No. 735,704. PATENTED AUG. 11, 1903.

E. G. BUDD.

MACHINE FOR CURVING PULLEY RIMS.

APPLICATION FILED JULY 10, 1901.

NO MODEL

4 SHEETS—SHEET 1.

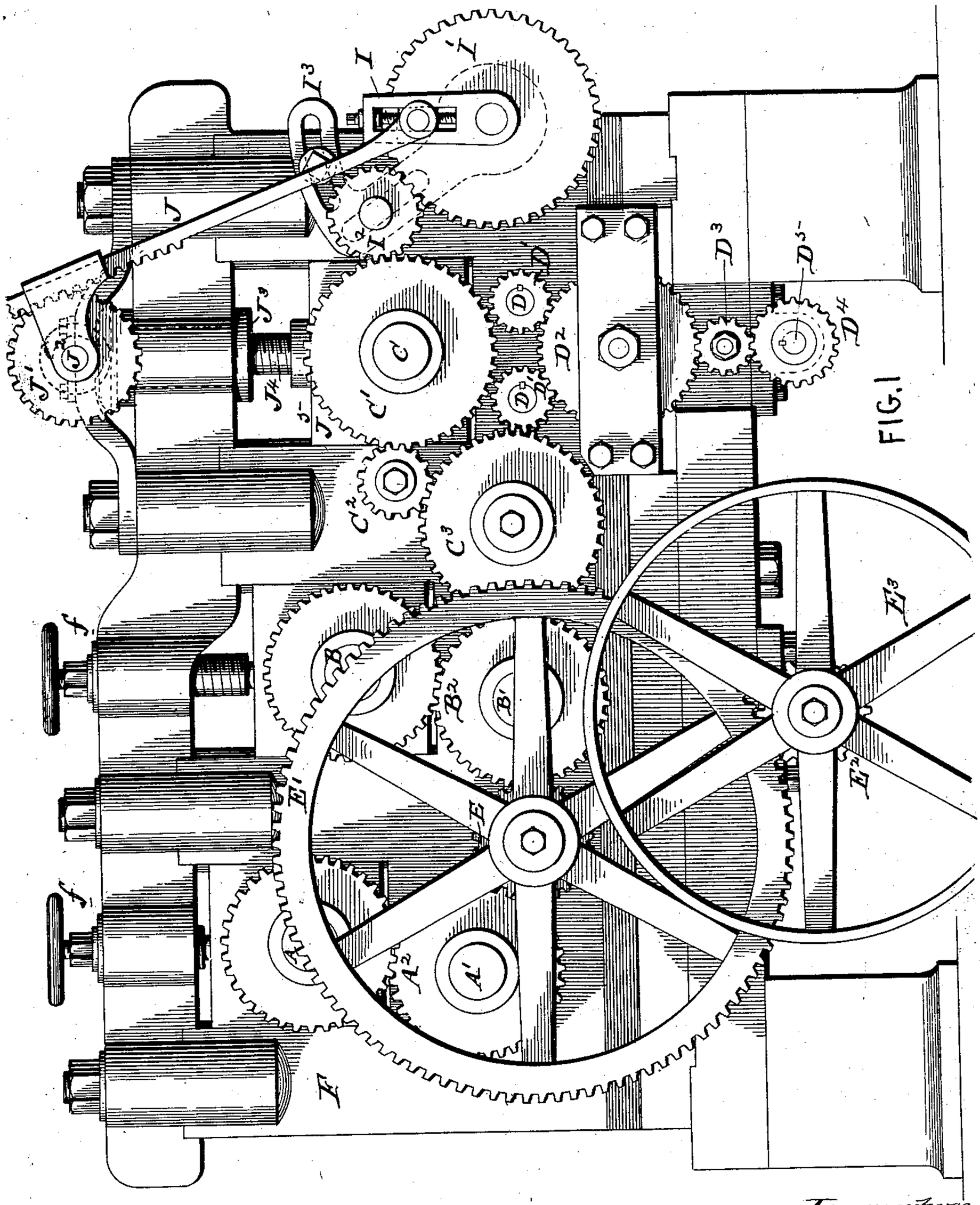

FIG. 1

Witnesses:

Louis D. Heinrichs

P. M. Tully.

Inventor

Edw. G. Budd

By Thos. G. Orrick & Co.

Atty

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NO MODEL. 4 SHEETS—SHEET 2.

