April 26, 1932. C. L. EKSERGIAN 1,855,710

METHOD OF MAKING HINGES

Filed July 24, 1929 4 Sheets-Sheet 1

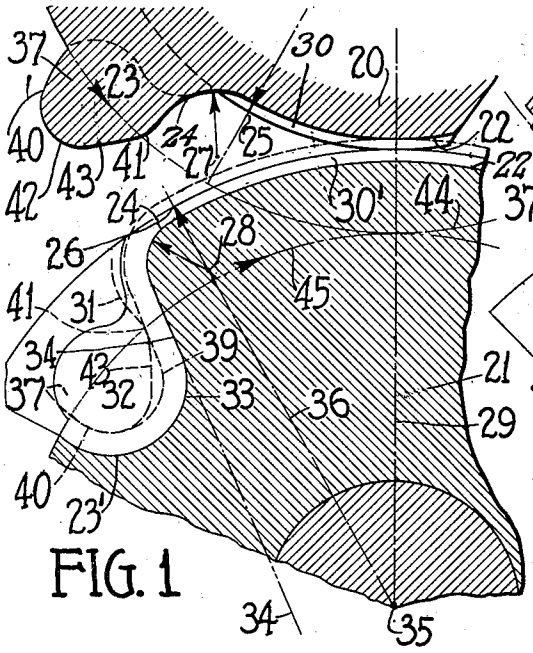


FIG. 1

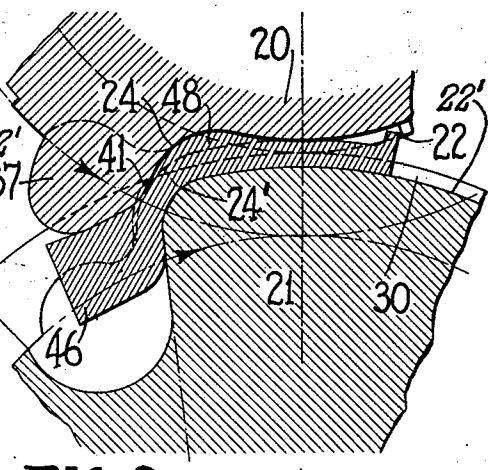


FIG. 3

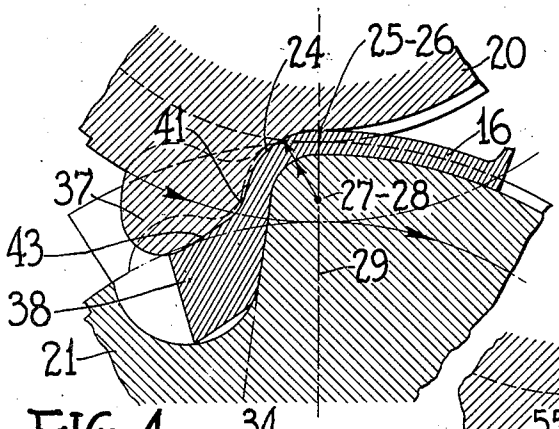


FIG. 4.

