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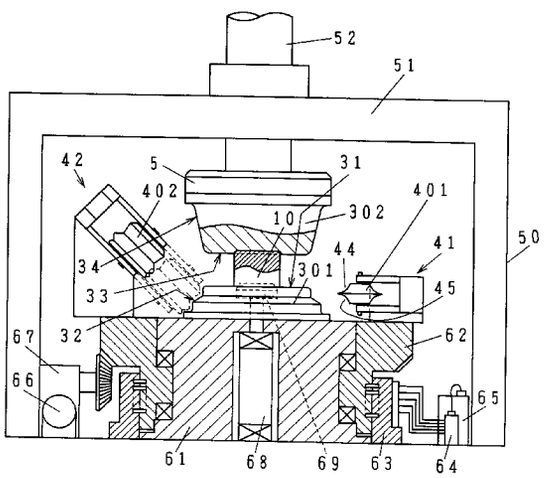
(54) Method of shaping a wheel.

(57) In the present application a pair of rams (301,302) press and squash the initial material (10) for shaping a central disc part. Extra material is extruded out of the interface of the rams. A roller unit (41,42) having several rollers forms rim parts by pressing the extruded material by the rollers from the sides.

FIG. 2



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This invention relates to a method of shaping various types of wheels combining a disc part and a rim part which are made from materials rich in plastic deformation, for instance, aluminum alloys or magnesium alloys.

This application claims the priority of Japanese Patent Application No.399164/1992 filed December 18, 1992, No.341995/1992 filed December 22, 1992 and No.348788/1992 filed December 28, 1992, which are incorporated herein by reference.

Automobile wheels or transmission pulleys are formed into a disc part and a peripheral rim part which is roughly perpendicular to the disc part in a unified body. An automobile wheel is once formed into a dish-shaped body having a disc part and an annular part perpendicular to the disc part. The annular part is further shaped into a drop center part (23), an outer rim part (22) and an inner rim part (24), as shown in Fig.1(a) and Fig.1(b). A pulley is formed into a dish-shaped body with a central disc part and a peripheral annulus. The annulus is further finished into a rim part which will wear a belt. The dish-shaped prototype is generally formed by several steps of forging, for instance, from a block or a disc (an initial material) of a light metal alloy.

Prior method exhibited in Japanese Patent Publication No.3-2574 has produced a dish-shaped prototype to the final shape by forging except an annular part. The peripheral annular part is then formed into a determined rim part by rolling formation. The conventional method requires an extremely strong pressure of forging, while the initial material is being transformed into the dish-like body. The dish-like prototype has a central disc part and a peripheral annulus perpendicular to the disc part. The forging process must expand and bend forcibly the peripheral portion of the block or disc initial material toward the annular wall in rams. The initial material resists against the deformation in the rams (alternatively called dice or molds). The resistance against expansion is very large. Thus the forging demands an immense pressure. If an initial material were to be deformed only by a single forging process into a dish-like body, the forging would require a huge forging machine, a giant pressing machine for supplying a sufficient pressure to the forging machine and a big ram for enduring against the large pressure. The use of large machines is impractical. Thus, the conventional method divides the deformation from an initial block to a dish-like body into several partial processes. Each partial process deforms a bit the material with a small pressure. The reduction of the pressure in partial processes decreases the size of forging machines.

Poor productivity, however, accompanies the conventional method including plural partial processes. The method requires various rams for all partial processes, long processing time from the initial material to the dish-like prototype and extra time for transferring the bodies between machines. Thus, it takes a long time to produce the wheel having a disc part and a rim part, because the formation of the wheel requires additional process to the dish-like prototype. The divisional, partial processes lowers the productivity of the wheels.

An object of this invention is to provide a method with less numbers of steps of shaping a wheel from a metal, plastic material. Another object of this invention is to provide a method of shaping a wheel which can save the process time. A still further object of this invention is to provide a method which can reduce the number of rams.

The method of this invention comprises the steps of pressing an initial material (10) by a pair of metallic rams (301) and (302) facing each other in an axial direction for forming a disc part, extruding a peripheral portion out of the rams, and shaping a peripheral portion into a rim part by a unit of rollers which rotate relatively to the rams.

Functions of this method will be explained now. The initial material (10) is sandwiched by a pair of the rams (301) and (302). The rams press the initial material in an axial direction. The material is squashed into a disc part. The peripheral, extra portion is extruded out of the rams (301) and (302). The peripheral portion extruded over the boundary of the rams is pressed from the side directions by a unit of rollers which rotate relatively to the rams. Namely, if the pair of the rams do not rotate, the rollers are rotated. If the rams rotate, the rollers are at rest. In this case, the rollers can displace a little in a radial direction or an axial direction for adjustment. In any cases, the rollers can form rim parts by the relative rotation to the rams.

The pressure applied between the pair of the rams is comparatively small, while the rollers are shaping the rim parts. The extruded portion is in contact only with the rollers. Thus, the resistance against the extension of material is still smaller than the extension resistance of the prior one in which a pair of rams press the whole of a material between wide, curved surfaces in order to form a wheel at a blow. This invention can reduce the force of the rams.

The advantages of this invention is high productivity, that is , short time of formation and small number of metallic rams. This invention can produce wheels at a low cost.

The invention will be more fully understood from the following description given by way of example only with reference to the several figures of the accompanying drawings in which,

Fig.1(a) is a sectional view of a wheel having a disc part and a rim part in a body.

Fig.1(b) is an enlarged sectional view of another wheel having a rim part alone.

Fig.2 is a sectional view of the apparatus for putting this invention into effect.

Fig.3 is a plan view of the set of rollers in the apparatus.

Fig.4 is a partially-sectional view of the material, the rams and the side roller at an early stage of forging.

Fig.5 is a partially-sectional view of the material, rams and roller at the final stage of forging.

Fig.6 is a sectional view of the material, rams and rollers at the process for forming the rim parts.

Fig.7 is a sectional view of the material having a wide central opening at a disc part, the rams and the rollers at an early step of forging.

Fig.8 is a sectional view of another apparatus for carrying out this invention.

Fig.9 is a sectional view of the material, rams and side roller of an example for shaping a V-belt pulley in a single process.

Fig. 10 is a sectional view of the material, rams and side roller of another example for producing a flat-belt pulley.

Fig. 11 is a sectional view of the material, rams and side roller of another example for integrating the processes of carving and formation of the outer rim into a single process.

Fig. 12 is a sectional view of the material, rams and side roller of an example for producing the dish-like prototype having an annulus around a disc part.

Fig.13 is a sectional view of the material, rams and side roller of an example for carving process at an early stage.

Fig. 14 is a sectional view of the material of the carving process for designating the locus of the carving.

Fig.15 is a partially-sectioned view of the material in carving, the ram and the side roller for carving an annulus from the dish-like body.

Fig. 16 is a sectional view of the material, rams and side roller of embodiment 1 in which a single process carries out carving and formation of an outer rim part at a stroke.

To achieve the foregoing objects and in accordance with the purpose of the invention, embodiments will be broadly described herein.

Embodiments of this invention are explained in accordance with figures.

