Aug. 7, 1951 M. H. ARMS ET AL 2,563,301

CARRIAGE RECIPROCATING MECHANISM

Original Filed Jan. 9, 1947 2 Sheets-Sheet 1

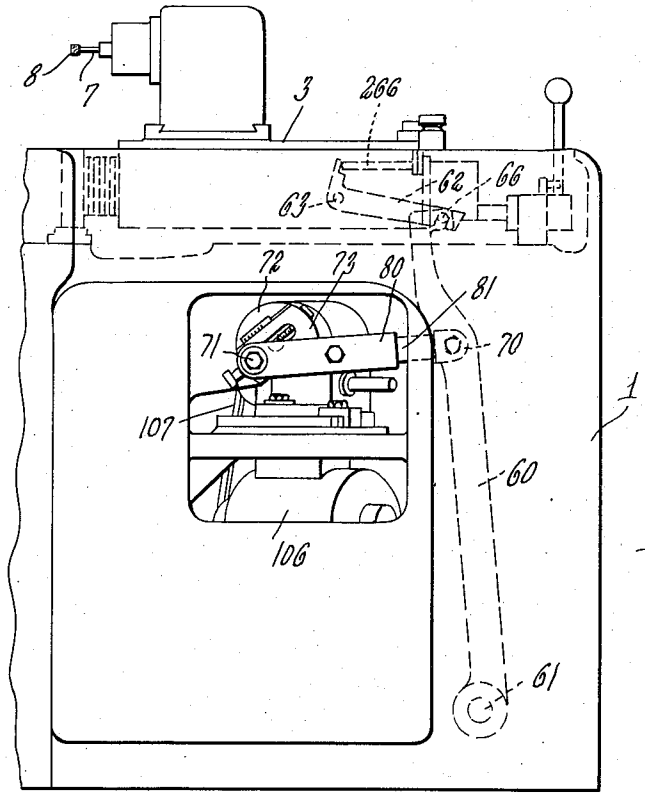


Fig. 1.

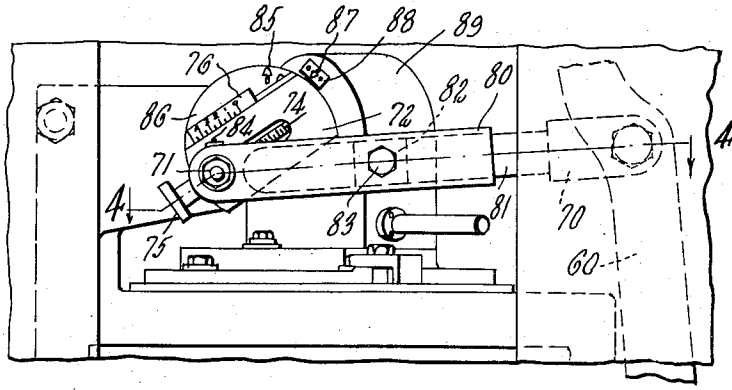


Fig. 2.

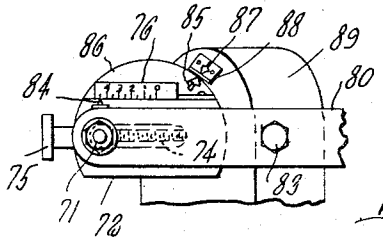


Fig. 3.

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CARRIAGE RECIPROCATING MECHANISM

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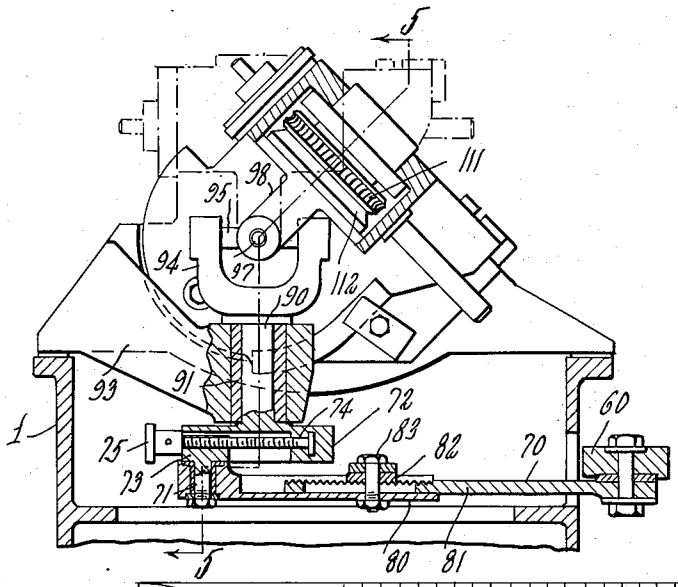


Fig. 4.