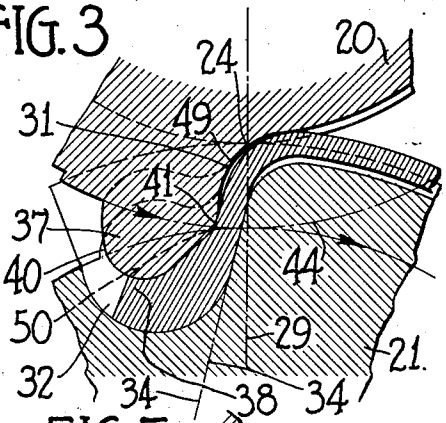


FIG. 5

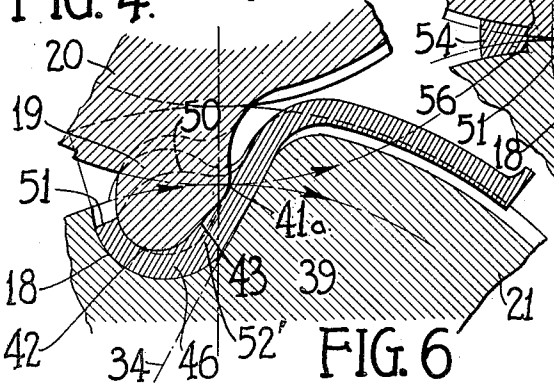


FIG. 6

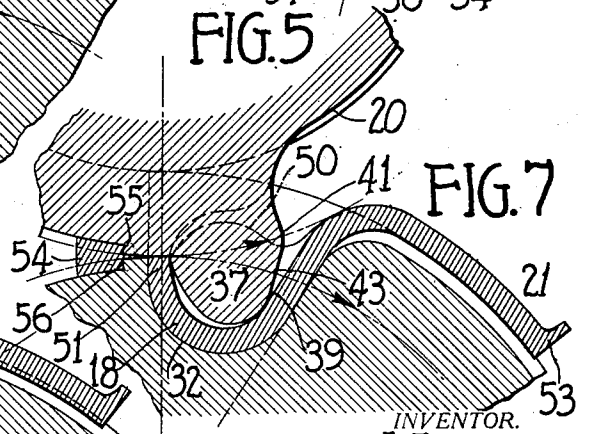


FIG. 7

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METHOD OF MAKING HINGES

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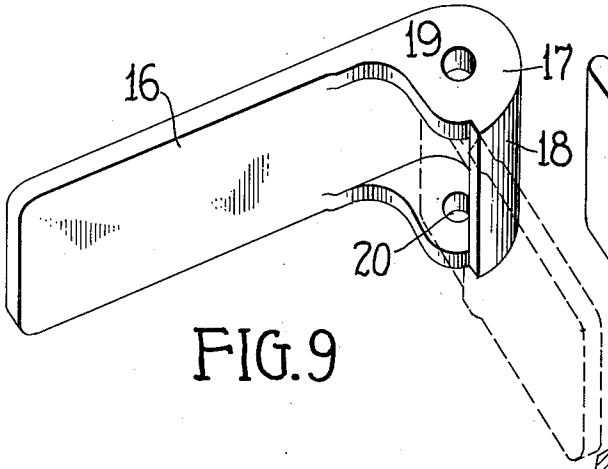


