(No Model.)

8 Sheets—Sheet 1.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

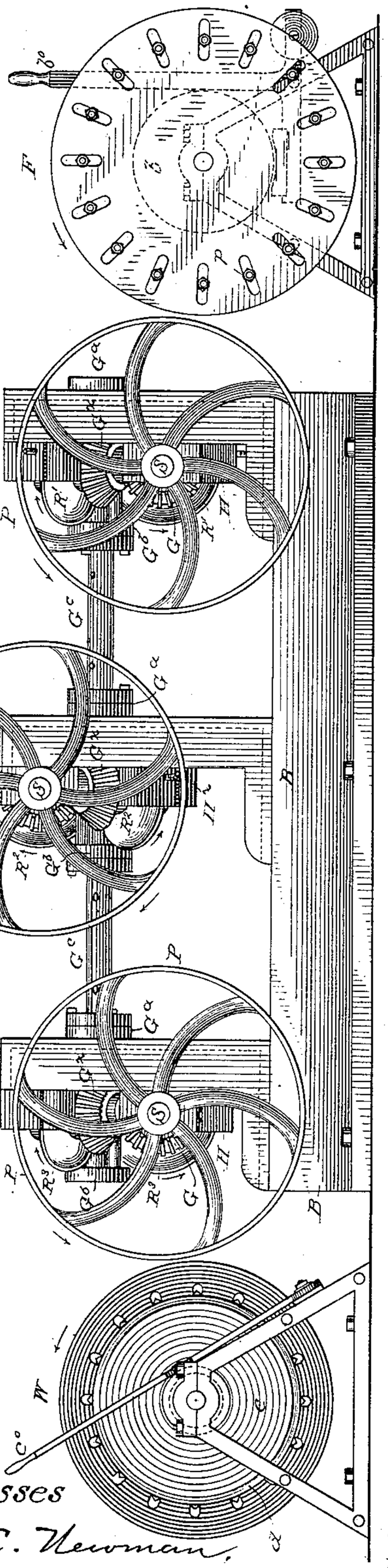

Fig. 1.

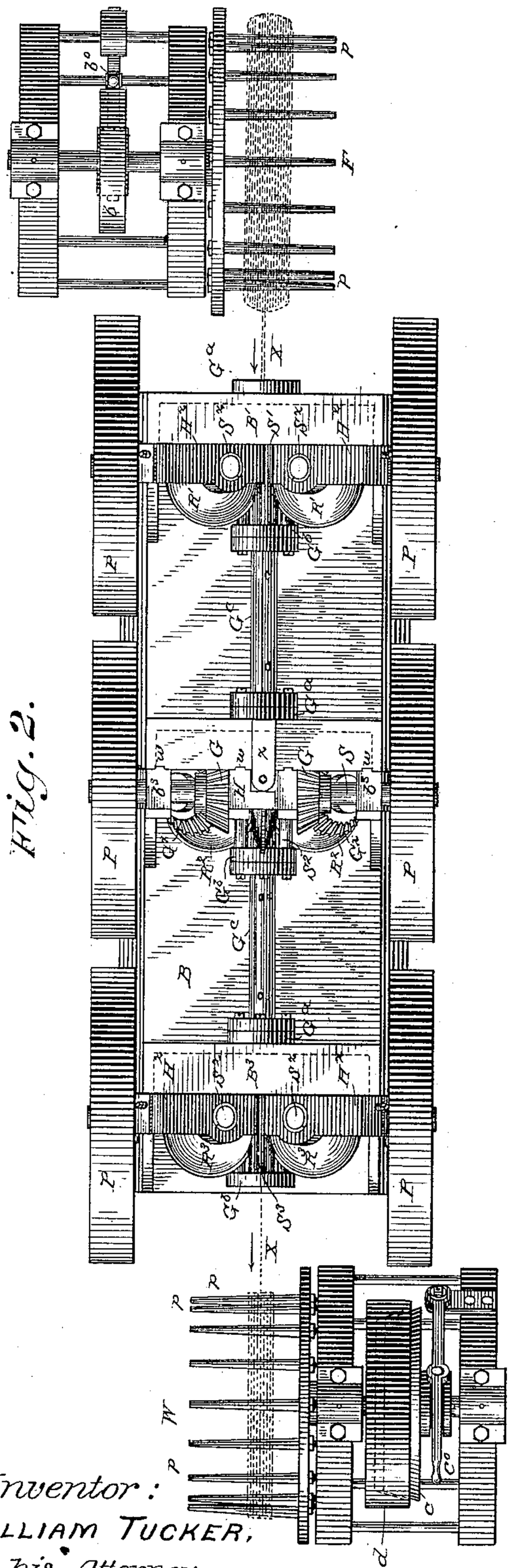

Fig. 2.

Witnesses
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Inventor:
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By his Attorney
T. L. Ewin.

(No Model.) 8 Sheets—Sheet 2.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

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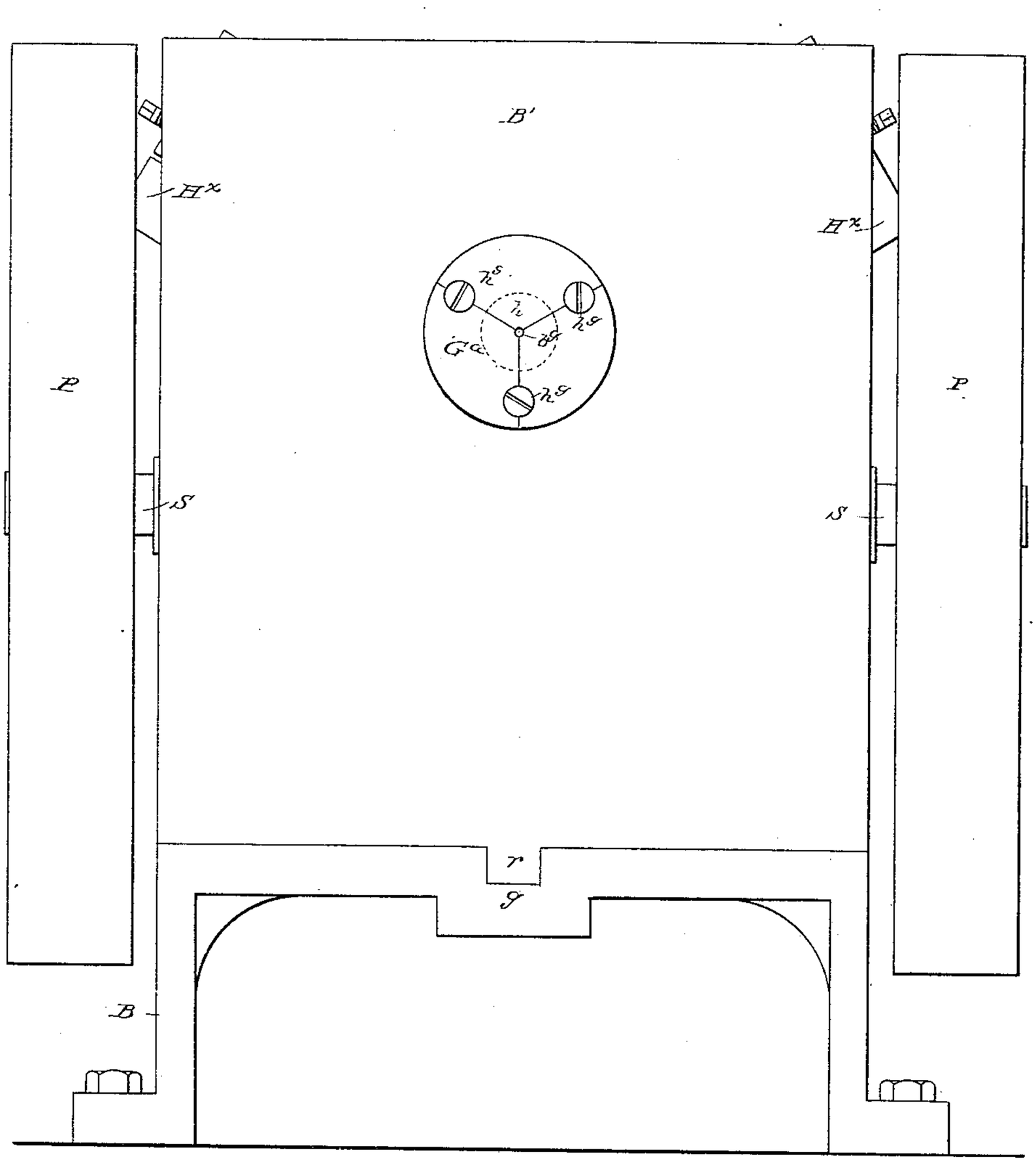
Fig. 3.