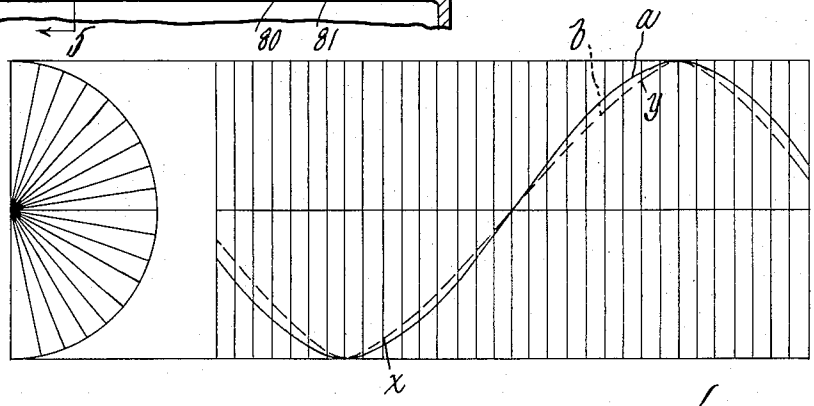


Fig. 6.

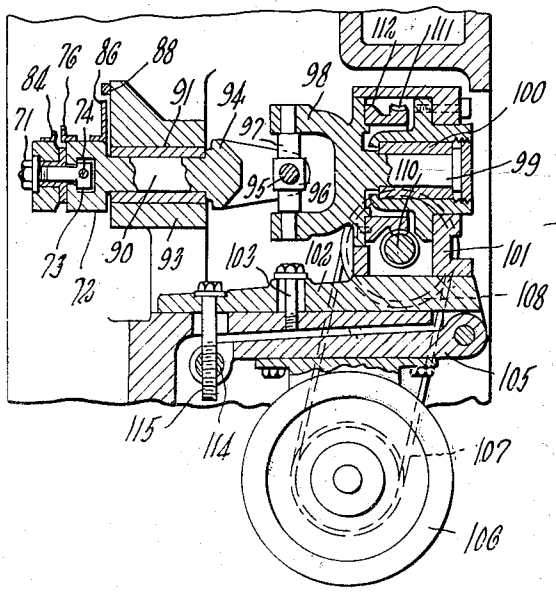


Fig. 5.

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UNITED STATES PATENT OFFICE

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CARRIAGE RECIPROCATING MECHANISM

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Original application January 9, 1947, Serial No. 721,052, now Patent No. 2,520,267, dated August 29, 1950. Divided and this application December 5, 1947, Serial No. 789,836

5 Claims. (Cl. 51—34)

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This invention relates to mechanism for reciprocating a carriage, as, for example, a carriage supporting a grinding wheel, and has for an object to provide such a mechanism by which a nearly constant velocity throughout the traversing stroke may be obtained, such an arrangement being particularly desirable when grinding long holes, or a harmonic motion at high speed which is in some cases desirable when grinding short holes.

A further object is to provide such a mechanism providing continuous adjustment between the harmonic motion and the substantially constant velocity motion as may be desired in any particular case.

Further objects and advantages will appear from a description of an embodiment of the invention shown in the accompanying drawings in which

Figure 1 is a fragmentary front elevation of a grinding machine embodying the invention.

Figure 2 is a similar view to a larger scale of a portion of the same.

Figure 3 is a view similar to a portion of Figure 2, but with parts shown in different positions.

Figure 4 is a detail sectional view on line 4—4 of Figure 2.

Figure 5 is a detail sectional view on line 5—5 of Figure 4.

Figure 6 is a velocity space diagram illustrating the motion of the carriage when the universal joint is set for straight line drive and when it is set for an angular drive at 45°.

