Jan. 16, 1923. 1,442,601

E. G. BUDD ET AL.

MACHINE AND METHOD FOR ROLLING TAPERED DISKS.

FILED JULY 3, 1919. 3 SHEETS-SHEET 1

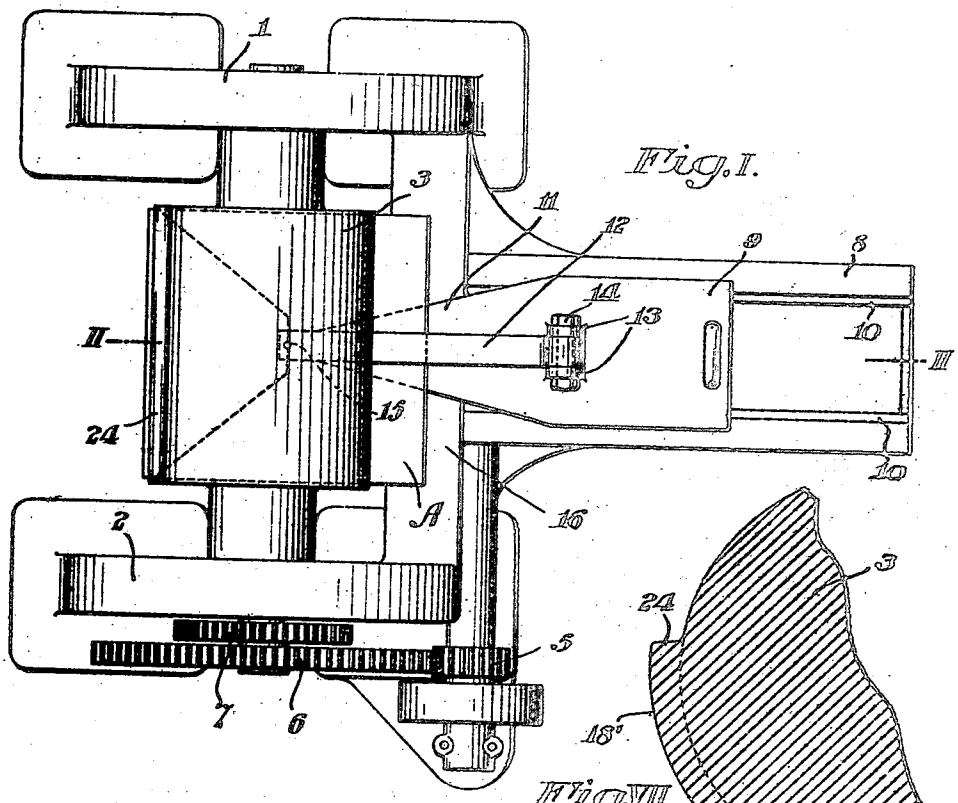

Fig. I.

Fig. VII.

