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24 JAN 2014

SHIVAM AUTOTECH LIMITED (A Leading Cold Extrusion Technology of Gear teeth Forming)-Gear Sterter Reduction		
S.NO	OPERATION DESCRIPTION	
1	Raw Material receipt	
2	Receiving Inspection of R.M. by QA	
3	**Forging Blank (Cold / Hot-AMP30S)**	
4	Annealing	
5	Shot Blasting	
6	Phosphating	
7	**Cold Extrusion at KP 250 Knuckle Joint Press (Small Gear)**	**No Shaping Requirement**
8	Phosphating	
9	**Cold Extrusion at KP 250 Knuckle Joint Press (OD Gear)**	**No Hobbing Requirement**
10	CNC	
11	Case Carburising	
12	Shot Blasting (Hanger Type)	
13	Honning / Hard Part Boring	
14	Gear Rolling	
15	Final Inspection (Sampling PDI)	

Figure 3

Date: 24/01/2014

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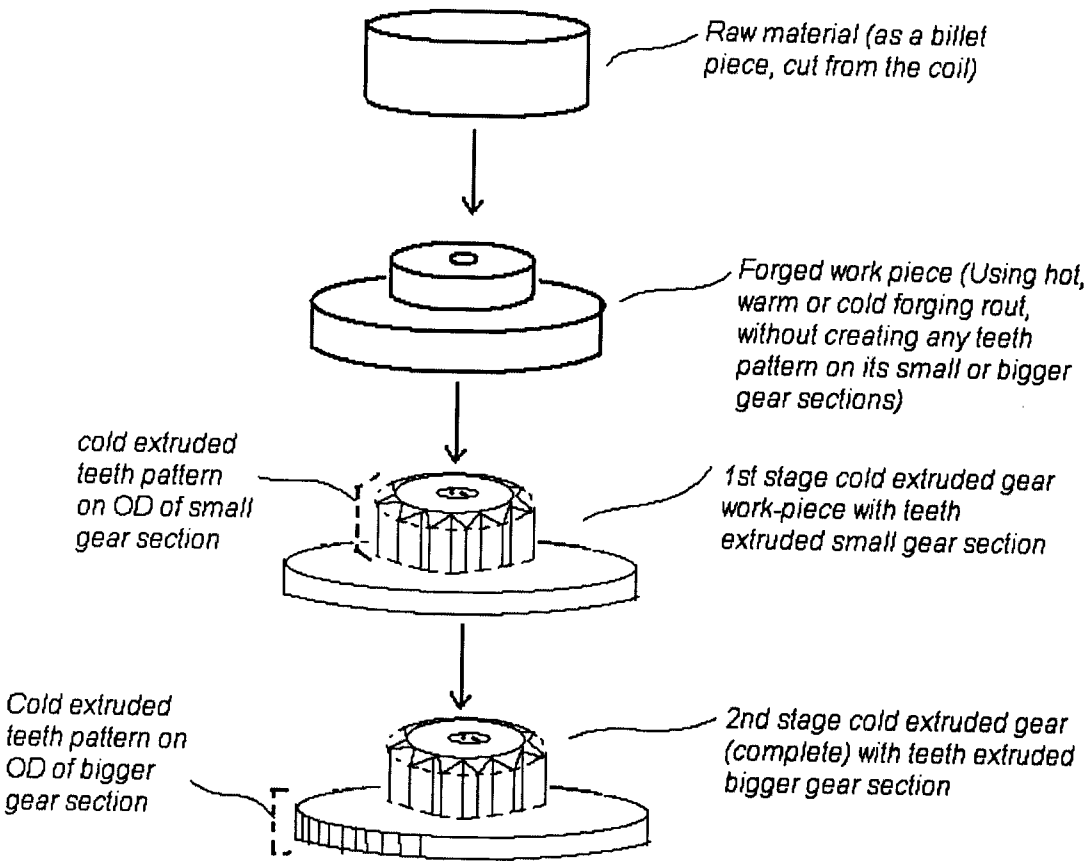

Figure 1

Date: 24/01/2014

(Agent for the Applicant)