[EMBODIMENT 1]

Embodiment 1 aims at producing an automobile wheel having a disc part and a rim part as one from a columnar initial material (10), as shown in Fig.1(a). Fig.2 shows an apparatus for shaping such an automobile wheel. The apparatus has a pair of rams (301) and (302) facing each other in the vertical direction. The lower ram (301) is a fixed one. The upper ram (302) is movable one which is displaced up and down. The center line of the upper ram (302) coincides with the center line of the lower ram (301). Three rollers (401), (402) and (403) are disposed at three points around the rams (301) and (302). The three rollers can displace in some directions by some distances. The carving roller (401) carves an outer surface of a material block in halves. The first shaping roller (402) shapes an outer half of a drop center (23) and an outer rim part (22). The second shaping roller (403) forms an inner half of the drop center (23) and an inner rim part (24). These three rollers are a set of forming rollers which play an important role in this invention.

The upper ram (302) is maintained by a holder (5). A frame (50) has a top deck (51). The top deck (51) of the frame (50) supports an oil pressure apparatus (52). The holder (5) is connected to an output shaft of the oil pressure apparatus (52). The oil pressure apparatus (52) lifts up or presses down the upper ram (302).

The upper surface of the lower ram (301) is a first pressing surface (31) which is a negative of the outer side of the disc part (1) of a wheel. The first pressing surface (31) is shaped after the disc part (1). The disc part (1) will have concave or convex patterns. The first pressing surface must have negative patterns similar to the concave or convex patterns of the disc part (1). The relation of convex and concave portions is reverse between the first pressing surface (31) and the disc part (1). A peripheral slanting surface (32) has the sectional shape which is a negative of a part of the drop center (23), the inner and outer surfaces of the outer rim (22).

Similarly the upper ram (302) has a second pressing surface (33) which is a negative of the inner side of the disc part (1). A peripheral slanting surface (34) of the upper ram (302) has a section which is a negative of another part of the drop center (23), inner and outer surfaces of the inner rim part (24).

Three roller devices (41), (42) and (43) are disposed at three-fold symmetric positions around the interface between the upper ram (302) and the lower ram (301). The lower ram (301) is founded on a fixed bed (61). Thus, the lower ram (301) is at rest in the embodiment. The three roller devices are installed upon a rotary bed (62) which rotates concentrically around the static bed (61). The first roller device (41) has a carving roller (401). The second roller device (42) has a first shaping roller (402). The third roller device (43) has a second shaping roller (403). The three roller devices are arranged counterclockwise in the order of the first roller device (41), the second roller device (42) and the third roller device (43). Each roller device has a roller and a bracket supporting the roller. All the brackets can be displaced both in a radial direction and in a vertical direction. Furthermore, the bracket of the third roller device (43) can be still displaced in an angular direction in order to change the posture of the second shaping roller (403), in addition to the radial or vertical movement.

The movements of the brackets are controlled by

oil pressure. Therefore, the lower portion of the rotary bed (62) is provided with a junction device of oil circuits which can rotate relatively to the rotary bed (62). An example of the oil circuit junction device is constituted of an annular joint (63) coaxial to the rotary bed (62), several grooves formed on an outer, lower surface of the rotary bed (62) and the same number of grooves shaped on an inner surface of the annular joint (63). Each of the grooves of the rotary bed (62) coincides with some one of the grooves of the annular joint (63). There is some sealing device between the inner surface of the joint (63) and the outer surface of the rotary bed (62). Therefore, no oil leaks from the pair of grooves of the oil circuit junction device in spite of the relative rotation of the rotary bed (62). An oil pressure source (65) supplies pressurized oil via a controlling valve unit (64) to oil pressure circuits in the annular joint (63) and the rotary bed (62). The controlling valve unit (64) contains plural controlling valves. Each of the oil circuits is independently adjusted by some controlling valves. For example, a microcomputer determines the positions of the brackets of the rollers and the posture of the second shaping roller (403) by adjusting the opening degrees of the controlling valves.

The rotary bed (62) is rotatably supported by the fixed bed (61). A wide bevel gear is formed around the rotary bed (62). Another small bevel gear is fitted to an output shaft of a reduction gear (67). A driving motor (66) rotates an input shaft of the reduction gear (67). The wide bevel gear meshes with the smaller bevel gear. Thus, the driving motor (66) rotates the rotary bed (62) at a reduced rate.

Fig.2 to Fig.6 demonstrate how to produce a wheel from an initial material (10). A columnar, initial material (10) is inserted into a space between the lower ram (301) and the upper ram (302), as shown in Fig.2.

The oil pressure apparatus (52) presses down the ram (302) against the initial material. The initial material is squashed between the upper ram (302) and the lower ram (301). The initial material is shaped into a dish-like body after the first pressing surface (31) and the second pressing surface (33). The upper patterns of the dish-like body are a negative of the second pressing plate (33) of the upper ram (302). Similarly the bottom pattern of the dish-like body is a negative of the first pressing surface (31). An extra portion is extended outward out of the interface of the rams (301) and (302).

The rotary bed is rotating then. The carving roller (401) is pressed to the extended material. A pair of symmetric, conically-curved surfaces (44) and (45) are formed around the carving roller (401). The boundary of two conical surfaces is a sharp, circular edge. The carving roller (401) resembles a bead of an abacus. The sharp edge of the carving roller (401) thrusts the extended material. The bracket (41) of the carving roller (401) revolves around the center line of the rams (301) and (302). Since the carving roller (401) is a free wheel, the carving roller (401) rotates around the axis of the bracket at the same line velocity of revolution around the center line. The sharp edge divides the extended material extruded from the interface of the rams (301) and (302) into halves. As the upper ram and the lower ram press and expand the material, the extended parts are pushed upward or downward by the carving roller (401).

When the upper ram (302) attains the lowest position, the material (10) is shaped into an intermediate form shown by Fig.5. The intermediate form has a disc part which is the negative of the first pressing surface (31) of the lower ram (301) and the second pressing surface (33) of the upper ram (302) and an annular part consisting of an outer bend (25) and an inner bend (26). The outer bend (25) is a part which will be shaped into a part of a drop center (23) and an outer rim (22). The inner bend (26) is a part which will be shaped into another part of the drop center (23) and an inner rim (24).

When the carving process has finished, the carving roller (401) recedes from the intermediate form. The first shaping roller (402) comes into contact to the outer bend (25). The first shaping roller (402) shapes the outer bend (25) into the part of the drop center (23) and the outer rim (22). The section of the first shaping roller (402) is a negative of the section of the outer surface of the drop center (23) and the outer rim (22). The section of the lower ram (301) is similarly a negative of the section of the inner surface of the drop center (23) and the outer rim (22). Therefore, the drop center (23) and the outer rim (22) are formed by the rolling of the first shaping roller (402) on the outer bend (25).

The second shaping roller (403) comes into contact with the inner bend (26) either in coincidence with or posterior to the formation of the outer rim (22). In the embodiment, the third roller device (43) having the second shaping roller (403) is a spinning roller device which adjusts the posture of the second shaping roller (403) and displaces the second shaping roller up and down. The second shaping roller (403) presses, extends and shapes the inner bend (26) into a thin conical part which is a negative of the peripheral slanting surface (34) of the upper ram (302). Thus, the third roller device (43) makes a part of the drop center (23) and the inner rim (24). The second shaping roller (403) recedes and separates from the inner rim (24).