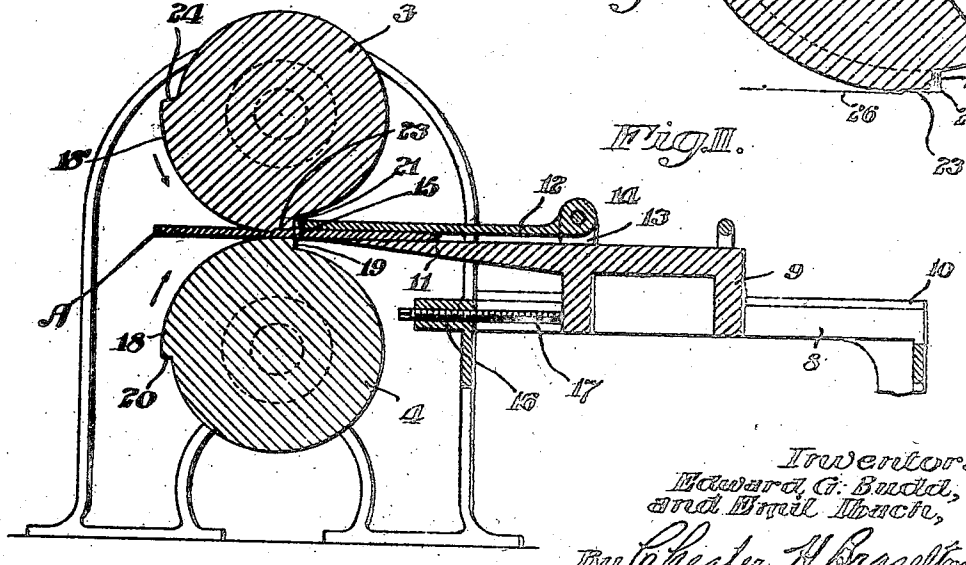

Fig. III.

Inventors
Edward G. Budd,
and Emil Ibach,
By Chester H. Braselton
Attorney.

Jan. 16, 1923.

1,442,601

E. G. BUDD ET AL.

MACHINE AND METHOD FOR ROLLING TAPERED DISKS.

FILED JULY 3, 1919.

3 SHEETS-SHEET 2

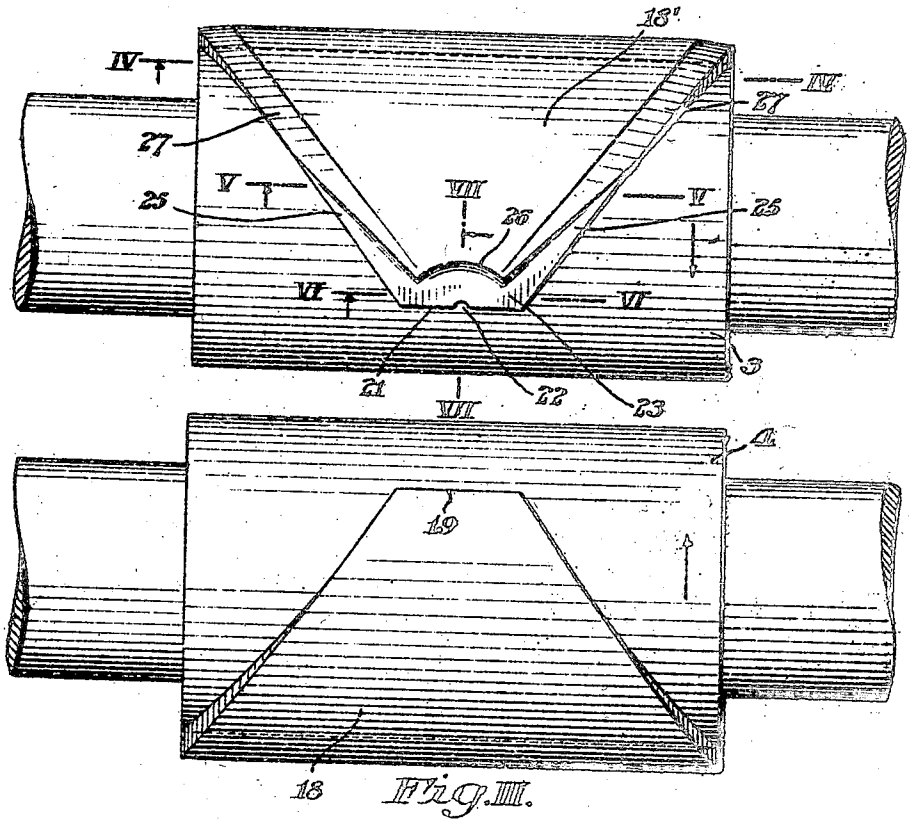

Fig. III.

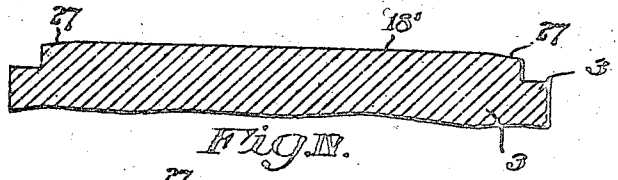

Fig. IV.