Witnesses

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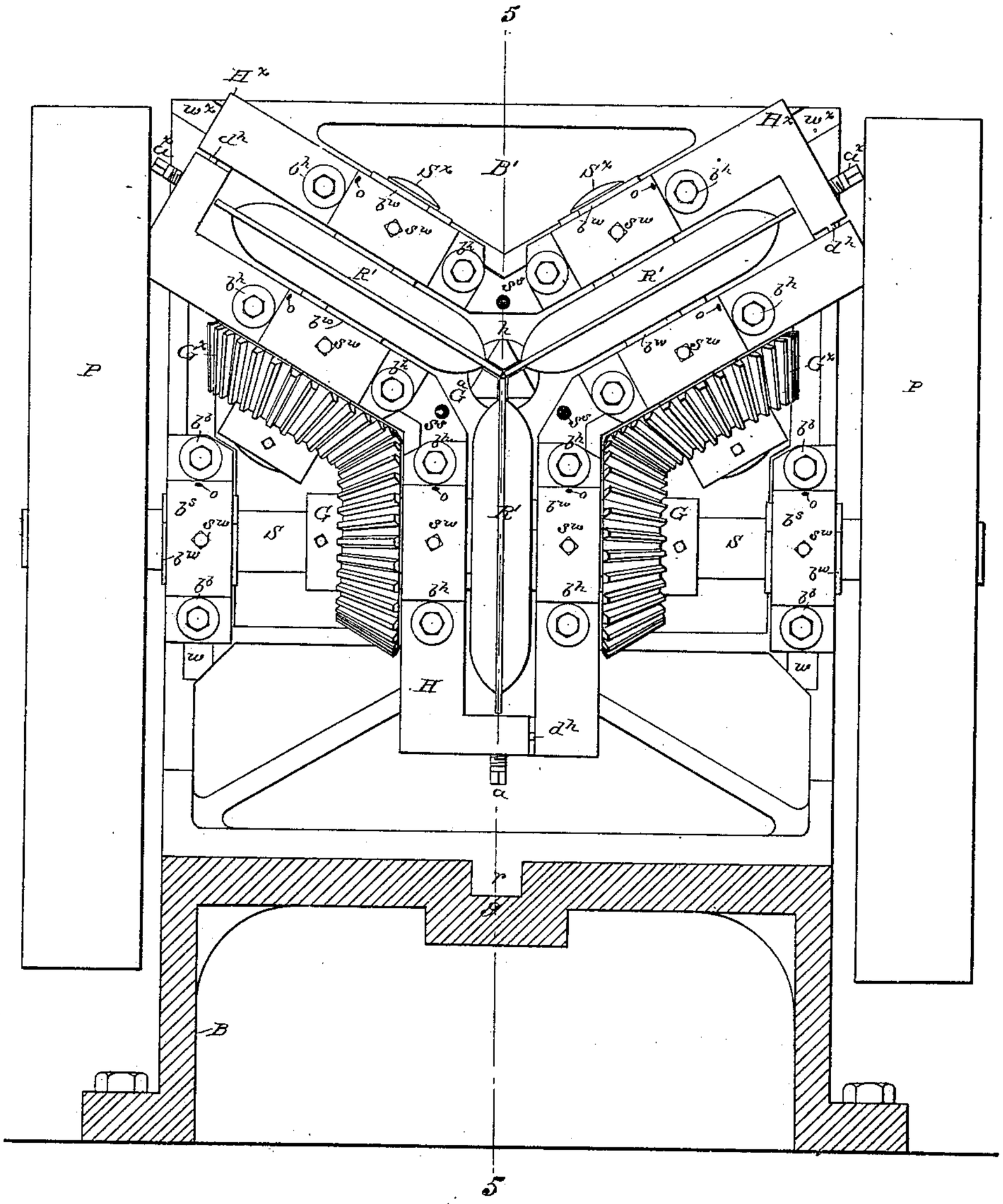
(No Model.) 8 Sheets—Sheet 3.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 4.



Witnesses

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(No Model.) 8 Sheets—Sheet 4.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 5.

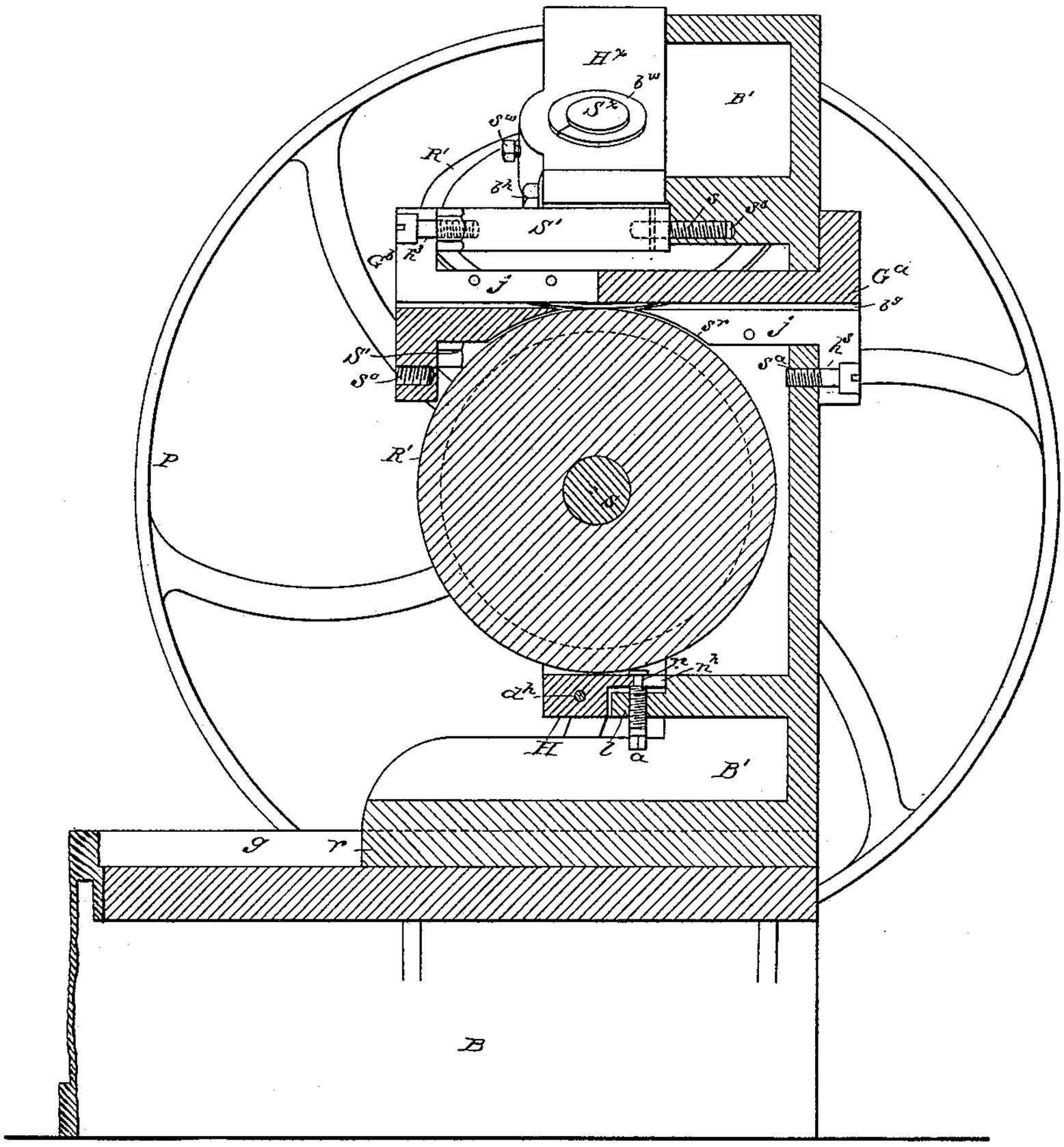
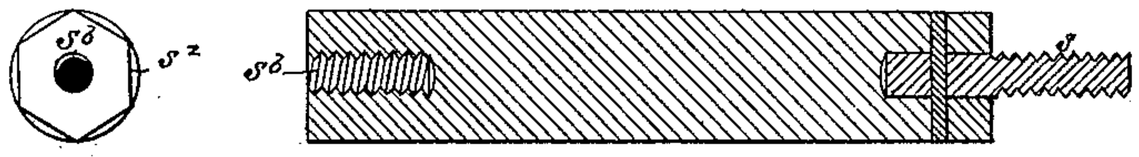


Fig. 15. *Fig. 16.*



Witnesses

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Ed. A. Newman.

By his Attorney

Inventor

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(No Model.)