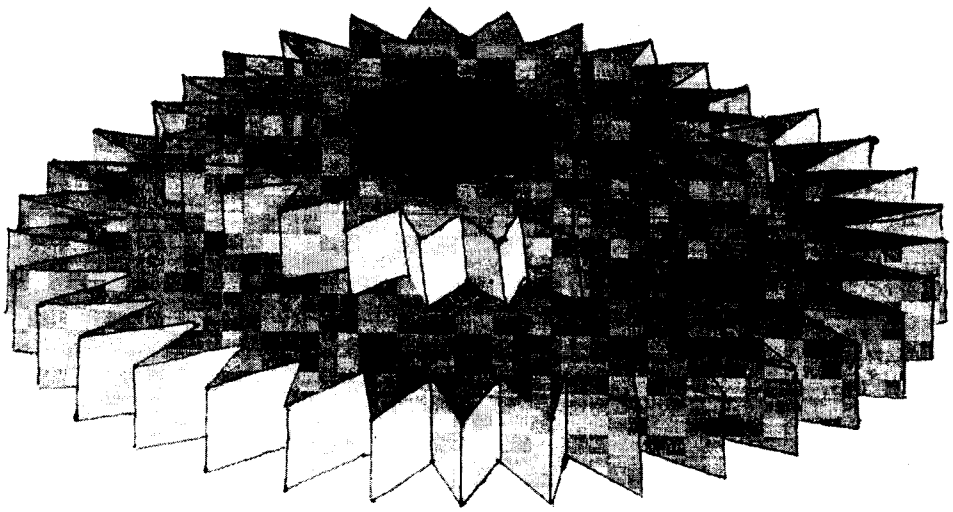

Figure 2

(Agent for the Applicant)

Date: 24/01/2014

Method of manufacturing gear with double teeth patterns involving forging and two stage cold extrusion processes

Field of the Invention:

Present invention is related to a new and advanced method of manufacturing a gear with double teeth patterns which mainly involves forging operation towards gear blank formation, followed by two stage cold extrusion operations towards forming teeth pattern on the outer circumference of the small gear section as well as on the outer circumference of the bigger gear section therein. The proposed manufacturing method herein also involves certain strategic secondary operations like annealing, shot blasting, phosphating, CNC machining, honing/hard part boring etc. at different strategic stages therein. Unlike the conventional practice, the proposed method do not include teeth shaping and hobbing operations towards creation of the proposed gear with double teeth patterns and achieve both the teeth patterns on the outer circumferences of small gear section and bigger gear section therein.

Background of the present invention:

Conventionally most of the gears with teeth patters, including the ratchet gears comprise a series of gear teeth, created as a specific pattern of teeth dimensions, and such teeth pattern is usually created as a circular surface or face/ circumference of the gear. The section of the ratchet that interacts with another gear or any other power transmission mean, normally the pawl, will slide over said rounded side, but will get caught on the flat side.

In one conventional practice, after casting of the main body of the said gear, it is subjected to substantial machining to create all the structural features, hole piercing for shaft assembly, teeth pattern cutting , hobbing and shaping etc.

Thus, such practice involves substantial resources, creates huge wastage of the material and is time consuming. It doesn't provide desired structural strength in the final product and thus, mainly responsible for its reduced functional life. In conventional practice the layer or pattern of teeth is formed on the gear by involving

teeth hobbing and/or teeth shaping. Due to such methodology of the ratchet gear produced, the production is associated with the low abrasion resistance property, lack of perfection and less probability of customized installation in the power transmission system, more prone to noise during functioning, very sensitive to accidental damage and limited in usage in automobiles.

Further, in an alternate practice for ratchet gear manufacturing, the piece of raw material, cut in suitable size, is subjected to partial forging or extrusion, mainly to obtain a basic plane ingot, suitable to be subjected to a series of machining operations, namely surface profile creation by machining/cutting; hole piercing; ingot's surface profile cutting/refining and strengthening; teeth pattern cutting etc. Most importantly, all such practices involve substantial machining towards structural features development on the ingot and for creation of the series of its teeth pattern. Teeth cutting are usually done by one-by-one teeth cutting or hobbing of teeth therein. Further this method is so time consuming that it is insufficient in fulfilling the requirements/demands of the concerned auto industry.

Therefore, the present invention is mainly intended to propose a manufacturing method, which mainly involves hot or cold forging towards creating the gear blank from the initial piece of ingot, followed by performing cold gear extrusion in two steps on duly annealed and conditioned said forged work piece towards creating two teeth patterns on the outer circumferences of small gear section and bigger gear section of the proposed gear with double teeth patterns. The most important object of the invention is to obviate the application of machining operations like teeth shaping and hobbing towards creation of the proposed gear with double teeth patterns and in a very unusual and innovative manner achieving both the teeth patterns on the outer circumferences of small gear section and bigger gear section therein by stepwise cold extrusion operations.

The invention is intended to propose a manufacturing method, which also includes certain supporting secondary steps as strategic steps in the whole manufacturing process, apart from performing the essential operations of cold/hot forging and thereafter two step cold extrusion; mainly towards supporting the performance of said essential steps in effective and perfect manner and towards finalization of said gear formation. Such secondary steps includes mainly annealing, shot blasting,

phosphating, CNC machining (very limited), case carburizing, shot blasting (hanger type), and honing (hard part boring) etc.

The ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections, being manufactured by the present proposed method is much advanced in its structural and functional properties in comparison to the similar conventional auto components prepared through conventional processes, namely in terms of very high stress bearing capacity, corrosion resistance, high temperature tolerance and very high structural strength etc.

Object of the present invention

The main object of the present invention is to propose a method of manufacturing a gear with double teeth patterns which mainly involves forging operation towards gear blank formation, followed by two stage cold extrusion operations towards forming teeth pattern on the outer circumference of the small gear section as well as on the outer circumference of the bigger gear section therein.

Another object of the present invention is to propose a method of manufacturing a ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein major structural features of the said gear and its teeth pattern are formed during cold extrusion operation and thereafter certain optional supportive machining processes are required for surface refining, product strengthening and finalizing the ratchet gear production.

Another object of the present invention is to propose a method of manufacturing a gear with double teeth patterns, which mainly involves hot or cold forging towards creating the gear blank from the initial piece of ingot, followed by performing cold gear extrusion in two steps on duly annealed and conditioned said forged work piece towards creating two teeth patterns on the outer circumferences of small gear section and bigger gear section thereof.

Another object of the present invention is to propose a method of manufacturing a gear with double teeth patterns, wherein it is characterized by obviating the application of machining operations like teeth shaping and hobbing towards creation

of the proposed gear with double teeth patterns and in a very unusual and innovative manner achieving both the teeth patterns on the outer circumferences of small gear section and bigger gear section therein by stepwise cold extrusion operations.

Another objective of the present invention is to propose a novel method for manufacturing the ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein the said method of manufacturing is characterized by performing the cold extrusion followed by Phosphating and CNC wherein the teeth pattern of the said ratchet gear on both layers are extruded during the formation of whole ratchet gear body, without performing any teeth cutting or hobbing operation.

Another objective of the present invention is to propose a method of manufacturing a ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein said gear with double teeth pattern is characterized by its advanced properties in comparison to conventional such gears and the teeth pattern therein, mainly in terms of structural strength, stress tolerance, abrasive strength towards proper performance in high temperature environments and continuous performing in critical conditions without fatigue etc., primarily due to creation of complete component including the teeth pattern therein in cold extrusion.

Yet another objective of the present invention is to propose new set of closed die designed for performing said cold or hot forging to create the gear blank and further two set of dies to perform said cold extrusion operations in two steps on the said forged gear blank towards creating teeth patterns on the outer circumferences of its small and the bigger gear sections thereof; wherein such dies are made in the state-of-the-art manner in variable optional range of shape, size, dimension, surface pattern and configuration for the said purpose.

Statement of the present invention:

The present invention is intended to propose:

A method of manufacturing a gear with double teeth patterns which mainly involves forging operation towards gear blank formation, followed by two stage cold extrusion

operations towards forming teeth pattern on the outer circumference of the small gear section as well as on the outer circumference of the bigger gear section therein;

a method of manufacturing a ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein major structural features of the said gear and its teeth pattern are formed during cold extrusion operation and thereafter certain optional supportive machining processes are required for surface refining, product strengthening and finalizing the ratchet gear production;

a method of manufacturing a gear with double teeth patterns, which mainly involves hot or cold forging towards creating the gear blank from the initial piece of ingot, followed by performing cold gear extrusion in two steps on duly annealed and conditioned said forged work piece towards creating two teeth patterns on the outer circumferences of small gear section and bigger gear section thereof;

a method of manufacturing a gear with double teeth patterns, wherein it is characterized by obviating the application of machining operations like teeth shaping and hobbing towards creation of the proposed gear with double teeth patterns and in a very unusual and innovative manner achieving both the teeth patterns on the outer circumferences of small gear section and bigger gear section therein by stepwise cold extrusion operations;

a method for manufacturing the ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein the said method of manufacturing is characterized by performing the cold extrusion followed by Phosphating and CNC wherein the teeth pattern of the said ratchet gear on both layers are extruded during the formation of whole ratchet gear body, without performing any teeth cutting or hobbing operation;

a method of manufacturing a ratchet gear, particularly with the double teeth patterns on the outer circumferences of its small and the bigger gear sections thereof, wherein said gear with double teeth pattern is characterized by its advanced properties in comparison to conventional such gears and the teeth pattern therein, mainly in terms of structural strength, stress tolerance, abrasive strength towards proper performance in high temperature environments and continuous performing in

critical conditions without fatigue etc., primarily due to creation of complete component including the teeth pattern therein in cold extrusion;

and

new set of closed die designed for performing said cold or hot forging to create the gear blank and further two set of dies to perform said cold extrusion operations in two steps on the said forged gear blank towards creating teeth patterns on the outer circumferences of its small and the bigger gear sections thereof; wherein such dies are made in the state-of-the-art manner in variable optional range of shape, size, dimension, surface pattern and configuration for the said purpose.