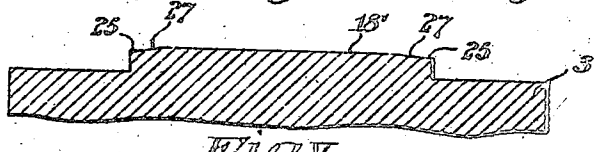

Fig. V.

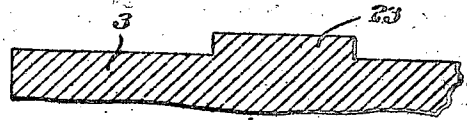

Fig. VI.

Inventors
Howard G. Budd
and Emil Ibach,
By Chester N. Braselton
Attorney

Jan. 16, 1923. 1,442,601

E. G. BUDD ET AL.

MACHINE AND METHOD FOR ROLLING TAPERED DISKS.

FILED JULY 3, 1919. 3 SHEETS-SHEET 3

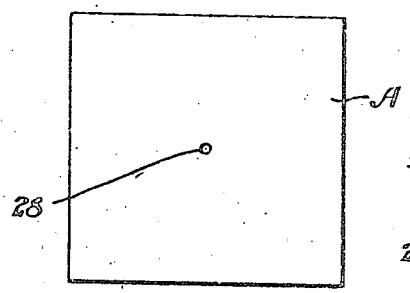

Fig. VIII.

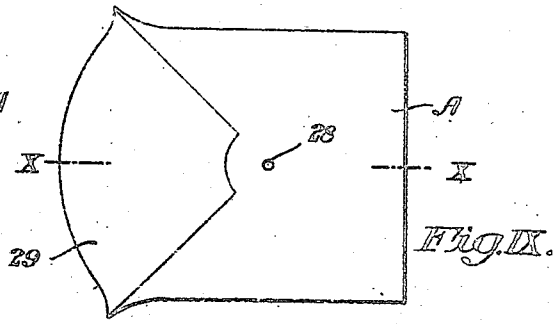

Fig. IX.

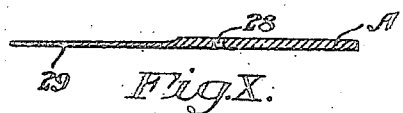

Fig. X.

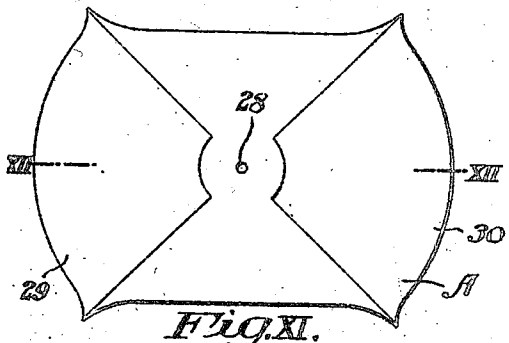

Fig. XI.

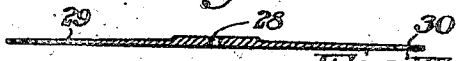

Fig. XII.

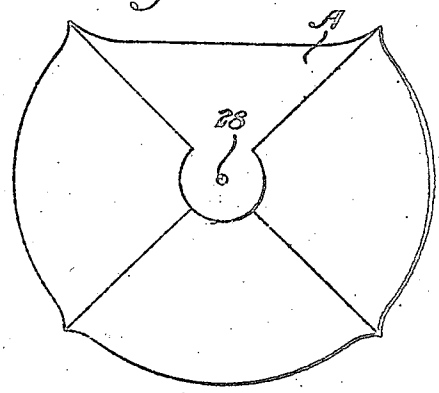

Fig. XIII.

