

May 10, 1938.

C. S. SWANSON

2,116,805

APPARATUS FOR FORGING AND FORMING STEEL DISK WHEELS AND THE LIKE

Filed May 9, 1936

4 Sheets-Sheet 1

Fig. 1

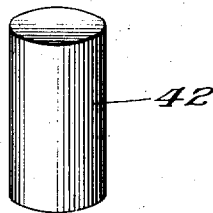


Fig. 2

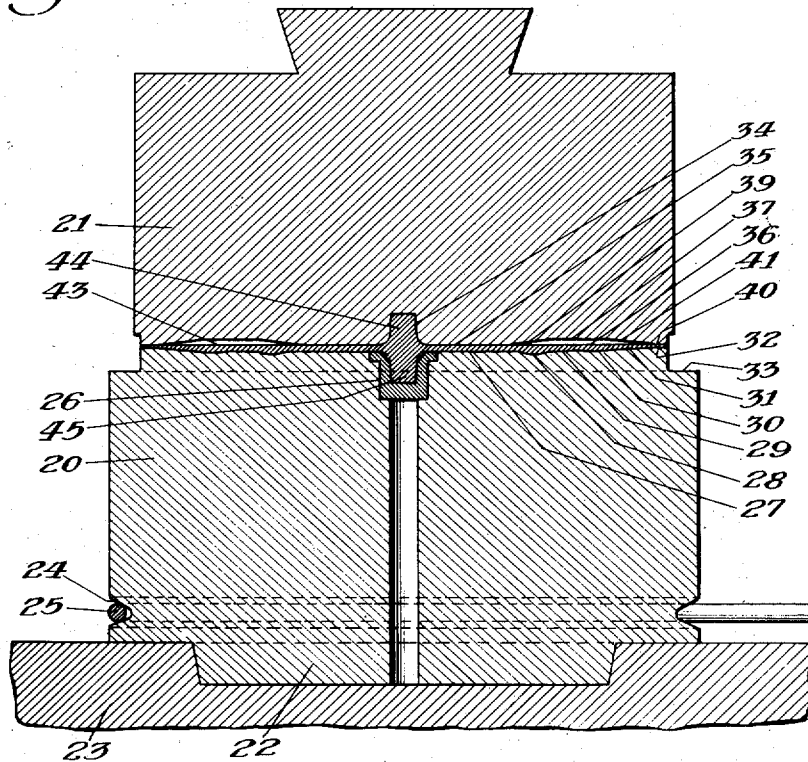
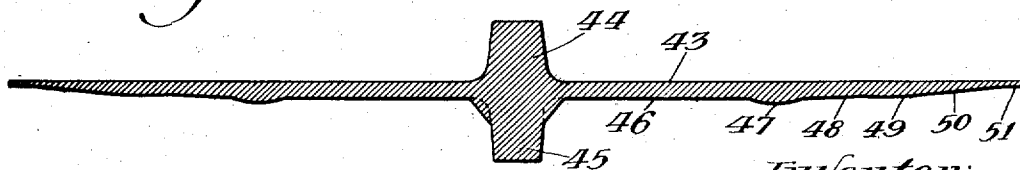


