Dec. 29, 1970 YUKIYASU NAKAMURA 3,550,330

PROCESS FOR GRINDING GEARS

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FIG-1

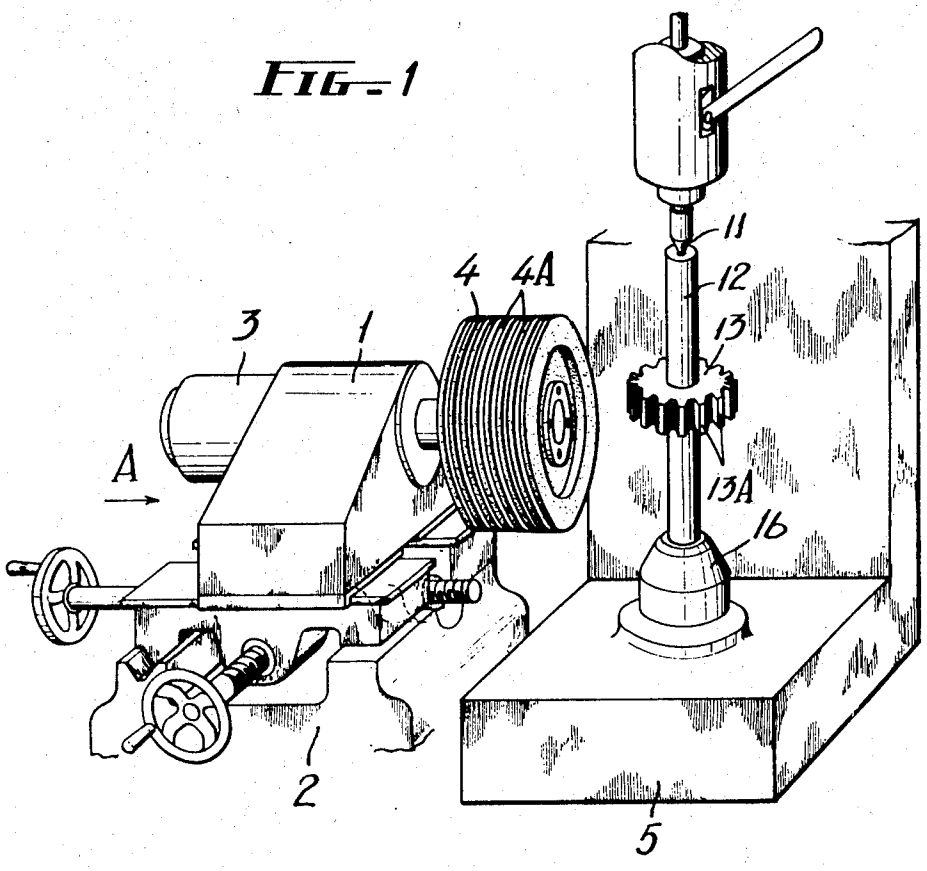


FIG-4

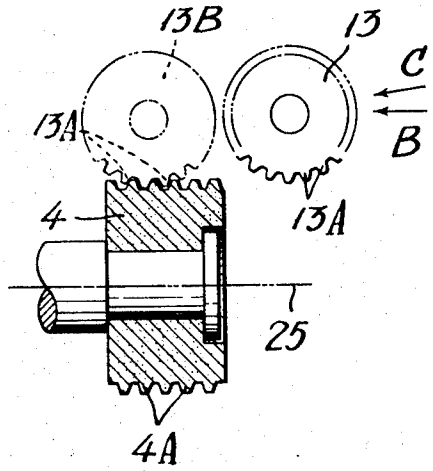
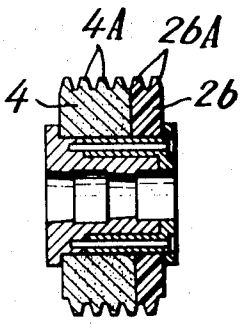