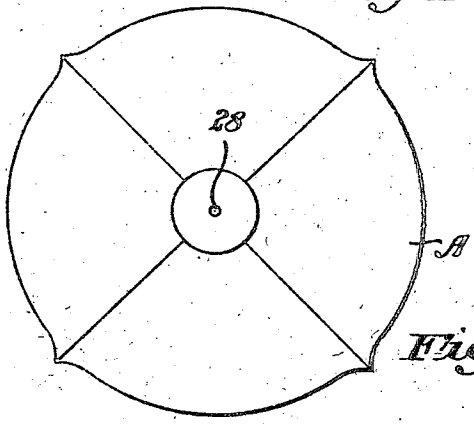

Fig. XIV

Fig. XV.

Inventors,
Edward G. Budd
and Emil Ilsch,
By Chester N. Greenleaf
Attorney.

Patented Jan. 16, 1923. 1,442,601

UNITED STATES PATENT OFFICE.

EDWARD G. BUDD AND EMIL IBACH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO BUDD WHEEL COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

MACHINE AND METHOD FOR ROLLING TAPERED DISKS.

Application filed July 3, 1919. Serial No. 308,548. REISSUED

To all whom it may concern:

Be it known that we, EDWARD G. BUDD and EMIL IBACH, the former a citizen of the United States and the latter a citizen of Germany who has declared his intention to become a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Machines and Methods for Rolling Tapered Disks, of which we declare the following to be a full, clear, and exact description.

This invention relates to machines and methods for forming tapered disks for instance, such as are used in the manufacture of disk wheels.

One of the chief objects of our invention is to provide a machine by which tapered steel disks may be formed from a square blank of uniform thickness with a minimum amount of waste and at a low cost.

Another object of our invention is to provide a method or process of forming tapered steel disks from a square blank of uniform thickness.

Further objects, and objects relating to economies of material and details of operation, will definitely appear from the detailed description to follow. We accomplish the objects of our invention by the devices and means described in the following specification. Our invention is clearly defined and pointed out in the appended claims. A machine constructed in accordance with our invention and capable of carrying out our improved process is illustrated in the accompanying drawings, forming a part of this specification, in which;

Fig. I is a plan view of a machine embodying our invention.

Fig. II is a sectional view through said machine taken on the line II—II of Fig. I.

Fig. III is an enlarged view, in front elevation, of the rolls shown in Fig. II.

Fig. IV is a fragmentary, detail, sectional view taken on the line IV—IV of Fig. III.

Fig. V is a fragmentary, detail, sectional view taken on line V—V of Fig. III.

Fig. VI is a fragmentary, detail, sectional view taken on line VI—VI of Fig. III.

Fig. VII is a fragmentary, detail, sectional view taken on line VII—VII of Fig. III.

Fig. VIII is a plan view of the square blank from which the disk is formed.

Fig. IX is a plan view of the blank after it has been given a pass in one direction.

Fig. X is a sectional view through the blank on the line X—X of Fig. IX.

Fig. XI is a plan view of the blank after the second pass has been given it.

Fig. XII is a sectional view through the blank on the line XII—XII of Fig. XI.

Fig. XIII is a plan view of the blank after the third pass.

Fig. XIV is a plan view of the blank after the fourth pass, and,

Fig. XV is a sectional view through the finished wheel disk.

In the drawings, similar reference numerals refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrow at the end of the section line.

In general our invention consists in rolling rectangular metal blanks of substantially uniform thickness into disks having substantially a circular periphery and which are preferably tapered from the central portion to the periphery thereof, by rolling the metal blank along a plurality of different radii from the center outwardly so as to force the excess metal radially of the blank toward the periphery thereof. This tapers the blank and also causes the periphery thereof to approach a circle. Our invention also comprises a machine for carrying out this method and including a pair of co-operating rolls which act upon the metal blank, one of said rolls having a substantially triangular working surface of cam formation so that points on said working surface are at progressively greater distances from the axis of the roll.

