HIGH PRODUCTION PRECISION GRINDING MACHINE

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ABSTRACT OF THE DISCLOSURE

A precision grinding machine, comprising an indexing turret, a plurality of work holders on said turret, each work holder comprising a pair of centers for supporting a workpiece, one of said centers being readily retractable to provide for the quick insertion and removal of workpieces, means for indexing said turret to bring the work holders successively to a work station, a movable supporting member engageable by the turret adjacent the work station to provide rigid support for the work holder at the work station, means for advancing and retracting said movable support, a drive wheel mounted on a first carriage means for moving the first carriage to bring the drive wheel into engagement with the workpiece at the work station, a grinding wheel mounted on a second carriage, and means for moving the second carriage to bring the grinding wheel into engagement with the workpiece at the work station.

This invention relates to a new and improved precision grinding machine which achieves the accuracy of a cylindrical grinder, while achieving a high rate of production, comparable to that of a centerless grinder.

In a conventional centerless grinder, the workpiece is mounted between centers, one of which is driven so that the workpiece is positively rotated as it is moved past the grinding wheel. Such a machine achieves a high degree of accuracy, but with a much lower rate of production than in the case of a centerless grinder.

The grinding machine of the present invention combines the advantages of a centerless grinder and a cylindrical grinder. The machine to be described as an embodiment of the present invention comprises an indexing head having a plurality of spaced work holders mounted thereon, for successive indexing movement to a work station. Each work support comprises a pair of centers, adapted to hold a workpiece. Thus, each workpiece is rotatably supported in a precise, fully controlled manner. In each work holder, one of the centers is readily retractable, to provide for quick insertion and removal of the workpieces. Preferably, the retractable center is provided with spring means for advancing the center, together with means whereby the center, once retracted, may be released. As an alternative to the spring means, the retractable center may be provided with screw means for advancing and retracting the center. Means are provided for moving the indexing head so as to bring each workpiece successively to the work station. The indexing head is preferably supported, at a point adjacent the work station, by a movable supporting member, having means whereby the supporting member may be advanced and retracted. The workpiece at the work station is adapted to be engaged by a drive wheel, mounted on a first movable carriage. Means are provided for advancing and retracting the first carriage, so that the drive wheel may be moved into and out of engagement with the workpiece. In this way, the workpiece may be frictionally driven by the drive wheel. The grinding wheel is mounted on a second movable carriage. Means are provided to advance and retract the second carriage, so as to move the grinding wheel into and out of engagement with the workpiece. When the indexing head is to be advanced, the first and second carriages and the movable supporting member are retracted. When a new workpiece has been brought to the work station, the supporting member is advanced to provide a rigid support for the indexing head. The first carriage is then advanced so as to engage the workpiece with the center piece. Finally, the second carriage is advanced so that the grinding wheel will perform the desired grinding operation upon the workpiece.

Further objects, advantages and features of the present invention will appear from the following description, taken with the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic plan view, showing a precision grinding machine to be described as an illustrative embodiment of the present invention.

FIG. 2 is a somewhat diagrammatic elevation, taken generally as indicated by the line 2—2 in FIG. 1.

FIGS. 3—7 are diagrammatic elevational sectional views showing successive stages in the operation of the grinding machine, the views being taken generally along the line 3—3 in FIG. 1.

As shown in the drawings, the invention is embodied in a precision grinding machine 10, adapted to perform grinding operations upon a succession of workpieces 12. As shown, the workpieces 12 take the form of cylindrical pins, but it will be understood that the invention is applicable to the grinding of a wide variety of workpieces.

The grinding operation is performed on each successive workpiece 12 at a work station 14. An indexing head 16 is provided to bring a series of successive workpieces 12 to the work station 14. Thus, the indexing head 16 comprises a plurality of spaced work holders 18.

While the indexing head 16 may assume various forms, it is shown as a rotary turret, mounted on a shaft 20 which is supported by a bearing 22. The illustrated shaft 20 is oriented along a horizontal axis of rotation. The turret 16 comprises a vertical plate 24 on which the work holders 18 are mounted.

Each of the work holders 18 comprises a pair of centers 26 and 28, at least one of which is readily retractable, to provide for the easy insertion and removal of the workpieces 12. In the illustrated construction, the center 26 is rigidly mounted on the turret 16, while the center 28 is retractably mounted. Thus, each workpiece 12 may be removed by retracting the center 28. A new workpiece may then be mounted between the centers 26 and 28.

