Sept. 27, 1932. L. L. ROBERTS 1,879,506

GRINDING MACHINE

Filed Feb. 21, 1931 2 Sheets-Sheet 1

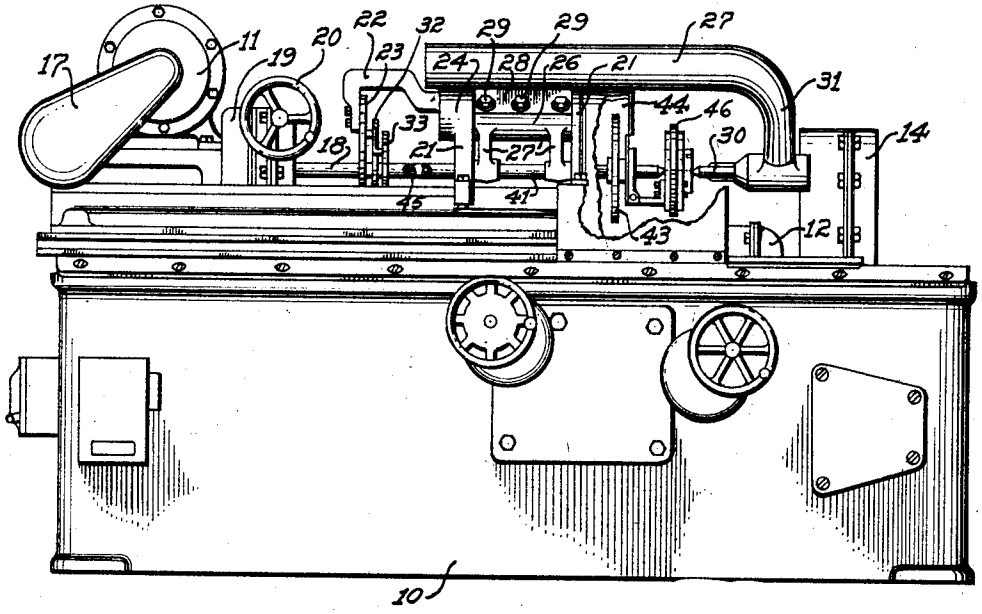


FIG. 1

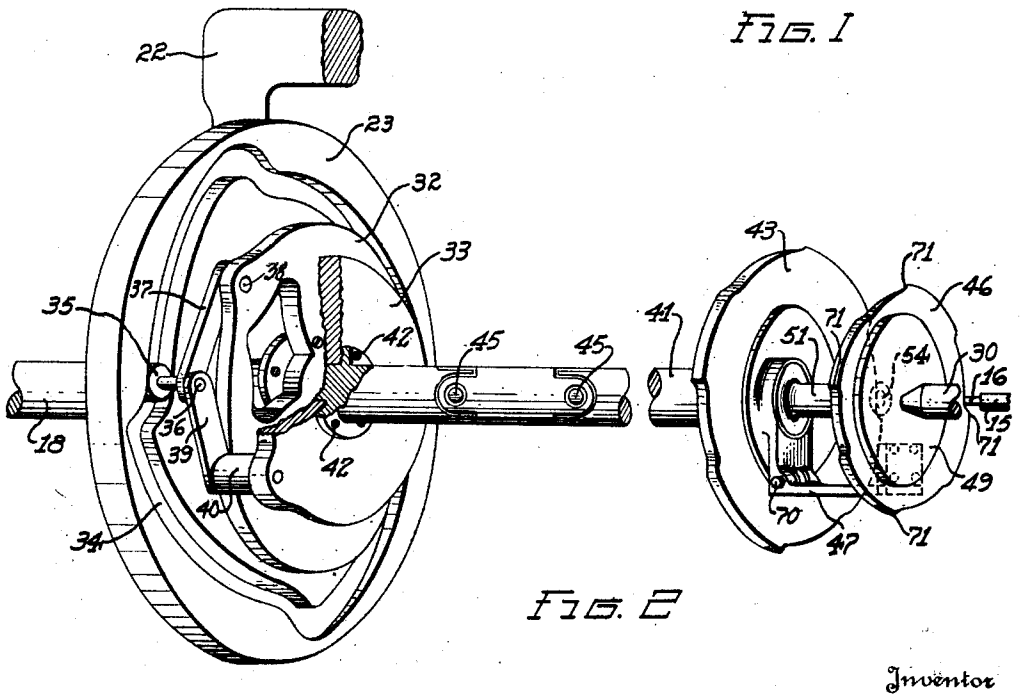


FIG. 2

Inventor