Referring to the drawings, I have illustrated a machine comprising the upright frame members 1 and 2, in which the rolls 3 and 4 are journaled, said rolls being driven in opposite directions from a suitable source of power through the gears 5, 6 and 7. A table 8 extends forwardly from the frame work, and is provided with ways 10, on which the carriage 9 is slidably mounted. The carriage 9 had a part 11 extending towards the rolls and adapted to support the blank A which is to be operated on. An arm 12 is pivoted at its forward end be-

tween the lugs 13 on the carriage 9 by means of the bolt or pin 14. A pin 15 projects downwardly from the rear end of the arm 12 and is adapted to extend through a central opening 28, formed in the blank A. This arm 12 and the pin 15 serves as a means for centering the blank with reference to the carriage 9 and consequently with reference to the rolls 3 and 4. A cross bar 16 extends between the uprights 1 and 2 at the forward part of the machine, and a stop screw 17 is threaded through said cross bar so that its forward end extends into a position to be engaged by the carriage 9 and serves as an adjustable stop to limit the movement of the carriage towards the rolls.

A substantially triangular raised portion 18 is formed on the roll 4, extending from the narrow shoulder 19 disposed midway between the ends of the roll to the base shoulder 20 (see Fig. II) which extends from one edge of the roll to the other. The surface of the portion 18 is, at all points, equi-distant from the axis of the roll 4. A substantially triangular portion is formed on the roll 3 and so positioned on said roll as to co-operate with the portion 18 on the roll 4. This portion extends from the narrow shoulder 21, which co-operates with the shoulder 19 on the roll 4. The working surface on the roll 3 is bounded by the parallel shoulders 21 and 24 (see Fig. II) and the lines drawn from the ends of the shoulder 21 to the ends of the shoulder 24. A notch 22 is formed centrally in the shoulder 21 so as to accommodate the centering pin 15. At the apex of this triangular portion there is the portion 23 all parts of which are equally distant from the axis of the roll. This portion is defined by the shoulder 21, the edges of the raised portion, the arc of a circle concentric with a notch 22 and covering substantially ninety degrees, and lines drawn from the ends of said arc rearwardly to the edges of the raised portion thus forming the horns 25 which are in the same cylindrical surface with the portion 23. From the line 26 forming the inner boundary of the portion 23, the cam surface 18′ extends rearwardly to the shoulder 24, said cam surface increasing in its distance from the axis of the roll continuously from the line 26 to the shoulder 24. At the edges of the cam surface 18′ there are formed the beveled surfaces 27 which are widest adjacent the shoulder 24 and grow narrower as they approach the parts 25 and the line 26.

The square blank A of uniform thickness, from which the tapered steel disc is formed, is heated and mounted on the part 11 of the carriage 9 and centered by means of the arm 12 and the pin 15. While the rolls are in such position that the working surfaces are on opposite sides of the rolls from each other, the carriage is moved inwardly until it engages the stop 17, thus carrying one-half of the blank between the rolls 3 and 4. As the rolls revolve, being driven in opposite directions, the surfaces 18 and 18′ move towards each other until the shoulders 19 and 21 are in line with each other, and the notch 22 receives the pin 15. At this position of the rolls the central part of the blank A is gripped firmly between the surface 18, of the roll 4, and the part 23 of the roll 3. The distance between these parts is such that there is no compression of the blank at this point. By this means the blank is firmly held at the beginning of the rolling operation. As the rolls continue to revolve, the central part of the blank is engaged by the apex of the cam surface 18′ on the roll 3, the blank being given a continuous support by the corresponding surface 18 on the roll 4. As the distance of the surface 18′ from the axis of the roll increases continuously from the line 26 to the shoulder 24, it will be seen that the pressure of the rolls increases continuously and the distance between the working surfaces on the rolls decreases continuously, with the result that the metal of the blank is pressed and squeezed out giving the metal the tapered cross-section and elongating it somewhat. Simultaneously with this rolling or squeezing action on the metal of the blank, which forces the excess metal radially of the blank, the blank is automatically ejected from between the rolls by the rolling action thereof, the carriage 9 moving forwardly on the ways 10 to permit this. The parts 25 in the same cylindrical surface as the part 23 extend rearwardly from the shoulder 21 and prevent buckling or curling of the sheet during the rolling operation as they tend to grip the blank on both sides of the point where the compression is taking place. The beveled edges 27 are provided in order to reduce the compression adjacent the edges of the surface acted upon so as to eliminate the pronounced ridges which would otherwise be caused at this point.

