrete in the mold, it is necessary to provide for such tilting or inclination in a degree corresponding to the taper of the particular pole being made. The means whereby I obtain this inclination or tilting of the axis of rotation is effective in that it secures the desired results while at the same time the driving shell or carrier is adequately supported. I have also found that it is of great importance to have all of the parts adequately centered and the improved means hereinbefore described are such as enable me to conveniently center the intermediate casing or holder D as well as the mold B with respect to the axis of rotation of the carrier or driving shell A. In connection with the first advantage just above considered, it is to be noted that the

rollers 22 are flanged to engage the wearing tires or rails whereby the carrier is held against longitudinal shifting with respect to the frame. The carriages, by means of which the rollers are adjustably supported for the purposes described, are such that the rollers may be adjusted to vary the inclination of the axis of rotation without causing binding of the flanges with the rails. In this connection it is to be observed that the idler rollers 24 have no flanges, and they, therefore, readily accommodate themselves to these adjustments.

It is also advantageous to drive the shell or carrier intermediate its ends and it will be observed that the type of driving mechanism employed is such that it readily accommodates itself to the shifting of the axis of the machine.

With regard to the mounting of the rollers 53 on the clamps H in the recessed or depressed portions of the driving shell or carrier, it is to be noted that this arrangement has the following advantage; namely, that a maximum size of intermediate casing D can be inserted in the carrier A, or reversely stated, for a given size of intermediate shell, an outer shell of minimum diameter and weight can be utilized.

It will be apparent that my invention is not limited to the precise details of construction shown and described, and that variations may be made therefrom without departing from the spirit of the invention as defined in the appended claims. It is also to be understood that certain of the terms employed in the specification and claims are used in their broad sense, as, for example, the word "shell" by which the carrier A has been designated.

I claim:

1. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of sets of oppositely arranged rollers in said frame revolvably carrying said mold, one of each set of rollers being yieldingly mounted in said frame.

2. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of sets of oppositely arranged rollers in said frame revolvably carrying said mold, one of the rollers of each set being adjustable to alter the axis of the mold and another roller of each set being yieldingly mounted in said frame.

3. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of groups of three rollers comprising a three-point support for said mold, the upper rollers being yieldingly supported in said frame and

the lower rollers being adjustable to alter the axis of the mold.

4. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of antifriction members for carrying the mold, said members being capable of adjustment longitudinally, laterally and vertically of the machine.

5. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of antifriction rollers having means for canting the axis of revolution thereof.

6. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of antifriction rollers having means for canting the axis of revolution thereof and adjusting the rollers longitudinally, laterally and vertically of the machine.

7. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of antifriction rollers provided with universal mountings and supporting the mold.

8. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a plurality of antifriction rollers having axles provided with ball and socket bearings, and means for canting the axles.

9. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported therein, a plurality of rollers mounted in the lower part of said frame and adapted to carry the mold, a plurality of guides mounted in the upper part of said frame, cross-heads on said guides, rollers in said cross-heads, and springs forcing said cross-heads inwardly toward the mold.

10. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported therein, a plurality of rollers mounted in the lower part of said frame and adapted to carry the mold, a plurality of guides mounted in the upper part of said frame, cross-heads on said guides, rollers on said cross-heads, springs forcing said cross-heads inwardly toward the mold, and means for positively limiting the outward movement of the cross-head away from the mold.

11. A rotary concrete pole making machine comprising in combination an outer shell, a frame in which said shell is revolvably mounted, a mold member adapted to be inserted into and withdrawn from said shell longitudinally thereof, said shell being provided with recessed portions, and anti-

friction means carried in said recessed portions.

12. A rotary concrete pole making machine comprising in combination an outer shell, a frame in which said shell is revolvably mounted, a mold member adapted to be inserted into and withdrawn from said shell longitudinally thereof, said shell being provided with outwardly extending bosses, and antifriction means mounted in said bosses and adapted to support said mold member.

13. A rotary concrete pole making machine comprising in combination a frame, a sectional mold receiving shell adapted to be revolvably supported in said frame, said shell comprising a plurality of sections having flanged ends, wearing tires or rails interposed between said sections and common means for fastening the flanges together with the rails therebetween, and antifriction means carried by the frame upon which said rails are adapted to ride.

14. A rotary concrete pole making machine comprising in combination a frame, a sectional mold receiving shell adapted to be revolvably supported in said frame, said shell comprising a plurality of sections having flanged ends, wearing tires or rails interposed between said sections, bolts passing through the flanges of adjacent sections and through the rails interposed therebetween, and antifriction means carried by the frame on which said rails are adapted to ride.

15. A rotary concrete pole making machine comprising in combination a frame, a mold receiving shell adapted to be revolvably supported in said frame, said frame comprising a plurality of sections placed end to end, each section at the end being provided with flanges, rail members being interposed between said flanges and means for fastening the flanges together with the rails therebetween.

16. A rotary concrete pole making machine comprising in combination a frame and a mold receiving shell adapted to be revolvably supported in said frame, said shell comprising a plurality of sections placed end to end, one of said sections intermediate the ends of the shell being provided with a drive engaging member, and means for driving said member.

17. A rotary concrete pole making machine comprising in combination a frame and a mold receiving shell adapted to be revolvably supported in said frame, said shell comprising a plurality of sections placed end to end, one of said sections intermediate the ends of the shell being provided with a sheave, and cable driving means engaging the said sheave.

