Oct. 17, 1939. H. W. ZIMMERMAN 2,176,163

APPARATUS FOR FINISHING CIRCULAR OBJECTS

Filed Jan. 4, 1936 3 Sheets-Sheet 1

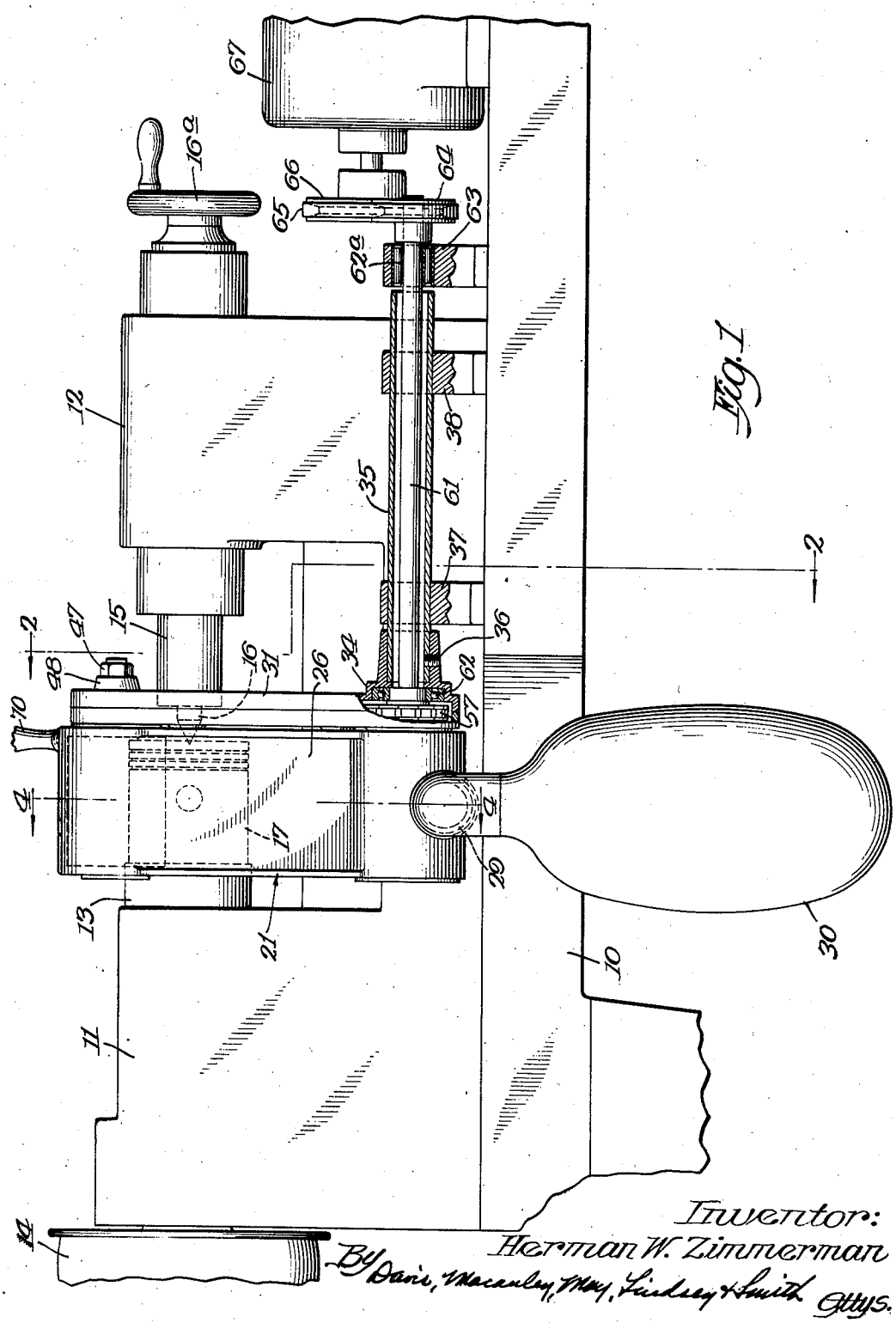


Fig. 1

Inventor:
Herman W. Zimmerman
By Davis, Macauley, May, Lindsey & Smith Attys.