In Fig. VIII, I have shown the square blank of uniform thickness from which the tapered disks are formed. In Fig. IX, I have shown this blank after it has been given one pass, as illustrated in Figs. I and II, showing how the blank is elongated and given a curved outline on one edge. Fig. X shows the cross-sectional dimensions of this blank. The blank is now given a turn through one hundred and eighty degrees and the opposite edge is rolled from the center outwardly bringing the blank to the form shown in Figs. XI and XII. The blank is then rotated through ninety degrees and passed between the rolls from the center outwardly bringing the blank to the form shown in Fig. XIII. The blank is then turned through one hundred and eighty de-

grees and given a pass bringing the blank to the form shown in Fig. XIV. The blank may be trimmed and finished at this point without rolling it any further, but we find it desirable in many cases to give it four more passes, along the radial lines shown in Fig. XIV, in order to eliminate the ridges and cause the periphery of the blank to approach more nearly a circle. After the rolling operation is completed, the blank may be trimmed to bring its periphery to a true circle, the flange 31 is pressed up from the body of the blank and the central opening 32 punched therein thus forming the completed wheel disk.

It will be apparent that, by the use of the machine and method which we have described, a wheel disk of tapered cross-section may be produced very efficiently, and at a low cost. The disk is formed by a simple rolling operation which can be quickly performed and there is practically no waste as the square blank is brought so nearly to a circle that there is very little metal to be trimmed off.

We are aware that the particular embodiment of our invention, which we have described here, is susceptible of considerable variation without departing from the spirit of our invention and, therefore, we desire to claim the same broadly, as well as specifically, as indicated by the appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In a machine of the class described, the combination of a pair of co-operating rolls, one of said rolls having a substantially triangular portion of its surface raised above the rest of said surface, the distance of said triangular surface, from the axis of the roll, increasing continuously from its apex to its base.

2. In a machine of the class described, the combination of a pair of rolls driven in opposite directions, each of said rolls having a substantially triangular surface raised above the surrounding cylindrical surface of said roll, one of said surfaces increasing continuously in distance from the axis of the roll from the apex of said surface to its base.

3. In a machine of the class described, the combination of a pair of oppositely driven rolls, one of said rolls having a substantially triangular working surface increasing in distance from the axis of the roll continuously from its apex to its base, and the other roll having a mating triangular working surface with all parts thereof equi-distant from the axis of the roll.

4. In a machine of the class described, the combination of a pair of rolls, one of said rolls having a substantially triangular working surface comprising an area near the apex thereof all parts of which are equi-distant from the axis of the roll and a portion extending from said area to the base of said working surface and in which the distance of the surface from the axis of the roll increases continuously from apex to base.

5. In a machine of the class described, the combination of a pair of rolls, one of said rolls having a substantially triangular working surface comprising a triangular portion, the distance of which from the axis of the roll increases continuously from the apex to the base thereof, and a surface, all parts of which are equi-distant from the axis of said roll, extending in advance of and alongside of the apex of said triangular portion.

6. In a machine of the class described, the combination of a pair of rolls, one of said rolls having a substantially triangular surface, the distance of which from the axis of the roll increases continuously from apex to base, and a bevel at each side of said surface.