FIG. 9

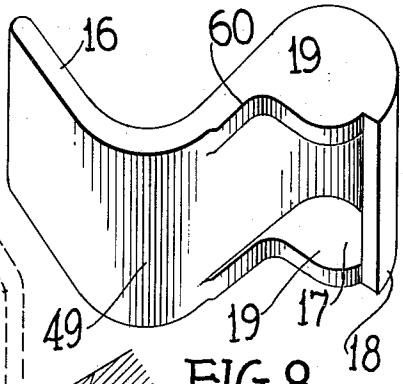


FIG. 8

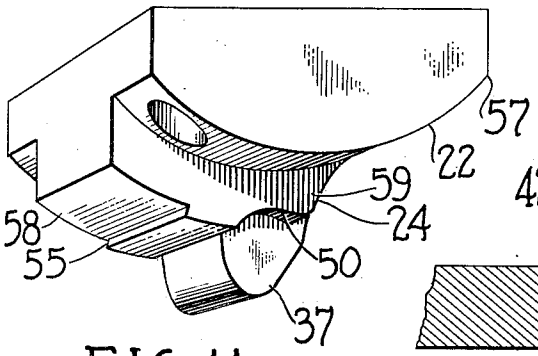


FIG. 11

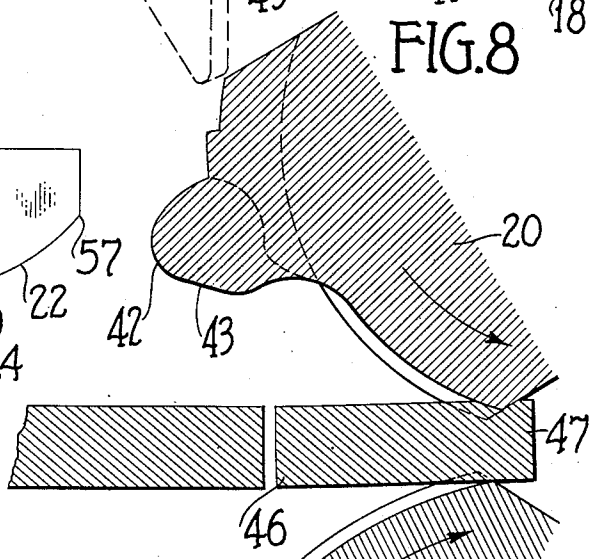


FIG. 2

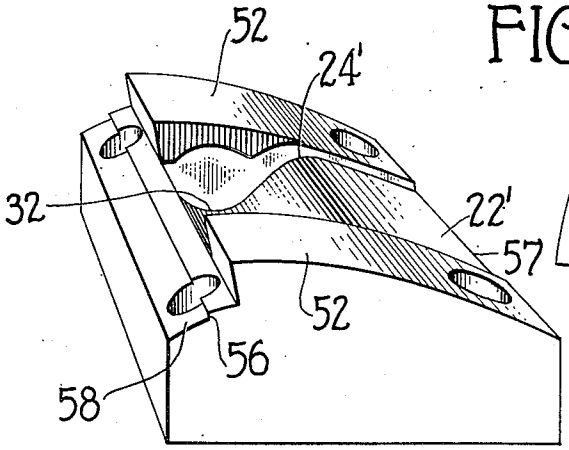
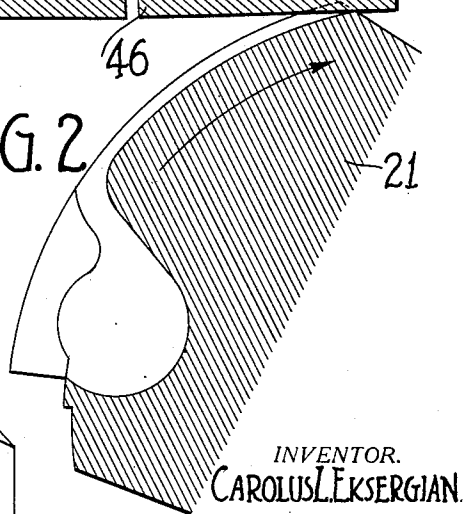


FIG. 12.



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METHOD OF MAKING HINGES

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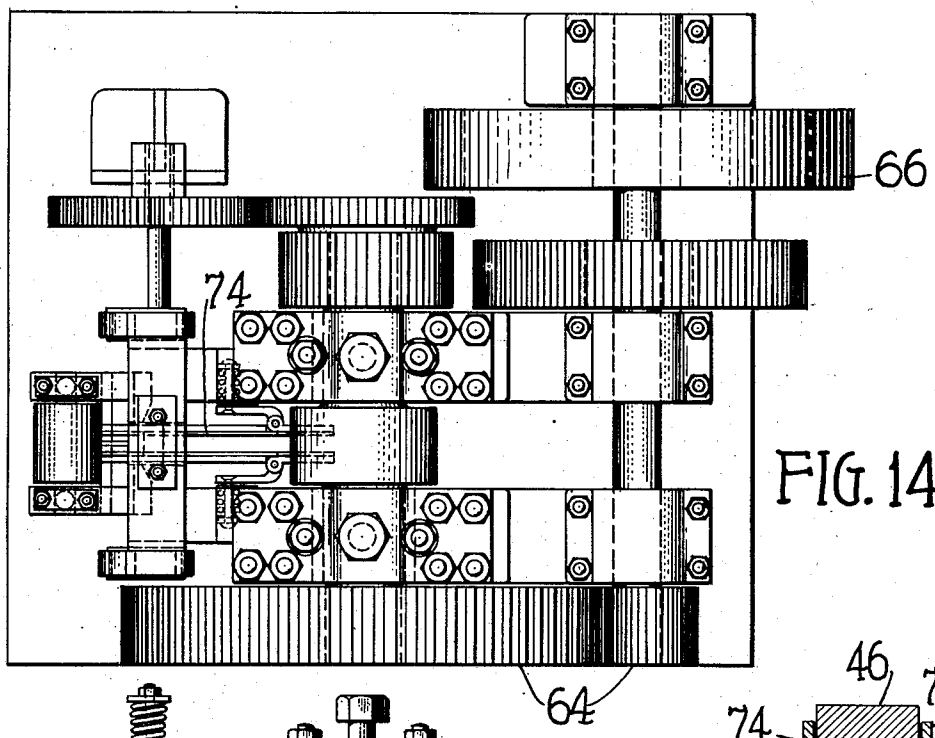


FIG. 14

FIG. 19

FIG. 13

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METHOD OF MAKING HINGES

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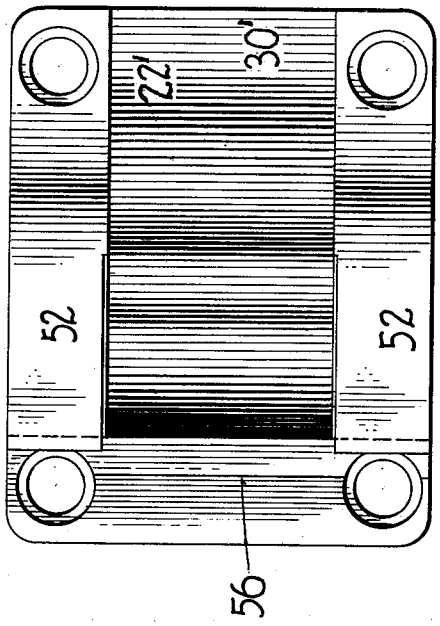