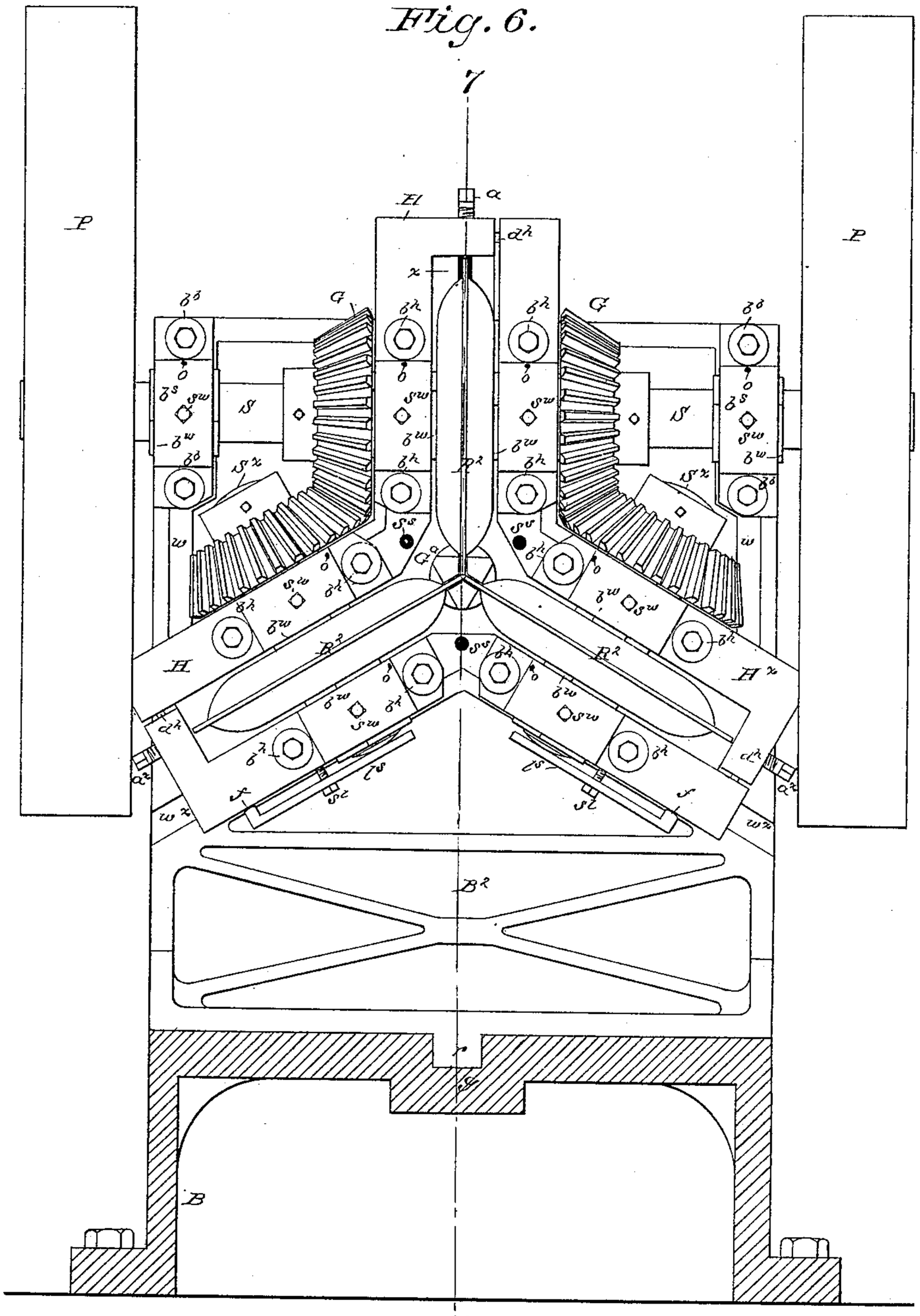
8 Sheets—Sheet 5.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 6.



Witnesses

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Inventor

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(No Model.)

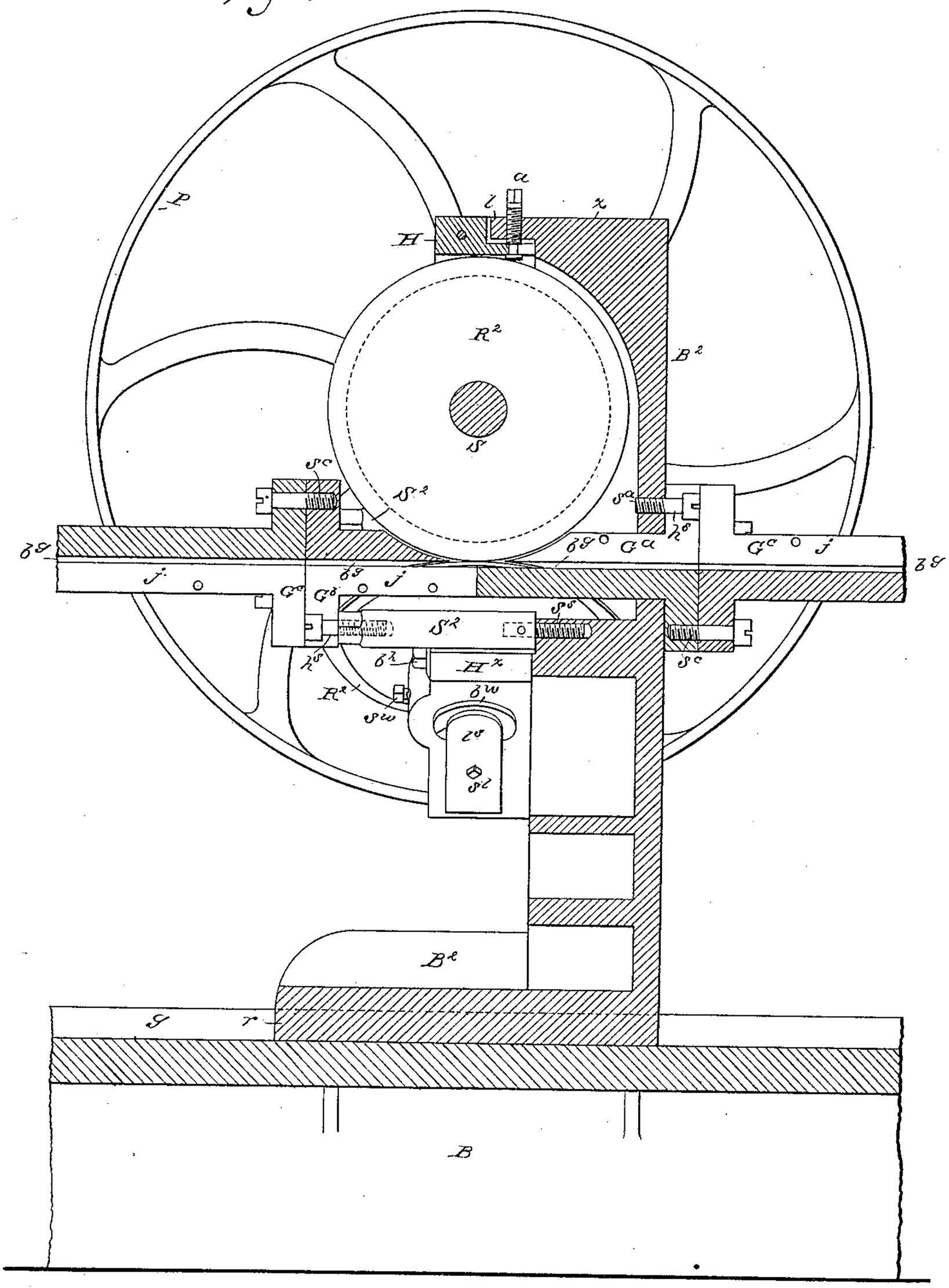
8 Sheets—Sheet 6.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 7.



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(No Model.)

8 Sheets—Sheet 7.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 8.

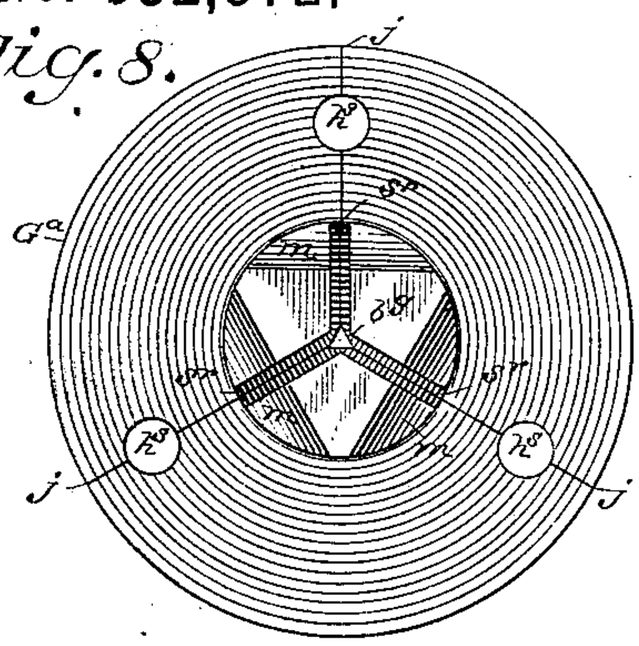


Fig. 9.

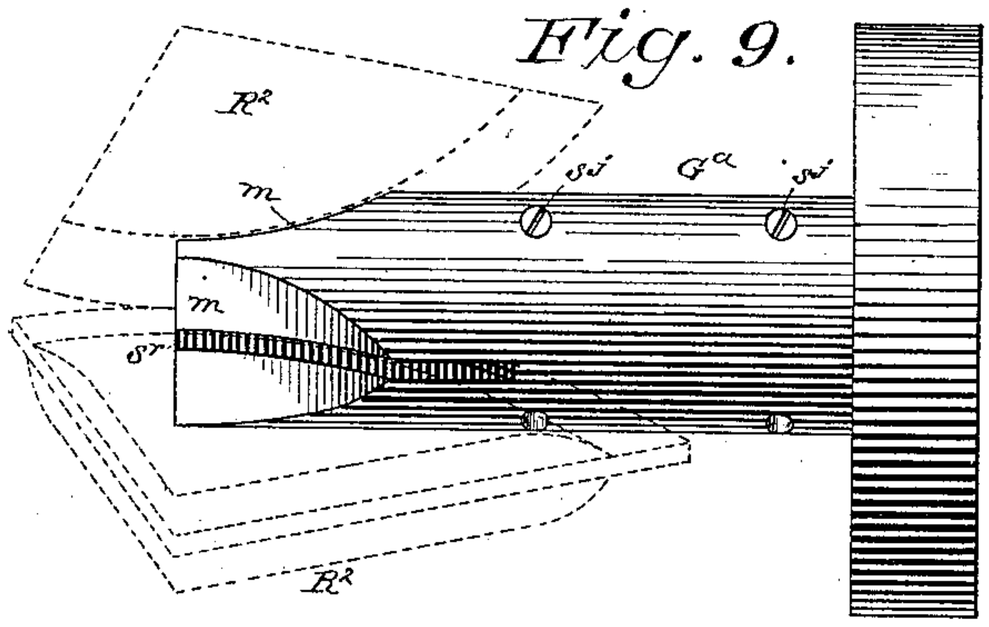


Fig. 10.