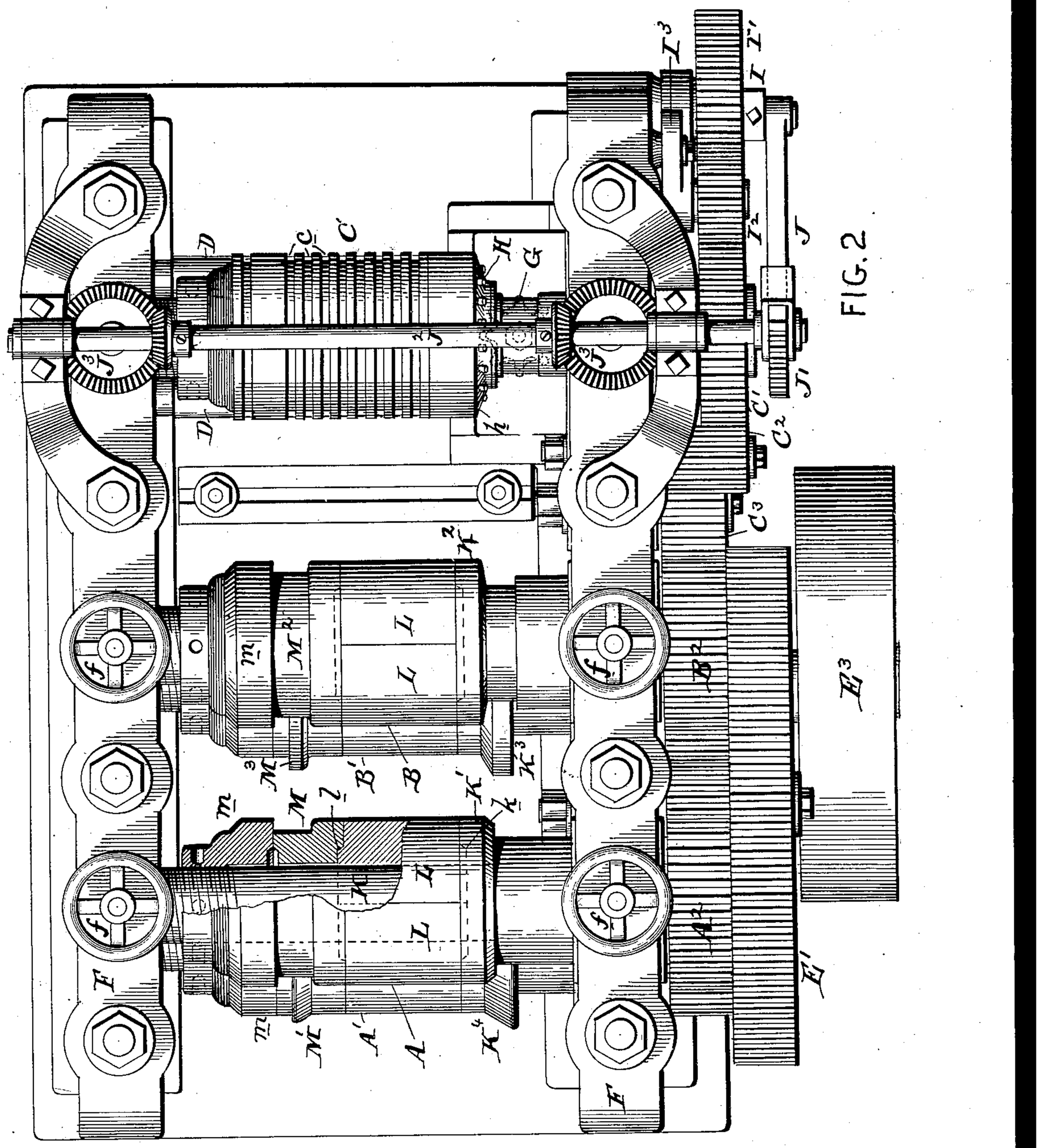

FIG. 2

Witnesses:
Louis D. Heinrichs
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No. 735,704. PATENTED AUG. 11, 1903.

E. G. BUDD.

MACHINE FOR CURVING PULLEY RIMS.

APPLICATION FILED JULY 10, 1901.

NO MODEL. 4 SHEETS—SHEET 3.