LOUIS L. ROBERTS

By Miller & Sibbett

Attorney

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GRINDING MACHINE

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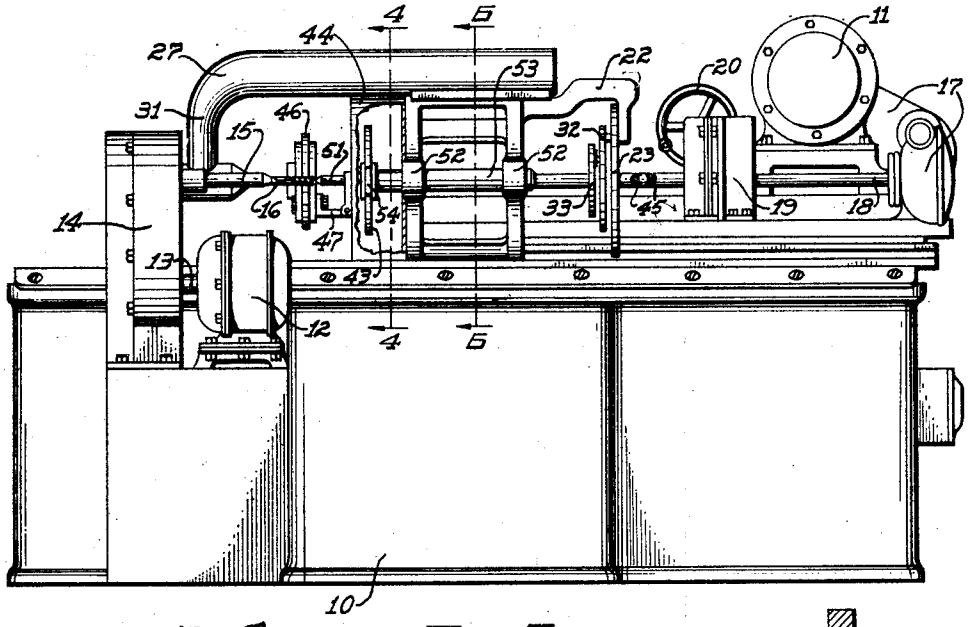