When the rolling processes by the rollers (401), (402) and (403) have finished, a wheel having a disc part (1) and rim parts (2) is produced around and between the rams (301) and (302). The fixed bed (61) is provided with a knockout device (68) at the center. An output shaft of the knockout device (68) penetrates a top hole of the lower ram (301). The output

shaft has a plate (69) which has the same shape as the disc part (1) of the wheel has. The wheel can be gotten rid of above from the ram (301) by projecting the output shaft of the knockout device (68).

Then the wheel is removed from the shaping apparatus. The output shaft is restored to the initial position. Another initial material is supplied between the upper ram (302) and the lower ram (301). Then another cycle of shaping of another wheel will be repeated. The wheel shaped by the apparatus will be further processed by finishing punching, flash elimination, finishing cutting and finishing grinding.

In the embodiment, the volume of the initial material must be equalized to the volume of the wheel which should be produced.

The carving roller (401) can be displaced both in the vertical direction and in the horizontal direction. The vertical displacement of the carving roller (401) changes the allotment of the material to the outer bend (25) and the inner bend (26). Although the length of the bends are equal, the volume of the bends is different, because the thicknesses differ with each other. If the carving roller (401) is settled at a higher level, the inner bend (26) becomes thinner and the outer bend (25) becomes thicker to the contrary. The volume ratio of the outer bend (25) to the inner bend (26) can be properly adjusted by settling the outer bend thicker than the inner bend (26).

In the embodiment, the disc part (1) has been formed to a shape which coincides with the disc of a wheel. Another disc part (1) as shown in Fig.l(b) is also available. The disc has a large opening and a narrow rim flange (21). An individual disc will be connected to the rim flange (21). In the version, the first pressing surface (31) of the lower ram (301) should have a negative shape of the outer surface of the rim flange (21). The second pressing surface (33) of the upper ram (302) has a negative shape of the inner surface of the rim flange (21). Fig.7 shows the state in which the upper ram (302) and the carving roller (401) have formed the intermediate body of the version. The upper ram (302) is positioned at the lowest level. The carving roller (401) divides the bends (25) and (26). The rams (301) and (302) sandwich a peripheral rim flange (21) and a central thin part (93) which will be eliminated afterward.

In this case, the apparatus produces a partial wheel which consists only of a rim part and a rim flange in a body. The central thin part is eliminated by punching, when the partial wheel has been removed out of the rams (301) and (302). Many bolt holes are perforated at a destined interval on the rim flange (21) simultaneous with the punching. The partial wheel is made up to a complete wheel by being coupled to an individual disc with bolts.

[EMBODIMENT 2]

Embodiment 1 rotates the roller devices (41), (42) and (43) around the fixed rams (301) and (302). What is important is the relative rotation between the rams and the rollers. Otherwise, it is possible to fix roller devices and rotate the rams (301) and (302) at the same angular velocity.

For example, such an apparatus exhibited in Fig.8 is available. The top deck (51) of the frame (50) suspends the upper ram (301). The fixed bed (61) sustains the lower ram (302). A cylindrical holder (57) hanging from the top deck (51) has an opening at the bottom. A supporting plate (59) is rotatably equipped at the bottom opening of the holder (57). The upper ram (301) is fixed to the bottom of the supporting plate (59). The holder(57) is fitted to an output shaft of the oil pressure device (52). Guide posts fixed to the holder (57) penetrate holes of the deck (51). The oil pressure device can lift or sink the holder (57). The supporting plate (59) can rotate with regard to the holder (57). A worm wheel (58) is fitted around the supporting plate (59). The holder (57) has a driving motor (not shown in the figures) with an output shaft (54) for rotating the ram (301) and a worm (53) fitted to the output shaft (54). When the driving motor rotates the worm (54), the worm wheel and the ram (301) revolve at a reduced velocity. Therefore the upper ram (301) is rotated by the driving motor and the worm gear device and is lifted up or down by the oil pressure device (52).

The lower ram (302) is fixed on a sustaining plate (501) which is furnished in a holder (65). The holder (65) is laid on the fixed bed (61). The sustaining plate (501) has the worm wheel (58) around the periphery. A driving motor (not shown in the figures) with an output shaft (54) is installed in the holder (65) like the upper ram. A worm (53) is fixed to the output shaft (54). The worm (53) meshes with the worm wheel (58) around the sustaining plate (59). Thus the lower ram (302) is rotated by the driving motor and the worm gear device. The angular velocity of the lower ram (302) is equal to that of the upper ram (301).

A first roller device (41) having a carving roller (401) is furnished on a side wall of the frame (50). Oil pressure devices can displace the carving roller (401) both in the horizontal direction and in the vertical direction. A roller device (7) having a shaping roller (40) is installed on another side wall of the frame (50). Similarly, the oil pressure devices can displace the shaping roller (40) both in the horizontal direction and in the vertical direction. Another oil pressure device can adjust the posture of the shaping roller. The roller device (7) is a conventional spinning roller device.

The function of the embodiment will now be explained. An initial material (10) is laid between the upper ram (301) and the lower ram (302). The upper ram (301) is lowered by the oil pressure device (52). The

rams (301) and (302) press and expand the initial material (10). The extruded portion out of the rams (302) and (301) is divided into two parts by the first roller device (41). The roller device (7) presses and shapes the rim parts (2) by the spinning roll process.

This invention has several versions in addition to the embodiments mentioned before.

① The embodiments have been explained as a wheel of automobiles. However, this invention can be applied to other kinds of wheels, for example, wheels for light wagons or pulleys. In this case, a final product can be integrally shaped by a unified processing roller (81) having a carving edge part (48) and shaping roller parts (49), as shown in Fig.9. Especially, in the case of V-belt pulley, such the unified roller (81) can shape and finish a final product at a time, because a V-belt has an outer rim (22) and an inner rim (24) which are symmetric with regard to the central plane. Some pulleys require no carving edge part (48) for the processing roller.

Furthermore, in the case of a flat belt-pulley, the processing roller is a simple columnar roller (82). The side shapes of the rams (301) and (302) have been formed in coincide with the inner surface of the rim part. The extruded portion becomes a rim part which will be contact to a belt.

In any cases, the side ends of the upper ram (301) and the lower ram (302) shall be in contact with the end of the processing roller (81) or (82), when the rim parts have been formed. The contact is only the requirement at the end of the formation. The side of the lower ram (302) is always in contact with the part of the processing roller (81) or the columnar roller (82) in the shaping process. But when the shaping process is in progress, it is allowable for the upper ram (301) to be separated from the upper side of the processing roller (81) or the columnar roller (82), as shown by double-dotted lines in Fig.9 or Fig.10. Then at the final stage, the bottom side of the upper ram (301) becomes into contact with the processing roller (81) or the columnar roller (82).