FIG. 17

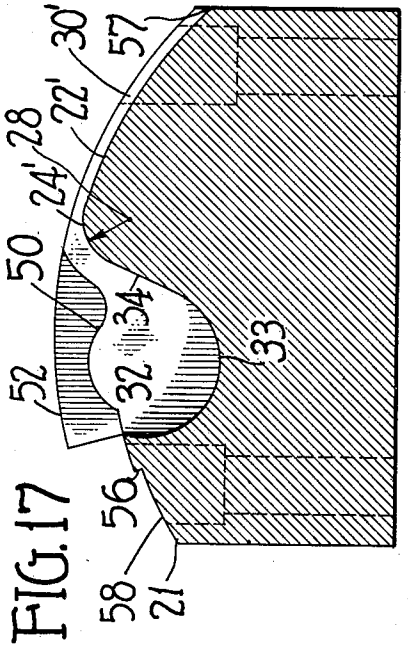


FIG. 18

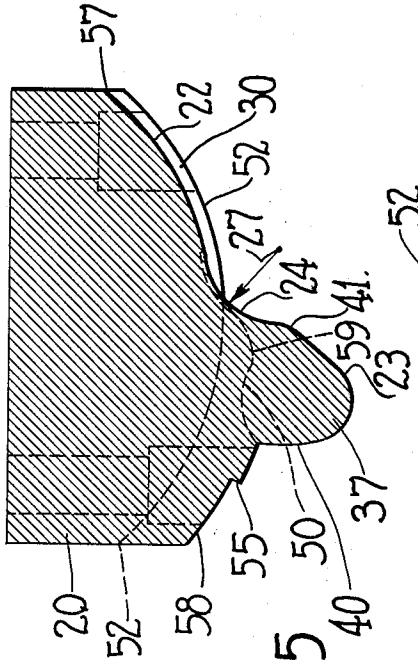


FIG. 15

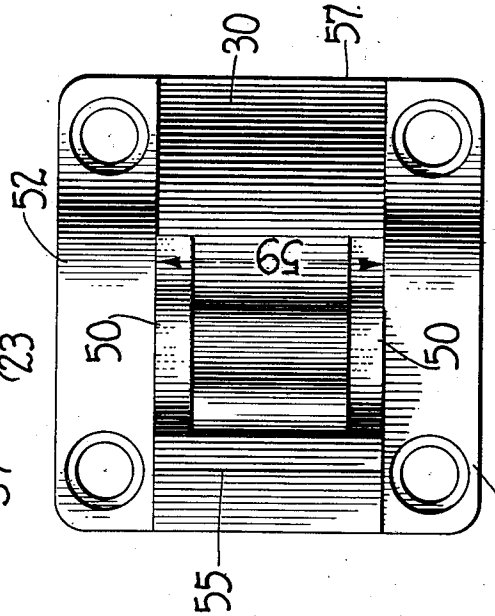


FIG. 16

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UNITED STATES PATENT OFFICE

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METHOD OF MAKING HINGES

Application filed July 24, 1929. Serial No. 380,520.

The method of rolling hinges of my invention finds especial utility in connection with the automobile industry, in that it is especially adapted to produce automobile door hinges. These hinges require knuckles of very superior finish and are very generally provided with hoods for the purpose of improving the finish, excluding dust and increasing the strength. These hoods have made hinges of this class relatively difficult to form as compared with hinges of the knuckle type. They have commonly been formed as separate pieces, or by drop forging in one piece with the stamping. The outstanding object of my invention is the continuous rolling of hinges of this type from bar stock. It is well known that continuous rolling of things of this type from hot bar stock is one of the most economical methods of fabricating articles, especially small articles. But rolling has had its limitations in the formation of hinge butts. It is an object of my invention to remove these limitations to so great an extent as to enable hooded hinge butts of superior strength of finish to be produced by this highly economical process.