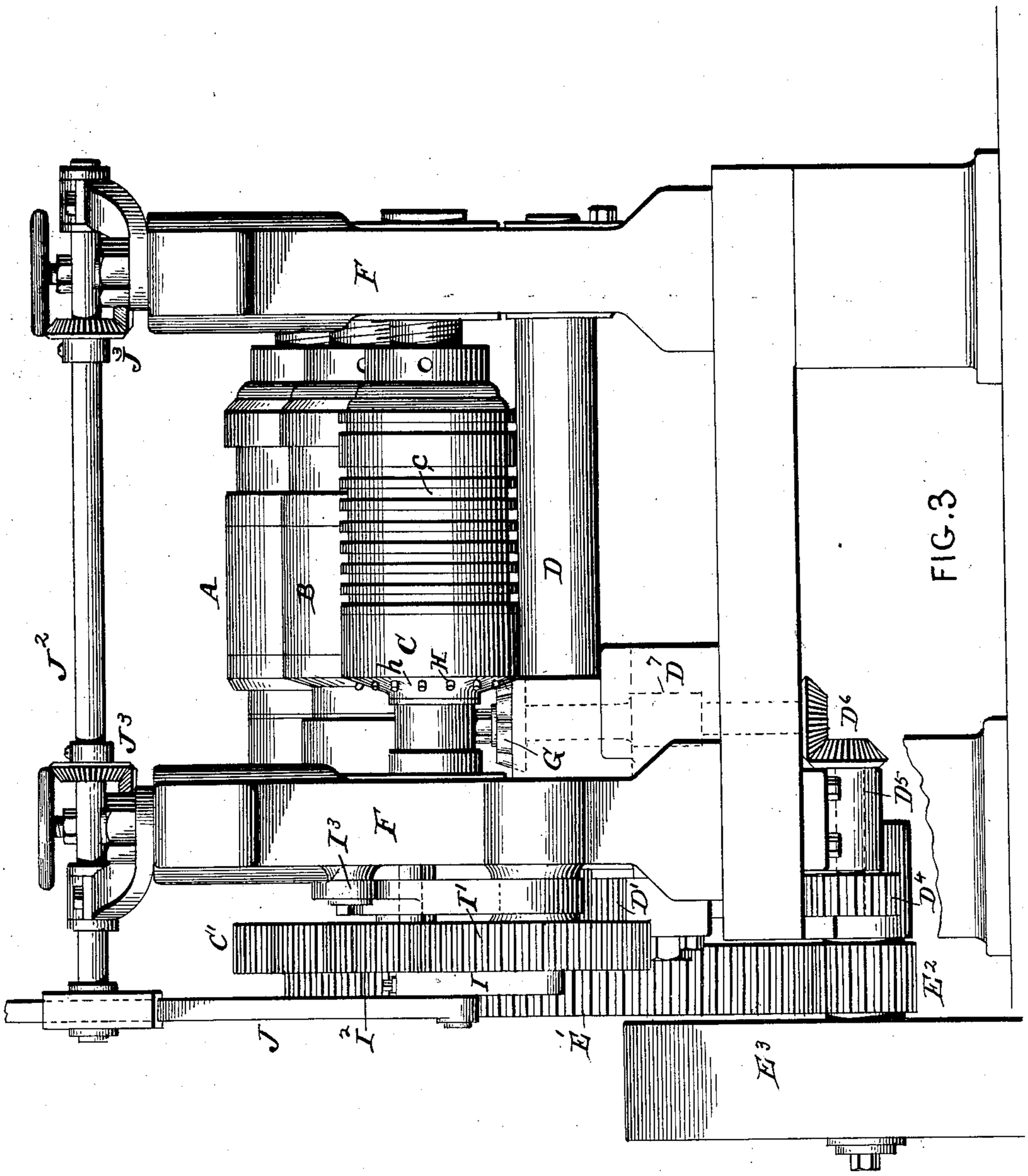

FIG. 3

Witnesses:
Louis D. Heinrichs
P. M. Kelly

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Edw. G. Budd
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No. 735,704. PATENTED AUG. 11, 1903.

E. G. BUDD.

MACHINE FOR CURVING PULLEY RIMS.

APPLICATION FILED JULY 10, 1901.

NO MODEL. 4 SHEETS—SHEET 4.

