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APPARATUS FOR POLISHING

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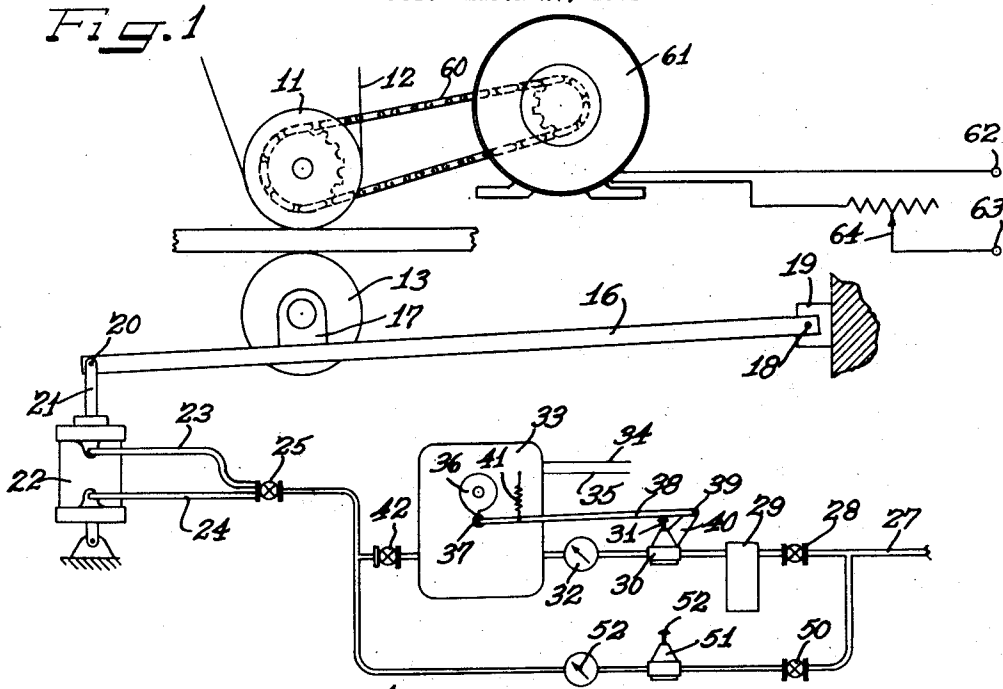
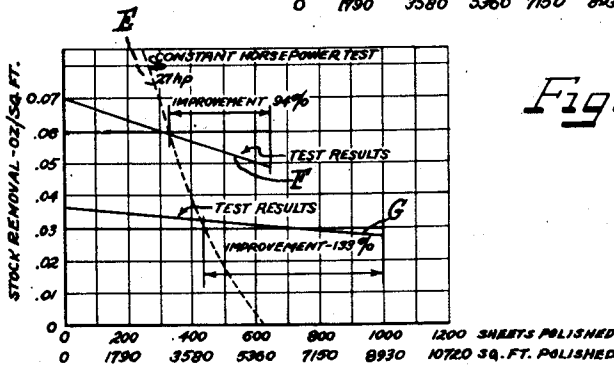
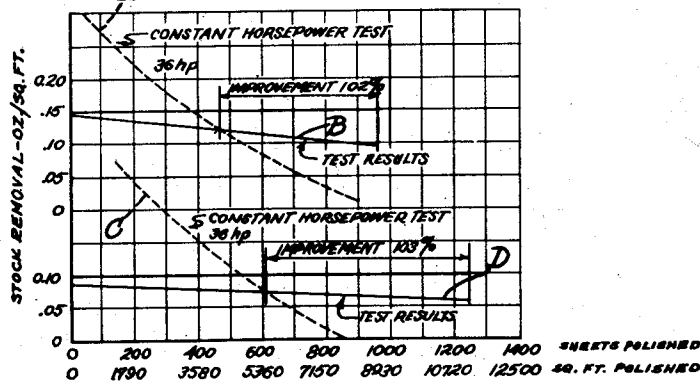


Fig. 2



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APPARATUS FOR POLISHING

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The present invention is particularly useful in connection with flat polishing machines wherein metallic stock is passed between an abrasive polishing belt and a rotatable backing roller. Under normal operating conditions, the prime mover which drives the moving polishing belt provides a constant horsepower input and the backing roll supplies a more or less constant pressure against the workpiece during the polishing operation. Under these conditions, at the beginning of the operation when the polishing belt is still new and the abrasive grit is sharp, an excessive amount of stock is removed from the workpiece during the polishing. On the other hand, as the polishing operation is continued and the grit on the working surface becomes worn and less sharp, insufficient amounts of stock are removed from the workpiece. Thus, a polishing belt, if operated in the usual way, will remove progressively less stock over successive equal time periods of its useful life.