FIG-5



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FIG. 2

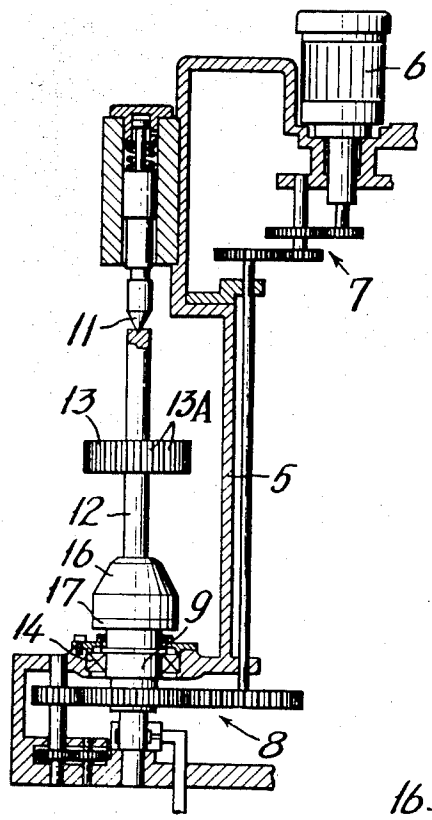
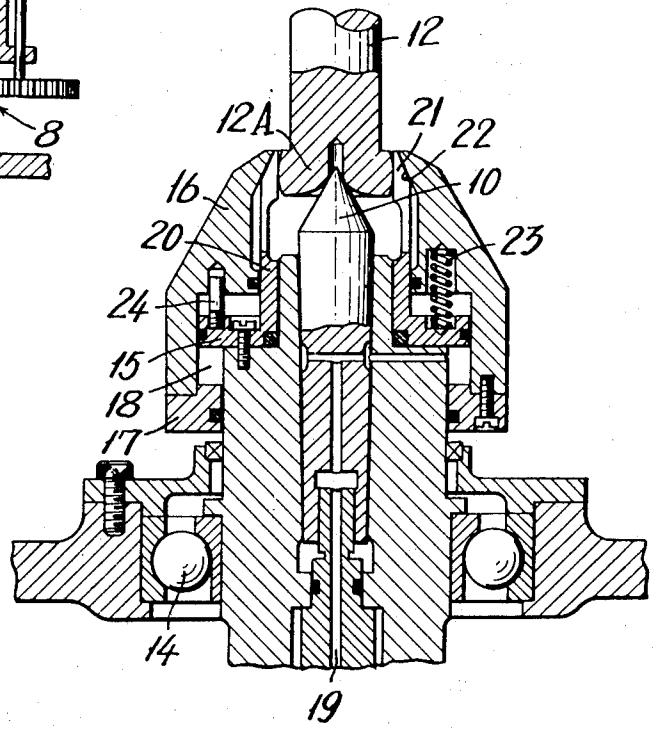


FIG. 3



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PROCESS FOR GRINDING GEARS

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Int. Cl. B24b 1/00
U.S. Cl. 51—287 3 Claims

ABSTRACT OF THE DISCLOSURE

A process for grinding gears wherein the gear to be ground is rotated by light frictional engagement with a driven shaft and is meshed with a rotating toothed grindstone after which the gear is rigidly held in a chuck and the gear and grindstone are forcibly rotated at a predetermined speed ratio to effect grinding of the gear.

BRIEF SUMMARY OF THE INVENTION

This invention relates to the grinding of gears and in particular to the finish grinding of gear stock.

There are known processes for grinding gears in which the gear to be ground by a grindstone having a spiral grinding groove is rotatably supported and the gear and grindstone are brought into mesh while at rest and then the spiral grindstone is rotated to cause the gear to follow it, and then the gear is forcibly rotated at a predetermined revolution ratio relative to the spiral grinding grindstone. In this process, however, it is unavoidable that the working efficiency is lowered because it is necessary, for each change of gear stock, to stop the spiral grindstone to permit meshing with the gear to be ground.

The present invention has for its object to improve the working efficiency of this kind of gear grinding process and is characterized in that a gear to be ground is rotated by being yieldability supported so as to be changeable freely in its angular phase relative to its axis and the rotating gear is meshed with a grindstone which is being rotated after which the gear is forcibly rotated at a predetermined speed ratio relative to the grindstone to effect grinding of the gear by the grindstone. Another characteristic feature of the invention is that, for facilitating the meshing engagement, the spiral grindstone is provided at the side surface which first engages the gear with a guide member which has a spiral groove in extension with the spiral groove of the grindstone and is made of a softer material than the grindstone.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a gear grinding machine according to the present invention;

FIG. 2 is a sectional view of a portion of the machine in FIG. 1;

FIG. 3 is an enlarged sectional view of a part of the portion of FIG. 2;

FIG. 4 is an explanatory diagram showing the relation between a grindstone and a gear to be ground; and

FIG. 5 is a longitudinal sectional view of a grindstone provided with a guide member connected thereto.

DETAILED DESCRIPTION

Referring to FIG. 1, numeral **1** denotes a grindstone supporting base attached to a machine frame **2** so as to be slidable therein front and rear and right and left. A spiral grinding grindstone **4** adapted for being rotated by an electric motor **3** is rotatably supported in frame **2**. Numeral **4A** denotes spiral grinding grooves of grindstone **4**. Numeral **5** denotes a supporting base for a gear to be ground. The base **5** is attached to the machine frame **2** in a manner not shown, and there is rotatably provided at the lower portion of the base **5** a driving shaft **9** driven by an electric motor **6** and a gear assembly **7** and **8**. There is provided at the center portion of the shaft **9** a driving center **10** fixedly mounted in shaft **9** for rotation therewith. Numeral **11** denotes a supporting center attached to an upper portion of the supporting base **5**. A core shaft **12** is supported between these centers **10** and **11** and carries a gear **13** to be ground. Numeral **13A** denotes the teeth of the gear **13**, and numeral **14** denotes a bearing for the driving shaft **9**. At the upper portion of the driving shaft **9**, there is secured a partition wall **15** and there is mounted a clamping tube **16** surrounding the wall **15**, so as to be axially slidable so that there is formed an oil pressure chamber **18** between a bottom plate **17** of the tube **16** and the partition wall **15**. Numeral **19** is an oil charging and discharging passage for the oil chamber **18**. Numeral **20** denotes a chuck secured to the top of the driving shaft **9**. The chuck **20** has a plurality of resilient segments **21** projecting upwards at the upper portion of the chuck. The segments **21** have outer tapered surfaces **22** which are in light pressing contact with an annular inclined inner surface of the upper end of the clamping tube **16**. A spring **23** upwardly acts on the clamping tube **16** to enable the resilient segments **21** to open outwards, and numeral **24** is a pin for preventing rotation of the clamping tube **16** relative to chuck **20**. The lower end of the core shaft **12** is formed with a rod portion **12A** supported on the driving center **10**. When pressure oil is charged into the oil pressure chamber **18**, the clamping tube **16** is lowered against the action of the spring **23** for inwardly moving the resilient segments **21** and the rod portion **12A** is thereby clamped and the core shaft **12** is coupled for rotation with the driving shaft **9**.