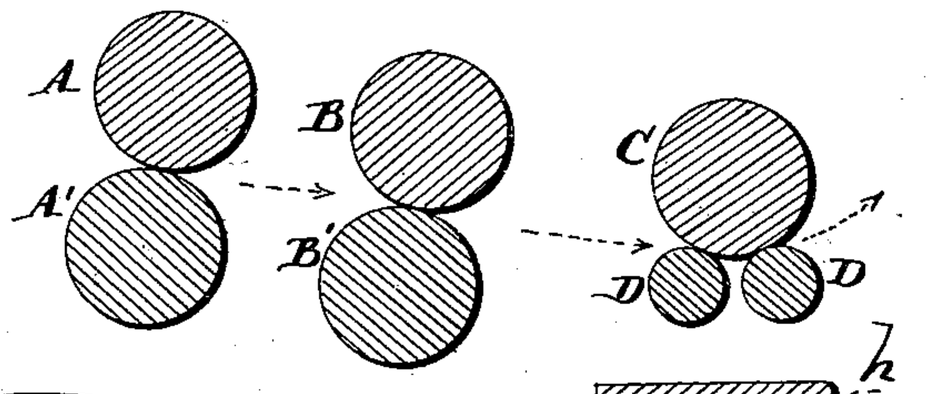

FIG. 4

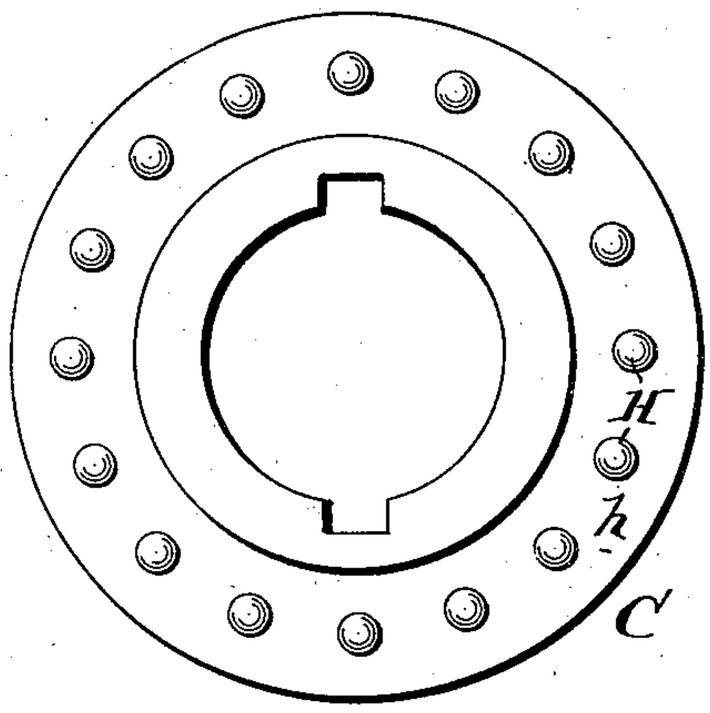

FIG. 6

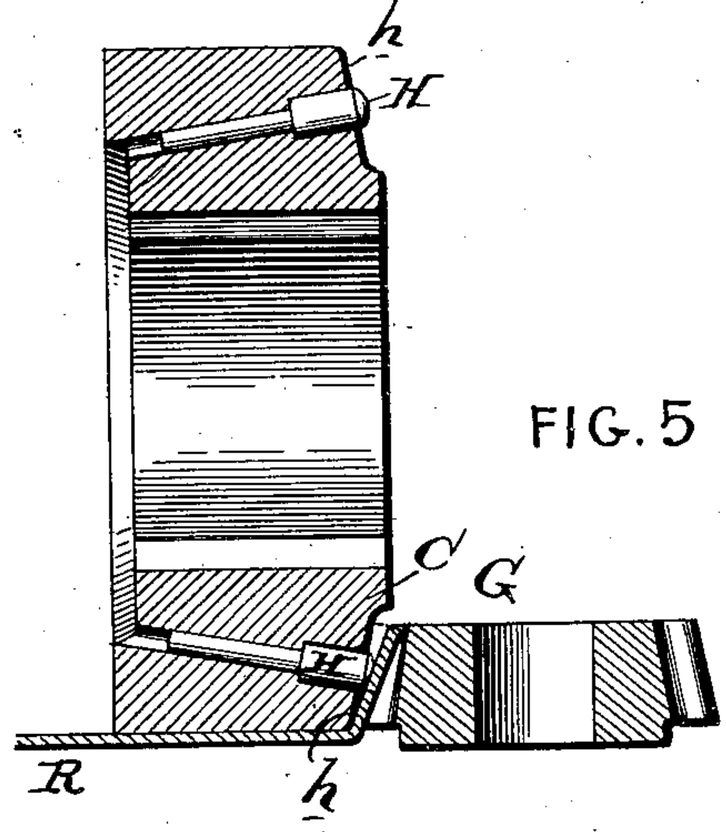

FIG. 5

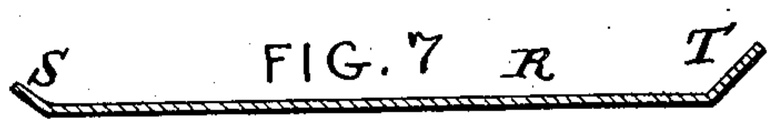

FIG. 7

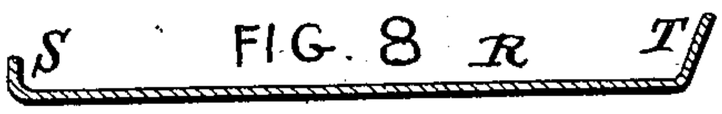

FIG. 8

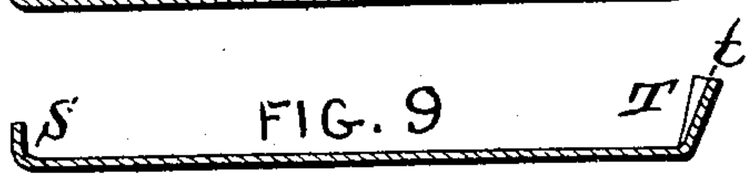

FIG. 9

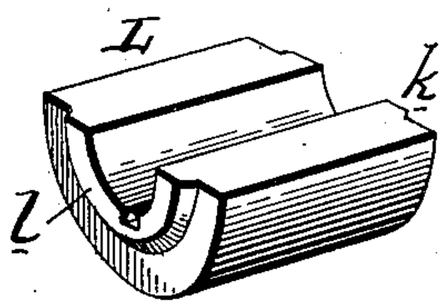

FIG. 11

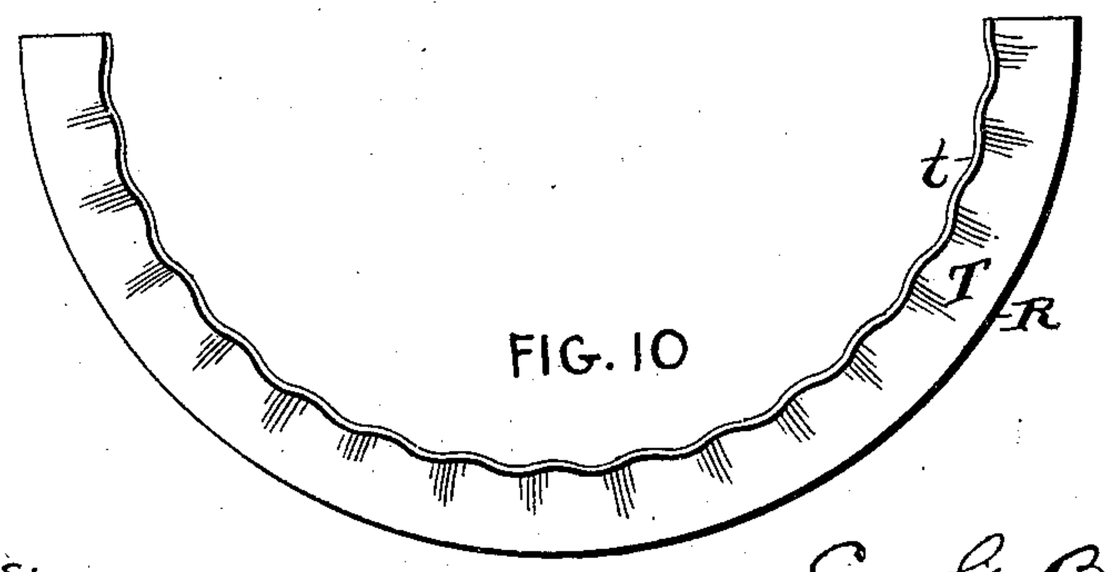

FIG. 10

Witnesses:
Louis D. Heinrichs
P. M. Kelly

Inventor
Edw. G. Budd.
By Thos. Hunt & Son
Atty

No. 735,704. Patented August 11, 1903.

UNITED STATES PATENT OFFICE.

EDWARD G. BUDD, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE AMERICAN PULLEY COMPANY, A CORPORATION OF PENNSYLVANIA.

MACHINE FOR CURVING PULLEY-RIMS.

SPECIFICATION forming part of Letters Patent No. 735,704, dated August 11, 1903.

Application filed July 10, 1901. Serial No. 67,724. (No model.)

To all whom it may concern:

Be it known that I, EDWARD G. BUDD, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Machines for Curving Pulley-Rims, of which the following is a specification.

My invention has reference to rolls for curving pulley-rims; and it consists of certain improvements fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

The object of my invention is to form a sheet-metal blank in true curved form and with its edges curved inward at one side and flanged inward at the other side almost at right angles, so that a blank is formed which may subsequently be subjected to hydraulic pressure, as set out in Letters Patent No. 630,449, dated August 8, 1899, to Corscaden, to complete the shaping into a section of pulley-rim. In making these rims I have found that in passing the plates through flanging and curving rolls the curvature of the plate is not a true curve, but instead is of varying curvature, said curvature decreasing from one end to the other—namely, the last to pass through the rolls. This is caused by the flanges, which have a neutral line of curvature that does not coincide with the neutral line of curvature of the body of the plate. In practice the result of this is that the free edge of the flange is held back or caused to resist being dragged through the rolls, so that the curving of the plate is more and more resisted as the plate passes through the curving-rolls. The plate thus formed is not of uniform curvature, and it is difficult to make the completed rim of the pulley absolutely true.