Fig. 3



Inventor:
Clarence S. Swanson
By: Bertha L. MacGregor
Attorney

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4 Sheets-Sheet 2

Fig. 4

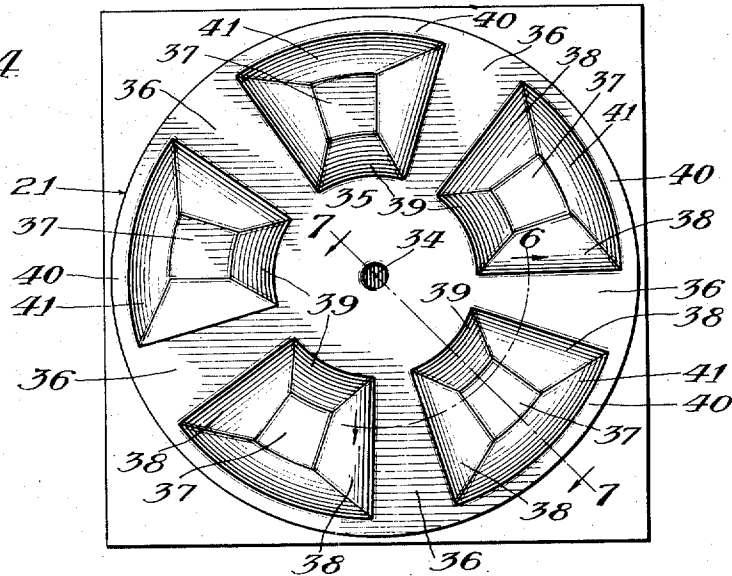


Fig. 6

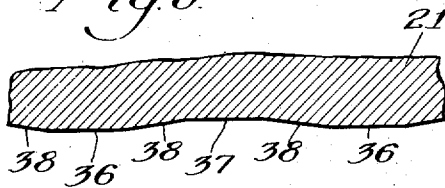


Fig. 7

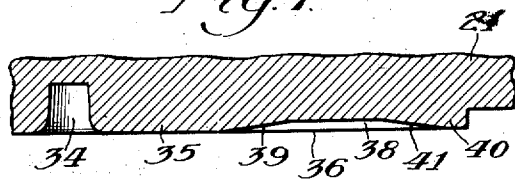
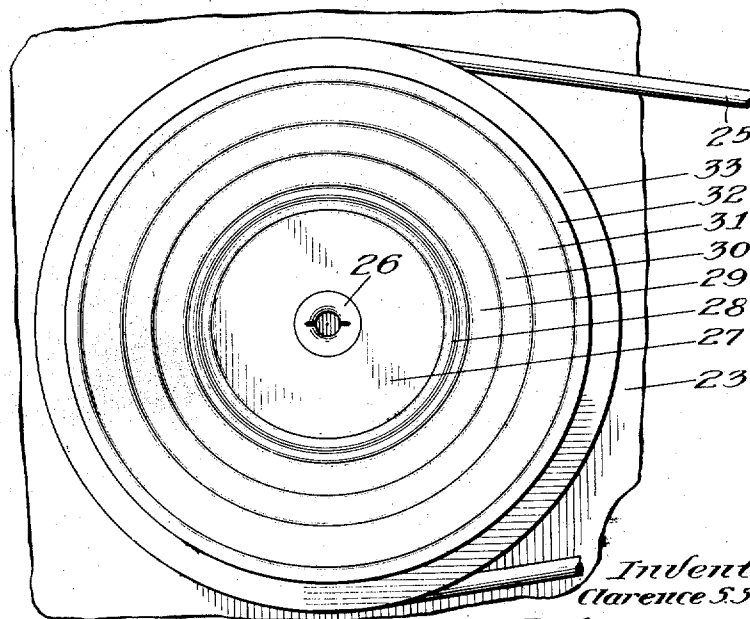


Fig. 5



Inventor:
Clarence S. Swanson

By: Bertha L. MacGregor
Attorney

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4 Sheets-Sheet 3

Fig. 8.