According to my method I utilize hot bar stock, preferably of rectangular cross section. Blanks of such lengths as to give them mass sufficient to embody the hinge butt are successively severed from this bar. The outer end of a severed blank is engaged first by the rolls, the rolls definitely biting into the outer end. This end is rolled in advance of the hooded end. It is rolled by cylindrical rolling, under a differential rolling action. Then the main body and the inner end of the blank are rolled to form the remainder of the blank and the knuckle which embodies the rolled portion. This latter is formed by radial rolling of the gear tooth variety. The arrangement is such that the top of the hood is rolled approximately on the pitch circle of the gear tooth action. The action is an action of combined rolling and extrusion. The mass of metal at the inner end of the blank is pocketed, gear tooth rolled radially, and simultaneously extruded to form the ears of the butt and of the hood. The while through the cylindrical rolling of the shank portion per se there is developed a hold down action which resists displacement of the mass under the gear tooth rolling in the formation of the knuckle. In the knuckle formation the gear tooth rolling first forms a pocketed depression and sizes the exterior of the hood and finally sizes the depression to form the interior and size the ears. In furtherance of exactitude the formation of the knuckle is arranged to take place under an equalized rolling action as distinguished from the differential rolling action under which the shank is formed.

In the drawings—

Figures 1 to 7 show diagrams illustrating the rolls employed and the various steps of the method.

Figures 8 and 9 are respectively perspective views of the hinge butt as rolled by my method and the hinge butt as ready for use in the automobile.

Figures 11 and 12 are respectively perspective views of the co-acting dies.

Figures 13 and 14 are respectively sectional side elevation and plan of the machine for carrying out the method.

Figures 15 and 16 are respectively sectional side elevation and plan of the upper die of Fig. 11 and

Figures 17 and 18 are respectively plan and sectional side elevation of the lower die of Fig. 12, the side elevations being shown in the relative positions which they occupy in the machine.

Figure 19 is a detail of cross section in line 19/19 of Fig. 14.

As clearly appears in the perspective of Fig. 9, the completed hinge butt comprises a shank 16 and a hooded knuckle 17. This knuckle is formed integrally with the shank 16. It comprises hood 18 in the form of an approximately semi-circular reverse bent extension of the shank 16 of the same or different wall thickness together with integrally formed ears 19 closing the ends of the hood 18, constituting a bracing inter-connection between the hood 18 and the shank 19, and also the bearing members of the knuckle, containing as they do the pintle holes 20. But

as rolled by my method the hinge is initially given the form shown in Fig. 8 in which the shank has a right angle bend.

Referring first to Figures 1 to 7 and particularly at the moment to Fig. 1, there are used upper and lower rolls 20—21 appropriately geared together as used in the machine. These rolls are provided with cylindrical portions 22, 22′ having a rolling contact with the blank, and with adjoining gear tooth portions 23, 23′ having a relation to each other of gear teeth, that is to say, a radial relative movement and a combined radial sliding and rolling action essentially similar to the teeth of gears. The cylindrical portions 22, 22′ merge into the gear tooth portions 23, 23′ by arcs 24, 24′. The cylindrical portions 22, 22′ are of different relative diameter. The rolls 20—21 are geared together on a 1—1 basis as will be seen and there is therefore a differential rolling action as between the cylindrical portions 22, 22′, that one of greater diameter in connection with roll 21 moving at a greater rate than that of lesser diameter in connection with roll 20. The arcs 24, 24′ differ in radius and they emanate from the terminii of the cylindrical portions 22, 22′. The angular relation of the rolls is such that the terminii 25—26 of the cylindrical portions 22, 22′ is radial at one point in the rolling as shown in Fig. 4. At this time arcs 24, 24′ also coincide and their centers 27—28 lie commonly on the line 29 connecting the centers of the rolls. Throughout the extent of the cylindrical surfaces 22, 22′ and the arcs 24, 24′ except for the differential diameters of the rolls and the incident differential cylindrical rolling action, the peripheral surfaces of the rolls are complemental. But both these complemental portions 22, 22′ are provided with rectangular depressions 30, 30′ of half the cross section of the shank of the hinge butt to be formed. Beyond the arcs 24, 24′ this depression of the roll 21 recedes at 31 radially inwardly at full cross section of the shank and into the radial pocket 32 of the gear tooth portions 23, 23′ of the rolls. The depression 30 of the roll 20 fades out in arc 24. Pocket 32 is of the form of the exterior of the hooded knuckle of the hinge butt. Its bottom 33 is precisely of the form of the exterior of the knuckle. The bottom 33 is merged smoothly into the bottom of the recess 30′ at the arc 24′. But this merging is on a line 34 which passes to the left of the center 35 of the lower roll. In other words, it converges outwardly toward the radius 36 to the terminus 26 of the cylindrical portion 22′ of the roll.

