United States Patent [19]

Delio

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[54] **STEERING KNUCKLES AND METHOD OF FORMING THE SAME**

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[52] **U.S. Cl.** **72/377;** 72/356

[51] **Int. Cl.** **B21k 1/74**

[58] **Field of Search** 72/356, 377; 29/DIG. 17; 74/555

[56] **References Cited**

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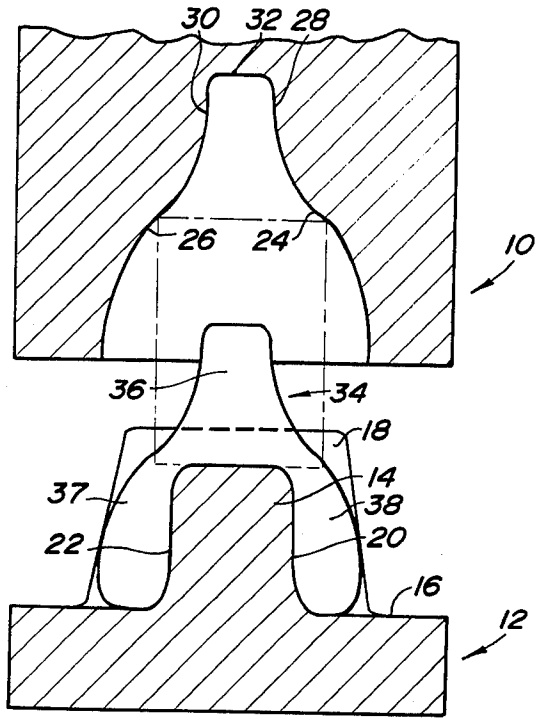
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Attorney, Agent, or Firm—Fay & Sharpe

[57] **ABSTRACT**

A novel forging process by which forged steering knuckles having improved toughness are produced. The method comprises splitting an elongated steel billet over the web of a buster die to provide material for the support legs by pressing the billet against the web with a mating die having a cavity which permits controlled flow of the hot steel in the opposite direction to produce a boss from which the spindle will be made. The saddle-shaped blank thus produced is layed on its side within a blocking die and pressed in a direction normal to said first flow of material to block the knuckle blank out and move excess material into a margin of peripheral flashing. A third and then a final fourth die pressing step gives the steering knuckle forging its final dimensions and trims the flashing from the blocked out blank.