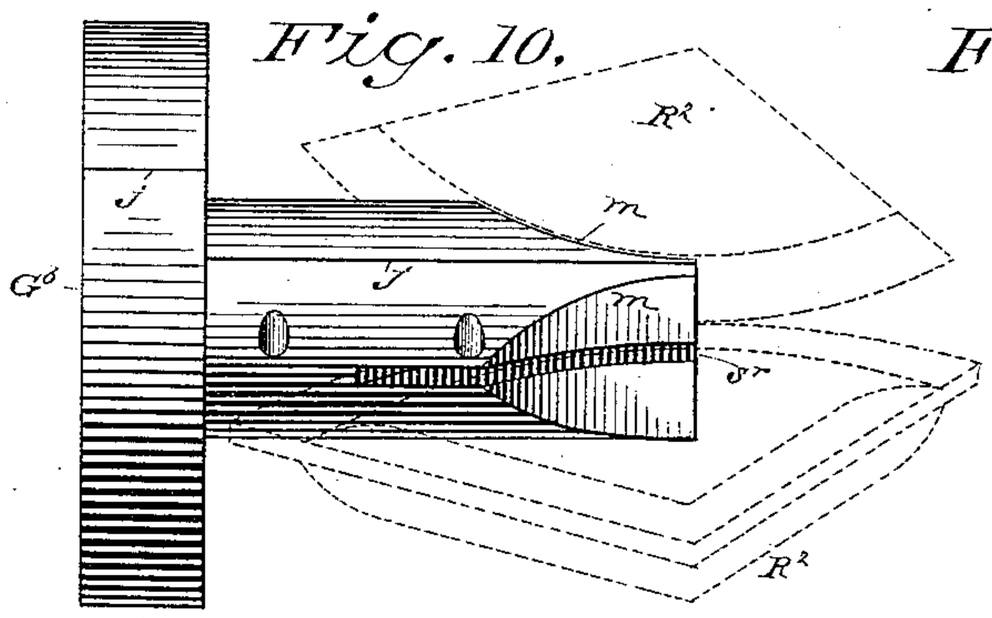


Fig. 11.

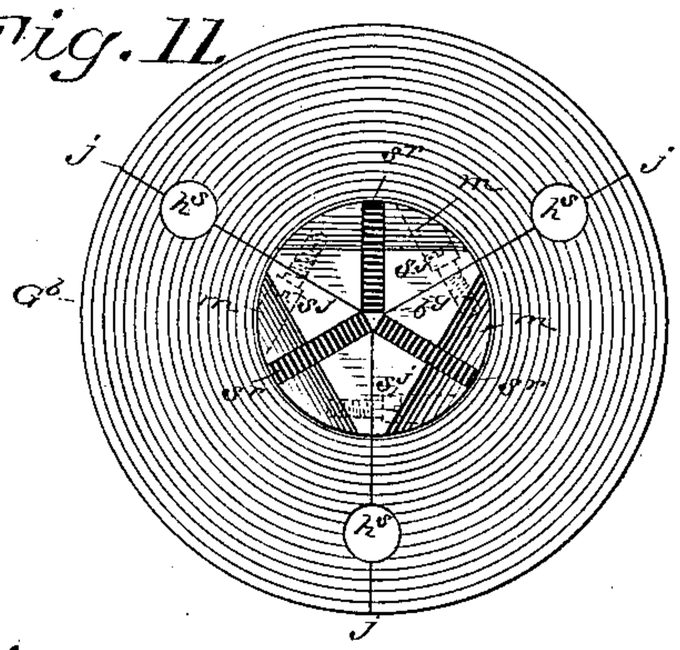


Fig. 12.

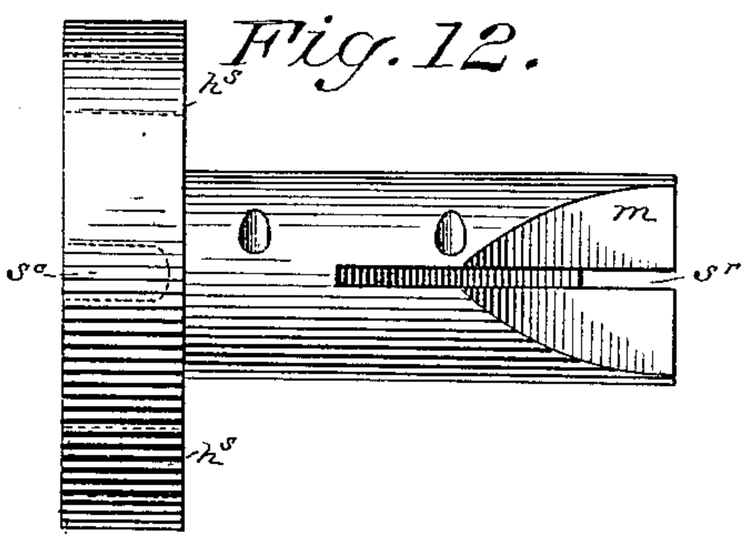


Fig. 13.

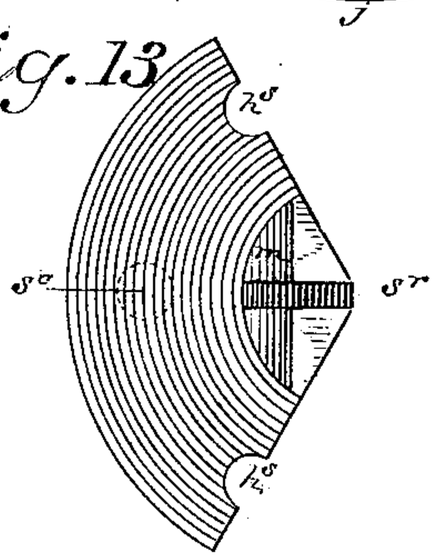
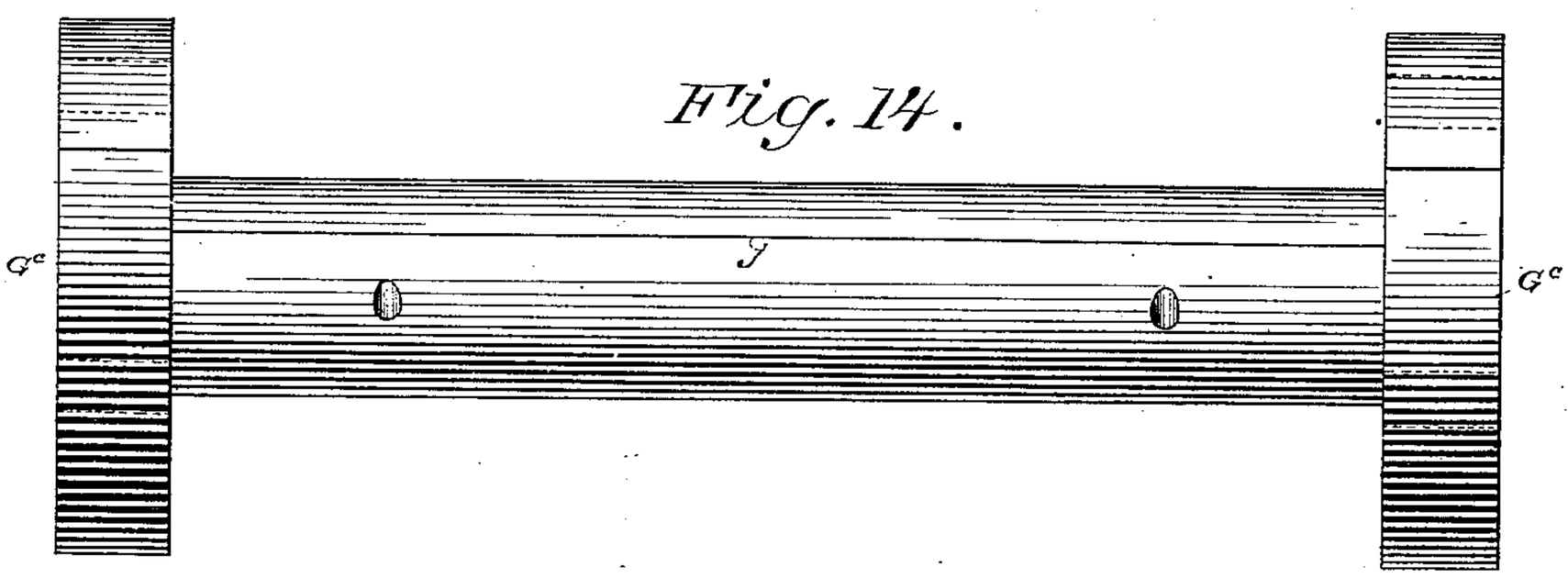


Fig. 14.