My object therefore is to overcome these defects by the employment of suitable means capable of producing a pulley-rim section of absolutely true and uniform curvature. In carrying out this part of my invention I provide the machine with suitable flanging-rolls and a set of curving-rolls, the latter comprising one large and two smaller rolls between which the flanged sheet passes. The large roll of the set of curving-rolls is provided on its end with pins or teeth, which, coacting with a horizontal toothed roll, act to crimp or corrugate the flange of the sheet, which is being curved, the result being to cause the flange to properly curve itself to conform to the curvature given to the body of the sheet. In this manner the resistance to curvature of the body heretofore experienced on account of the flange is removed. However, where the curvature is very great, the sheet long, and the flange deep the crimping of the latter is not always sufficient of itself to permit of uniform curvature, because there is a certain slip or dragging tendency to the flange through the teeth and toothed roll. To overcome this, I simultaneously with the said crimping operation cause the large curving-roll to be moved closer to the small rolls to induce a gradually greater curvature to the sheet as it passes through the curving-rolls, said action counteracting the resistance to curvature due to the flange. The adjustment of the curving-rolls may be done automatically or otherwise, and, if desired, this mode of inducing the sheet to assume a uniform curvature may be employed without the crimping of the sheet.

My invention also comprehends certain improvements in the details of the flanging-rolls, whereby they may have their body parts varied as to length between the flanging-collars to suit sheets of different widths without necessitating the removal of the roll-shaft or dismantling the machine. In carrying out this part of my invention I provide the roll-shaft with collars relatively adjustable to and from each other, and between the said collars a split sleeve or roll body is located and clamped in position, the two semicylindrical halves of the roll-body being held together and concentric upon the shaft by the said collars, as more fully set out hereinafter.