2 Claims, 5 Drawing Figures



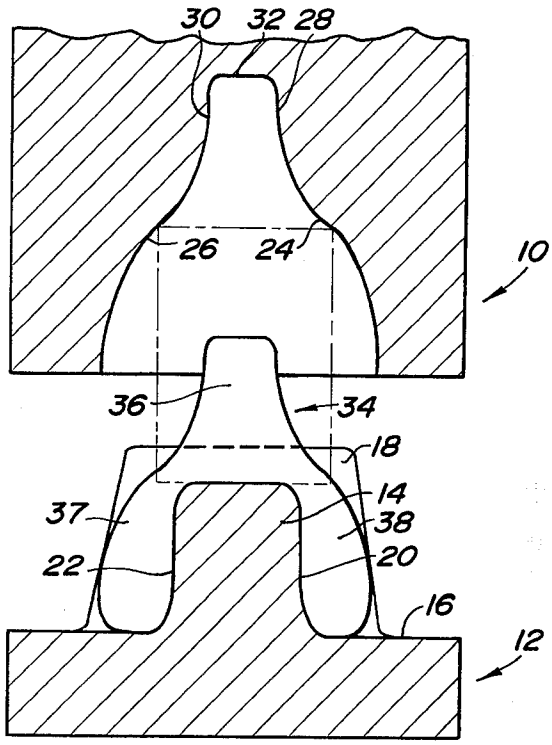


FIG. 1

FIG. 2

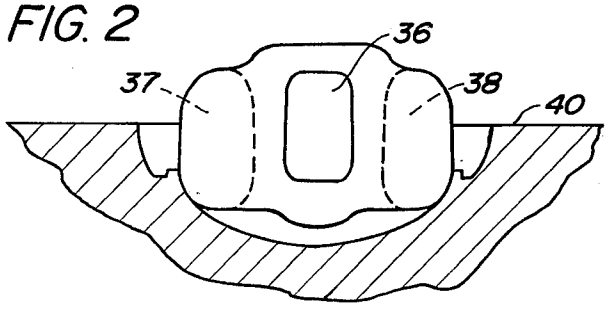


FIG. 3

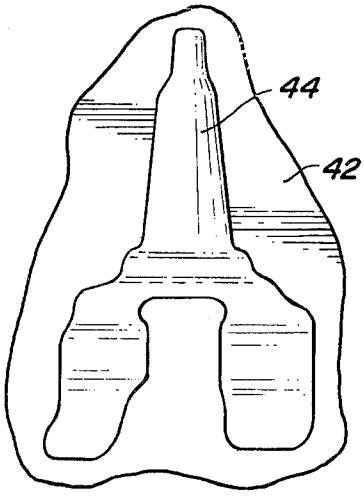
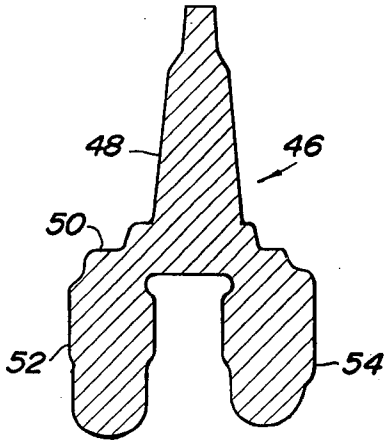