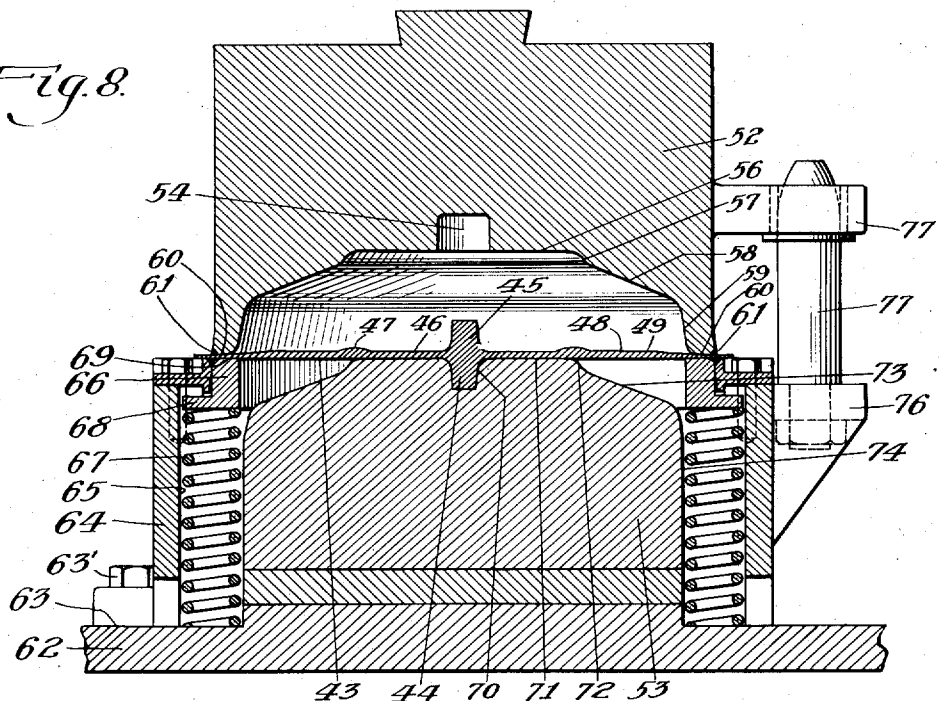
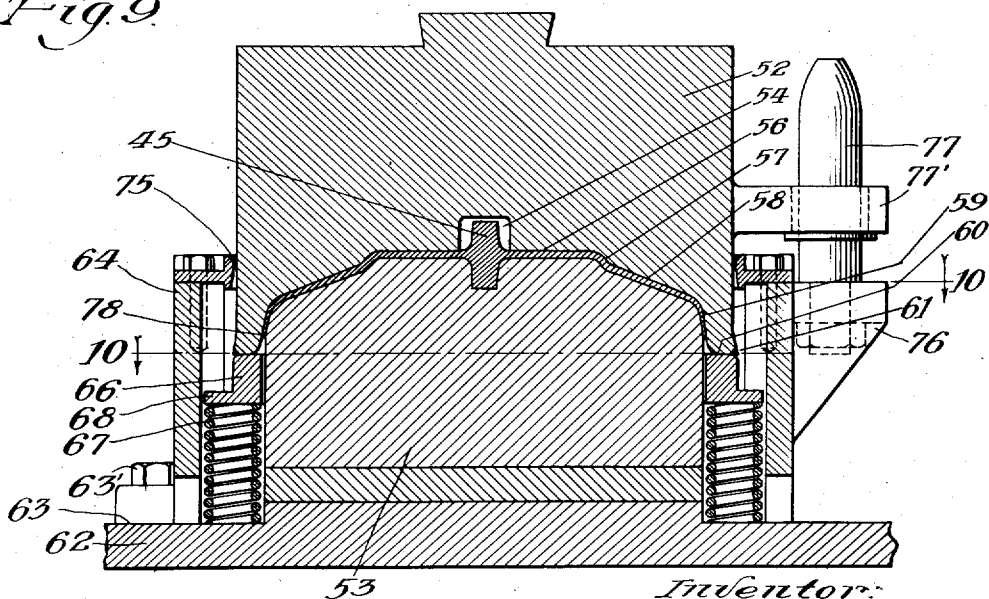


Fig. 9.



Inventor:
Clarence S. Swanson
By: Bertha L. MacGregor
Attorney:

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4 Sheets-Sheet 4

Fig. 10.