Gear tooth 37 of roll 20 enters this pocket as shown in dotted lines. It does not bottom in the pocket, but is spaced from the bottom a depth equal to the desired thickness of the wall of the hood of the knuckle. Nor is it truly complemental to the inner surface 39 of the hood of the knuckle (see Figs. 6 and 7 as well as Fig. 1). It is complemental to the inner surface 39 only on its off side 40 and at the flank 41 on its near side. Between its end 42 and the point 41 it is cut away as at 43. It is non-complemental in the part cut away. There is a smooth merging of the rounded flank 41 into the arc 24 of the roll 20. Yet further, the tooth 37 does not contact with the ends of the pocket 32. It falls short at each end of contact by a space equal in thickness to the thickness of the ears of the hooded knuckle.

Approximately, when fully entered in pocket 32, 23 occupies a position in space between the ears 19 of Figs. 8 and 9. An approximate pitch circle 44 of the tooth 37 passing through the flank 41 is tangent and of equal diameter to a circle 45 comprehending the top and mouth of the pocket 32. Thus, the gear tooth engagement of the roll is one of substantially equalized peripheral action as distinguished from the differential action of the cylindrical portions 22, 22′ of different diameter.

With this understanding of the general geometrical relations of the parts of the rolls employed, the various steps of the method can be easily followed in Figs. 2 to 7. In Fig. 2 a blank 46 cut from bar stock of rectangular cross section is shown with its outer end 47 entered between the rolls 20 and 21. The rolls being progressed in the direction shown by the arrows, the outer end 47 is rolled down into the shank portion of the die 30 as shown in Figure 3. The action is a cylindrical rolling action between the cylindrical portions 22, 22′ of the rolls 20, 21. It is differential by reason of the fact that the portion 22 of roll 20 is of lesser diameter than the portion 22′ of the roll 21. It is rolled down to the exact dimension of the shank.

The mass of metal before the rolls quickly fills the spaces between the terminal ends 25—26 of the cylindrical portions and the arc shaped portions 24, 24′. The mass of metal in this space in the stage of the process illustrated in Fig. 3 has a considerable bulge 48 being much greater in transverse cross section at this point than at the point between the flank 41 of tooth 37 and the closest point of the roll 21, the differential cylindrical rolling being effected between the surfaces 22, 22′ together with this enlarged mass 48 anchors and aligns the blank, and exerts a holding reaction against the following forging action upon the inner end of the blank 46. This action just starting in the stage of Fig. 3 is shown well progressed in Fig. 4.

In Fig. 4 the differential cylindrical rolling of the outer end of the shank is completed. The terminii 25—26 of these portions of the rolls lie on the line of centers 29 of the roll. The arcs 24, 24′ are concentric. The bend of the shank has been formed through the coin-

cidence of these arcs. The bulged mass of metal 48 has been reduced to the dimensions of the bend and the excess metal extruded between the flank 31 of the tooth 37 and the adjacent face of roll 21. The radial gear tooth rolling is well under way.

This radial gear tooth rolling instituted in Fig. 3 starts with the progress of the flank 41 over the end of the arc portion 24', and continues with the downward movement of this flank substantially parallel to the line 34 through the stage of Fig. 4 and into the stage of Fig. 5 in which stage the flank 41 lies approximately upon the pitch circles 44—45 and closely adjacent to the line of centers 29. Passing from the institution in Fig. 3 to the two phases in Figs. 4 and 5 flank 41 has progressed radially inwardly around and beyond the bend 49 substantially parallel to line 34 and forming accurately the inner portion of the shank 19 between the bend and the knuckle. In this formation extrusion from the bulge 48 as the arcs 24, 24' have approached each other has taken its part, the metal being forced out under the rolling approach of the arcs 24, 24' and regulated in its dimensions by the proximity of the flank 41 to the face of roll 20. But in the stage of Fig. 4 flank 41 has reached its closest proximity to line 34 defining the face of the roll 21 and the rolling action of arcs 24, 24' has ceased. From this stage into the stage of Fig. 5 flank 41 moves radially inwardly substantially parallel to the line 34 shaping a further section of the shank 16 immediately adjoining the knuckle 17, in fact, shaping it right up to the mouth of the pocket 32. In the progress from the stage of Fig. 4 to that of Fig. 5 the arc portions 24, 24' have left each other. The formation of this root connection between the shank and the knuckle therefore is wholly by the radial movement of the flank 41 assisted by slight extrusion incident to the gear rolling action of the point 42 of the tooth 37.