FIG. 4



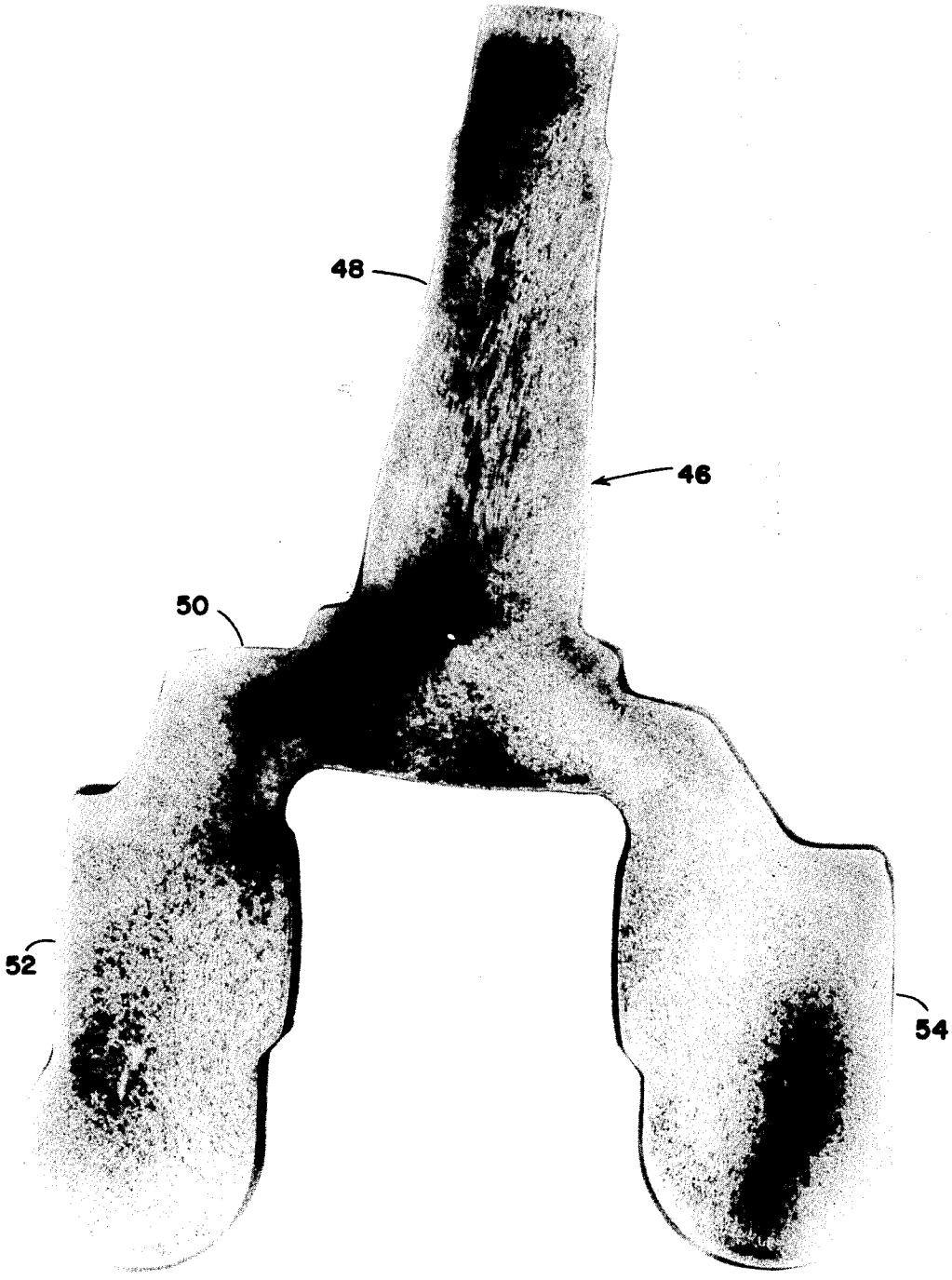


FIG. 5

STEERING KNUCKLES AND METHOD OF FORMING THE SAME

BACKGROUND OF THE INVENTION

Conventionally, steering knuckles have been forged from solid metal blocks by hammering in a sidewise manner or hammering with multiple blows longitudinally. Steering knuckles have three arms a spindle and two arm bosses. The arm bosses extend in one direction away from a flange and are joined by a yoke. The spindle extends at right angles to the flange. Each of these bosses may be of a different shape and has complexly changing cross-sectional configurations. Obviously, at the points where the cross-section is thinnest in the yoke the steering knuckle bosses are weakest and it is these portions which are the first portions to fail. Often this is because the metal grain flow lines produced from hammer forging are not uniformly spaced apart and do not follow the contours of the complexly shaped body. When steering knuckles are made by longitudinally hammering to avoid the problem of crosswise grain flow, they still have uneven grain flow due to the different blows of the hammer and they are therefore denser and more highly stressed in some areas than in others. Moreover, the forging hammer's many blows to form the knuckle forging results in nonuniform forging thickness creating problems at the machine lines. A press knuckle because of uniform thickness in the knuckle and because of lower residual stresses results in a more uniform heat treat and facilitates machining. The resulting forged knuckle has better grain flow. This is shown by lower variation in hardness readings from the thinnest to the thickest part of the press forging.

This invention is directed to truck steering knuckle forgings for 7000 pound rated front ends and larger. It is particularly adapted to meet government safety regulations requiring increased sizes of flanges. Hammer forging steering knuckles to meet these demands are very difficult to produce because of the difficulty in getting sufficient material in the area of the flange during the repeated blows necessary to forge the desired shape. Accordingly, the present methof of forging steering knuckles and particularly large steering knuckles for use on trucks has been developed.

BRIEF DESCRIPTION OF THE INVENTION

The forging method according to principals of this invention is performed by pressing rather than conventional hammering of a hot steel billet. The first shaping of the blank creates an overall flow of material axially out the spindle boss in one direction and axially out the support legs in the other direction. In addition, however, because of the nature of the pressing or busting stroke the billet is upset or squeezed in the axial direction such that a good supply of material is provided in the flange and yoke region.