This version which relies upon an integrated, unified roller has been described for producing light wagons or pulleys. But this version can also be applied to the production of automobile wheels. In this case, the side shapes of the rams (301) and (302) shall be the negatives of the automobile wheel at the inner surfaces of the rim part. The unified processing roller (81) shall be harmonized with the sectional shape of the outer surface of the rim part.

② Embodiment 1 has proposed a roller unit having the first roller device (41) with the carving roller (401) and the second roller device (42) with the first shaping roller (402) independently. In the case of high asymmetry of the rim part to the disc part, namely when the outer rim part is much narrower than the inner rim part, the two roller devices can be unified into a roller device. Fig. 11 demonstrates an example of a unified roller. The unified processing roller (83) integrates a shaping roller part (49) and a carving edge part (48) twinly in series along the axial line. The integrated roller (83) enables the carving edge part (48) to divide the material into upper bend and lower bend and the processing roller part (49) to shape the outer rim (22) and a part of the drop center (23) at a time.

③ Both embodiment 1 and embodiment 2 have employed the carving roller in order to divide the material for forming rim parts on both sides of the disc part. However, when the rim part lacks either of the rim parts and only a bending annulus (90) is formed as a rim part, a simplified roller device can replace the roller devices, as explained so far. The roller unit shall have only a conical processing roller (84) having an arc section. When the rams (302) and (301) press an initial material, a peripheral part of the material is extruded out of the rams. The conical processing roller (84) is pressed onto the extruded portion. As the rams exclude the material, the extruded portion is bent upward by the processing roller (83). Finally, the material is formed into a prototype having the disc part (1) and the bending annulus (90) projecting only to one direction from the periphery of the disc part (1). The prototype has a dish-like shape. Depending on sorts of wheels, the dish-like prototypes can be adopted as final products.

For other sorts of wheel, the prototypes shall be further shaped by by adding some processes to the products obtained by embodiment 1 and embodiment 2. In this case, the dish-shaped prototype shall be carved by the carving roller (401) posteriorly, as shown in Fig. 13, Fig. 14 and Fig. 15. Fig. 13 exhibits the beginning of the posterior carving by the abacus-bead-like roller (401). Fig. 14 shows the locus (92) along which the edge of the carving shall progress. The carving locus (92) shall be determined by the volume ratio of the inner rim part to the outer rim part. Then the carving roller (401) cuts its way along the determined locus (92). The outer rim part (22) and the inner rim part (24) are formed, as shown by Fig.15.

④ Fig. 16 shows another version of simultaneous carving and outer rim formation. The lower ram (301) has a sectional shape which is a negative of the drop center and the outer rim (22). The integrated, processing roller (85) similarly has a shaping roller part (491), an expanding roller part (492) and a carving roller part (493). The carving roller part (493) is an interface between the shaping roller part (491) and the expanding

roller part (492). The carving roller divides the material into two and shapes the drop center part. The lower shaping roller part (491) has been modeled after the drop center and the outer rim part (22). The upper, expanding roller part (492) has an arc section. The processing roller (85) is furnished at a certain point in the vicinity of the power ram (301). The relative height and the relative distance of the roller (85) to the lower ram (301) have been properly determined.

The upper ram (302) has been modeled upon the inner rim part (24) and the drop center. The pair of the rams (302) and (301) sandwich and press an initial material. Then the rams rotate around the center axis. The upper ram (302) squashes the initial material. Some portion is extruded out of the rams. The extruded portion is shaped by the processing roller (85). The carving roller part (493) divides the portion into two parts. The lower allocated portion fills the space between the shaping roller part (491) and the lower ram (301). The portion is finished as the outer rim (22). On the other hand, the rest of the extruded part rises in the narrow space between the upper ram (302) and the processing roller (85), as the upper ram (302) is sinking. The portion of the material is pressed into the upper bend (26), as shown in Fig. 16. Then the upper bend (26) will be further formed into the inner rim (24) by an additional roller process.

Claims

1. A method of shaping, from a starting material which has plasticity, a wheel of the type having a disc part and a rim part which extends generally in an axial direction relative to the disc part, said method comprising the steps of:

   pressing the initial material (10) in an axial direction by means of a pair of facing rams (301) and (302),

   forming a disc part between the rams,

   extruding an extra portion of the initial material (10) out of the rams, and

   forming the extruded material into a rim part by a roller unit having one or more than one forming rollers, said rollers and rams being capable of relative rotation.

2. A method of shaping a wheel as claimed in claim 1, wherein the rams (301) and (302) have edge sides shaped to form inner surface of the rim part, the rams can rotate around an axial line, and the roller unit with one or more roller devices forms the rim parts.

3. A method of shaping a wheel as claimed in claim 2, wherein the roller unit has a unified processing roller having a carving edge part (48) and a shaping roller part (49) formed in series the relative position of the processing roller with respect to either of the rams is determined both in the axial direction and in the radial direction, the shape of the space between an outer surface of the ram and the surface of the shaping roller part (49) is the same as the shape of either of the inner rim part and the outer rim part, the carving edge part (48) is arranged to divide the extruded material into two portions, whereby the two portions penetrate into the space between the ram and the shaping roller, and either the inner rim part or the outer rim part is shaped by the ram and the shaping roller.

4. A method of shaping a wheel as claimed in claim 2, wherein a processing roller has shaping roller parts (49) with sectional surfaces which are a negative of the outer surface of the rim part, the relative position of the processing roller to either of the rams (301) and (302) is predetermined both in the axial direction and in the radial direction, the shape of the space between the side ends of the rams and the outer surfaces of the shaping roller parts is the same as the section of the rim part and the rim part is shaped by pressing the extruded material into the space between the rams and the shaping roller parts.

5. A method of shaping a wheel as claimed in claim 4, wherein the processing roller is a columnar roller which is parallel with the axis of the rams, and the columnar roller shapes the outer surface of the extruded material into a column surface.

6. A method of shaping a wheel as claimed in claim 2, wherein the material extruded out of the pair of rams is formed into the rim part by the steps of carving the extruded material by a carving roller into an inner bend and an outer bend, and roll-shaping the bends by shaping rollers into the rim part.

7. A method of shaping a wheel as claimed in claim 6, wherein the process of roll-shaping is simultaneous with the process of carving.

8. A method of shaping a wheel as claimed in claim 2, wherein the roller unit shapes the rim part of a wheel from the extruded material by the steps of bending the extruded material to either of the rams into a bending annulus by a conical processing roller, forming the bending annluus into an inner bend and an outer bend, and roll-shaping the inner bend and the outer bend into an inner rim part and an outer rim part.

9. A method of shaping a wheel as claimed in claim 6, wherein the process of roll-shaping the outer rim part progresses simultaneously with the process of carving by employing a processing roller unifying a carving edge part (48) and a shaping roller part (49) for shaping the outer rim.

10. A method of shaping a wheel as claimed in claim 8, wherein the process of roll-shaping the outer rim part progresses simultaneously with the process of carving by employing a processing roller having both a carbing edge part (48) and a shaping roller part (49) for shaping the outer rim.

11. A method of shaping a wheel as claimed in claim 7, wherein a carving roller and a shaping roller is unified into a processing roller, and the extruded material is pushed to a space sandwiched between the ram (301) or ram (302) and the processing roller.