Witnesses

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(No Model.)

8 Sheets—Sheet 8.

W. TUCKER.

MACHINE FOR REDUCING WIRE RODS.

No. 332,572. Patented Dec. 15, 1885.

Fig. 17.

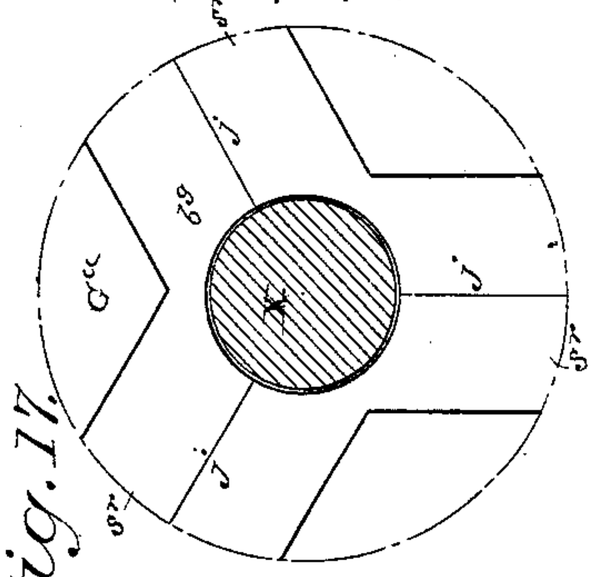


Fig. 18.

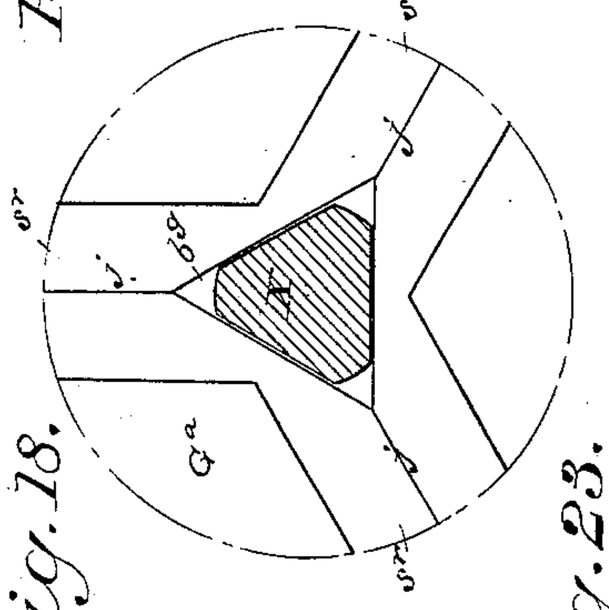


Fig. 19.

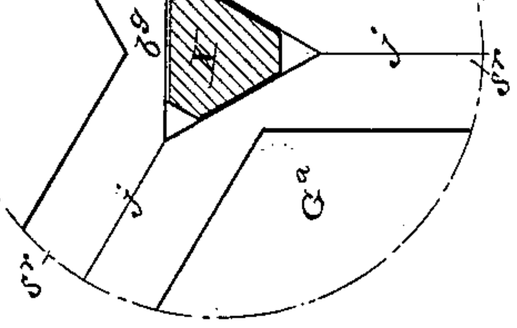


Fig. 20.

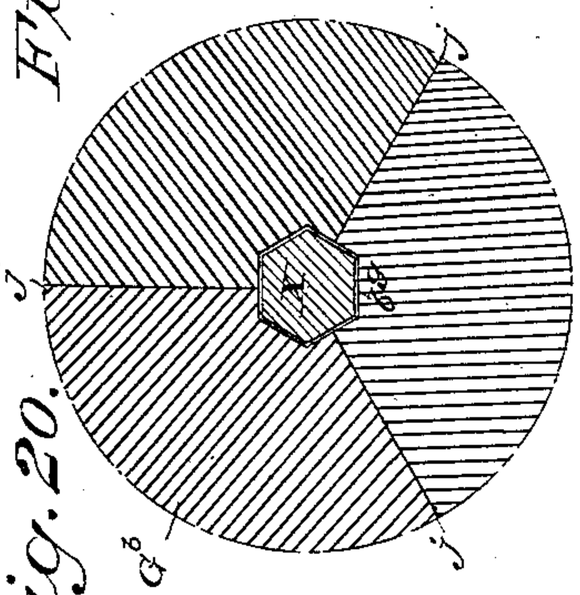


Fig. 21.

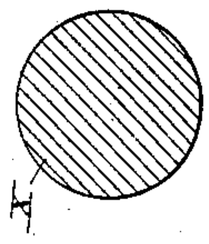


Fig. 22.

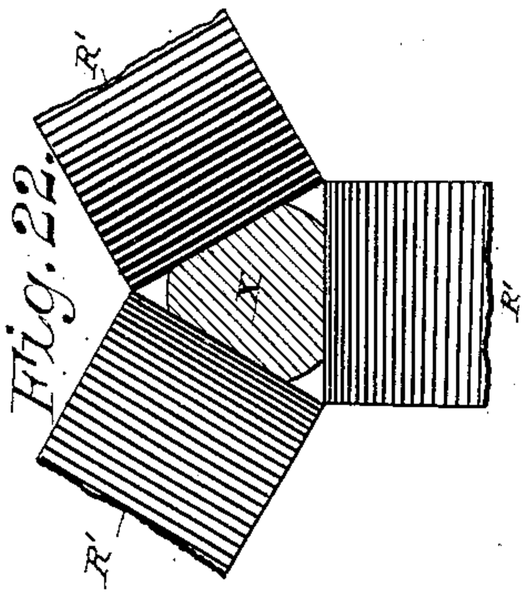


Fig. 23.

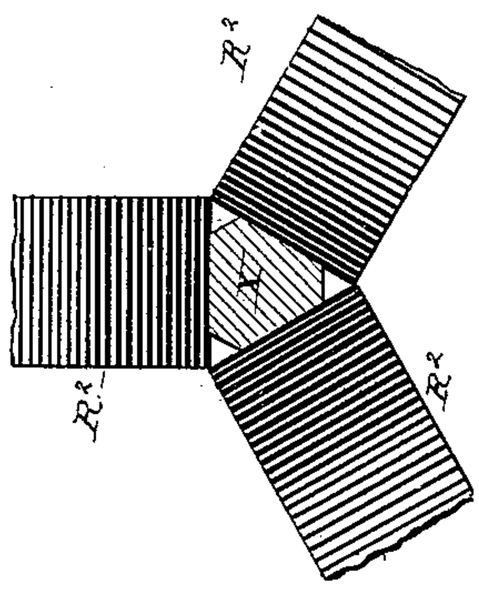


Fig. 24.

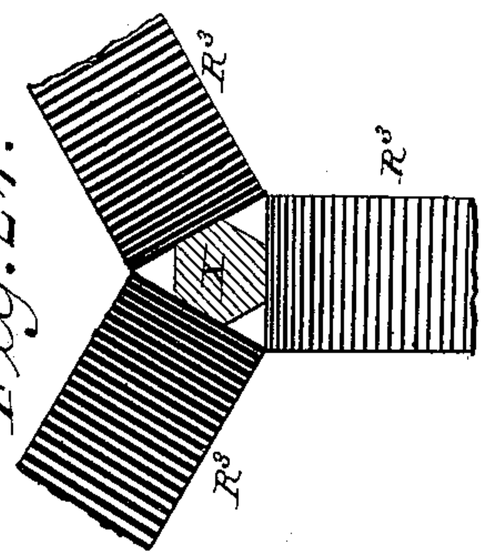


Fig. 25.

Fig. 26.

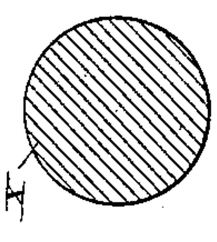


Fig. 27.

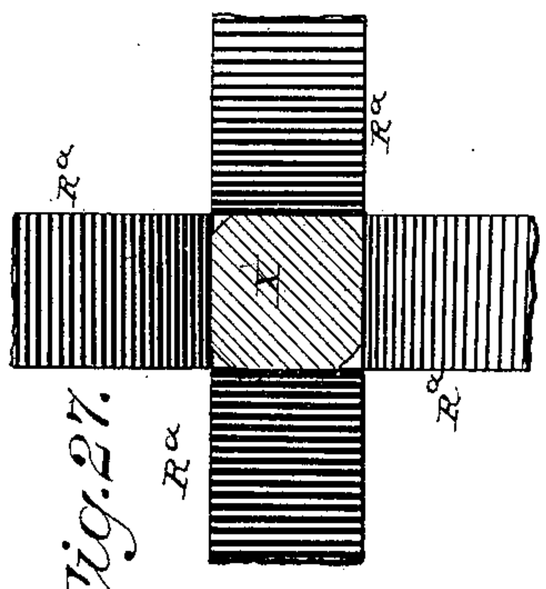


Fig. 28

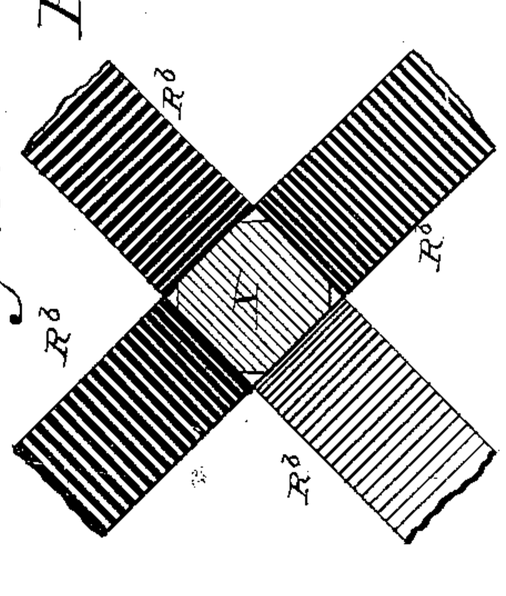


Fig. 29.