Referring first to Figure 1, the machine includes a bed 1 on which is mounted a reciprocating carriage 3 which supports a grinding wheel spindle 7, carrying on its projecting end a grinding wheel 8. The carriage 3, for example, may be mounted for reciprocation on a pair of parallel cylindrical guide bars as is more fully shown and described in our application for United States Letters Patent Serial No. 721,052, filed January 9, 1947, now Patent No. 2,520,267, dated August 29, 1950, for Grinding Machines, of which the present application is a division.

The carriage 3 may be reciprocated by the rocking of an arm 60 fulcrumed in the bed 1 at 61 and normally operatively connected at its upper end to the carriage 3. As shown this construction includes a latch 62 pivoted to the carriage 3 at 63 and engaging over a cross pin 66 carried by the upper end of the arm 60 and normally held in latching position but releasable by pressure exerted by a bar 266. Further details of this latch connection are not material to this invention and hence are not further described herein, though they are fully shown and described in the parent application Serial No. 721,052 to which reference has heretofore been made.

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Power actuating means is connected to the arm 60. In order to avoid contact of the wheel with the work adjacent to the end portions of its stroke for a substantially greater length of time than at its center of motion as with harmonic motion, which is important where the stroke is of substantial length, means may be provided by which the traverse may be adjusted so as not to take place in harmonic motion, but is speeded up somewhat away from the center of stroke and retarded at the center. By this means bell mouthing of the work is avoided. For short strokes harmonic motion is desirable. The arm 60 is connected to a connecting rod 70, which engages a crank pin 71 on a crank arm 72. This crank pin is adjustable for throw on the arm 72 and is therefore formed as a flanged sleeve carried by a T bolt 73 (see Figures 4 and 5) adjustable diametrically lengthwise of the arm 72. For effecting such adjustment, the arm 72 has journaled therein a threaded rod 74 provided with a hand wheel 75 at its outer end, this threaded rod being threaded through the T bolt 73. The link 70 is made adjustable in length in order to change the limiting end positions of the path of motion of the wheel carriage 3, and to this end the link 70 comprises telescopically related sections 80 and 81 which may be clamped in adjusted relation by means of a serrated clamp bar 82 engaging mating serrations in the section 81 and held in position as by a bolt and nut at 83. The arm 72 may be provided with a scale 76 for cooperation with a pointer 84 carried by the link section 80 when the link 70 comprising the sections 80 and 81 is in the dead center relationship to the arm 72 shown in Figure 3, in which position an arrow 85 on a guard plate 86 carried by the arm 72 is opposite to an arrow 87 on an element 88 of a bearing bracket 89 carried by the machine frame.

The arm 72 has an integral shaft portion 90

which extends through a bearing 91 in the bracket 89. Inwardly of this bracket 89, this shaft portion 90 has a fork 94 bridged by a pivot 95. This pivot 95 passes through a block 96 carried by a transverse pivot 97 journaled between the arms of a fork 98 carried by a shaft 99, the two forks, the pivots, and the block constituting a single universal joint of the well known Hookes type. The shaft 99 is journaled in a bearing 100 mounted in a bracket 101 supported eccentrically on a table 102 clamped to the machine frame bracket 93 by a bolt 103 in a clearance hole in the table. The table 102 has pivoted thereto beneath a portion of the bracket 93, a platform 105 from which a motor 106 is suspended. This motor is connected through a belt 107 with a belt pulley 108 fixed to a worm shaft 110 which is journaled in the bracket 101 and which meshes with a worm wheel 111 carried by a hub portion 112 which is secured to the fork 98. The free end of the platform 105 which supports the motor has threaded connection through a nut 114 with an adjusting bolt 115 by the adjustment of which the proportion of the weight of the motor effective to tension the belt 107 may be adjusted as desired. It will be seen that by rotation of the motor 106, the worm 110 will be driven, imparting rotation to the worm wheel 111 and the fork member 98 of the universal joint and through this, motion will be transmitted to the shaft 90 in a single direction of rotation and the crank pin 71 by which oscillation of the wheel carriage actuating arm 60 will be produced. When the shafts 99 and 90 are in axial alinement, the shaft 90 will be driven from the shaft 99 in uniform angular velocity, the shaft 99 being so driven from the motor 106. However, by adjusting the table 102 angularly about the axis of the pivot 97, the shaft 99 is brought out of alinement with the shaft 90, whereupon the shaft 90 will be driven at a variable angular velocity from the shaft 99 and the maximum extent of this variation will take place when the shaft 99 is arranged at 45° out of alinement with the shaft 90.