12. A method of shaping a wheel as claimed in claim 7, wherein a carving roller and a shaping roller is unified into a processing roller, and the extruded material is pushed to a space sandwiched between the ram (301), ram (302) and the processing roller.

13. A method of shaping a wheel as claimed in claim 2, wherein the disc part has only a rim flange extending inward from the rim part in a wheel.

FIG. 1(a)

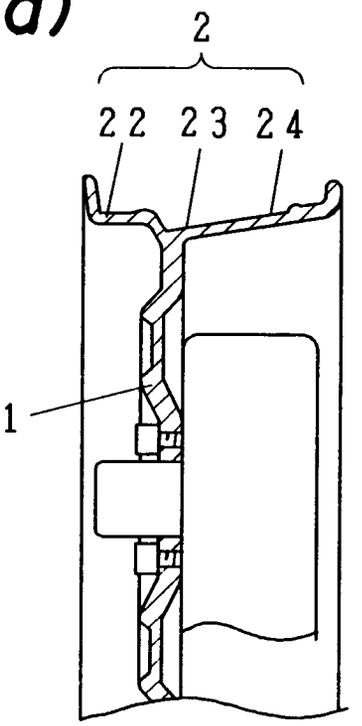

FIG. 1(b)

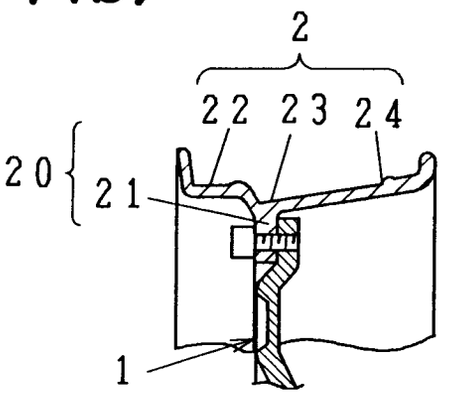

FIG. 2

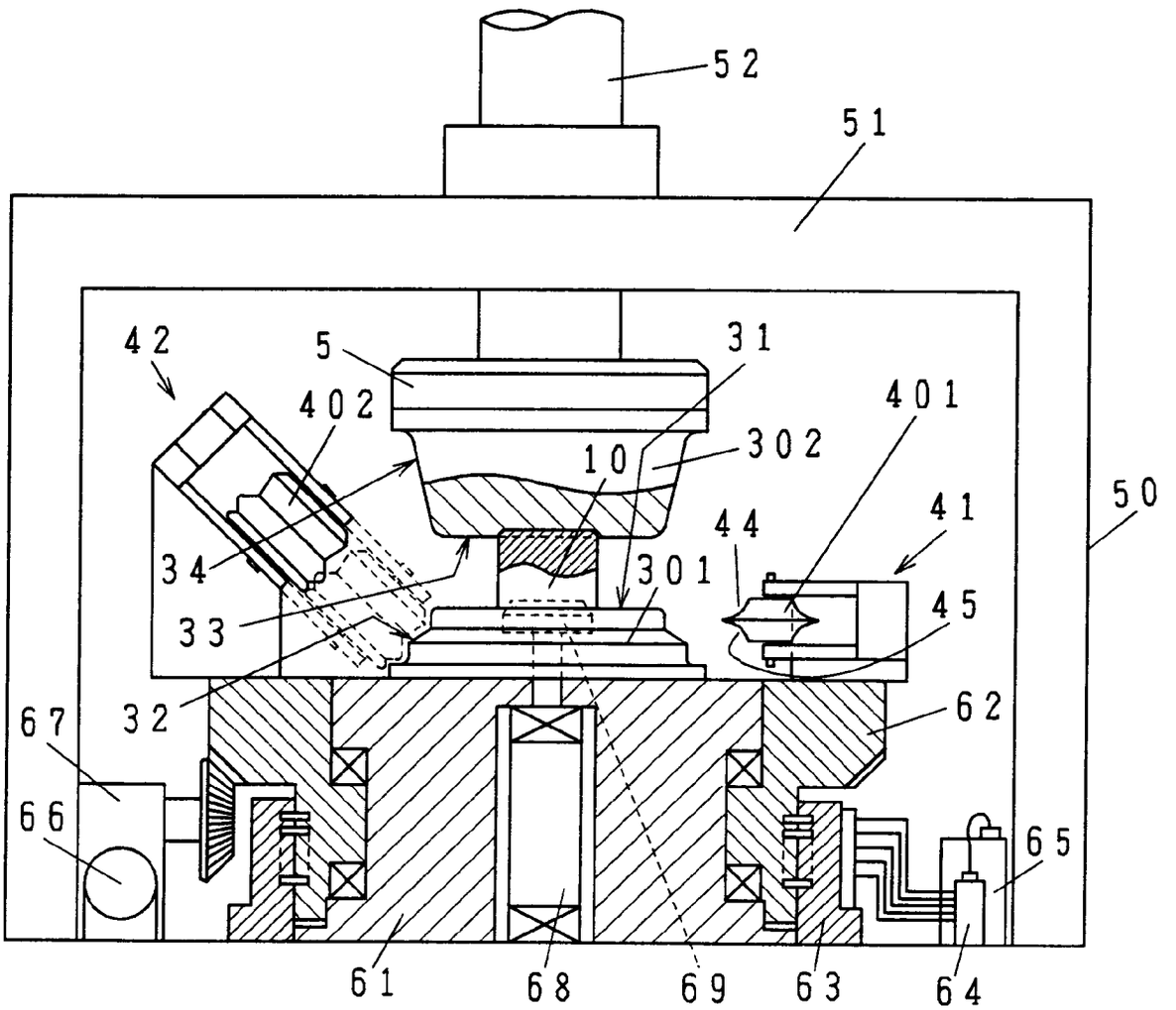
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FIG. 3