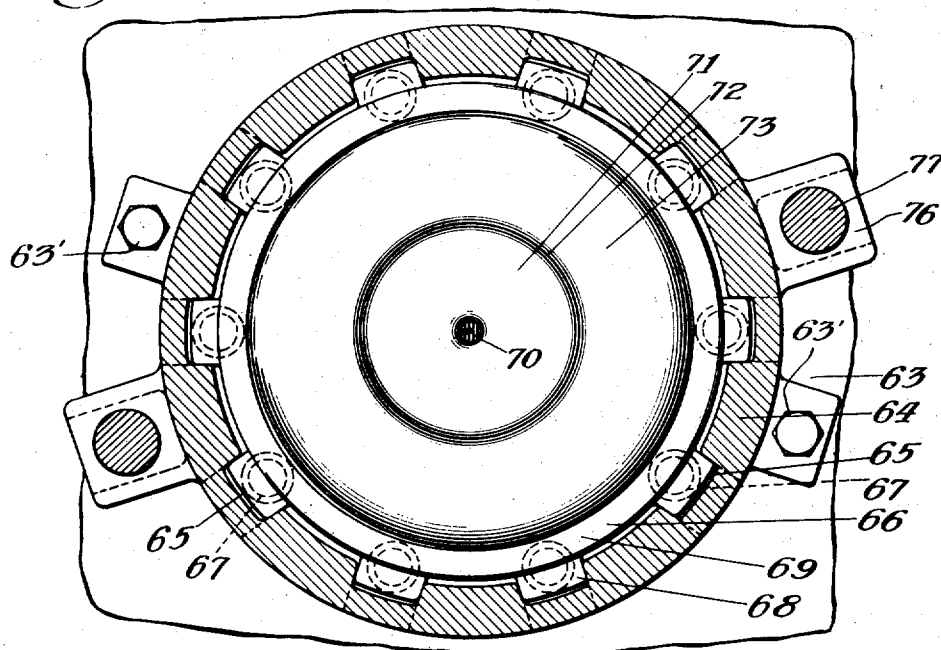
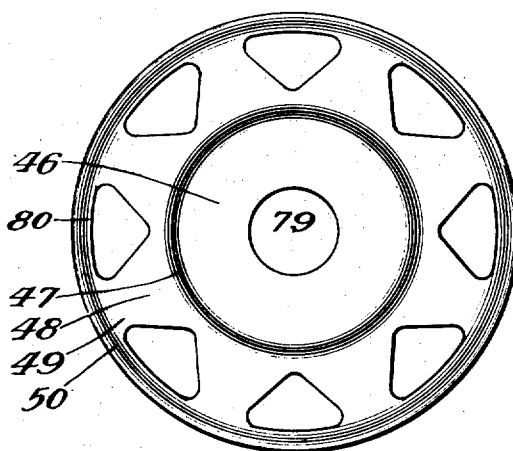
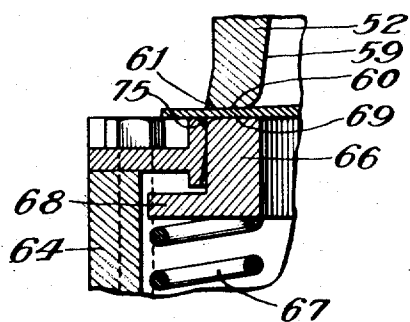


Fig. 12.

Fig. 11.



Inventor:
Clarence S. Swanson.
By: Bertha L. MacGregor
Attorney

UNITED STATES PATENT OFFICE

2,116,805

APPARATUS FOR FORGING AND FORMING
STEEL DISK WHEELS AND THE LIKE

Clarence S. Swanson, Chicago, Ill., assignor, by
mesne assignments, to Standard Forgings Cor-
poration, Chicago, Ill., a corporation of Dela-
ware

Application May 9, 1936, Serial No. 78,860

4 Claims. (Cl. 78—80)

This invention relates to apparatus for forging and forming steel disks for vehicle wheels and the like, and to the method of producing forgings of the character described.