The grinding operation is as follows:

The spiral grindstone **4** is driven by the electric motor **3** at a predetermined regular grinding speed. Then, pressure oil is charged through the oil passage **19** to operate the chuck **20** and couple shafts **9** and **12**. The electric motor **6** is then driven to rotate the core shaft **12**. When the gear **13** rotates at a predetermined speed ratio relative to the grinding stone **4**, the chuck **20** is released so that the core shaft **12** and accordingly the gear **13**, is driven by the driving center **10** by the frictional engagement therewith. If the grindstone supporting base **1** is then shifted in the direction of arrow A in FIG. 1, that is, in the direction of its axis **25** in FIG. 4, the gear **13** is moved relative to the grindstone **4** in the direction of arrow B, that is, in a direction parallel to the axis **25**, so that the teeth **13A** are meshed with the spiral grinding grooves **4A** of the grindstone. It is usual in this engagement that the angular phase relation of the two are not in coincidence one with another, but due to the fact that the core shaft **12** is supported by the centers **10** and **11** in light frictional engagement, the gear **13** is changeable freely in its angular phase about its axis, whereby the gear **13** may be corrected in its angular phase position when the teeth **13A** are initially brought into side surface contact with the grinding grooves **4A**, whereby meshing may be effected smoothly without any difficulty. If, thus, there is now obtained the condition that the gear **13** is meshed with the grindstone **4** in the grinding position as shown by chain lines in FIG. 4, the shift movement of the grinding stone **4** is stopped, whereupon the chuck **20** is operated and the gear **13** is forcibly rotated at a predetermined speed ratio relative to the grindstone **4**, and at the same time there is provided the known feed required for grinding between the two, whereby the grinding operation is effected and completed.

When the gear **13** is to be shifted in relation to the grindstone **4**, it can be considered that the gear **13** is first moved from outside as shown by arrow C in FIG. 4 and

then is moved in parallel with the axis **25** after beginning of the meshing. It is usual for rotating the gear and the grindstone at a predetermined speed ratio that the electric motors **3** and **6** are both synchronous motors, but this can be modified so that the two are driven together mechanically by a single common electric motor. It is not always necessary for starting the core shaft **12** to operate the chuck **20** as described above, and such starting can be obtained merely by the friction between the center **10** and the core shaft **12**. Additionally, the mounting of the core shaft **12** between the centers **10** and **11** can be also carried out under the condition that the center **10** is maintained in its rotation.

According to the present invention, not only can the working efficiency be improved because the gear is meshed with the grindstone which is being rotated, but also these can be meshed smoothly without being damaged because the gear is in rotation when they are meshed and is supported so as to be changeable freely in its angular phase position and can be shifted from the side of the grindstone.

FIG. 5 shows a guide member **26** connected to the spiral grindstone **4** at the side surface of grindstone **4** at which meshing begins for making the meshing smoother. Guide member **26** is made of a material softer than the grindstone, such as rubber or synthetic resin, and the guide member is provided at the periphery thereof with teeth **26A** defining a spiral groove which is in extension with the spiral grinding groove of the grindstone **4**. With such an arrangement, the teeth **13A** of the bear mesh with the spiral groove of the soft material of guide member **21** prior to its meshing with the teeth of the grindstone **4**. Thereby improper grinding of the teeth **13A** at the time

of initial meshing is prevented and also any damage between teeth **13A** and **4A** is avoided, thus making the meshing more accurate and smoother.

What is claimed is:

1. In a process for grinding a gear in which a toothed grindstone is meshed with a gear to be ground and the grindstone and gear are forcibly rotated at a predetermined speed ratio, an improvement comprising rotating the gear to be ground through a drive containing a frictional coupling to provide a yieldable angular support for the gear, meshing the rotating gear with the teeth of a rotating grindstone by relatively moving the gear and grindstone with respect to the axis of revolution of the grindstone, and thereafter rigidly holding the gear and forcibly rotating the gear and grindstone at a predetermined speed ratio to effect grinding of the gear.

2. An improvement as claimed in claim **1**, wherein said gear and grindstone are meshed by relative movement in a direction parallel to the axis of revolution of the grindstone.

3. An improvement as claimed in claim **1**, wherein said gear is rotated about an axis which is perpendicular to the axis of revolution of the grindstone.

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U.S. Cl. X.R.

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