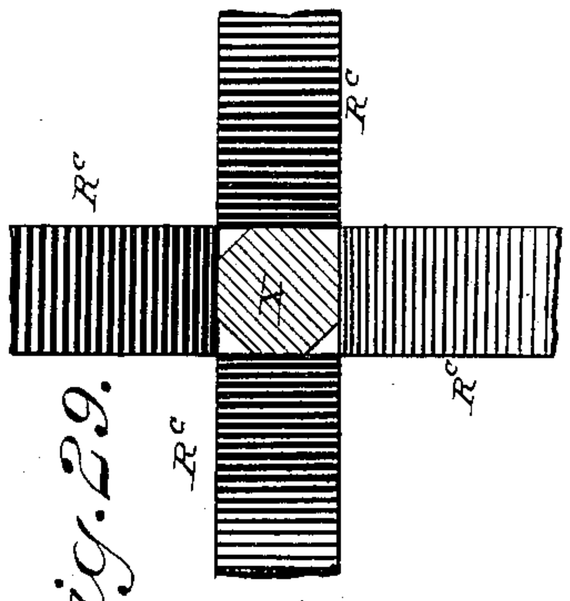
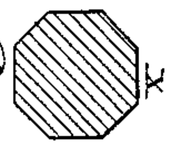


Fig. 30.



Witnesses

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Inventor

WILLIAM TUCKER

By his Attorney

Thos. L. Ewin.

UNITED STATES PATENT OFFICE.

WILLIAM TUCKER, OF EAST BROOKFIELD, ASSIGNOR TO HIMSELF AND F. F. BULLARD, OF PALMER, MASSACHUSETTS.

MACHINE FOR REDUCING WIRE RODS.

SPECIFICATION forming part of Letters Patent No. 332,572, dated December 15, 1885.

Application filed March 6, 1885. Serial No. 157,906. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM TUCKER, a citizen of the United States, residing at East Brookfield, in the State of Massachusetts, have invented a new and useful Improvement in Apparatus for Reducing Wire Rods, &c., of which the following is a specification.

This invention relates to improvements in trains of rolls for reducing wire rods and other small rods or bars of iron or steel, or apparatus of this general description. Heretofore two systems of rolling have been employed in the more simple forms of such apparatus. In one the sectional shape of the rod or bar is preserved, or substantially preserved, throughout the reducing process. In the other the sectional shape becomes round, or approximately round, and square, or substantially square, alternately. Both involve the use of grooved rolls of high original cost, and requiring frequent adjustments and renewals, except for the reduction of angular bars according to the system first named. In this case the whole width of one or more narrow roll-faces must be used, resulting in the rapid destruction of their edges, and the metal is rolled at the greatest disadvantage.

My present invention consists in an improved apparatus of said general class, so constructed that rods or bars are reduced therein with alternate change of sectional shape in one sense, so that fresh narrow surfaces or edges are exposed to the successive sets of rolls, while at the same time the successive sets of rolls are uniform as to shape of pass and general arrangement. The rolling is at each pass radially inward and upon relatively narrow edges of the metal. All the rolls are flat-faced, and their edges need never be subjected to strain. Reduction may be prodigiously rapid, and "fins" are absolutely avoided. The product may be of hexagonal or octagonal cross-section, preferably the former, and it is adapted for such uses as telegraph-lines and fences, or to be further reduced by drawing in the manufacture of wire below its gage size, which may be No. 12 or less.

This invention consists, further, in certain novel combinations of parts, hereinafter set forth and claimed, whereby the construction and adjustment of the respective parts of the apparatus are facilitated. Twisting or deflecting the metal in order to present fresh edges thereof to the successive rolls, as aforesaid, is obviated. The metal is positively guided at every point, so as to preclude its accidental escape, and a suitable stretching tension on the same is preserved with facility.

Eight sheets of drawings, bearing thirty figures, accompany this specification as part thereof.

Figures 1 and 2 of these drawings, Sheet 1, are respectively a side elevation and a top view of an apparatus for reducing wire rods illustrating this invention. Fig. 3, Sheet 2, is an elevation, on a larger scale, of the receiving end of the reducing apparatus proper. Fig. 4, Sheet 3, is a face view of that "rolls-section" seen in Fig. 3. Fig. 5, Sheet 4, is a vertical section of said rolls-section and adjoining parts on the line 5 5, Fig. 4. Fig. 6, Sheet 5, is a face view of the next or middle rolls-section, and Fig. 7, Sheet 6, is a vertical section of the latter and adjoining parts on the line 7 7, Fig. 6, all on the same scale as Fig. 3. Figs. 8 to 14, inclusive, Sheet 7, are detail views of portions of the continuous guide of the apparatus, on a still larger scale, Figs. 8 a n 9 being, respectively, end and side views of that guide-section which delivers the metal to the second set of rolls; Figs. 10 and 11, respectively side and end views of the receiving guide-section which adjoins the former; Figs. 12 and 13, side and end views of one part of the guide-section last named, and Fig. 14 a side view of a connecting guide-section. Figs. 15 and 16, Sheet 4, are respectively an end view and longitudinal section, on said larger scale, of one of the struts which support the receiving guide-sections. Figs. 17 to 20, inclusive, Sheet 8, are magnified end views of the bore, with cross-sections of the metal therein, showing the shape of the former and the relative positions of its angles in successive delivering guide-sections, and also the positions of the joints between the parts of the latter, Fig. 17 showing the delivery end immediately before the pass of the first set of rolls, Fig. 18 that immediately before the pass of the second set, Fig. 19 that immediately before the pass of the third set, and Fig. 20 the final delivery. Figs. 21 to 25, inclusive,

Sheet 8, are corresponding magnified cross-sections of the metal and elevations of the inner edges of the successive sets of rolls, showing the relative positions of the latter and the form of each pass more clearly, Fig. 21 being a cross-section of the wire rod, Fig. 22 a cross-section in the plane of the first pass, Fig. 23 a cross-section in the plane of the second pass, Fig. 24 a cross-section in the plane of the third pass, and Fig. 25 a cross-section of the product. Figs. 26 to 30, inclusive, Sheet 8, are a series of magnified views corresponding with those last described, illustrating the employment of four rolls in each set, and the production of wire octagonal in cross-section, as a modification of this invention.

Like letters of reference indicate parts of like name and function in the several figures.

One and the same apparatus for reducing round wire rods to hexagonal wire is illustrated by all the figures of the drawings, except the last five figures aforesaid. In this apparatus three upright "beds," $B' B^2 B^3$, (seen assembled in Figs. 1 and 2,) are supported upon the planed top of a horizontal base, B, common to all, which is provided with a central longitudinal groove, *g*, in its top, and is bolted to the floor, while said beds stand thereon, having planed bottoms provided with central ribs, *r*, fitted to and occupying said groove *g*, whereby said beds are kept in line, and provision is made for readily moving them toward or away from each other in assembling the parts and in making repairs. Three sets of reducing-rolls, $R' R^2 R^3$, three in each set, are mounted, with their appurtenances, on the respective beds, and a continuous "guide," composed of three delivering-sections, G^a, three receiving-sections, G^b, two connecting-sections, G^c, making eight in all, extends from end to end of the apparatus, being supplemented by three sets of tie-rods or struts, $S' S^2 S^3$, three in each set, as hereinafter more fully set forth.

Finally, with reference to the apparatus as a whole, a pair of suitable reels, F W, Figs. 1 and 2, are erected at the respective ends of the apparatus, each being preferably constructed, as shown, with radially-adjustable tapering pins *p*, to receive the coils of wire rod and wire, while the reel proper of each is fast on a horizontal shaft mounted in a strong frame, by which the delivery-point of the feeding-reel F and the receiving-point of the winding-reel W are located in line, or nearly in line, with the passes of the rolls. The feeding-reel F has a brake-wheel, *b*, fast on its shaft, and a brake-lever, b^c, pivoted in its frame, and the winding-reel W has a driving-pulley, *d*, loose on its shaft and constructed with the inside of its rim tapering. A clutch-slide, *c*, having a conical periphery fitting into said rim, is feathered to said shaft, so as to turn the latter, and a hand-lever, c^c, is pivoted to the reel-frame, and connected by pin and groove with said clutch-slide, so as to provide for moving the latter and holding it more or less tightly in frictional mesh with said pulley.

As these reels are old, *per se*, further description of their construction is deemed unnecessary.