FIG. 3

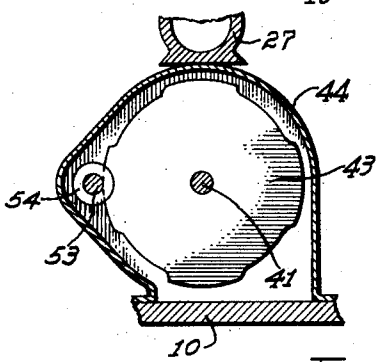


FIG. 4

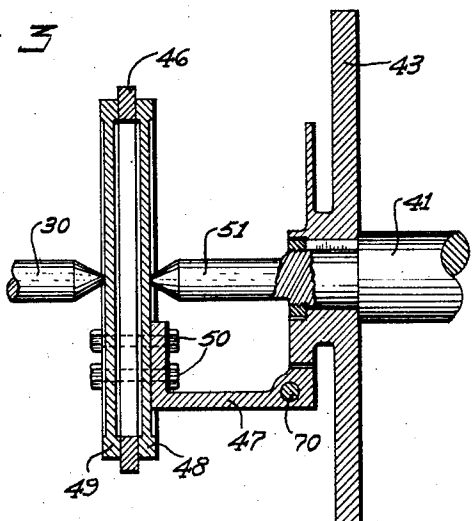


FIG. 5

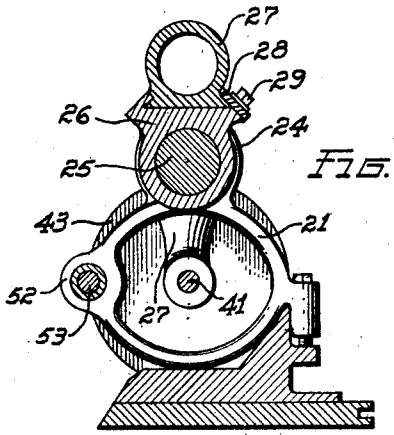


FIG. 6

Inventor

LOUIS L. ROBERTS

By Miller-Sibbett

Attorney

Patented Sept. 27, 1932 1,879,506

UNITED STATES PATENT OFFICE

LOUIS L. ROBERTS, OF DETROIT, MICHIGAN, ASSIGNOR TO PACKARD MOTOR CAR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN

GRINDING MACHINE

Application filed February 21, 1931. Serial No. 517,504.

This invention relates to grinding machines and more particularly to such machines employed for grinding an irregular peripheral surface.

In machines now employed for grinding cams or similar elements having irregular peripheral surfaces, the velocity of the grinding element is constant and the angular velocity of the element to be ground is constant. As a result it is found in the grinding of cams the angular peripheral surfaces of the lobes are rotated faster than the peripheral surfaces intermediate the lobes and, consequently, the faster rotated peripheral surface portions are not fully finished, thus necessitating another individual grinding operation therefor.

An object of the invention is to provide a grinding machine in which a cam is rotated in relation with a grinding element so that its peripheral wall surface to be ground moves at a uniform speed relative to the grinder.

Another object of the invention is to provide a cam grinding machine in which the cam and the grinder are associated and driven so that the effective portion of the peripheral surface of the lobes will be ground to exact form during rotation of the cam.

A further object of the invention is to provide mechanism for rotating a cam in relation with a grinding wheel so that the peripheral surface of the cam is moved at substantially a uniform speed while in engaging relation with the grinding element.

Still another object of the invention is to provide a grinding machine in which a member with an irregular periphery can be accurately and quickly finished.

Other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Fig. 1 is a front elevational view of a grinding machine incorporating my invention;

Fig. 2 is a fragmentary perspective view showing the indexing mechanism, the master cam, the cam to be driven and the associated driving mechanism;

Fig. 3 is a rear elevational view of the grinding machine;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a fragmentary vertical sectional view of the cam holding and driving mechanism.

Fig. 6 is a sectional view taken on line 6—6 of Fig. 3.

Referring now to the drawings by characters of reference, 10 represents the base of a grinding machine having an electric work driving motor 11 supported at one end and a grinder rotating electric motor 12 mounted upon its other end. A motor driven shaft 13 extends into an upstanding gear housing 14, carried at one rear end of the base, and is associated with gearing within such housing 14 to drive the shaft 15 to which the grinder 16 is secured. At the other end of the machine is arranged a housing 17 through which driving means extends from the motor 11 for rotating the shaft 18 which extends into a gear change housing 19. A hand wheel 20 is associated with a shaft which extends into the change gear housing 19 and is connected to rotate the work driving mechanism when manual operation thereof is desired.

A superframe 21 is secured upon the top of the base and from one end thereof extends a bracket 22 to which an indexing plate 23 is fixed. This superframe is also formed with a longitudinally extending bearing portion 24 which carries a shaft 25, and pivotally mounted upon this shaft is a carrier member 26 having depending arms 27'. Upon the upper end of the carrier is mounted a bracket 27 which is secured by a plate 28 fastened to the carrier by bolts 29. This plate is detachable from the carrier and can be loosened in its relation with the bracket 27 so that the bracket can be adjusted longitudinally without removing the plate, if desired. A spindle 30 is carried by the depending arm 31 of the bracket 27.