This gear rolling action of the point of tooth 37 is instituted in Fig. 4. In Fig. 4 the inner end 38 of the blank is under radial rolling action between the cut-away portion 43 of the side of the tooth and the opposite side wall of pocket 32. This rolling action fills the bottom of the pocket as shown in Fig. 5 and rolling action is instituted on the point of tooth 37. There is very little if any extruding action incident to this rolling past flank 41 for the reason that the general radial movement of tooth 37 into pocket 32 exerts a strong downward component, but such as there is may be sufficient to raise the bend of the outer end of shank 19 from the face of the roll as appears in Fig. 5. There is no alteration in dimension of the shank because flank 41 is moving parallel to line 34. But there is at this stage decided extrusion laterally from the inner end 46 of the blank into the space between the ends of tooth 37 and the ends of pocket 32. This is shown by the dotted line height 50 to which the extrusion may have reached.

There is instituted in Fig. 5 what may be termed a rocking movement of the tooth 37 about the point of flank 41 on the pitch circle 44, since flank 41 has reached the end of its radial sliding movement while the opposite flank 40 has just started into the mass of metal 38. As the rolls progress in the direction of the arrows, this rocking movement sinks tooth 37 under the rolling action into the depth of the metal 38 rolling and extruding it to completely fill the pocket 32 and to completely form the ears 19 of the knuckle of the hinge. The endmost wall 51 of the hood 18 is formed by a combined rolling and extruding action, the point of the tooth 37 as it approaches the bottom of the pocket restricting the flow of the metal before the rolls to a cross section less than that of the bulged portion 52' lying behind the rolls and between the cut away portion 41^a and the line 34. The rolling action on this bulged portion 52' extrudes the metal between the point of the tooth and the outer side wall of pocket 32 and the inner flank 40 rolls it accurately to dimension as it is extruded. At full depth of the tooth the flank 40 being shaped complemental to the inner surface of the hood 18 accurately forms this surface.

Finally, in the stage of Fig. 7 the tooth 37 starts to leave the pocket 32. Flank 40 leaves the inner face of the hood 18 which it has formed. At this point the tooth in effect rocks about the outer end 51 of the hood. Flank 41 is no longer an approximately stationary part. It is lifted by the rocking action and carried away from line 34. But the relation of the parts is such that the point of the tooth 37, sweeping outwardly approximately with the edge 51 as a center, describes a path of movement which reduces to final dimension the inner wall 39 of the hood 18, extruding the metal past the flank 40 and perhaps slightly past the flank 41 which at this stage has moved but slightly if at all, from its position of closest proximity to the face 34. Thereupon tooth 37 passes out of the pocket without further action except as the point of tooth 37 may smooth the inner surface of the inner wall 39 of the back of the hood 18.

There has been produced at the termination of the rolling the hinge butt of Fig. 8 having a bent shank and having also a flash 53 and 54 at its opposite ends. The flash being removed and the shank straightened by any desired method, the hinge butt has the usuable form of Figure 16. The flash 53 of Fig. 7 is the result of the initial bite of Figure 2 on the outer end 47 of the blank. The flash 54 is the result of the cut off action

of the rear end of the blank by cut-off portions 55—56 of the dies.

The mechanical details of the construction of the die is more fully shown in the perspectives of Figs. 11 and 12 and the projections of Figs. 15 to 18. In these figures the configuration corresponding to the diagrammatic showing of Figs. 1 to 7 are similarly numbered. The dies are made as inserts for the rolls arranged to be screwed or bolted on. One half of the configuration of the shank 16 is made in one die and the other half in the other. The initial bite of the outer end of the dies upon the billet is by the advance edge portions 57. The final bite is by the rear portions 55—56. These are cylindrical about the axes of the rolls. Beyond them the dies are opened away from each other by recesses 58. The cylindrical portions 52 of the dies are carried beyond the bend 49 of the shank and flank also the pocket 32. Arc shaped surfaces 24, 24′ project without the cylindrical surfaces 52 of the upper die and within those of the lower die. Surface 24 is therefore embodied on the tooth 37. The contour 50 of end walls 19 is defined by similarly numbered shoulders on the opposite ends of the tooth 37. The width of the root 59 of the tooth 37 is equal to the full width of the shank 16 of the hinge. The width of the point portion of the tooth beneath the shoulder is less by the thicknesses of two end walls 19. The end walls extend by their portions 60 (Fig. 8) a distance up the shank 16 and this extension is marked by a continuation of the contour of the shoulder 50 into the arc shaped surfaces 24.