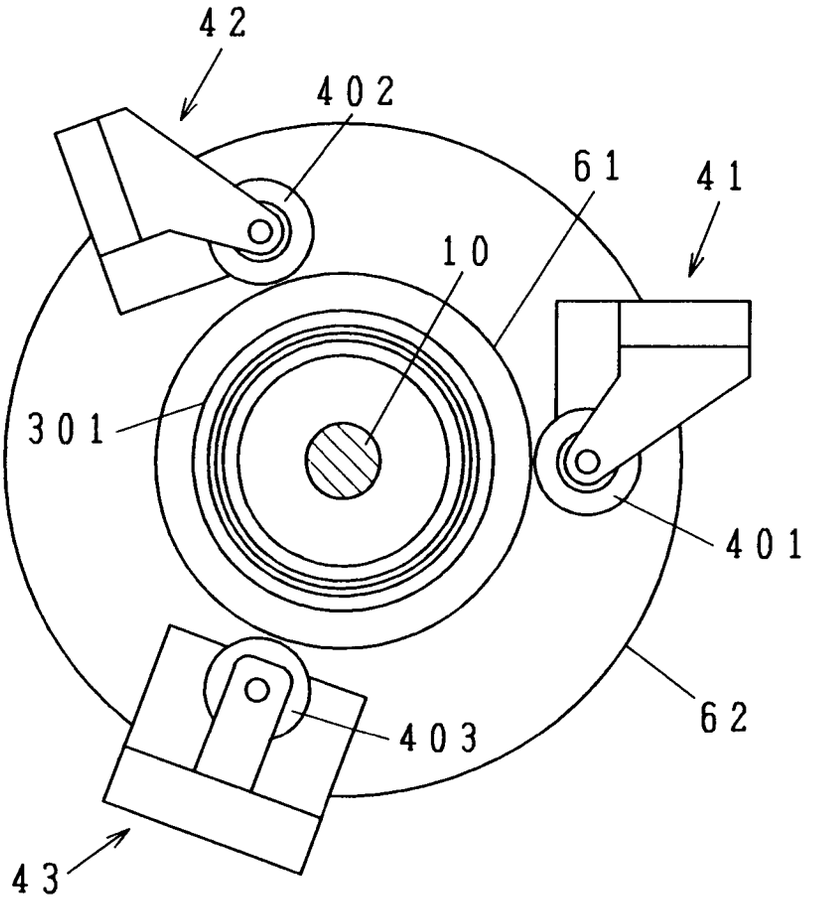

FIG. 4

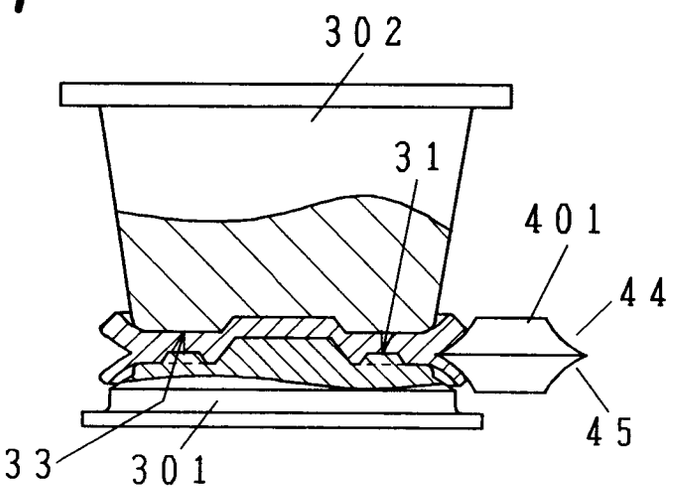

FIG. 5

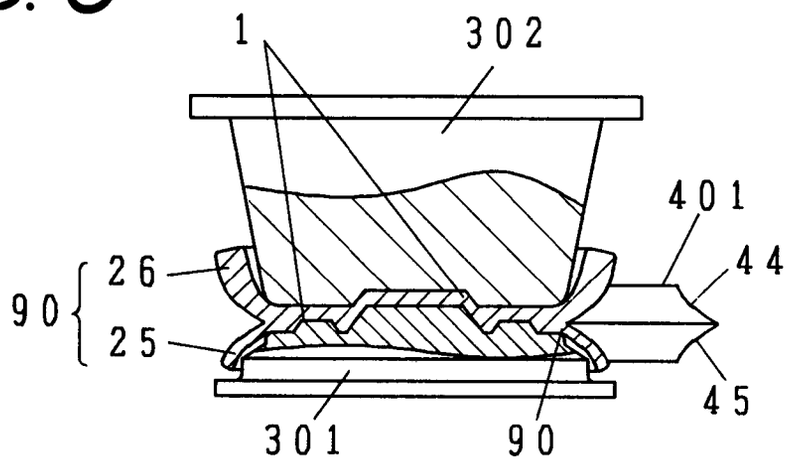

FIG. 6

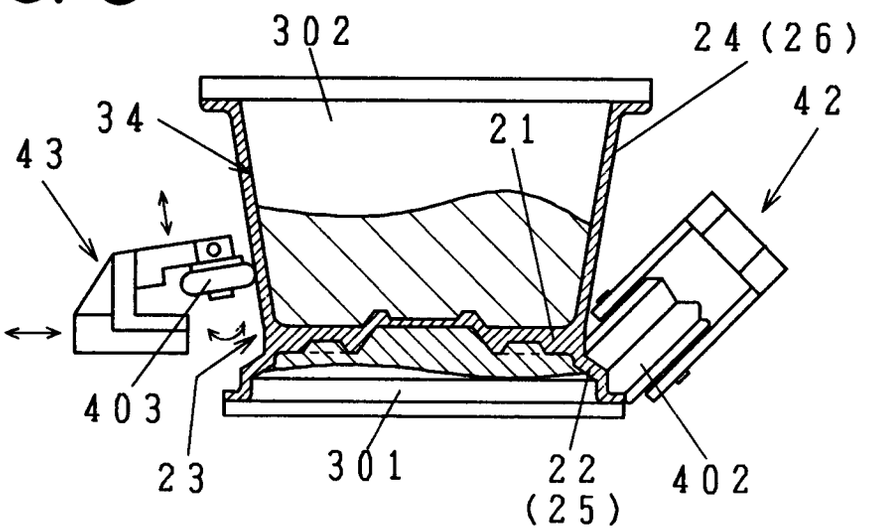

