Dec. 16, 1958 H. E. BALSIGER ET AL 2,864,211

METHOD OF PLUNGE GRINDING

Original Filed Aug. 26, 1948 2 Sheets-Sheet 1

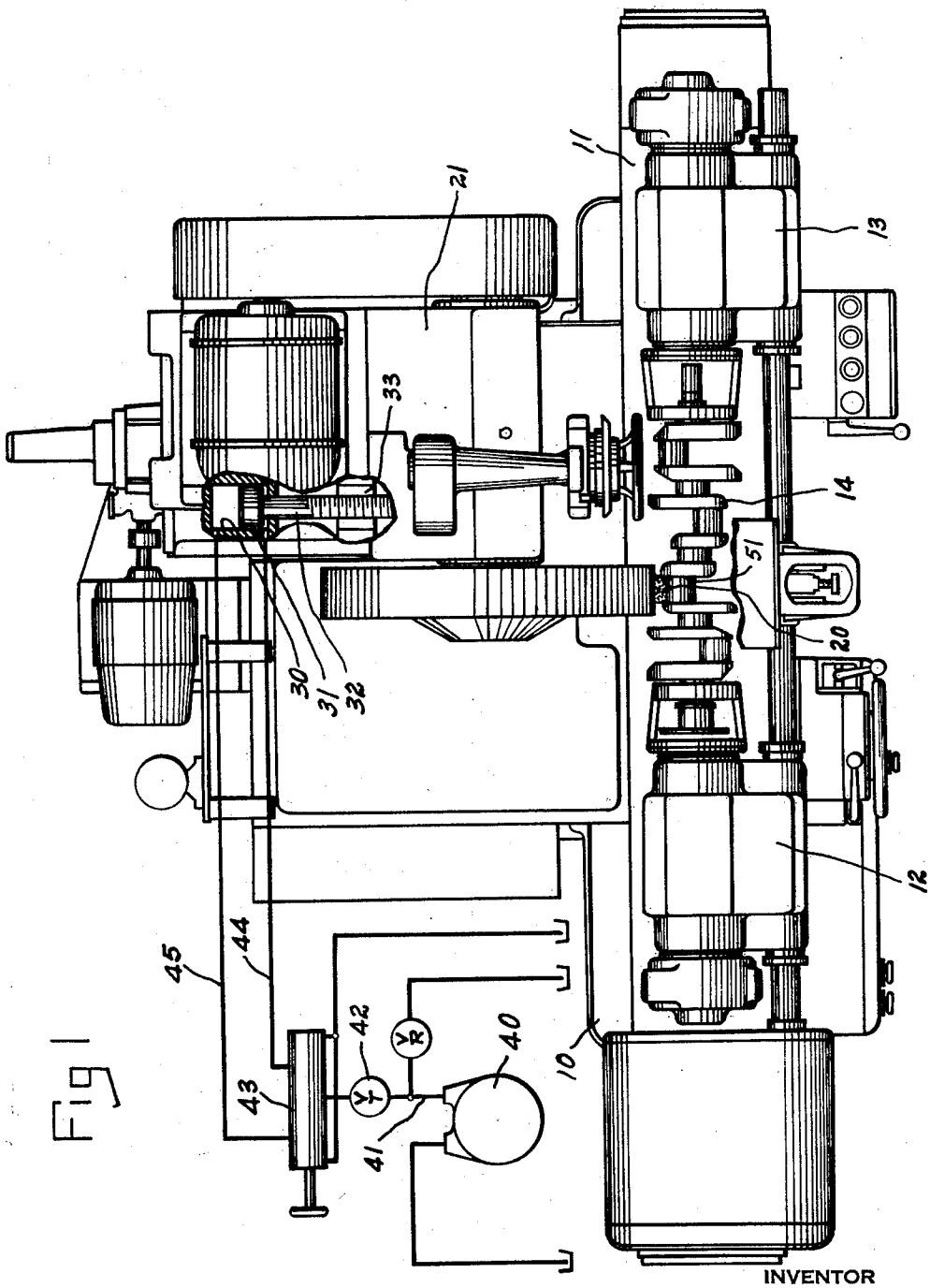

Fig 1

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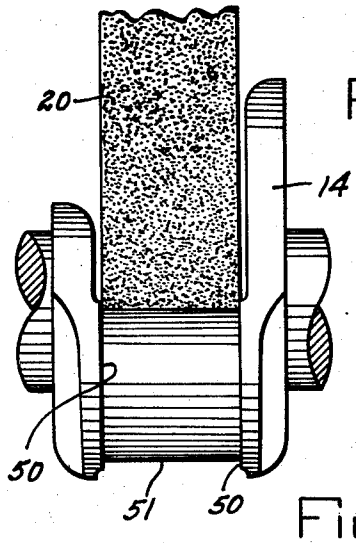