My invention will be better understood by reference to the drawings, in which—

Figure 1 is a side elevation of my improved rolls for curving pulley-rims. Fig. 2 is a plan view of same. Fig. 3 is an end elevation of same. Fig. 4 is a cross-section through the rolls and is diagrammatic to indicate the relative arrangement of the rolls. Fig. 5 is a sectional elevation of the means for crimping the flange of the sheet. Fig. 6 is an elevation of the end of the large curving-roll.

Figs. 7, 8, and 9 are cross-sections of the sheet during process of formation. Fig. 10 is a side elevation of a curved sheet constituting a pulley-rim segment before being subjected to the action of the hydraulic press, and Fig. 11 is a perspective view of one section of the flanging-rolls.

F is the main frame of the machine and may be of any suitable shape.

A A′ represent one pair of flanging-rolls for flanging the sheet to the shape shown in Fig. 7. B B′ represent a second pair of flanging-rolls for bringing the sheet to the shape shown in Fig. 8.

C D D are the curving-rolls which crimp the flange T, as at *t*, Fig. 9, and also positively curve the body of the sheet, as shown in Fig. 10. In general construction all of the flanging-rolls are alike, but specifically they differ with respect to the flanging-collars. The rolls consist of a central shaft K, carried in suitable bearings in the main frame or housings F. One end of each of the shafts is fitted permanently with a collar, as K′, K^2, K^3, and K^4, respectively, and the other ends, respectively, with adjustable collars M, M′, M^2, and M^3, and nuts *m*, the latter being screwed upon the shafts. Between the fixed collars and the adjustable collars are the split tubular roll-bodies L. These bodies are made up of semicylindrical sections, such as shown in Fig. 11, having at one end the annular rib *k* and at the other a similar annular rib *l*. These ribs *k* and *l* are respectively received in annular grooves in the fixed collars K′ to K^4 and in the adjustable collars M to M^3, and by means of said collars said segments L L of each roll are clamped firmly to the shaft K, which they snugly fit and held against rotating on the shafts by keys *l*. The adjustable collars are clamped against the roll-segments by the nuts *m*. The normal diameters of the collars and roll-body segments L are the same, but the collars are grooved and flanged, as shown, for the purpose of operating in pairs to flange the sheet passed between the body parts of the rolls. I do not confine myself to any specific construction of flanging elements of these collars, as while the construction shown is adapted to produce the flanges S and T upon the side edges of the body R of the sheet shown in Figs. 7 and 8 flanging of other character may be performed or even omitted without removing the specific mode of holding the segmental parts L L of the roll-body together.

The two rolls A A′ are geared together by gears A^2 and are driven from a pinion E, which latter in turn is driven by a large spur-wheel E′, operated by a pinion E^2 on the power-shaft, which may be rotated by the belt-pulley E^3. The rolls B B′ are geared together by gears B^2, and these are also driven by pinion E. Adjusting-screws *f* may be employed to adjust the distance apart of the rolls A A′ and B B′ to suit metal of different thickness.

The curving-roll C is driven by a spur-wheel C′ on its end, receiving power from roll B^2 by intermediate gears C^2 and C^3. The lower curving-rolls D D are also preferably positively rotated by gearing, the same consisting of pinions D′ on the ends of the shafts of said rolls meshing with an intermediate gear D^2, and one of said pinions is also driven direct from the gear C^3, before referred to. In this manner all of the rolls rotate in the proper directions and at the proper speeds.

The upper roll C is journaled in boxes J^5, and these are raised and lowered by screws J^4 working in rotating nuts J^3, carried in the housings and adapted to be rotated in both directions for alternately raising and lowering said roll relatively to and from the small rolls D D. The nuts J^3 are rotated by a shaft J^2 by bevel-gears J^3, and said shaft J^2 is rotated in one direction and then in the other by gear J′ and reciprocating rack-bar J. This bar J is operated by a crank I, having an adjustable throw, said crank being rotated by gear I′ and intermediate gear I^2, driven by the gear C′ of the upper curving-roll C. To suit different sizes of sheets and consequent difference in curving action necessary, I make the crank I adjustable as to its throw and provide means for adjustably supporting the intermediate gear I^2, so that both the gears I′ and I^2 may be changed to vary the revolutions of the crank with a given rotary action of the curving-rolls. This is especially necessary where the sheet is longer or shorter, and consequently where the gradual increasing of the curving action of the rolls is required to be more gradual or to a different extent, or both.