18. A rotary concrete pole making machine comprising in combination a frame, a mold receiving driving shell revolvably mounted therein and capable of adjustment

to vary the horizontal axis thereof, said driving shell being provided with a drive engaging means intermediate its ends, and a flexible drive engaging said means.

19. A rotary concrete pole making machine comprising in combination a frame, a mold receiving driving shell revolvably mounted in said frame, means for varying the horizontal axis of the shell, and driving means engaging said shell intermediate the ends thereof and constructed to permit the horizontal axis of the shell to be varied.

20. A rotary concrete pole making machine comprising in combination a mold receiving driving shell revolvably mounted in said frame and comprising a plurality of sections, one of said sections intermediate the ends being provided with driving means and with a brake hub, and braking means engaging said hub.

21. A rotary concrete pole making machine comprising in combination a frame, a mold receiving casing adapted to be revolvably supported in said frame, said casing being provided with annular stiffening means, and a mold adapted to be supported in said casing, said mold having means engaging said stiffening means to prevent relative rotation of the mold with respect to the casing.

22. A rotary concrete pole making machine comprising in combination a mold receiving frame, a mold receiving casing adapted to be revolvably mounted in said frame and provided with a plurality of annular stiffening rings, a sectional mold adapted to be inserted in said casing, and annular flanges on said mold adapted to be engaged in said bearing rings whereby to center the mold within the casing.

23. A rotary concrete pole making machine comprising in combination a frame, a mold receiving casing adapted to be revolvably supported in said frame, said casing being provided with a plurality of bearing rings and stiffening rings, a mold adapted to be inserted in said casing, said mold being composed of a plurality of flanged sections, said bearing rings engaging the periphery of the flanges and said stiffening rings engaging the periphery of the mold intermediate the flanges, whereby to center and support the mold in the casing.

24. A rotary concrete pole making machine comprising in combination a frame, a mold receiving casing adapted to be revolvably supported in said frame, said casing being provided with an annular stiffening ring-like member, and a mold adapted to be inserted in said casing provided with an annular rib-like member, one of said members being provided with means engaging the other member whereby to prevent the mold from shifting longitudinally with respect to the casing.

25. A rotary concrete pole making machine comprising in combination a frame, a mold receiving casing adapted to be revolvably supported in said frame, a mold adapted to be inserted in said casing, means for centering the mold with reference to the casing, means for preventing relative rotation of the mold with respect to the casing, and means for preventing longitudinal displacement of the mold relative to the casing.

26. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a stop-off means adapted to stop-off the flow of fresh concrete at any predetermined point in the mold.

27. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, said mold being provided with variable means for stopping off the flow of grout.

28. A rotary concrete pole making machine comprising in combination a frame, a mold adapted to be revolvably supported in said frame, and a stop-off means comprising in combination a member having at one end a plate adapted to fit the interior of the mold and at the other end a positioning means.

29. A mold for making poles and the like comprising a mold shell provided with means adapted to make poles of varying lengths.

30. A mold for making hollow concrete poles by the rotary process, comprising a mold shell having end-plates provided with central apertures substantially corresponding to the contour to be made in the pole.

31. A mold for making concrete poles and the like comprising a shell composed of flanged sections adapted to be brought face to face, hooks carried by certain of said flanges and slid in the other flanges through which said hooks are adapted to be passed previous to locking, and means for maintaining said hooks in position to be passed through said slots.

32. A mold for making concrete poles and the like comprising a shell composed of flanged sections adapted to be brought face to face, hooks carried by certain of said flanges, and elongated apertures in the other flanges through which said hooks are adapted to be passed, and means for maintaining said hooks in position to be passed through said apertures.

33. A mold for making concrete poles and the like comprising a sectional mold shell, one of said sections being provided with a hook-like member and the other section being provided with an elongated aperture through which said hook-like member is adapted to be passed and turned for a locking operation, and means for maintaining

said hook-like member in position to be passed through said aperture.

34. A rotary machine for making hollow concrete poles and the like comprising in combination a frame, a tapered mold adapted to be revolubly supported in said frame, and means whereby the axis of rotation may be altered to secure proper distribution of the concrete.

35. A rotary machine for making concrete poles and the like comprising in combination a frame, a plurality of antifriction supports extending longitudinally of the machine, a tapered mold adapted to be revolubly supported on said supports, and means for raising said supports toward one end of the machine and lowering them toward the other end of the machine to alter the axis of rotation whereby to secure proper distribution of the concrete.

36. A mold charging apparatus comprising in combination a tilting frame, means whereby a mold may be supported thereon, and means for tilting the frame.

37. The combination of a mold having an open end and tilting means for said mold, said support having means whereby the open end of the mold is closed, and means for tilting the support.

38. A charging apparatus for molds com-

prising in combination a foundation, a tilting support mounted on said foundation and adapted to support the mold to be charged, means for tilting said support, and a pit in the foundation.

39. In an apparatus for making reinforced concrete poles and the like, the combination of a mold adapted to receive a skeleton reinforcement in the interior thereof, and means for supporting the skeleton in the mold comprising a plurality of spacing members carried on the skeleton and adapted to engage the interior of the mold at spaced intervals and to lie intermediate the skeleton and the mold.

40. In an apparatus for making reinforced concrete poles and the like, the combination of a mold adapted to receive a skeleton reinforcement in the interior thereof, and means for supporting the skeleton in the mold comprising a plurality of spacing members adapted to engage the interior of the mold at spaced intervals and to lie intermediate the skeleton and the mold, said spacing members having a pointed end for engagement with the inner face of the mold. In testimony whereof I have hereunto signed my name.

JULIUS J. GRUENFELD, JR.