The machine of Figs. 13 and 14 operates the rolls and carries out the complete method. It comprises the rolls 20 and 21, roll shafts 61—62, and inter-roll gears 63. The main bodies of the rolls and gears are respectively of the same diameter. The rolls are driven by a train of gears 64 extending from the lower shaft 62 first to the upper of two countershafts 65 and then to the lower, which lower is provided with a fly-wheel 66 for driving. In the rear of the rolls is provided a pair of rollers 67 for feeding in bar stock 68. Between the feed-in rolls 67 and the forming rolls 20 and 21 is erected blank cut-off and feeding-in mechanism 69. This mechanism 69 is shown as being provided with reciprocating cutting dies 70 operated from an eccentric 71 driven by gearing 72 from the roll axis 62. The severed blanks are dropped on a trackway 73 between cut-off mechanism 69 and the rolls and having their inner ends projecting between the rolls. The tracks comprise a pair of spaced rails 74 as clearly appears in Fig. 19 and Fig. 14. The blank is held upon and between the flanges of these rails as appears in the detail of Fig. 19. A finger 75 oscillatable about a pivoting shaft 76 projects into space between rails 74 and behind the end of the blank as severed. The finger is oscillated in time with the movement of the dies on the rolls by means of bell crank 76 operated in such timed relation by means of the lobe shaped cam 77 carried by the same shaft 78 which operates cam 71 of the cut-off mechanism 69. The level of the bottom of the track 74 is such as to present the billet in the proper plane to be initially engaged by the dies of the rolls 20 and 21. But the cut-off dies 70 and the bar feed 67 are above this plane whereby the end of finger 75 may underlie the dies 70 and the bar 68 and the blank may be dropped into a position before the finger. In this manner dies 70 are continuous, yet finger 75 engages the end of the severed blank symmetrically and projects it with its center in the plane of symmetry of the machine and the dies.

Any other machine and any other mechanisms may be substituted for that which I have shown. The chief merit in that which I have shown is the simplicity, compactness and the greater freedom from interference with perfect performances of the one mechanism by another.

What I claim as new and useful and desire to protect by Letters Patent is:

1. The method of forming hinge butts from bar stock which consists in forging the shank by forcing the metal of the stock peripherally while rolling it radially between cylindrical rolling surfaces, and forging the knuckle by radially rolling the metal of the blank between opposed concave and convex rolling surfaces.

2. The method of forging hinge butts from bar stock which consists in shaping the shank portion of a blank between cylindrical portions of a pair of rolls, and the knuckle portion between a projecting portion on one roll and a depression in the other roll.

3. The method of continuous forging of hinge butts from bar stock which consists in shaping a shank portion from a blank between cylindrical portions of a pair of rolls and then shaping a knuckle portion between a projecting portion on one roll and a depression in the other roll.

4. The method of continuous forging of hinge butts from bar stock which consists in shaping a shank portion from a blank between cylindrical portions of a pair of rolls and then shaping the knuckle portion between a projecting portion on one roll and a depression in the other roll by rolling pressure and angular extrusion of portions of the blank between the sides of said projection and depression to form the ears of the knuckle portion.

5. The method of rolling hinge butts having hooded knuckles which consists in pocketing and extruding the blank by intermeshing convex and concave surfaces to form a depression on one side of the blank and an elevation on the other and thereupon rolling

the depression and elevation to further size the same.

6. The method of rolling hooded hinge butts which consists in shaping the blank by rolling of the hood portion between a pair of rolls having a geartooth-like projection on the one roll and a depression in the other roll, with the top of the hood portion approximately on the pitch line of the geartooth-like projection.

7. The method of rolling hinge butts which consists in rolling the shank between cylindrical rolling surfaces under differential rolling action and the knuckle under substantially equalized rolling action between opposed convex and concave surfaces.

8. The method of rolling hinge butts having bent shanks which consists in shaping the outer end of the shank portion and a portion of the bend from a blank between cylindrical portions of a pair of rolls and shaping the remainder of the shank portion and the knuckle portion between a projection on the one roll and a depression in the other roll.

9. The method of continuous rolling of hinge butts from bar stock which consists in severing the bar into lengths of sufficient mass to embody the butt, and rolling the outer end of the blank to form the shank between substantially cylindrical rolling surfaces and then the inner end between opposed convex and concave surfaces to form the knuckle.

10. The method of rolling hinge butts which consists in shaping the blank to form a shank portion of the butt between cylindrical portions of a pair of rolls and shaping the knuckle portion between a projection on one roll and a depression in the other roll, and controlling the rolling of the knuckle by development of a holding action in the cylindrical rolling of the shank.

In testimony whereof he hereunto affixes his signature.

CAROLUS L. EKSERGIAN.