One of the objects of the invention is to produce forging apparatus comprising a lower die and an upper reciprocating die, one of which is rotatable about a vertical axis, for speedily and efficiently producing a relatively large, thin forging, such as a disk, from a relatively narrow, thick billet of hard forging steel. Said means comprises a lower die having concentric surfaces adapted to support and shape the work, and a reciprocating upper die having a face as large as or slightly larger than the forging to be produced, provided with three or more segmental, spaced apart striking surfaces occupying approximately one-half of the face of the die. Said striking surfaces are preferably four or five in number, and merge with intermediate non-striking areas by gently inclined portions. The form, location and size of the striking surfaces and their relationship to the non-striking areas enable me to obtain great reduction in thickness of the metal being worked, without the use of unduly powerful or large hammer-operating equipment.

Another object is to provide means in the apparatus for maintaining the striking surfaces of the upper die in their intended planes, to insure uniform striking and working of the metal by the spaced apart striking surfaces as they contact the work on the lower die. By the means to be described hammer marks on the forging are avoided and very smooth forgings as well as close duplication of disks as to thickness from center to perimeter are assured.

Another object of the invention is to produce forging apparatus comprising dies provided with means for centering the work and means for centering the dies relatively to each other.

Another object is to produce a lower die which is shaped to cooperate with an upper die having striking surfaces in one horizontal plane, whereby may be produced an initially flat top disk having its bottom shaped to compensate for bending and stretching of the disk in a subsequent forming operation.

Another object is to produce forming apparatus provided with means for preventing buckling or wrinkling of the disks in the forming operation, and also preferably provided with means for trimming the disk.

An important advantage of the method of forging herein described is the fact that the forg-

ings produced are of superior strength and durability and are characterized by the long grain flow lines inherent in the thick billet used in their production. These grain flow lines, vertical in the billet, extend radially in the forging and impart to the disk a radial or spoke-like reinforcement.

The apparatus and method herein described enable me to use billets of hard forging steel which are initially substantially deeper than their width or diameter, and to work the metal into a relatively thin forging whereby great reduction in thickness is obtained and long radially extending grain flow lines are preserved in the forging, and this result is produced without increasing the size and power of hammer supporting and operating equipment over that heretofore used for substantially less upsetting of the metal.

Not only are the forgings thus produced highly superior in strength, durability and appearance, but a substantial saving is effected due to the decreased loss of metal resulting from sawing through a relatively narrow bar of rolled steel to form a deep, narrow billet as distinguished from a shorter, wider billet.

In the drawings:

Fig. 1 is a perspective view of a billet such as is preferably used for making a forged disk embodying the invention.

Fig. 2 is a vertical sectional view of the dies constituting the apparatus for forging a wheel disk, which is shown between the dies.

Fig. 3 is a vertical sectional view, on an enlarged scale, of the disk shown in Fig. 2.

Fig. 4 is a plan view of the face of the upper die of the apparatus.

Fig. 5 is a plan view of the face of the lower die.

Fig. 6 is a sectional view taken on the curved line 6—6 of Fig. 4.

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 4.

Fig. 8 is a vertical sectional view of a pair of dies for forming and trimming the forged disk of Fig. 3.

Fig. 9 shows the apparatus of Fig. 8 in another position.

Fig. 10 is a horizontal sectional view taken in the plane of the line 10—10 of Fig. 9, the die face being shown in elevation.

Fig. 11 is an enlarged sectional view of a detail of the construction as shown in Fig. 8.

Fig. 12 is a plan view of the formed disk.