The shaft 18 extends through an opening in the index plate 23 and has secured to its projecting end a driving disk 32. A driven disk 33 is arranged coaxially with the driv-

ing disk and is connected by a link connection with the driving disk and the indexing groove 34 in the index plate. A roller 35 is arranged to ride in the indexing groove so that it will follow the direction thereof in rotating therearound, and pivotally connected to the shaft 36 on which the roller is mounted is a link 37 which is pivoted by the pin 38 to the driving disk. A link 39 is pivoted at one end to the roller pin 36 and is pivoted at its other end to the pin 40 which is fixed to the driven disk. A shaft 41 extends through and is supported by the depending arm 27' of the carrier and is fixed at one end to the driven disk 33 by means of bolts 42. A master cam 43 is fixed adjacent the other end of this shaft and the end of the shaft terminates in a spindle 51. The shaft 41 is of a flexible nature to permit the master cam to move laterally and is composed of a plurality of sections joined together by universal joints 45 of a conventional nature.

The cam 46, to be ground, is fastened in spaced relation to the master cam by means of an angular two-part dog 47. One part of the dog is fixed to the master cam at one end and at the other end is detachably secured to a plate 48, a pin 70 being arranged to secure the dog sections together. The cam 46 is secured between the plates 48 and 49 by the bolts 50 which also extend through the dog. The spindles 30 and 51 engage the plates 49 and 48, respectively, to maintain the cam to be ground in an axial relation with the driving shaft 41.

The super frame 21 is provided with aligned bearings 52 through which a shaft 53 extends, and this shaft extends longitudinally of the machine and carries a roller 54 within the master cam housing 44. The axis of the roller is fixed relative to the base of the machine and the roller is arranged so that the peripheral surface of the master cam will bear thereagainst in its rotation. Rotation of the shaft 41 will rotate the master cam 43 which, due to its engagement with the roller 54, will move the shaft 41 adjacent the master cam and the master cam laterally as the angular portions of the lobes come into engagement therewith. The end section of the shaft 41 fixed to the driven plate 33 will be rotated axially relative to the shaft 18 and the universal joint connection will permit lateral movement of the section of the shaft 41 to which the master cam 43 is fixed without affecting the rotation imparted thereto. As the cam to be ground is fixed relative to the master cam and is of the same peripheral conformation, it will be moved laterally relative to the grinding element the necessary degree to cause the peripheral surface to make such contact with the grinder as to be finished in an outline corresponding to that of the master cam. Heretofore the master cam has been laterally movable, but it has been driven at a uniform angular velocity corresponding to that of the shaft 18. Through means of the index plate and the driving connection between the plate and the plates 32 and 33, I provide for a rotation of the master cam and the cam to be ground in which there is a lost motion during the grinding of the effective peripheral angular surface 71 of the lobes, preferably to such an extent that the velocity of the peripheral surface of the cam being ground is substantially uniform relative to the grinding element 16. The groove in the index member is of a character such that the motion transmitted from the shaft 18 through the link 37, the roller 35 and its pin 36, and the link 39 and pin 40 to the driven plate will cause a variation in the angular velocity of the driven plate which will rotate the shaft 41 in this desired manner. As the roller moves toward the outermost points of the cam groove in the index plate, the motion transmitted from the shaft 18 to the shaft 41 becomes slower and this occurs while the angular surfaces 71 of the lobes are in engagement with the grinding element.

No provision has been made for retarding the cam speed as the angular portion of the lobes remote from the faces 71 engage the grinder because such surfaces perform no work with a cam of the character illustrated, and the finish is of no consequence. These angular surfaces could be finished, however, as exactly as the surfaces 71 if the cam groove in the index plate were formed to slow up the rotation transferred when the surfaces were engaging the grinder.