The presently devised system overcomes the difficulties encountered in the conventional polishing operation described above and substantially prolongs the useful life of polishing belts. In one phase of the operation, the power input to the prime mover which actuates the moving polishing belt is varied in accordance with the condition of the polishing belt, and so a correlation is achieved such that the prime mover is operated at a lower power level when the abrasive polishing belt is new and at a higher power level as the belt becomes worn. To compensate further for the decrease in the polishing ability of the belt after extended polishing operations, the pressure from the backing roll is also adjusted contemporaneously with the adjustment of the power input to the prime mover. By means of these two adjustments, the polishing operation can be carried out to achieve controlled amounts of stock removal. Ordinarily, it is desired that the amount of stock removal be constant over a given area of the workpiece, but the presently devised system is equally operable to effect removal of amounts of stocks between defined limits.

An object of the present invention is to provide a method for removing controlled amounts of stock from a workpiece during the polishing operation.

Still another object of the present invention is to provide a method for compensating for wear on an abrasive polishing belt of the type employed in a flat polishing machine.

Another object of the present invention is to provide a method for polishing workpieces in a

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flat polishing machine to compensate for varying polishing characteristics of the belt during a series of polishing operations, and do so in an automatic manner.

Still another object of the present invention is to provide an improved form of polishing machine for removing controlled amounts of stock from a workpiece.

Another object of the present invention is to provide an improved flat polishing machine which automatically compensates for the decrease in polishing ability of the polishing belt as the operation progresses.

The invention will be described with more particularity in connection with the attached sheet of drawings, in which:

Figure 1 is a schematic representation of one system which can be employed in the practice of the present invention;

Figure 2 is a graph of the results achieved using the system of the present invention, the ordinates representing the amount of stock removal, plotted against the number of sheets polished as well as the square feet of surface polished when using a standard 100 grit polishing paper; and

Figure 3 is a graph similar to that in Figure 2 illustrating the results obtained when using a standard 180 grit paper.

As shown on the drawings:

The system illustrated in Figure 1 represents one type of assembly which may be employed in the practice of the present invention. In that drawing there is illustrated an elongated metallic strip 10 which is fed between a constantly rotating contact roll 11 having a belt 12 containing abrasive polishing material trained therearound. The workpiece 10 is supported in its polishing position by means of an upwardly biased backing roll 13, which is an idler roll and which supplies the proper pressure against the workpiece during the polishing operation.

The contact roll 11 which carries the abrasive belt 12 may be rotated by means of a chain 60 from a prime mover which, in most installations, will be a heavy duty electric motor such as motor 61.

Instead of operating the prime mover at a constant horsepower, as is conventional in polishing operations, I propose to vary the power input to the prime mover during the progress of the polishing operation. In the case of an electric motor prime mover, this can be conveniently done by varying the current into the motor as the polishing operation progresses. In the arrangement shown in Figure 1, the motor 61 is ener-

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gized from a source of electrical energy at terminals 62 and 63. A rheostat 64 in one side of the line is provided to vary the current input to the motor and thereby vary the power input to the motor. Thus, at the start of the operation when the abrasive grit of the polishing belt is sharpest and therefore has its greatest abrading action, the current into the motor 61 will be held at a relatively low value. As the polishing operation progresses and the abrasive belt 12 becomes worn, the current input to the motor is correspondingly increased to achieve the required degree of stock removal.

The adjustment of the power input to the motor will, of course, depend upon the nature of the polishing belt, the type of material being polished, and the amount of stock to be removed. The proper current values to be maintained during any phase of the polishing cycle can be readily ascertained after a few test pieces have been put through the polishing operation and the constancy of stock removal determined from these test samples.