The preferred apparatus embodying this in-

vention for forging disks for vehicle wheels is shown in Figs. 2 to 7, inclusive. In this embodiment the lower die 20 is rotatable about a vertical axis and the upper die 21 is reciprocable, but either the upper or lower die may be rotatable. The lower die is provided on its bottom with a male member 22 which fits into a complementary recess in the anvil 23. Near the bottom of the lower die a sheave groove 24 is machined in the circumferential wall to accommodate a flexible steel driving cable 25 for rotating the die. The face of the die will be formed to produce any desired configuration of one surface of the disk. In the present embodiment said face has a central recess into which is fitted a cup shaped member 26 which serves to prevent cracking of the die 20. The usefulness of the die is lengthened by replacement of the member 26 when it becomes fractured or worn. The member 26 is notched or roughened to prevent movement of the billet or forging relatively to the die. Surrounding the center, the face of the lower die is provided with an annular flat portion 27. Outwardly of the portion 27 is a radially narrow annular depressed portion 28, surrounded by a radially inclined, annular, web-forming region 29, a second narrow depressed portion 30 and an inclined portion 31. A flat narrow ring or surface 32 in a horizontal plane, surrounds the inclined part 31 of the die. Offset from the operating face of the die is a shoulder 33. The surfaces 26 to 32, inclusive, are concentric and complementary to one surface of the disk to be forged.

The upper die 21 is mounted in any suitable manner in a reciprocable support, not shown, with its face in juxtaposition to the face of the lower die. The face of the upper die is best shown in Fig. 4. It has a central recess 34 surrounded by a central striking surface 35 disposed in a horizontal plane. Continuous with and in the same plane as the central striking surface 35, are five radially extending striking surfaces 36. Intermediate said striking surfaces 36 are five non-striking surfaces 37. The non-striking surfaces lie in a plane slightly above the plane of the striking surfaces 36 when the die is in operative position. Said surfaces 37 each merge with the striking surfaces 36 through gently inclined surfaces 38 at each side and merge at one end with the central striking surface 35 through a gently inclined surface 39. The striking surfaces 36 and non-striking surfaces 37 gradually increase in circumferential width from the center toward the perimeter of the die. At the peripheral annular portion directly above and registering with the ring 32 of the lower die, the upper die is provided with a flat horizontally disposed surface 40 in the same plane as the striking surfaces 36. Said peripheral flat surface 40 merges with the non-striking surfaces 37 by gently inclined portions 41. The non-striking surfaces 37 are thus surrounded by gently inclined surfaces which join each of them with the central striking surface 35, with adjacent striking surfaces 36, and with the peripheral flat surface 40.

The surfaces 35, 36 and 40 are preferably in one horizontal plane, and the surfaces 37 are in a plane only about one-quarter inch above the plane of the surfaces 35, 36 and 40. Since the inclined surfaces 38, 39 and 41 which join the surfaces 37 to those in another plane are two or more inches in the direction of their respective inclinations, the result is that said surfaces 38, 39 and 41 are very gently inclined. This construction and contour of the face of the strik-

ing die 21 produce great and rapid upsetting of the metal, together with a smooth surface on the forging, and freedom from hammer marks. The registering ring surfaces 32 and 40, respectively, on the dies 20 and 21, insure uniform striking and working of the metal by maintaining the dies in their intended planes, and cooperate with the other novel features of the apparatus to produce smooth forgings, free from hammer marks, and close duplication of the successively forged pieces.

In Fig. 1 is shown a billet 42 cut from a rolled bar, in this instance cylindrical in cross section, the grain flow lines of the metal being vertical in the billet. Preferably the billet 42 is 6 to 8 inches high and $4\frac{1}{2}$ inches in diameter, for making a forged disk $23\frac{1}{4}$ inches in diameter. In Fig. 3 is shown the forged disk in which the upper surface 43 is flat and smooth and is provided with a central boss 44. The lower surface is complementary to the face of the lower die, and has a central boss 45, a surrounding flat annular portion 46, thickened annular portion 47, radially inclined region 48, slightly thickened annular member 49, radially inclined portion 50 and peripheral flat, narrow fin surface 51.

The provision of means for forming the axially aligned bosses 44 and 45 on opposite sides of the disk is a feature of the invention which enables the operator to test the correctness of the relative positions of the dies 20 and 21 from time to time. If the bosses are not in perfect axial alignment the forging apparatus requires adjustment. Faulty alignment may thus be noted promptly and the production of imperfect forgings be prevented. The die recesses which form the bosses 44 and 45 have another function, namely, the centering of the billet relatively to the dies, and the form of the member 26 in the lower die prevents rotation of the billet relatively to the die.