Fig 2

Fig 3

NEW METHOD

RAPID FEED

CHEEK FEED

ROUGH GRIND

SPARKOUT

FINISH GRIND

SPARKOUT

Fig 4

OLD METHOD

RAPID FEED

CHEEK FEED

ROUGH GRIND

FINISH GRIND

SPARKOUT

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METHOD OF PLUNGE GRINDING

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Original application August 26, 1948, Serial No. 46,336, now Patent No. 2,638,719, dated May 19, 1953. Divided and this application May 14, 1953, Serial No. 355,112

5 Claims. (Cl. 51—289)

This invention relates to a method of grinding, particularly a method of feeding a grinding wheel during a plunge grinding operation and is a division of application Ser. No. 46,336 filed August 26, 1948, now Patent No. 2,638,719, granted May 19, 1953.

Unground work pieces may be either out of round or off center or both.

A work piece which is off center or "runs out" may be perfectly round but the portion to be ground rotates about a center other than its own.

Run out is corrected by grinding without the support of a steady rest so that the center of the work and the center of rotation tend to come together until they meet at a point somewhere between the original points.

An out of round work piece may rotate about its own center but its surface may be irregular.

Out of round is in process of correction throughout the grinding operation but should be completed with the aid of a steady rest before the final sparkout.

This invention is concerned primarily with a method of correcting "run out."

The current method of plunge grinding consists in feeding the grinding wheel against a work piece at a relatively fast feed rate without using a steady rest, to grind the work rapidly to within a few thousandths of finished size, changing to a slower rate until the work is almost to size. So long as grinding pressure is maintained on the work it is impossible to eliminate run out completely. The present feed method attempts to eliminate run out during the sparkout period when only about a thousandth inch of stock remains. Run out in a shaft is variable, the sparkout period is fixed and when run out is greater than the amount left for sparkout, the finished shaft or pin will not run true.

The term "sparkout" as used herein may be defined as a stopping of the feed movement of a grinding wheel but continuing the grinding operation by virtue of the returning of the work to its normal position after having been distorted by the force of the grinding feed. The grinding action stops when the strain on the work has been completely relieved due to the grinding away of the peripheral or other surface.

The method of this invention solves the problem by stopping the grinding feed after rapidly removing a substantial amount of stock without using a steady rest, and relieving the deflection, and most, if not all of the run out condition of the work piece. Thereafter the work is supported by a work rest and the finish grinding operation is performed with a comparatively light cut or by a succession of progressively lighter cuts. The feed is stopped again just short of the desired size for the relief of any remaining run out.

It is therefore an object of this invention to provide a method whereby the work piece is ground accurate as to angular location in the early part of a grinding operation thus leaving a substantial amount of stock to be removed for providing a fine finish and accurate size and avoiding

a finished surface accurate as to size but inaccurate as to center of rotation.

A further object is to provide a method whereby strain in a workpiece due to grinding pressure is relieved and run out is corrected at the end of the rough grinding operation.

A further object is to provide a method whereby the finish grinding operation and size control are effected on a surface rotating about its own center.

A further object is to provide a grinding feed and method by which the feed movement of the grinding wheel is interrupted for a brief period and then resumed at a slower rate.

Figure 1 is a plan view of a crank grinding machine including a diagram of a hydraulic feed mechanism.

Figure 2 is a close-up of a grinding wheel in operative engagement with the cheeks and peripheral surface of a crank pin.

Figure 3 is a chart of a novel method of grinding crank pins and other work pieces.

Figure 4 is a chart of the current method of performing such grinding operations.

Numeral 10 indicates the bed of a grinding machine, 11 a work carriage slidably mounted thereon. 12 and 13 are work heads mounted on carriage 11 for rotatably supporting a crank shaft 14. A grinding wheel 20 is rotatably mounted on wheel support 21. Said wheel support is slidably mounted on bed 10 for movement transversely of said crank shaft.