In some installations it will not be particularly feasible to vary the power input to the prime mover over the relatively wide range that is sometimes required to compensate for the wearing of the polishing belt. To compensate further for this wear, the present system also provides means for varying the pressure on the workpiece 10 applied by the backing roll or "billy-roll" 13. This pressure controlling system includes a lever 16 having a bearing housing or bracket 17 thereon for rotatably supporting the backing roll 13. One end of the lever 16 is pivotally mounted by means of a pin 18 to a support means 19. The opposite end of the lever 16 is also pivotally mounted by means of a pin 20 to an arm 21 of a displacement device. In the form of the invention illustrated in Figure 1, this displacement device includes a pneumatically-operated cylinder 22. The latter is of conventional design in that it includes a piston reciprocable in the cylinder and a piston rod 21. The direction and extent of displacement of the piston within the cylinder is determined by the differential air pressure acting upon the piston. A pair of compressed air feed lines 23 and 24 supply air under pressure to the cylinder 22 on opposite sides of the piston and thereby control the displacement of the piston and its associated rod 21.

A solenoid-actuated three-way valve 25 controls the differential air pressure in the feed lines 23 and 24, and hence between opposite sides of the piston. It is this differential pressure that is applied to the backing roll 13.

The remainder of the system includes means for automatically varying the pressure of the backing roll 13 against the workpiece 10 and also includes a by-pass for manual operation of the system.

Both portions of the control system are fed from a common supply of compressed air entering the system through a conduit 27. The upper branch of the system illustrated in Figure 1 includes the automatic control means for adjusting the displacement of the piston within the cylinder 22 and includes a gate valve 28 for metering the flow of compressed air into the upper branch. After passing through the gate valve 28, the compressed air is filtered by means of the suitable air filter 29. Control of the rate of flow of filtered air leaving the filter 29 is accomplished by means of a pressure regulating

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valve 30. An operating button 31 on the pressure regulating valve 30 is actuated by an automatically-controlled pressure control system to feed the proper amount of compressed air into the cylinder 22. A pressure gauge 32 is also included in the compressed air line to provide means for visually determining the existing air pressure in the line.

The heart of the automatic control system illustrated in Figure 1 is an electrically-operated pressure controller 33. The latter is energized by means of a pair of leads 34 and 35 from a suitable voltage source.

The pressure controller 33 includes a small electric timer motor (not shown) which drives an arcuately-shaped control cam 34. The periphery of the cam 34 is in contact with a roller 37 carried by an arm 38. The opposite end of the arm is pivotally secured as at 38 to an extension 40 on the pressure regulator valve 30. A spring 41 biases the roller 37 against the periphery of the cam 36. The timer motor driving the cam 36 preferably runs at a speed such that the cam 36 makes one complete revolution during a predetermined period which approximates the useful life of the polishing belt 12. As the cam 36 is rotated in a clockwise direction, as viewed in Figure 1, the arm 38 is urged downwardly against the biasing action of the spring 41 and depresses the operating button 31 of the pressure regulator valve 30. As a consequence, the compressed air is fed into the solenoid-actuated valve 25 through a gate valve 42. After the belt 12 has reached the end of its useful life, it is replaced and the control mechanism reset so that the roller 37 contacts the cam 36 along the periphery of the cam where the radius of the cam 36 is at a minimum. In this position, the minimum differential air pressure is maintained within the cylinder 22 so that only a relatively small pressure is exerted by the backing roll 13 against the workpiece 10. As the polishing operation progresses, the operating button 31 of the pressure regulator valve 30 is depressed further by the action of the arm 38 and more air pressure is supplied to the cylinder 22. This increased pressure moves the arm 21 to urge the backing roll 13 against the workpiece 10 with increased pressure, thereby compensating for the reduced ability of the polishing belt 12 to effect the proper degree of stock removal.

An auxiliary system is also provided to permit manual operation. This portion of the system includes a gate valve 50, a pressure regulator valve 51, and a pressure gauge 52. The manual system operates in the same manner as the automatic system described previously, except that control of the flow of compressed air into the cylinder 22 is regulated manually by depressing the operating button 52 on the pressure regulator valve 51 when the pressure on the backing roll 13 is to be varied.