When the shafts 99 and 90 are arranged in axial alinement, the motion imparted to the wheel slide will be substantially harmonic as shown by the curve *a* of Figure 6, and as is well known, harmonic motion of a reciprocating wheel carriage produces a relatively rapid motion in the center of the path and relatively slow motions toward the ends of the path, which cause the wheel to remain in contact with the work a longer time toward the ends of the path than at the center. By adjusting the table 102 so that the shaft 99 is angularly displaced from alinement by 45°, the velocity space relation shown by the curve *b* (Figure 6) is produced, the angular velocity of the shaft 90 being lowest when the carrier is nearest to the center of its path of motion. It will be noted that the velocity is substantially linear throughout the major portion of the traverse between the points *x* and *y*. Particularly where the stroke is of substantial length, this modification of the velocity of traverse to substantially a linear value is of substantial importance in grinding to close tolerances and it will be noted that this is produced without the use of elliptical gears or other complicated mechanisms which may result in an uneven or jerky motion of the carriage, and this arrangement makes possible any intermediate setting of the table to produce any desired intermediate velocity space diagram between harmonic motion, curve *a*, and the substantially straight line motion shown in curve *b* of Figure 6.

From the foregoing description of an embodiment of this invention, it should be evident to those skilled in the art that various changes and modifications might be made without departing from its spirit or scope.

We claim:

1. In combination, a support, a carriage on said support, means guiding said carriage for rectilinear motion on said support, means for moving said carriage comprising a crank shaft, a crank on said crank shaft, connections from said crank to said carriage, and means for turning said crank shaft comprising a drive shaft, means for rotating said drive shaft at uniform angular velocity, a universal joint connecting said shafts, and means supporting said drive shaft so angularly related to said crank shaft that a non-uniform angular rotation of said crank shaft by said universal joint causes a more uniform rate of motion of said carriage than would a uniform angular rotation of said crank shaft.

2. In combination, a support, a carriage on said support, means guiding said carriage for rectilinear motion on said support, means for moving said carriage comprising a crank shaft, a crank on said crank shaft, a connecting rod connecting said crank and carriage, a table journaled for rocking motion on said support, a motor carried by said table to turn therewith, a worm shaft parallel to the axis of said motor and driven by said motor, a worm on said worm shaft, a drive shaft, a worm wheel on said drive shaft and with which said worm meshes, said drive shaft being arranged perpendicular to the axis of said table, said crank shaft being carried by said support and arranged perpendicular to said table axis, a single universal joint connecting said drive and crank shafts, and means for angularly adjusting said table.

3. In combination, a support, a carriage mounted on said support for rectilinear motion, a shaft rotatable at uniform angular velocity, a rotary driven shaft connected to said carriage to reciprocate said carriage by rotation of said driven shaft, and driving connections between said drive and driven shafts adjustable to provide either harmonic or non-harmonic motion of said carriage by uniform rotation of said drive shaft.

4. In combination, a support, a carriage mounted on said support for rectilinear motion, a shaft rotatable at uniform angular velocity, a rotary driven shaft connected to said carriage to reciprocate said carriage by rotation of said driven shaft, and driving connections between said drive and driven shafts adjustable to provide either uniform or non-uniform angular velocity of rotation to said driven shaft, the connections between said driven shaft and carriage imparting harmonic motion to said carriage when said driven shaft is rotated at a uniform angular velocity.

5. In combination, a support, a carriage mounted on said support for rectilinear motion, a shaft rotatable at uniform angular velocity, a rotary driven shaft connected to said carriage to reciprocate said carriage by rotation of said driven shaft, and driving connections between said drive and driven shafts adjustable to provide either uniform or non-uniform angular velocity of rotation to said driven shaft, the connections between said driven shaft and carriage imparting harmonic motion to said carriage when said driven shaft is rotated at a uniform angular ve-

locity, said non-uniform angular velocity being slower when said carriage is near to its center of motion to impart a more uniform than harmonic motion to said carriage when said driven shaft is being rotated at said variable angular velocity.

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PAUL A. GROBEY.

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