Another feature of the invention is the provision of means on the non-reciprocating die for shaping the disk in the forging operation in such form that the metal will be distributed to compensate for stretching and bending of the metal in the subsequent forming operation.

Referring to Figs. 8 to 12, inclusive, the forged disk shown in Fig. 3 is formed by means of dies 52 and 53. The die 52 is mounted in a suitable reciprocating support (not shown), and its face is complementary to the intended surface of one side of the disk. In this embodiment, said die face has a central recess 54; surrounding the recess 54 is a flat annular surface 56, a radially curved concentric ring 57, two radially downwardly inclined concentric surfaces 58 and 59 and a peripheral horizontally disposed surface 60. On the outer edge of the surface 60 is a peripheral cutting edge 61 made of stellite, chromium or other suitable material welded on the carbon steel casting constituting the die 52.

The lower forming die 53 is rigidly mounted on an anvil 62 having a flat shoulder 63 on which is mounted by bolt 63' a circular housing 64 internally recessed at 65, 65, to accommodate a ring 66 between the housing 64 and die 53. The ring 66 is supported on a plurality of coiled springs 67, located beneath the flanges 68 of the ring adapted to move vertically in the recesses 65 of the housing 64. The ring 66 has a flat upper surface 69.

The face of the die 53 is provided with a central recess 70, surrounded by a flat annular surface 71, radially curved concentric ring 72, and radially downwardly inclined portions 73 and 74.

The forged disk is placed on the lower forming die 53 with its flat surface 43 adjacent the face of the die, and the central boss 44 in the recess 70. In this position the disk surfaces 46, 47, 48, 49 and 50 face the upper die 52 as shown in Fig. 8, and the peripheral portion of the disk is engaged between the flat peripheral surfaces 60 and 69, respectively, of the die 52 and ring 66. As the die 52 is moved downwardly the engaging surfaces 60 and 69 continue to clutch the disk and prevent wrinkling of the metal as the diameter and circumference of the disk are reduced in the forming operation.

As the cutter edge 61 meets a cutter edge 75 fixed on the inner edge of the housing 64, the disk is peripherally trimmed by cutting off the fin 51, and as the die 52 continues its downward movement, the ring 66 is depressed, the disk gradually slips from between the surfaces 60 and 69 and the parts assume the position shown in Fig. 9.

Supports 76 are provided on the housing 64 for the purpose of supporting guide bars or rods 77. The upper ends of the rods 77 are beveled and each rod enters the bore of a reinforced ear 77' rigidly connected to the upper die 52, when the upper die has moved downwardly to a predetermined extent. This construction keeps the forming dies in vertical alignment.

In the forming operation, the thickened portions 47 and 49 of the disk are adjacent the curved part 57 and the curve between the inclined surfaces 58 and 59 of the upper die, so that when the disk is bent into the shape shown in section in Fig. 9 and in plan in Fig. 12, the said portions 47 and 49 will compensate for the stretching and bending at those parts and a wheel disk of uniform strength will be produced. Another advantage of the apparatus is the provision of means for trimming the peripheral edge before the forming of the disk is accomplished, which results in an edge surface 78 (Fig. 9) at right angles to the disk surfaces adjacent the edge, instead of an edge forming an acute angle, as heretofore.

In Fig. 12 the formed and trimmed disk is shown after its center has been punched out to provide an aperture 79, and the web portion has been punched to provide apertures 80. The several surfaces have been indicated by the same numerals used to designate the parts of the disk before it was subjected to the forming operation.

The forging of the disk with an upper flat surface and providing for compensation for the subsequent bending and stretching by special shaping of the bottom surface in the forging, followed by reversal of the disk and a forming operation, results in producing a dished disk for vehicle wheels, wherein the metal is disposed most efficiently for uniform strength of the disk in use. Weakening of the disk such as results from bending metal of uniform thickness, with undue stretching at one side and buckling at the other, is avoided.