Description of the present invention:

The present proposed method for manufacturing gear with double teeth patterns involving forging and cold extrusion processes is mainly so designed that it simply forges the piece of raw material/ingot, after receiving the preliminary treatment therein, into the gear with all its structural features, desired surface patterns, and also its suitable double teeth patterns; and thus is very much favorable to motor-bike industry. After such forging operation on the ingot very limited machining operations is required, which are mainly of refining nature and towards finalizing the gear product.

Application of single step forging process for the production of Gear with double teeth is not conventionally being practiced, mainly due to following reasons:

(i) Technical complications in die designing for commercial production of the said component;

(ii) Non-achievement of ideal forging conditions for producing commercially acceptable gear with teeth;

(iii) Involvement of so many dimensional aspects of the said auto component of various size range, namely the central hole creation, size optimization of the said component, teeth formation etc., which are difficult to consider in one single standardized process, mainly towards achieving all required

and preferred structural and functional features of the said auto component.

Forging has a number of cost-saving advantages which underscore its increasing use as a manufacturing method. The temperature range for the forging of steel runs from above room temperature to below the recrystallization temperature which is suitable for commercial production of auto component like present gear.

For such forging not only a particular range of temperature is Important, but several other factors require especial strategic planning, namely: (i) a very effective selection/designing of die for forging of the desired article; (ii) material for making said die; (iii) customized, state of the art technology involvement towards die making; (iv) selection of suitable lubricant, to be used for forging; (v) adopting the forging conditions according to the material of the ingot undergoing forging etc. The ingot, concerning the present invention, usually of steel or alloy material with pre-determined carbon content plays important role towards selecting an optimized forging conditions and thereafter performing other supportive operations, depending upon the structural features of the final product, structural strength, functional features of the product etc.

After performing said forging on the piece of raw material, a raw shape of gear with double teeth patterns is formed over which annealing is performed at temperature range of 450°C to 550°C, shot blasting; phosphating and cold extrusion at KP 250 Knuckle Joint Press is performed to create teeth of small gear which eliminates the shaping requirements; then again phosphating and cold extrusion at KP 250 Knuckle Joint Press is performed to create teeth of OD gear which eliminates the requirement of hobbing; followed by CNC operation upto very limited extant to finish the product.

In the present invention of manufacturing gear with double teeth patterns, the slope and teeth angles at two mutually adjacent teeth are very low in OD gear; the size, length and no. of teeth vary in both gears.

One schematic scheme for performing all essential and optional operations towards manufacturing gear by proposed method herein is shown in following table hereinbelow:

No. of Step	Particular of the step performed during manufacturing gear with double teeth patterns involving forging and cold extrusion processes
1	Raw Material Receipt
2	Receiving Inspection of R.M. by QA
3	Forging Blank(Cold/Hot-Amp30S)
4	Annealing
5	Shot Blasting
6	Phosphating
7	Cold Extrusion at KP 250 Knuckle Joint Press (Small Gear)
8	Phosphating
9	Cold Extrusion at KP 250 Knuckle Joint Press (OD Gear)
10	CNC
11	Case Carburising
12	Shot Blasting (Hanger Type)
13	Honning/ Hard Part Boring
14	Gear rolling
15	Final Inspection (Sampling PDI)

Cold Extrusion at KP 250 Knuckle Joint Press therein, the forged component attains the suitable temperature for further machining operations, mainly CNC machining,

case carburising, shot blasting, honning/hard part boring, gear rolling therein and final inspection (sampling PDI), in stepwise manner.

Main features of the proposed method are:

1. Formation of the gear blank by forging operation, optionally using either the hot forging route or warm/cold forging route; wherein the gera blank ackieves the basic structural features, namely the smaller gear section, the bigger gear section and the central hole position;

2. Performing cold extrusion of the forged work piece of the gear blank in two steps: (a) first stage cold extrusion is performed on the outer circumference of the smaller gear section to create the teeth pattern there, and (b) second stage cold extrusion is performed on the outer circumference of the bigger gear section to create the teeth pattern there;

3. Completely obviating the convention application of teeth shaping and teeth hobbing operations in creation of any teeth on the smaller gear section or on bigger gear section of the proposed gear with double teeth pattern; wherein said double patterns of the teeth on smaller and bigger gear sections are achieved by two stage cold extrusion.

Above discussed and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

Figure 1: It represents the schematic plan of the proposed process of manufacturing the gear with double teeth patterns;

Figure 2: It represents one schematic view of the most preferred embodiment of the gear with double teeth patterns showing the teeth profiles on the outer circumferences of its small gear section as well as on that of bigger gear section.

Figure 3: It represents the schematic plan of the proposed method herein indicating the steps eliminated from the instant method, namely the hobbing and shaping operations.

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