The lower and smaller rolls D D of the set of curving-rolls are smooth, but the upper and larger roll C is made as shown, being provided with a series of circumferential grooves *c*, adapted to receive the small flange S of the sheet R and permits it to pass without injury. The various grooves *c* are so spaced apart as to correspond to the different widths of sheets to be formed. The end section of this roll C is provided on its end surface *h*, near the periphery of the roll, with a series of pins or studs H, which may be of hard steel and act as teeth, between which the flange T of the sheet may be corrugated or crimped, as shown at *t*, Figs. 9 and 10, by the action of the beveled toothed roll G. This roll G is beveled to correspond to the inclination of the end surface *h* of the roll C and is secured upon an upright shaft D^7, which extends vertically between the rolls D D. The shaft D^7 is driven by miter-gears D^6, a shaft D^5, spur-gears D^4 and D^3, the latter being driven from spur-gear D^2, before referred to, in connection with the driving of the rolls D D. In this manner the crimping-roll G is rotated in the proper direction and with a speed commensurate with that of the roll C; but it is evident that any other suitable manner of driving this crimping-roll may be employed. In some cases the gearing for roll G may be

omitted. It is also evident that the roller G need not be beveled, as any toothed roller may be employed in this connection. I, however, have shown the construction which I have found in use to be excellently adapted to the purpose.

The curving-rolls D D may be simply used as idlers, for while it is preferable to positively rotate them it is not essential. It is also preferable to positively rotate the shaft of the crimping-roll G; but it is not essential, as it may be driven by friction or meshing with the pins or teeth H of roll C through the sheet-flange when performing the crimping operation and directly by the said pins or teeth when the sheet is not present.

The curving devices may be greatly varied, if so desired, so long as the crimping-roll G is employed.

The sheet being first flanged in the rolls A A′ and B B′, it is passed through the curving-rolls C D D and is curved to the required degree. While the said rolls are curving the sheet, the deep flange T thereof is simultaneously crimped or corrugated on its edge, as at *t*. This causes the flange to also curve to correspond to the body of the sheet; but, as before pointed out, in cases of long sheets or deep flanges there is a tendency for the sheet to assume a gradually-decreased curvature as it passes through the rolls, and this I overcome by feeding down the roller C toward the rolls D D slightly and gradually as the sheet passes between them for the purpose of increasing the curving action of these rolls, the result being that the finished sheet comes from the rolls on a true arc of a circle and in fine condition for treatment in the dies of the hydraulic press, which finishes the forming operation. It is evident that while the best result is secured by the employment of both the crimping means and the means for increasing the curving tendency of the rolls, either of these may be omitted in some classes of work. For example, when wide flanges and slight curvature are required the crimping-rolls will be sufficient. Where the flanges are small, the crimping may be omitted and the downward feeding of the roll C be relied upon; but in work of the cross-section shown in Fig. 8 both should be employed.

The feeding of the roll C in the above operation is toward the rolls D when the metal is passing between them, and then apart when the metal has passed and before the next sheet enters. The means shown will accomplish this result and has capacity for adjustment to suit sheets of different lengths or different requirements in the degree of adjustment, the increased curving action being different with different sizes, thicknesses, and shapes of metal to be treated. Any other suitable feeding means may be employed for automatically feeding this roll C in lieu of that shown. I would point out that the vertical adjustment of the roll C may be performed by hand with very good results after a little experience, and consequently I do not limit myself to the use of automatic means for adjusting the rolls C and D D relatively to and from each other with each given number of revolutions.

While I have shown two pairs of flanging-rolls, it is evident that where the flanges are not required to be very large one set of rolls will suffice. In case that a sheet to be flanged and curved is required to be of less width, I simply screw back the nuts *m* on the shafts K and then replace the sections L with similar sections of greater or less length and clamp them in position, as shown, by screwing up the nuts *m* again. In this manner I am enabled to vary the length of these rolls between the flange-producing collars without dismantling the machine and without material loss of time.

While I prefer the construction shown, the details may be varied without departing from the essential features of my invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a machine for forming curved sheets, the combination of a pair of lower rolls, a large roll for depressing the sheet between the two lower rolls to curve it, gearing for rotating the rolls all at the same surface speeds, and means for moving the large roll to and from the pair of lower rolls to increase the tendency to curvature of the sheet while passing between the rolls.

2. In a machine for forming curved sheets, the combination of flanging-rolls for flanging the edge of the sheet and feeding it forward to the curving-rolls, a pair of lower rolls, a large roll for depressing the sheet between the two lower rolls to curve it, gearing for rotating the rolls all at the same surface speeds, and means for moving the large roll to and from the pair of lower rolls to increase the tendency to curvature of the sheet while passing between the rolls.

3. In a machine for forming curved sheets, the combination of flanging-rolls for flanging the edge of the sheet and feeding it forward to the curving-rolls, a pair of lower rolls, a large roll for depressing the sheet between the two lower rolls to curve it having its end formed with a series of pins or teeth, a crimping-roll having teeth working between the pins or teeth of the large curving-roll, gearing for rotating the rolls at the same surface speeds, and means for moving the large roll to and from the pair of lower rolls to increase the tendency to curvature of the sheet while passing between the rolls and having its flange crimped.

4. In a machine for forming curved sheets, the combination of flanging-rolls for flanging the edge of the sheet and feeding it forward to the curving-rolls, a pair of lower rolls, a large roll for depressing the sheet between the two lower rolls to curve it, gearing for ro-

tating the rolls at the same surface speeds, and automatic means for moving the large roll to and from the pair of lower rolls alternately in a gradual manner to increase the tendency to curvature of the sheet while passing between the rolls.