Various arrangements may be employed to provide for the retraction of the center 28. Two such arrangements are shown in FIG. 2. In one construction, the center 28 is formed on the end of a pin 30 which is slidable in bearings 32 and 34. A handle or knob 36 is formed on the outer end of the pin 30, to provide for the manual retraction of the center 28. Spring means are preferably provided to advance and hold the center 28 against the workpiece 12. As shown, a compression coil spring 38, mounted around the pin 30, and compressed between the bearing 32 and a stop collar or shoulder 40 on the pin 30. The center 28 may be retracted manually by pulling the knob 36 outwardly against the biasing action of the spring 38. When the handle 36 is released, the spring 38 biases the center 28 against the end of the workpiece 12.
As shown in the other arrangement of FIG. 2, screw means are provided to advance and retract the corresponding center 28. In this construction, the center 28 is formed on the end of an externally threaded pin 42, which is screwed through an internally threaded bearing 44. The pin 42 is provided with a handle or knob 46, which may be turned manually, so as to advance and retract the center 28.

Various means may be provided to advance the turret 16 so that each successive workpiece 12 will be indexed to the work station 14. In the specific construction of FIG. 2, a fluid power cylinder 48 is provided to index the turret 16. As shown, the cylinder 48 is pivotally connected between a stationary bracket 50 and an indexing arm 52. A one way clutch 53 is connected between the arm 52 and the shaft 20. When the cylinder 48 is extended, the arm 52 is advanced, and the turret 16 is carried along by the one way clutch 53. When the cylinder 48 is retracted, the clutch 53 provides for the retraction of the arm 52, without moving the turret 16.

The movable center may be operated by either hydraulic pressure or compressed air. The bearing 22 for the turret 16 is preferably mounted on a stationary base 55.

The portion of the turret 16 at the work station 14 is preferably supported in a rigid manner by a movable supporting member 54. The turret 16 has a plurality of shoulders 56, adapted to be supported by the member 54. It will be seen that the shoulders 56 are adjacent the work supports 18. Preferably, the supporting member 54 is formed with a channel or groove 58, as shown to best advantage in FIG. 3, for receiving the shoulders 56. The interlocking engagement between each successive shoulder 56 and the groove 58 prevents lateral displacement or vibration of the corresponding work support 18.

The movable supporting member 54 is adapted to be retracted, out of the way of the turret 16, so that the turret can be indexed. As the indexing movement of the turret is being completed, the member 54 is again advanced so that it will be engaged by the next shoulder 56.

To provide for such advancing and retracting movement, the member 54 is mounted on a movable carriage 60. Means are provided to advance and retract the member 54 and the carriage 60. In the specific construction of FIG. 1, such means comprise a fluid power cylinder 62, which may be operated by either hydraulic pressure or compressed air.

The workpiece 12 at the work station 14 is adapted to be engaged by a drive or control roller 64, preferably made of fairly soft rubber or rubberlike material. As shown in FIG. 1, the drive roller 64 is mounted on a shaft 66 which is rapidly rotated by a motor 68 or the like. It will be understood that the workpiece 12 is adapted to be frictionally driven by the roller 64.

To provide for relative movement between the drive roller 64 and the workpiece 12, the motor 68 is mounted on a slide or carriage 70. Means are provided for advancing and retracting the carriage 70. In the specific construction of FIG. 1, such means take the form of a fluid power cylinder 72, which may be operated by either hydraulic pressure or compressed air.

The workpiece 12 at the work station 14 is adapted to be engaged by a grinding wheel 74, mounted on a shaft 76 which is rapidly rotated by a motor 78. To provide for relative movement between the grinding wheel 74 and the workpiece 12, the workpiece 12 is mounted on a slide 80. Means are provided to advance and retract the slide 80. In the specific construction of FIG. 1, such means take the form of a fluid power cylinder 82, adapted to be operated by either hydraulic pressure or compressed air.

In the operation of the grinding machine 10, the unfinished workpieces are mounted on the turret 16 by the operator, preferably at a loading station 84, displaced by 180° from the work station 14. With four work holders 18, as shown in FIG. 2, one of the work holders is at the loading station when the diametrically opposite workholder is at the work station. The movable center 28 at the loading station 84 is retracted so that the finished workpiece 12 is indexed to the center 28. The center 28 is advanced so that the unfinished workpiece will be securely held.

As each workpiece 12 is finished, the grinding wheel 74 and the drive wheel 64 are retracted from the workpiece. Then the supporting member 54 is retracted from the turret 16 so that it can be indexed. The member 54 is retracted by actuating the cylinder 48. To index the turret 16, the cylinder 48 is actuated. As the indexing movement is completed, the cylinder 48 is actuated in the opposite direction to move the support 54 under the next shoulder 56 on the turret 16. The support 54 engages and holds the shoulder 56 in a rigid manner.