Transverse movement of the wheel base may be effected by a hydraulic motor consisting of a cylinder 30, a piston 31 slidably mounted therein and a piston rod 32 which may be connected to wheel base 21 through a lug 33. Fluid under pressure for operating said motor may be supplied by a pump 40 through a line 41 and a throttle valve 42, to a reversing valve 43 which may be actuated to direct fluid under pressure alternately to lines 44 and 45 to the rod end and head ends respectively of cylinder 30.

The method of plunge grinding, which is the subject of this application, is shown graphically in Figure 3. In the current application, the steps disclosed in Figure 3 are controlled automatically for the most part. However, since the method is not dependent for its novelty on the control means it will be described for the purpose of simplification as a series of manually controlled operations.

Valve 43 is shifted to direct fluid under pressure through line 45 to the head end of cylinder 30 to move the wheel base 21 and grinding wheel 20 toward the work. The speed of this movement is controlled by the setting of throttle valve 42. The operator will set the valve for a rapid feed movement until the sides of the grinding wheel engage the cheeks 50 of crank pin 51. He will then reduce the feed rate by means of throttle valve 42 to a feed suitable for grinding said cheeks. Just before the grinding wheel engages the peripheral surface of the crank pin, the rate of feed will be further reduced by adjustment of valve 42 to a speed suitable for rough grinding in which a substantial amount of stock is removed in a short time. At a predetermined point in the movement of the wheel, which may be determined either by feel or by a suitable gauge, the operator closes valve 42 stopping the feed altogether. During this rough grinding operation run-out or eccentricity is removed from the pin so that during the sparkout period, after the feed has been stopped, the surface of the pin will be ground concentric with its center of rotation. As soon as this has been accomplished, valve 42 may be opened to a setting to cause the feed to be resumed at a rate suitable for finish grinding. When the work is ground almost to size the feed is again stopped and the final size is reached

during the sparkout. Since the run-out was removed during the rough grinding operation the operator need be concerned only with the matter of grinding accurately to size during the finishing operation.

As indicated in Figure 4 the old method does not include a sparkout operation following the rough grinding operation and as a result the operator has the problem of eliminating run-out as well as holding size right up until the final sparkout. When the amount of run-out remaining in the shaft at the end of the finish grind is greater than the amount of stock left on for sparkout, the finished pin might be accurate as to size but will not run true to its own center and the shaft will have to be reground or scrapped.

What is claimed is:

1. The method of plunge grinding a workpiece which consists in effecting a continuous rapid feeding movement of a grinding wheel against the workpiece, stopping said feeding movement of the wheel at a predetermined point for a selected interval to relieve the work from the stress imposed by the rapid feeding movement, continuing the grinding operation by the wheel in fixed position upon the work, freed from the stress produced by said rapid feed movement and finally resuming said feed until a predetermined size is reached.

2. The method of plunge grinding a workpiece which consists in effecting a rapid feeding movement of a grinding wheel against the workpiece to rough grind it, stopping said feeding movement of the wheel at a predetermined point for a selected interval to permit the work to sparkout to correct any out of round condition, and thus find its own center and finally resuming the feeding movement at a slower fine grinding rate until the final size is reached.

3. The method of plunge grinding a workpiece which consists in effecting a rapid feeding movement of a grinding wheel against the workpiece to rough grind it, stopping said feeding movement of the wheel at a predetermined point and for a predetermined time to permit the work to sparkout and finally resuming said feeding movement at a slower fine grinding rate in a series of steps, said steps being initiated in response to predetermined changes in size of the work.

4. The method of plunge grinding a workpiece which consists in effecting a rapid feeding movement of a grinding wheel against the workpiece to rough grind it, stopping said feeding movement of the wheel at a predetermined point for a predeterined time to permit the work to sparkout and finally resuming said feeding movement at a slower fine grinding rate in a series of steps at progressively slower speeds until the final size is reached.

5. The method of plunge grinding a pin on a crankshaft which consists in feeding a grinding wheel against the crankshaft at a relatively rapid rate during the grinding of the crank cheeks, rough grinding the pin at a reduced feed rate and starting the flow of coolant, stopping the feeding movement for a sparkout period to permit the work to find its own center, resuming the grinding feed, at a further reduced rate until a predetermined size is reached, continuing the feeding movement at a still further reduced rate until a second predetermined size is reached, and stopping the feeding movement for a second sparkout until the final size is reached.

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