7. In a machine of the class described, the combination of a pair of rolls, one of said rolls having a substantially triangular raised portion comprising a substantially triangular surface, the distance of which from the axis of the roll increases continuously from apex to base, a portion in advance of and alongside of said surface all points in the surface of which are equi-distant from the axis of the roll, and a bevel at each side of said triangular surface.

8. In a machine for forming tapered metal disks, the combination of a pair of rolls, one of said rolls having a substantially triangular raised portion, the distance from apex to base being substantially equal to the radius of the disk to be formed, comprising a cam surface of continuously increasing radius and a surface of constant radius in advance of said cam surface and equal in width to the radius of the hub portion of the disk.

9. The process of treating a square metal blank to cause the periphery thereof to approach the circumference of a circle comprising successively rolling the blank in radial directions from the center to the periphery.

10. The process of forming tapered metal disks comprising successively rolling a square blank of uniform thickness in radial directions from the center to the periphery.

11. The method of making tapered disks comprising the rolling of a square blank successively in a plurality of directions extending radially from the center of the blank with a pressure increasing as the radial distance of the part of the blank acted upon from the center increases.

12. The process of forming a substantially circular plate comprising rolling a substantially rectangular blank successively in different directions to force excess metal toward the periphery of the blank.

13. The process of forming a metal plate having a substantially circular periphery and decreasing in thickness from the center to the periphery thereof comprising rolling a substantially rectangular blank of uniform thickness successively in different directions.

14. The process of forming a tapered wheel disk comprising successively rolling a blank of uniform thickness in different directions, trimming the edges of the rolled blank to cause the same to more closely approach a true circle, and forming a peripheral flange on said rolled blank.

15. The process of forming a tapered wheel disk comprising rolling a substantially rectangular blank of uniform thickness successively in different directions and forming a peripheral flange on said rolled blank.

16. The process of forming a substantially circular plate comprising rolling a substantially rectangular metal blank successively in radial directions from the center to the periphery.

17. The process of forming a substantially circular tapered metal plate comprising rolling a substantially rectangular metal blank of uniform thickness successively in radial directions from the center to the periphery.

18. The process of forming tapered disks comprising passing a substantially rectangular metal blank of uniform thickness, successively, between a pair of rollers, one of which has a cam portion of progressively increasing radius.

19. The process of forming a wheel disk comprising rolling a metal blank successively in radial directions from the center to the periphery, and forming a peripheral flange on the rolled blank.

20. The process of forming a tapered disk comprising rolling a substantially rectangular metal blank successively in radial directions from the center to the periphery, and forming a peripheral flange on the rolled blank.

21. The process of making tapered circular plates comprising the rolling of a substantially rectangular metal blank successively in a plurality of directions radially from the center of the blank with a pressure increasing as successive portions of the blank at increasing distances from the center are acted upon.

22. The process of making tapered circular plates comprising the rolling of a rectangular blank of uniform thickness, successively, along a plurality of different radii, extending from the center of the blank, with a pressure at points in a line radial of the blank proportional to the radial distance of the part of the blank acted upon from the center of the blank.

23. The process of making tapered disks of substantially circular periphery comprising the passing of a substantially rectangular metal blank, along a plurality of different radii, between rolls such that the distance between the operating surfaces of the rolls decreases as the distance of the portion of the blank acted upon from the center increases.

24. The process of making tapered disks comprising the rolling of a rectangular metal blank of substantially uniform thickness from the center outwardly along a plurality of different radii to force the excess metal radially towards the periphery of the blank.

25. The process of making tapered disks comprising the rolling of a rectangular metal blank of substantially uniform thickness, from the center outwardly, along a plurality of different radii, between rolls such that the portion of the roll surface in contact with the blank increases and the distance between the working surfaces of the rolls decreases as the distance of the portion of the blank acted upon from the center increases.

In testimony whereof, we affix our signatures.

EDWARD G. BUDD.
EMIL IBACH.