FIG. 7

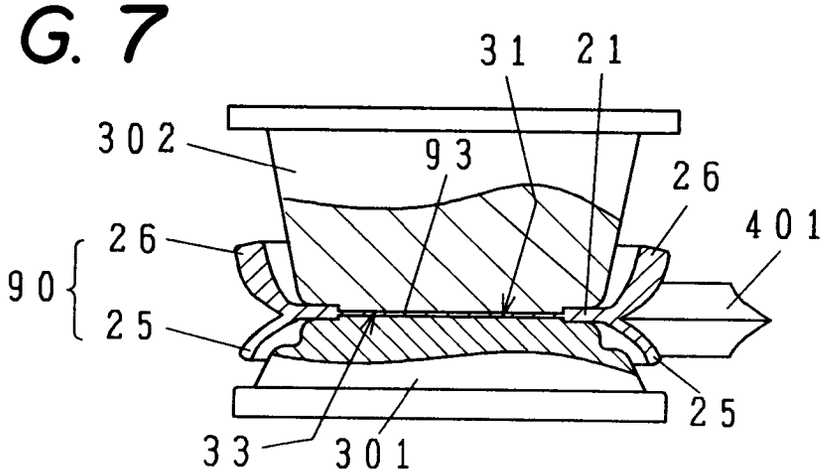

FIG. 8

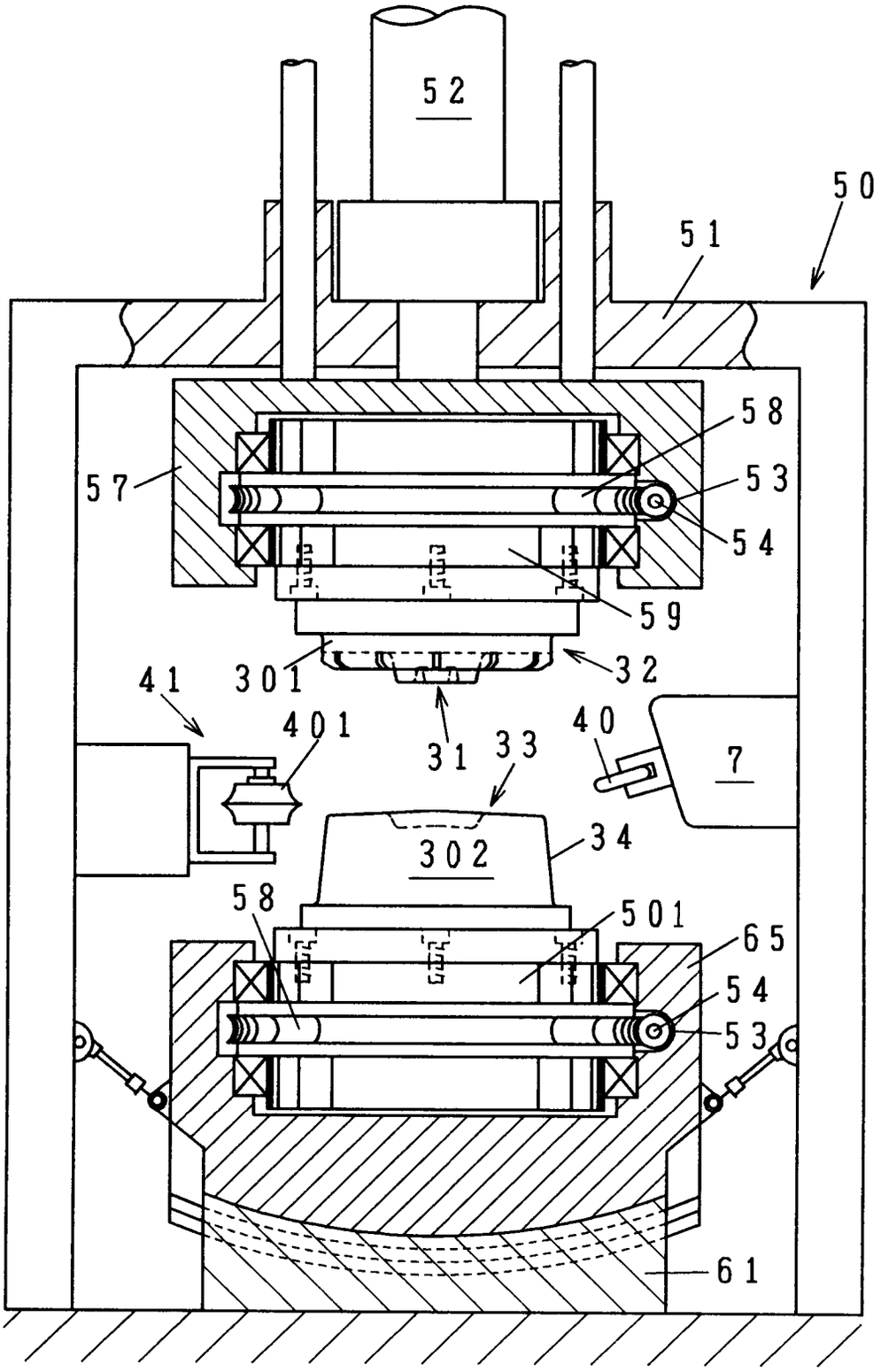
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FIG. 9