While the indexing movement of the turret 16 is taking place, the drive wheel 64 and the grinding wheel 74 are retracted from the workpiece 12, as shown in FIG. 3. To drive the workpiece 12, the drive roller 64 is advanced into engagement with the workpiece, as shown in FIG. 4. This is done by actuating the cylinder 72. Next, the grinding wheel 74 is advanced into engagement with the workpiece 12, as shown in FIG. 5. This is done by actuating the cylinder 82. When the grinding operation has been completed, the cylinder 82 is actuated in the opposite direction, so as to retract the grinding wheel 74, as shown in FIG. 6. Finally the cylinder 72 is actuated in the opposite direction so as to retract the drive wheel 64, as shown in FIG. 7.

It will be evident that the grinding machine achieves a high rate of production, because the work holders and workpieces are rapidly indexed to the work station by power means. An automatic timer may be provided to coordinate the operation of the cylinders 48, 62, 72 and 82. In this way, the operation of the machine is fully automatic, except for the loading and unloading of the workpieces from the turret 16.

The grinding machine 10 operates with a high degree of precision, because the workpieces 12 are fully supported and controlled by the mounting centers 26 and 28 of the work holders 18. The centers 26 and 28 establish the rotary axis of each workpiece with a high degree of precision, so that the grinding operation is carried out without any appreciable error in roundness or concentricity of the workpieces.

Thus, the grinding machine of the present invention achieves a rate of production comparable to that of a centerless grinder, while achieving a higher degree of precision, comparable to that of a cylindrical grinder.

Various other modifications, alternative constructions and equivalents may be employed without departing from the true spirit and scope of the invention, as exemplified in the foregoing description and defined in the following claims.

I claim:

1. A precision grinding machine, comprising the combination of an indexing head having a plurality of spaced work holders mounted thereon, each of said work holders comprising first and second centers for rotatably supporting the opposite ends of a workpiece to be ground, at least one of said centers being retractably mounted on said indexing head, said one center being rotatable relative to the other center of the work holder to provide for easy insertion and removal of the workpiece, means movably supporting said indexing head for successive movement of said work holders to a work station, means for moving said indexing head to index each work holder in turn to the work station, a driving wheel for frictionally engaging the workpiece at the work station to rotate the workpiece on said centers of the work holder at the work station, and
5 a grinding wheel for engaging and grinding the work-
piece at the work station.

2. A machine according to claim 1,
including a first movable carriage for supporting said
driving wheel for movement into and out of engage-
ment with the workpiece at the work station, and
means for advancing and retracting said first carriage
to move said driving wheel into and out of engage-
ment with the workpiece.

3. A machine according to claim 1,
including a second movable carriage for supporting
said grinding wheel for movement into and out of
engagement with a workpiece at the work station, and
means for advancing and retracting said second car-
rriage to move said grinding wheel into and out of
engagement with the workpiece.

4. A machine according to claim 1, comprising
a first movable carriage for supporting said drive wheel
for movement into and out of engagement with the
workpiece at the work station,
means for advancing and retracting said first carriage,
a second movable carriage for supporting said grind-
ing wheel for movement into and out of engagement
with the workpiece at the work station, and
means for advancing and retracting said second car-
rriage.

5. A machine according to claim 1,
in which said indexing head is in the form of a rotatable
turret,
said work holders being spaced on said turret at an-
gular intervals.

6. A machine according to claim 5,
in which said indexing head is in the form of a rotatable
turret,
said work holders for engaging said work holders for engag-
holding member, and
means for advancing and retracting said supporting
member.

7. A machine according to claim 1,
including spring means for advancing the movable
center of each work support,
the movable center being retractable against the bias-
ing action of said spring means.

8. A machine according to claim 1,
including screw means for engaging and retracting the
movable center of each work support.

9. A machine according to claim 1,
including a first movable carriage supporting said
drive wheel for movement into and out of engage-
ment with the workpiece at the work station,
means for advancing and retracting said first carriage,
a second movable carriage supporting said grinding
wheel for movement into and out of engagement with
the workpiece at the work station, and
means for advancing and retracting said second car-
rriage,
said indexing head being in the form of a rotatable
turret which is movable between said drive wheel
and said grinding wheel when said wheels are re-
tracted,
said work holders being spaced at angular intervals on
said turret.

10. A machine according to claim 1,
in which said indexing head is in the form of a rotatable
turret,
said work holders being spaced on said turret at an-
gular intervals,
each work holder including spring means for ad-
vancing the corresponding movable center,
said movable center being retractable against the bias-
ing action of said spring means.

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