Because of this important initial busting step, the process of forging steering knuckles according to the invention has the advantages of saving metal, providing increased toughness because of uniform longitudinal grain flow and reducing the number of strokes and thereby permitting faster production. In addition, it is possible to use smaller size billets and therefore the operation of shearing billets is faster and easier.

Less steel is used to make steering knuckles according to the method of the invention because the central cavity is produced by one pressing stroke where in

hammer forging it is impossible to get the central cavity in the blank without several hammer strokes, each of which requires a little more steel in the billet because of the densening and flattening which the hammering action creates. The novel method produces an ample supply of metal for the flange without a lot of thin flashing. Moreover, in steering knuckles made by the method of this invention the grain flow is much more uniform and dense all the way through with very few irregular stresses or interruptions. This uniform grain structure results because the steel flowing out into the yoke and flange and the arm bosses in one direction and going in the opposite direction to make the spindle, is controlled throughout the initial single pressing stroke. After the initial pressing or busting stroke the saddle-shaped blank is rotated 90° and oriented sideways in a set of blocking dies for pressing in a direction normal to the longitudinal flow lines. During this step the excess material is squeezed out into a flashing which is then trimmed in one or more sets of finishing dies which also set the final dimensions and surface finish of the forged steering knuckle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic cross-sectional elevational view of the busting dies of the first step of the novel method with the billet shown in phantom and the completed press forged saddleshaped blank in position on the web of the die;

FIG. **2** is a schematic view of the saddle-shaped blank removed from the die of FIG. **1** and placed on its side in a blocking die;

FIG. **3** is a view of the blank as it is removed from the blocking die;

FIG. **4** is a cross-section of the finished steering knuckle;

FIG. **5** is a photomicrograph of the grain structure of the steering knuckle of FIG. **4** made according to the principal of this invention.

DETAILED DESCRIPTION OF THE METHOD

The novel method of press forging steering knuckles begins with shearing an appropriate length of a billet, heating it and forming the billet between two buster dies. The billet is of a material suitable for steering knuckles and typically would be a boron steel alloy 94B30 or in a more conventional steel such as 4140H. Before placing the billet in the dies, it is heated to a temperature of approximately 2140°F. FIG. **1** shows a first pair of mating buster dies in position for a pressing stroke with a billet shown in phantom therebetween. The upper end spindle boss defining die **10** and a lower splitting die **12** for making the central cavity in the saddle-shaped blank to be produced as an intermediate product. The heated billet is oriented with one end of the billet adjacent and as illustrated resting on a narrow tapered central web portion **14** of the die **12.** The web portion **14** projects a base **16** and has transversally extending walls **18** located at either end of the web **14.** Thus when the heated billet is placed on the web **14,** it extends laterally beyond the sides **20** and **22** respectively of the web **14** over pockets defined by the sides **20** and **22,** the base **16** and the transverse walls one of which wall **18** is shown. Mating die **10** has a cavity which is defined by shallower surfaces **24** and **26** and deeper surfaces **28** and **30** which with end surface **32** of the cavity form a boss producing die cavity. The

shallower surfaces **24** and **26** define the outer surfaces of the saddle legs and with the base **16** the end wall **18** and the web side walls **20** and **22** control the flow of the billet steel around the web **14** during the busting or pressing stroke, simultaneously with the flow of steel from the billet around the web **14** the shallower surfaces **26** and **24** act against the billet so that steel flows in a direction opposite the web **14** of the die **12** up into and along the deeper surfaces **28** and **30** and to the end surface **32** which with the deeper surfaces defines the boss which ultimately will provide the material for the spindle. The saddle-shaped blank which is generally designated by the numeral **34** is thus produced by one pressing stroke of the dies **10** and **12** acting upon the heated billet. The saddle-shaped blank **34** is made up of the oval shaped spindle boss **36** and two wide and tapered legs **37** and **38** which will supply the metal for the arm bosses of the ultimate steering knuckle. The legs **37** and **38,** of course, are larger as well as the whole of the saddle-shape blank **34** then the ultimate product to insure the adequate material is present for the succeeding press forging steps.