The rolls-sections of the reducing apparatus proper and said guide-sections and struts are of peculiar construction and arrangement, which will now be more particularly set forth. The "back" of each of the beds $B' B^2 B^3$, (seen at the right in Figs. 1, 2, 5, and 7, and in the end view, Fig. 3,) is a flat surface simply penetrated by a central round hole, *h*, concentric with the passes of the rolls, and provided with three screw-holes, s^a, around said hole, as indicated in said Figs. 3, 5, and 7, to receive the countersunk attaching-screws of said delivering guide-section G^a, Figs. 1, 2, 5, 7, 8, and 9. The "face" of each bed, (seen at the left in Figs. 1, 2, 5, and 7, and in the face views, Figs. 4 and 6,) is likewise provided around said hole *h* in each with screw-holes s^s, to receive screws *s*, projecting from the inner ends of said struts $S' S^2 S^3$, Figs. 1, 2, 5, 7, 15, and 16, to provide for attaching said receiving guide-sections G^b, Figs. 1, 2, 5, 7, and 10 to 13, inclusive, which are held in place by countersunk screws passing through the flanges of the guide-sections into screw-holes s^b in the outer ends of the struts, as shown in Figs. 5 and 7. (See Figs. 15 and 16 for large scale views of one of said struts detached.) As best shown in these figures, said strut-attaching screws *s*, Fig. 16, are preferably made separate, inserted in axial holes in the inner ends of the struts and pinned fast, and the outer end of each strut is preferably milled to hexagonal form, to provide for screwing home said screws *s* by means of a wrench applied to the "square" s^z so formed. After the struts are attached, the receiving guide-sections are attached thereto, as aforesaid, and the connecting guide-sections G^c, Figs. 1, 2, 7, and 14, are coupled at their respective ends to the flanges of those attached receiving and delivering guide-sections between the middle and end rolls-sections by screws inserted through its flanges into screw-holes s^c in the flanges first named, as clearly shown in Fig. 7. Each of said guide-sections G^a G^b G^c is composed of three parts, as clearly shown in Figs. 8 to 14, inclusive, its radial joints *j* being one hundred and twenty degrees apart, planed true, and made tight by clamp-screws, s^j, perpendicular to each joint, as best seen in dotted lines in Fig. 11, and elsewhere indicated. The holes h^s, Figs. 5, 7, 8, 11, and 13, through which said attaching-screws enter said screw-holes s^a and s^b, are in each case formed in the radial joints of the flanges of the guide sections, being subjected to no lateral strain, while the heads of said screws lap the joints, and said screw-holes s^c are thus accommodated in solid metal midway between the radial joints. The body or trunk of each guide-section is preferably cylindrical, and its flange or flanges concentric therewith, as shown, to facilitate making them. The inner ends of the delivering and receiving

guide-sections are milled to triangular form, as indicated at *m* in Figs. 8 to 13, inclusive, and three radial slots, s^r, are milled therein perpendicular to its sides, said sides and slots being arranged with reference to the respective sets of rolls so that the slots coincide with the rolls and admit the latter to the guide proper or "bore" of the guide, as indicated by dotted outlines of fragments of the rolls R^2 in Figs. 9 and 10. (See, also, Figs. 4 to 7, inclusive, and Figs. 17 to 19, inclusive.) The bore of the guide (best seen at b^g in Figs. 17 to 20, inclusive) is of four patterns. The first pattern of bore is round, being fitted to the wire rod X, Fig. 21, as shown in Fig. 17, and is formed in the delivering-section G^a, attached to the bed B′ of the first rolls-section, into which the wire rod is fed from said feeding-reel F, Figs. 1 and 2. This extends to the first pass, that of said rolls R′ shown in Fig. 22. The second pattern of bore (shown in Fig. 18) is triangular, being fitted to the metal X, as shaped in said first pass, and this pattern of bore is formed in the receiving-section, G^b, attached to said bed of the first rolls-section by said struts S′, and in the connecting-section G^c, between this rolls-section and the second one, and in the delivering-section G^a, attached to the bed B^2 of said second rolls-section and extending to the second pass, Fig. 23, being that of said second set of rolls, R^2. The third pattern of bore, Fig. 19, is triangular, but of smaller size, and inverted, as compared with said second pattern, being fitted to the metal, X, as shaped in said second pass, and this pattern of bore is formed in the receiving-section G^b, attached to said bed of the second rolls-section by said struts S^2, and in the connecting-section G^c between this rolls-section and the third one, and in the delivering-section G^a, attached to the bed B^3 of said third rolls-section and extending to the third pass, Fig. 24, being that of said third set of rolls, R^3, as aforesaid. The fourth pattern of bore, Fig. 20, is hexagonal, as shown, but may be similar to the second, only smaller, being fitted to the metal, X, as shaped in said third pass, and this pattern of bore is formed in the receiving-section G^b, attached to said bed of the third rolls-section by said struts S^3, the outer end of which forms the final delivery or exit, from which the product, X, Fig. 25, passes to said winding-reel W, Figs. 1 and 2.

To facilitate forming said triangular portions of the guide-bore b^g, and at the same time to provide for locating said screw-holes s^c in solid metal, as aforesaid, and for locating the struts S′ S^2 S^3 between the rolls R′ R^2 R^3 of the respective sets, each of the successive guide-sections from the feeding end to the discharging end of the apparatus, or from right to left, as viewed in Figs. 1 and 2, is turned or "reeled" one-sixth of a revolution, or sixty degrees, relative to the one to its right. Consequently said triangular portions of the guide-bore may be formed by simply planing off the central angles of each part of the several guide-sections, as shown in Figs. 8, 11, 13, 18, and 19, and the screw-holes and struts are all accommodated, as aforesaid.

The second and third sets of rolls, R^2 R^3, are each reeled correspondingly sixty degrees relatively to the one next to the right, as viewed in Figs. 1 and 2, and the result is that at the second and third passes, Figs. 23 and 24, the roll-faces are opposed to the angles or edges of the metal, X, as shaped at the next preceding pass, and the metal consequently offers the least possible resistance to the reducing action of the rolls, and is worked with great uniformity in the rolling in of the angles successively formed, while, owing to the fact that the metal is acted on simultaneously by three rolls in each set, the corners of the passes are never filled, and hence there can be no fins on the product, the edges of the rolls never do any rolling, and the greatest strain is located at the middle of each roll-face, where the rolls are strongest, as aforesaid. The rolls R′ R^2 R^3 diminish in thickness or in width of face from the feeding end of the apparatus to its discharging end, or from right to left, as viewed on the first and last sheets of the drawings in said Figs. 1 and 2 and 22 to 24, inclusive. Taking the thickness of the wire rod X, Fig. 21, at about twenty-five one-hundredths of an inch, (0.25,) the thickness of the first set of rolls may be twenty-four one-hundredths, (0.24,) that of the second set one hundred and eighty-four one-thousandths, (0.184,) and that of the third set one hundred and twelve one-thousandths, (0.112.) The use of three such sets of rolls for reducing wire rods to hexagonal wire is preferred, although it might be done in some cases by two, as wire rods vary in size as found in the market. With three sets of rolls a larger range in size of rods can be reduced, and a smaller wire than No. 12 can be produced, if desired. The rolls are preferably of uniform diameter, and each is composed of a disk of hardened steel—such as are used in making circular saws—tightly clamped between cast-iron cheek-disks, which distribute the driving strain and keep the edge of the roll-disk true, after the manner of attaching circular saws to their arbors. One roll of each set is secured centrally on a horizontal shaft, S, to the ends of which a pair of large pulleys, P P, are applied to receive driving-bands, said shaft carrying also in the complete apparatus a pair of bevel-gears, G G, while the other two rolls of the set are carried by short oblique shafts $S^\times$ $S^\times$, provided with bevel-gears $G^\times$ $G^\times$, matching in diameter and number of teeth and in mesh with those first named. All the rolls of each set are thus driven positively and with uniform speed. The successive sets of rolls from the feeding end of the apparatus to its discharging end, or from right to left, as viewed in Figs. 1 and 2 and 22 to 24, inclusive, are driven at increasingly high rates of speed, proportioned to the re-

duction of the metal at the respective passes, so that there shall be a slight draft on the metal undergoing reduction throughout the apparatus.

The first and third rolls-sections, composed, in part, of said beds B′ and B³ and said reducing-rolls R′ and R³, with the shafts S S× of the latter, and their pulleys P and bevel-gears G G×, are preferably identical with each other, except as to thickness of rolls or width of roll-faces, as aforesaid. The first roll-section (shown in detail by Figs. 3, 4, and 5 in connection with Figs. 1 and 2,) may consequently represent both. Its back, Fig. 3, and some of the parts above named have already been fully described. The horizontal shaft S of its set of rolls, carrying the vertical roll, is located below the pass of the rolls, and is mounted in a housing, H, and a pair of end bearings, b^s b^s, and the oblique shafts S× S×, carrying the inclined rolls are mounted at angles of sixty degrees above said horizontal shaft, in similar housings, H× H×, the rolls being one hundred and twenty degrees apart, less their thickness. Said housings and bearings have ribbed backs fitted to ways w $w^×$, milled to receive them in the face of the bed, and each is slotted in line with its ways to receive strong attaching-bolts b^h b^b, received by screw-holes in the face of the bed. Each of said housings is cast and planed in one part, then sawed in two to admit the roll within it, and provided with strong dowel-pins d^h, so that its parts shall move together in its ways w or $w^×$. To so move the housings in adjusting the rolls, adjusting-screws a $a^×$, parallel with said ways w and $w^×$, respectively, work in lugs l $l^×$, cast on the face of the bed, and having screw-tapped holes fitted to said screws, the inner end of each screw having a neck, n, Fig. 5, which is embraced by the walls of a notch, n^h, in the cross-bar of the housing, so that the housing may be moved positively either out or in. All said bolts b^h b^b are loosened when the rolls are to be adjusted. The adjusting is done by means of said adjusting-screws a $a^×$, so that the edges of the rolls shall be just in contact with each other, and said bolts are then tightened up very firmly, and the adjusting-screws serve also to resist any back-thrust on the rolls by the intrusion of the wire-rod metal, X. Each of the bearings of the shafts S S×, including those in the housings H H×, are provided with removable bushings b^w and screws s^w, for holding and tightening them, and with oil-holes o, to provide for keeping the shafts well lubricated. Between those portions where depth of metal is required for said ways and screw-holes in the bed, the latter is constructed with a relatively thin web, as indicated by dotted lines in Fig. 1, and shown in part in Fig. 5.