It will be understood that the superstructure can be moved lengthwise of the base in the conventional manner employed for associating and removing work to and from position in the machine.

While I have herein described in some detail a specific embodiment of my invention, which I deem to be new and advantageous and may specifically claim, I do not desire it to be understood that my invention is limited to the exact details of the construction, as it will be apparent that changes may be made therein without departing from the spirit or scope of my invention.

What I claim is:

1. In a grinding machine, a cam carrying holder, a driven grinder element adjacent the holder, means for guiding the cam relative to the grinder, and mechanism for rotating the holder at a varying angular velocity, said holder being driven at the slower velocity during contact of the effective irregular cam surfaces with the grinder.

2. In a grinding machine, a cam carrying device, a grinder, guide means positioning the cam relative to the grinder, and mechanism rotating said device at a varying angular velocity to rotate the cam at a substantially uniform peripheral surface velocity.

3. In a grinding machine, a cam carrying device, a grinder, automatic guide means positioning the cam relative to the grinder, and driving mechanism connected to rotate carrying device at varying angular speed, said mechanism including a speed indexing means.

4. In a grinding machine, a cam carrying device, a grinder adjacent the device, automatic guide means positioning the cam device relative to the grinder, sectional shaft mechanism connected to rotate said device, means for driving one section of the shaft at a constant velocity, and a velocity indexing connecting means transmitting motion from the constant velocity shaft section to the associated shaft section at a variable velocity.

5. In a grinding machine, a cam carrying device including a master cam, a grinder adjacent the device for engaging the cam to be ground, means engaging the master cam positioning the holder relative to the grinder, a shaft formed in sections, one of the sections being rotated at a constant velocity, a fixed plate having a velocity indexing groove therein, a connection between the constant velocity shaft section and the other shaft section including a pair of pivoted links, and roller means associated with the links and guided in said indexing groove, said roller means varying the angular relation of the links and the velocity of one of the shaft sections.

6. In a cam grinding machine, a driving mechanism for the cam comprising a power driven shaft section rotated at a uniform velocity on a fixed axis, a plate fixed to one end of said shaft, a universally jointed shaft section, a master cam fixed to said jointed shaft section, a plate fixed to one end of the jointed shaft section, two pivoted together links, one of the links being pivoted to one shaft section and the other link being pivoted to the other shaft section, a fixed member having an indexing cam groove therein, and a follower in the groove fixed to the pivotal connection of the links.

7. In a cam grinding machine, a driving member rotatable at constant angular speed, a driven member carrying a cam, a grinder adjacent the cam, guide means positioning the cam relative to the grinder, and speed indexing mechanism connecting the driving member and the driven member to rotate the driven member at a varying angular speed.

8. In a cam grinding machine, a driving mechanism for the cam comprising a power driven shaft section rotatable at a uniform angular speed on a fixed axis, a sectional shaft having universal connecting joints, a master cam fixed to one of said jointed shaft sections, two links having a pivotal connection, one of the links being pivoted to one shaft section and the other link being pivoted to the other shaft section, a plate fixed to one of the shaft sections having an indexing cam groove therein, and a follower in the groove fixed to the pivotal connection of the links.

9. A speed indexing mechanism comprising a constant speed driving member, a driven member, and connecting means for transmitting the constant speed of the driving member to the driven member at varying speed.

10. A speed indexing mechanism comprising a constant angular speed driving member, a driven member, and connecting means including a cam for transforming the constant speed of the driving member to drive the driven member at varying angular speed.

11. A speed indexing mechanism comprising a constant angular speed driving member, a driven member, a plate fixed to the driven member having a cam groove therein, a follower in the groove, and means connecting the follower with the driving and driven members to transmit the constant speed of the driving member to the driven member at varying angular speed.

12. In a speed indexing mechanism, a driving member rotatable at constant angular speed, a driven member, and speed indexing means connecting said members to drive the driven member at varying angular speed.

In testimony whereof I affix my signature.

LOUIS L. ROBERTS.