The graphs of Figures 2 and 3 illustrate the improved results obtained by varying the horsepower input to the prime mover as compared with using a constant horsepower drive on the prime mover. The upper portion of the graph of Figure 2 represents the results obtained in a test using a standard 100 grit polishing paper to remove 0.15 ounce of stock per square foot of stock.

The dashed line plot, labeled curve A, was obtained during a polishing operation employing a 36-horsepower electric motor operated under conditions of constant horsepower. As shown

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on curve A, the amount of stock removed from the piece varied quite substantially from the start of the run until its completion, and for most of the pieces the amount of stock removal was outside the desired range of between 0.10 and 0.20 ounce per square foot. On the other hand, when provision was made for adjusting the horsepower input to the motor, the amount of stock removal was far more constant. The results obtained are shown in the solid line plot, labeled curve B. The net result was an improvement of 102% in the useful life of the polishing belt. The percentage improvement was found by comparing the constant stock removal test results which the curves obtained when employing constant power. When the constant horsepower curve falls below the required stock removal, the belt may be considered no longer effective. The amount of improvement is then calculated from this point. For example, in the previously described plot, the constant horsepower curve falls below the test result line at 470 pieces. The duration of the constant stock removal test extended for 950 pieces. Therefore, the percentage improvement was:

$$\frac{950-470}{470} \times 100 \text{ or } 102\% \text{ improvement}$$

The bottom portion of the graph of Figure 2 represents the results obtained in attempting to remove 0.10 ounce of stock per square foot of stock. The dashed line labeled curve C illustrates that the requisite amount of stock was removed only on a limited number of workpieces during the constant horsepower test. On the other hand, the solid line labeled curve D shows the improved results obtained by operating under conditions of varying power input. The net result, calculated as previously, was an improvement of 103% in the useful life of the belt.

The curves in Figure 3 are quite similar to those in Figure 2 except in this series of tests a 27-horsepower motor was used in combination with a standard 180 grit paper. The dash line curve, labeled curve E, shows the results obtained when using a constant power input. These results have been compared with the results obtained by varying the power input to achieve a constant stock removal of 0.06 ounce per square foot (curve F) and a constant stock removal of 0.03 ounce per square foot (curve G). The improvements in extending the useful life of the abrasive belt were, respectively, 94% and 133%, as shown.

The results shown on the graphs of Figures 2 and 3 are typical and could be improved by a more accurate correlation of the power input to the prime mover and by proper adjustment of the pressure of the backing roll. However, the results do indicate clearly that an increase in the useful life of the polishing belt up to 100% and more are obtainable by the method of the present invention. This substantial improvement

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represents a significant saving in the expense of polishing belts, while at the same time providing a predetermined degree of stock removal which is practically unattainable by running the polishing sheet in the conventional manner.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A polishing apparatus including a movable endless abrasive member, a rotatable backing roll in juxtaposition to said member, the member and backing roll being arranged to receive a workpiece therebetween, means adjustably supporting said backing roll, and means cooperating with said adjustable supporting means to increase the pressure of said backing roll against said workpiece as the polishing operation progresses.

2. A polishing apparatus including a moving abrasive belt, a rotatable backing roll in spaced relation to said moving abrasive belt to receive a workpiece therebetween, supporting means pivotally supporting said backing roll in position, displacement means engaging said support means for varying the pressure of said backing roll against said workpiece, and actuating means associated with said displacement means for controlling the amount of pressure on said backing roll.

3. A polishing apparatus including a moving abrasive belt, a rotatable backing roll in spaced relation to said moving abrasive belt to receive a workpiece therebetween, support means pivotally supporting said backing roll in position, pressure-responsive displacement means engaging said support, and control means associated with said pressure-responsive means for controlling the pressure-responsive displacement means to thereby vary the amount of pressure on said backing roll.

4. A polishing apparatus including a moving abrasive belt, a rotatable backing roll in spaced relation to said moving abrasive belt, said belt and roll being arranged to receive a workpiece therebetween, support means pivotally supporting said backing roll in position, pressure-responsive displacement means engaging said support means, means for supplying fluid under pressure to said displacement means, and means for continuously and cyclically varying the amount of fluid supplied to said displacement means.

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