5. In a machine for forming curved sheets, the combination of a pair of lower rolls, a large roll for depressing the sheet between the two lower rolls to curve it, gearing for rotating the rolls at the same surface speeds, and means for moving the large roll to and from the pair of lower rolls to increase the tendency to curvature of the sheet while passing between the rolls and adjustable devices for varying the extent and period of movement the large curving-roll to and from the lower rolls.

6. In a curving-machine for flanged sheets, the combination of flanging-rolls, with three curving-rolls working together to curve the sheet one of said rolls having upon its end a series of pins or teeth for crimping the flange of the sheet, a crimping-roll having teeth meshing with the pins or teeth on the curving-roller, and means for positively driving the curving-rolls.

7. In a curving-machine for flanged sheets, the combination of flanging-rolls for flanging both edges of the sheet, with three curving-rolls working together to curve the sheet one of said rolls having upon its surface a series of parallel circumferential grooves and upon its end a series of pins or teeth for crimping the flange of the sheet, a crimping-roll having teeth meshing with the pins or teeth on the curving-roller, and means for positively driving the curving-rolls.

8. In a machine for curving sheet metal, the combination of three rolls two of which act upon one face of the sheet at a distance apart and the other of which acts upon the opposite face of the sheet and at a point intermediate of the other two rolls, and means for relatively moving the rolls gradually together to increase the curving tendency while the sheet is passing between them.

9. In a machine for curving sheet metal, the combination of three rolls two of which act upon one face of the sheet at a distance apart and the other of which acts upon the opposite face of the sheet and at a point intermediate of the other rolls, means for relatively moving the rolls gradually together to increase the curving tendency while the sheet is passing between them and then separate them again, and adjustable devices for varying the extent of relative movement of the rolls.

10. In a machine for curving sheet metal of different lengths, the combination of three rolls two of which act upon one face of the sheet at a distance apart and the other of which acts upon the opposite face of the sheet and at a point intermediate of the other two rolls, and means for relatively moving the rolls gradually together to increase the curving tendency while the sheet is passing between them and then separate them again, and adjustable devices for varying the extent and period of relative movement of the rolls.

11. In a sheet-metal-curving machine, the combination of a pair of parallel rolls of small diameter separated a short distance apart, a large bending-roll adapted to work with both of said rolls of small diameter and having its end provided with a series of pins or teeth, a shaft extending between the two rolls of small diameter, a crimping-roll having teeth meshing with the pins or teeth of the curving-roll and secured to the shaft, and gearing for causing the several rolls to rotate at the same surface speeds.

12. In a machine for treating sheet metal, a pair of rolls having flanging-collars, and cylindrical body portions split longitudinally, combined with clamping-nuts for holding the body portions in position, and curving-rolls one of which is provided with a series of circumferential grooves in line with the flanging-collars and split body portions whereby the flange produced by the flanging-collars is received in one of the grooves of the curving-rolls when curving the sheet.

13. In a machine for rolling sheet metal the combination of a pair of rolls each consisting of a central shaft having a collar near one end, an adjustable collar near the other end, a cylindrical body portion split longitudinally into two parts and having annular ribs fitting into annular recesses in the collars for holding them together upon the shaft, and curving-rolls one of which is provided with a series of circumferential grooves in line with the flanging-collars and split body portions whereby the flange produced by the flanging-collars is received in one of the grooves of the curving-rolls when curving the sheet.

14. In a machine for rolling sheet metal, the combination of a central shaft, a roll-body consisting of a cylindrical part split longitudinally into two semi-annular parts, two collars on the shaft clamping the two parts of the body together upon the shaft, and curving-rolls one of which is provided with a series of circumferential grooves in line with the flanging-collars and split body portions whereby the flange produced by the flanging-collars is received in one of the grooves of the curving-rolls when curving the sheet.

15. In a machine for curving flanged sheet metal, the combination of a bending-roll, a crimping-roll having teeth adapted to act upon the flange of the sheet and press it toward the end of the bending-roll in the act of crimping it and rotating about an axis at an angle to the axis of the bending-roll, and means for supporting the sheet to the bending-roll during the curving action thereof upon the flanged sheet.

16. In a machine for curving flanged sheet metal, the combination of a bending-roll having its end provided with a series of pins or

teeth, a crimping-roll having teeth adapted to act upon the flange of the sheet and press it toward the end of the bending-roll and over its pins or teeth in the act of crimping it and rotating about an axis at an angle to the axis of the bending-roll, and means for supporting the sheet to the bending-roll during the curving action thereof upon the flanged sheet.

17. In a machine for curving flanged sheet metal, the combination of cylindrical rolls for curving the body of a sheet into a cylinder, with means located at one end of the cylindrical rolls for crimping the flange of the sheet along its free edge to cause the flange to curve commensurate with the cylindrical body, and power devices for causing the curving means and crimping means to operate at the same surface speeds upon the metal.

In testimony of which invention I have hereunto set my hand.

EDWARD G. BUDD.

Witnesses:
RUSSELL H. BOWEN,
ALEX R. CHESTON.