The second or middle rolls-section, composed, in part, of said upright bed B² and said reducing-rolls R², with the shafts S S× of the latter and their pulleys P and bevel-gears G G×, is shown in detail by Figs. 6 and 7 in connection with Figs. 1 and 2. To alternate with said first and third rolls-section, this one must have a vertical roll at top, and the other two of its set, equidistant therefrom and from each other, below. Its rolls R² are consequently so arranged, the horizontal shaft S, which carries the vertical roll and the driving-gears G G, and to which the driving-pulleys P P are applied, being located, with the shaft-bearings b^s b^s and the housing H of said vertical roll, at the top of the upright bed. The latter, to accommodate said housing and the roll within it, is constructed with a central upward extension, x, Figs. 1, 2, and 7, and the ways w $w^×$ and lugs l $l^×$ to coact with the radial adjusting-screws a $a^×$, and the screw-holes to coact with the attaching-bolts b^h b^b of the several housings, and supplemental shaft-bearings are likewise located and accommodated by the disposition of thick portions of the bed, in conformity to the arrangement of the rolls. The oblique shafts S× S× of the inclined rolls, having the bevel-gears G× G×, through which they are driven, on their upper ends, require provision for overcoming their tendency to gravitate, any yielding to which might affect the coincidence of the roll-edges, so as to require its correction. Such provision is afforded by step-levers l^s, Figs. 6 and 7, attached and adjusted at will by central screws, s^l, working in tapped holes in the lower sides of the housings H× H×, the heel end of each step-lever having a fulcrum projection, f, Fig. 6, in contact with the housing, while its other extremity bears upward against the rounded lower end of the shaft.

In operation, the pulleys P having been belted to suitable driving-pulleys for the requisite relative speed of the respective sets of rolls, as aforesaid, and the pulley d of the winding-reel W having been belted to a suitable driving-pulley, so as to turn somewhat more rapidly than the reel should, to take up the delivery of the reducing apparatus, a red-hot coil of wire rod, X, is placed on the pins p of the feeding-reel F. The outer end of the wire rod is inserted in the adjacent end of the guide-bore b^g at the feeding end of the apparatus, (seen in Fig. 3,) and the rolls are started. At the first pass of the rolls, Fig. 22, the wire rod X, Fig. 21, is reduced to triangular shape, and at the second pass, Fig. 23, is presented in a different relative position, without having been twisted or deflected, owing to the "reeling" of the guide-sections and rolls, as aforesaid, and is here reduced to a smaller and reversed triangular section, while at the third pass, Fig. 24, it is presented in another different position, and is reduced to hexagonal wire, Fig. 25, No. 12, more or less. As soon as a sufficient length of wire has issued at the discharging end of the apparatus, this is wrapped on the winding-reel W, and the latter is started with the rolls, being controlled as to relative speed by manipulating its clutch-lever c^o, so as to preserve a light draft on the wire, as aforesaid, while

the escape of the wire rod from the feeding-reel F is retarded more or less by means of the friction-brake *b b°*, so as to cause it to run off under a sufficient tension to straighten it. The movements of the respective reels and rolls are represented by arrows in Fig. 1, and the wire rod and wire are shown in position in dotted lines in Fig. 2. Owing to the interposition of said connecting guide-sections G° between the roll-sections, free access to each set of rolls and its appurtenances is at all times afforded, so that any loosening or heating may be at once detected and remedied, and as each connecting-section is attached wholly to the flanges of the receiving and delivering sections attached to the beds of successive rolls-sections, either of them may be readily removed without disturbing any other part of the apparatus, and either of said sections with which it connects may then be removed for inspection or repairs without moving the beds B′ B² B³, which is a desideratum.

I have described in detail the construction, arrangement, and operation of said apparatus for reducing wire rods to hexagonal wire, but do not wish to limit my claims, hereinafter stated, to details not essential to the respective parts and combinations of parts for the respective objects or results herein set forth.

In the modification illustrated by Figs. 26 to 30, inclusive, round wire rods X, Fig. 21, are reduced at three passes, by means of successive sets of rolls R^a R^b R^c, four in each set, to hexagonal wire, Fig. 30, the angles of the metal being opposed to the faces of the rolls at the second and third passes, as in said apparatus described in detail. The guide-bore *b*^g would in this case be round, square, and octagonal in its respective lengths, and each guide-section would be divided radially into four parts. It will furthermore be obvious that square bars could be fed to reducing-rolls four in a set as readily as the round wire rod, Fig. 26, with their angles opposed to the faces of the first set of rolls, and that greater or less reductions on the same principle may be arranged for by other mere modifications of the apparatus.

Having thus described my said improvement in apparatus for reducing wire rods, &c., I claim as my invention and desire to patent under this specification—

1. In an apparatus for reducing rods or bars, the combination, substantially as herein specified, of two or more sets of flat-faced rolls, three or more in a set, the angular pass of the second set of rolls having its angles intermediate to those of the first pass, whereby the angles or edges produced in one pass are opposed to the faces of the rolls, so as to be rolled radially inward at the next pass, and the production of fins is avoided.

2. In apparatus for reducing rods or bars, the combination, substantially as herein specified, of two or more sets of flat-faced rolls, three or more in a set, each succeeding set having the angles of its pass intermediate to those of the preceding pass, and a straight guide extending from one pass to the next and corresponding with the former, whereby the metal is continuously guided and its angles or edges produced at the first pass are opposed to the faces of the rolls at the next pass without twisting or deflecting the metal.

3. In apparatus for reducing rods or bars, the combination, substantially as herein specified, of two or more sets of flat-faced rolls, three or more in a set, each succeeding set having the angles of its pass intermediate to those of the preceding pass, and a continuous guide composed of successive sections, coupled end to end by screws, and each made up of a number of radial parts corresponding to the number of rolls in the set, and correspondingly reeled with reference to the section next behind it, for the purposes set forth.

4. In apparatus for reducing rods or bars, the combination of a set of three or more flat-faced rolls and a delivering guide-section on the feeding side, extending inward to the pass of the rolls, and having an angular bore with angles intermediate to those of the pass, and slotted to admit the rolls to the metal within it, substantially as shown.

5. In apparatus for reducing rods or bars, the combination of a set of three or more flat-faced rolls mounted on an upright bed, a corresponding set of struts screwed fast to said bed between the rolls and extending beyond the pass of the rolls on the discharging side, and a receiving guide-section attached to the outer ends of said struts, and having a bore corresponding with said pass and a slotted rear end which penetrates to the pass, substantially as shown.

6. In apparatus for reducing rods or bars, a guide-section composed of three or more radial parts, and having an angular bore formed by truncating the inner angles of said parts, substantially as shown.

7. In apparatus for reducing rods or bars, the combination, substantially as herein specified, of two or more sets of rolls, a receiving guide-section attached to the bed of one set and extending from its pass, a delivering guide-section attached to the bed of the next set and extending to its pass, and a connecting guide-section attached at its respective ends to said receiving and delivering guide-sections, substantially as shown.

8. In apparatus for reducing rods or bars by means of three or more rolls in a set, the combination, as herein specified, of an upright bed, provided on its face with ways radial to the pass of the rolls, and lugs having screw-tapped bores parallel to said ways, housings for the roll-shafts, having ribbed backs fitted to said ways, and adjusting-screws working through said lugs and swiveled to the outer ends of said housings, for moving the rolls positively inward and outward at will, substantially as shown.

9. The within-described apparatus for reducing wire rods to hexagonal wire, compris-

ing three sets of flat-faced rolls, three in a set, the successive sets of reduced thickness, and with the angles of each of the second and third passes intermediate to those of the one next preceding it, and a continuous guide composed of a delivering-section having a round bore fitted to the wire rod, sections having a triangular bore corresponding with the first pass, other sections having a reversed triangular bore corresponding with the second pass, and a last receiving-section having a hexagonal bore fitted to the final product, substantially as specified.

10. The combination, substantially as herein specified, of a feeding-reel adapted to support red-hot coils of wire rod, and provided with a friction-brake or tension device, a reducing apparatus comprising three sets of flat-faced rolls, three in a set, the successive sets of reduced thickness, and with the angles of each of the second and third passes intermediate to those of the one next preceding it, a continuous guide for the metal, and mechanism for driving the successive sets of rolls at different speeds, each roll being driven positively, and a winding-reel having an independently-driven loose pulley and a speed-controlling clutch mechanism, arranged and operating substantially as set forth, for the objects stated.

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