After the completed saddle-shaped blank **34** is removed from the dies **10** and **12** the blank is oriented **90°** and placed between two mating blocking dies which for purposes of illustration are only one die **40** in FIG. **2** as shown. The blocking dies **40** and its mating die are brought together to press and block out the steering knuckle. This operation creates a flow of excess metal within the saddle-shaped blank outwardly between the dies in the form of flashing. As will be seen in FIG. **3,** the flashing **42** forms a thin marginal web about the blocked out steering knuckle blank **44.** The blocked out steering knuckle **44** and its integral flashing portion **42** are removed from the blocking dies **40** and its mate and oriented in a third and fourth set of dies not shown which form and trim flashing **42** from the blocked out steering knuckle **44.** The finished steering knuckle of **46** is seen in cross-section in FIG. **4.** The final finishing of the knuckle which provide the trimming and forming operation will be in more than one operations, i.e. the forming will be carried on in one pair of dies and the trimming in a second pair of finishing dies. The finished steering knuckle **46** has the correct size, shape and grain structure and includes a spindle **48,** a flange **50** and arm bosses **52** and **54.** The substantially longitudinal flow pattern of the steel in densening in the flange and yoke area wherein the arm bosses **52** and **54** are connected to the yoke can be seen from the photomicrograph of FIG. **5.** An examination of the photomicrograph shows that a dense sound structure is produced by the method of this invention which will permit increased toughness in steering knuckles. Thus it will be seen that the novel method of press forging steering knuckles has been developed which produces a superior forged steering knuckle efficiently. In fact, the normal time for completion of the novel method from the placing of the heated billet in the buster dies **10** and **12** to the completed product as seen in FIGS. **4** and **5** is only 12 seconds and this is a significant speed up in the manufacturing of steering knuckles while employing 10% less steel in the heated billet than prior forging methods. The present invention may be embodied in other specific forms without departing from the essential characteristics and spirit thereof. The present embodiment is to be considered as illustrated, it being my intention that the scope of the invention be indicated by the appended claims rather than by the foregoing description.

What is claimed is:

1. A method of press forging steering knuckles comprising the procedural combination of steps of:

orienting one end of a heated elongated steel billet adjacent a narrow tapered central web portion projecting from a base of a first one of a first pair of dies such that said billet extends laterally beyond each side of said web over pockets defined by each of the sides of said web, said base and generally transverse walls at either end of said web, said one end extending generally parallel to said base;

pressing said billet axially in a direction generally perpendicular to said one end and said base by means of shallower surfaces defining the cavity of the second mating die of said pair to split the end portion of said billet and cause the web relatively to move axially and longitudinally into said billet as steel of the billet simultaneously flows into said pockets and to said base in one direction and in the opposite direction toward and to the deeper surfaces defining the cavity of said second mating die to form a saddle-shaped blank having one leg in each pocket and an oppositely extending boss ending at the deepest surface of said mating die;

removing the saddle-shaped blank from said first pair of dies and orienting said blank on its side in one die of a second pair of mating dies;

pressing said blank in said second set of mating dies in a direction normal to said first axial pressing to block out said steering knuckle and to move excess steel laterally to form a surrounding integral flashing;

removing said blocked out steering knuckle from said second set of dies and orienting it on its side in one die of at least a third pair of mating dies which define a cavity substantially the shape and dimension of the desired finished steering knuckle forging;

pressing said third set of dies together to press forge the blocked out steering knuckle to proper size;

removing from the forging any flashing remaining and thereby providing a steering knuckle forging of the desired size, shape and grain structure.

2. The method of claim **1** in which the steps of pressing the third set of dies together and removing from the forging any flashing remaining are accomplished by a fourth set of trimming dies.

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