The action of the spring supported ring 66 keeps the disk under tension by holding it between the surfaces 60 and 69 while the upper die forces the ring downwardly against the spring 67, which overcomes the tendency of the disk to buckle as its shape is being altered and its diameter and circumference are being reduced in the forming operation.

Changes may be made in details of construction without departing from the scope of my invention and I do not intend to be limited to the exact

form shown and described, except as set forth in the appended claims.

I claim:—

1. Apparatus for forging disks for vehicle wheels and the like, comprising a pair of cooperating dies, one of which is rotatable, the lower die having a face provided with a flat, annular center-forming surface, a radially inclined concentric web forming surface for forming a thickened annular portion surrounding the annular center, an annular depression between said center and inclined surface, a second annular depression surrounding the inclined surface, and a radially inclined surface outwardly of said second annular depression, and the upper die being reciprocable and having a face approximately as large as the disk to be forged, said face being provided with striking surfaces in one horizontal plane and relatively shallow non-striking areas between said striking surfaces, said surfaces and areas being connected by relatively wide merging surfaces which are gradually inclined in a circumferential direction.

2. Apparatus for forging disks for vehicle wheels and the like, comprising a pair of cooperating dies, one of which is rotatable, the lower die having a face provided with a flat, annular center-forming surface, a radially inclined concentric web forming surface, an annular depression between said center and inclined surface, a second annular depression surrounding the inclined surface, and a radially inclined surface outwardly of said second annular depression, and the upper die being reciprocable and having a face approximately as large as the disk to be forged, said face being provided with striking surface portions in one horizontal plane and non-striking areas between said striking surfaces, said surface portion and areas being connected by relatively wide surfaces gradually inclined to merge therewith, each of said dies having on its face a flat peripheral surface in a horizontal plane, registering with and spaced a short distance from the other when the dies are in their most proximate operative position.

3. Apparatus for forming a forged disk having one flat surface and provided on its opposite surface with a flat annular center, a radially inclined concentric web portion, and a thickened annular portion between said center and said inclined web, said forming apparatus comprising a lower die provided with an annular flat central surface in a single horizontal plane for supporting the forged disk with its flat surface on the lower side, the peripheral margin of the flat portion of said lower die registering with the annular thickened portion on the opposite side of the disk, a radially, downwardly inclined concentric surface on said lower die adjacent said flat center, and an upper die adapted to bear on said disk and to bend the disk at said thickened annular portion to move the web toward the lower die.

4. Apparatus for forming a forged disk having one flat surface and provided on its opposite surface with a flat annular center, a radially inclined concentric web portion, a thickened annular portion between said center and said inclined web, a second thickened annular portion outwardly of the web, and a thin peripheral portion outwardly of said second thickened portion, said forming apparatus comprising a lower die provided with an annular flat central surface in a single horizontal plane for supporting the forged disk with its flat surface on the lower side, the peripheral margin of the flat portion of said lower die registering

with the annular thickened portion on the opposite side of the disk, a radially, downwardly inclined concentric surface on said lower die adjacent said flat center, a second concentric surface located adjacent and outwardly of the first and downwardly inclined at an angle different

from the first, and an upper die adapted to bear on said disk and to bend the disk at said thickened annular portions to move the web and peripheral portion of the disk toward the lower die.

CLARENCE S. SWANSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,116,805.

May 10, 1938.

CLARENCE S. SWANSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, lines 9 and 10, claim 1, strike out the words "for forming a thickened annular portion surrounding the annular center" and insert the same after "surface" and before the comma in line 12, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of May, A.D. 1939.

Henry Van Arsdale

(Seal)

Acting Commissioner of Patents.

with the annular thickened portion on the opposite side of the disk, a radially, downwardly inclined concentric surface on said lower die adjacent said flat center, a second concentric surface located adjacent and outwardly of the first and downwardly inclined at an angle different

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