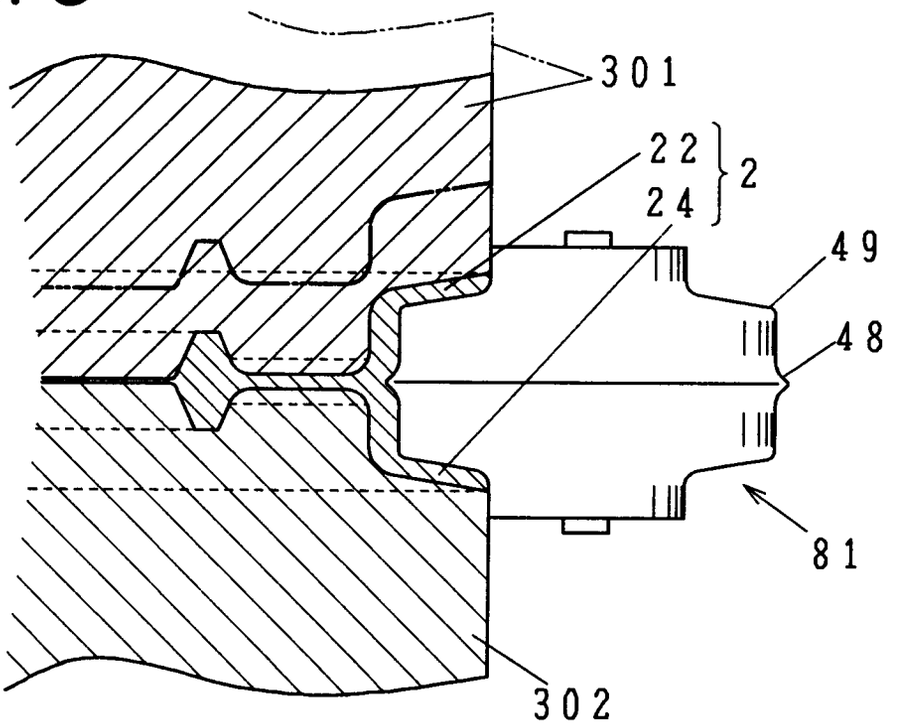


FIG. 10

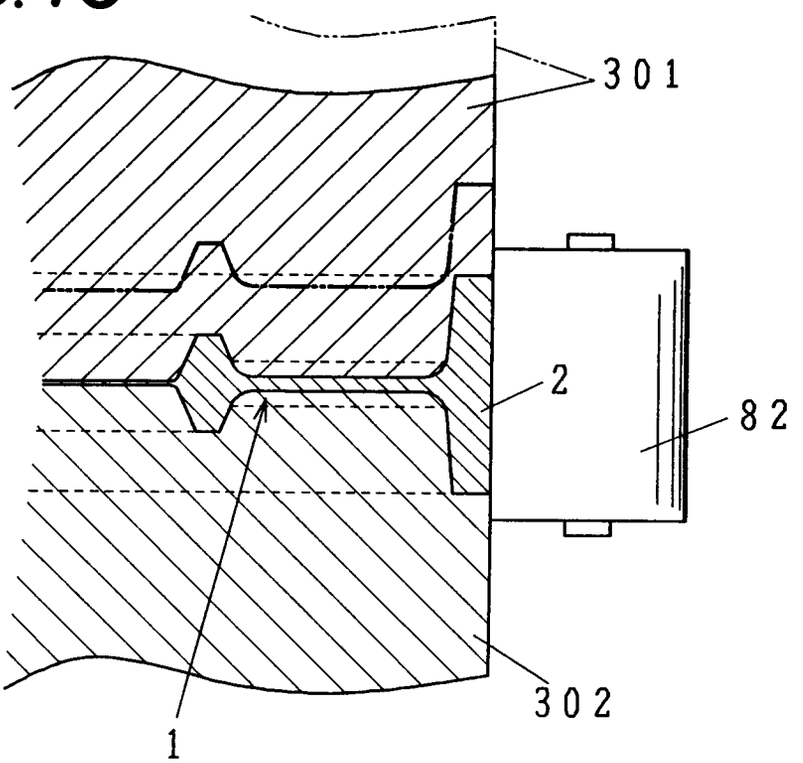


FIG. 11

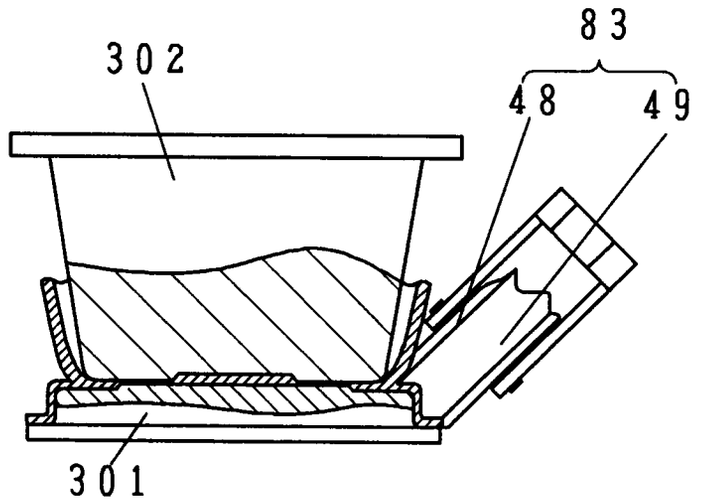


FIG. 12

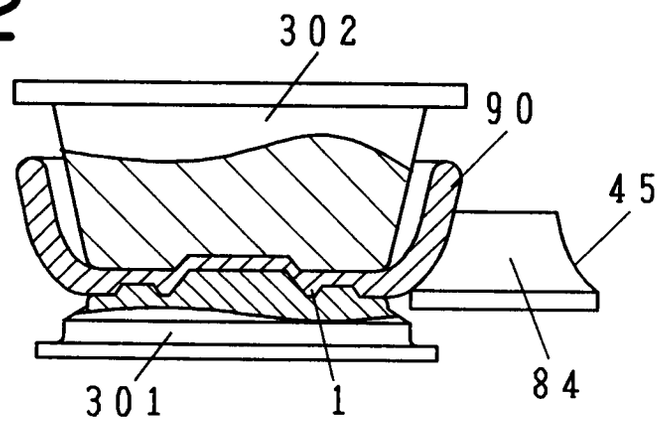


FIG. 13

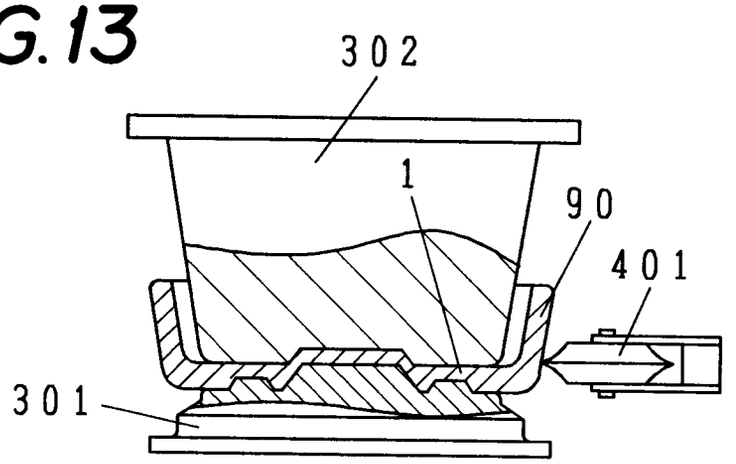


FIG.14

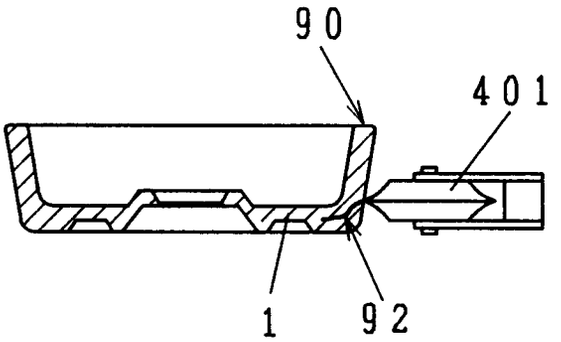


FIG.15

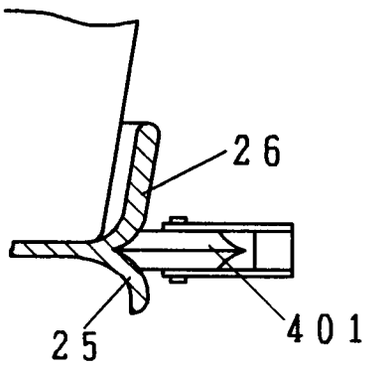
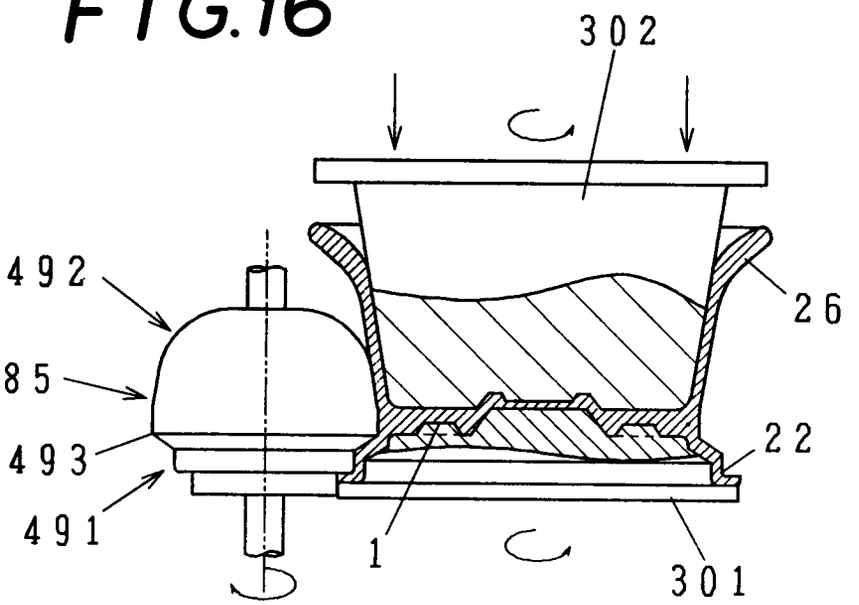


FIG.16



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 31 0126

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	FR-A-1 550 081 (ROTARY PROFILE ANSTALT) * the whole document *	1,2,4,5	B21K1/28 B21H1/04
X	GB-A-L16794 (MIDLAND RAILWAY) * the whole document *	1	
A	FR-A-2 361 174 (HOESCH) * page 1 - page 2; figures *	1	
A	GB-A-2 055 065 (KEITH PERCIVAL-BARKER) * page 3, line 89 - line 130 *	2,3,6,7, 9-12	
A	FR-A-2 677 279 (AUBECQ-AUXI) * figures *	8	
A	US-A-3 672 021 (FUCHS)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
B21K B21H B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 March 1994	Ris, M

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