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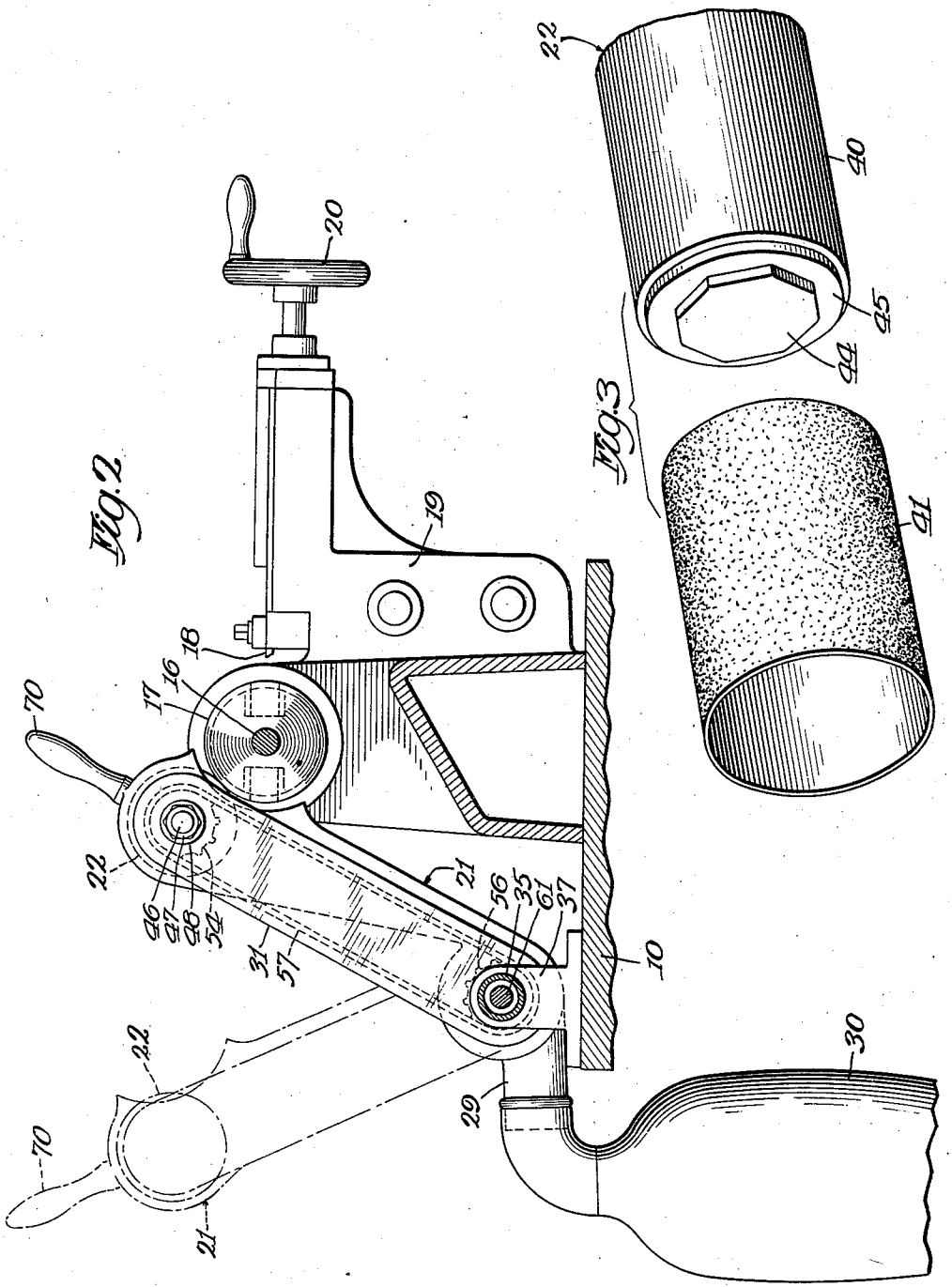


Fig. 2

Fig. 3

Inventor:
Herman W. Zimmerman
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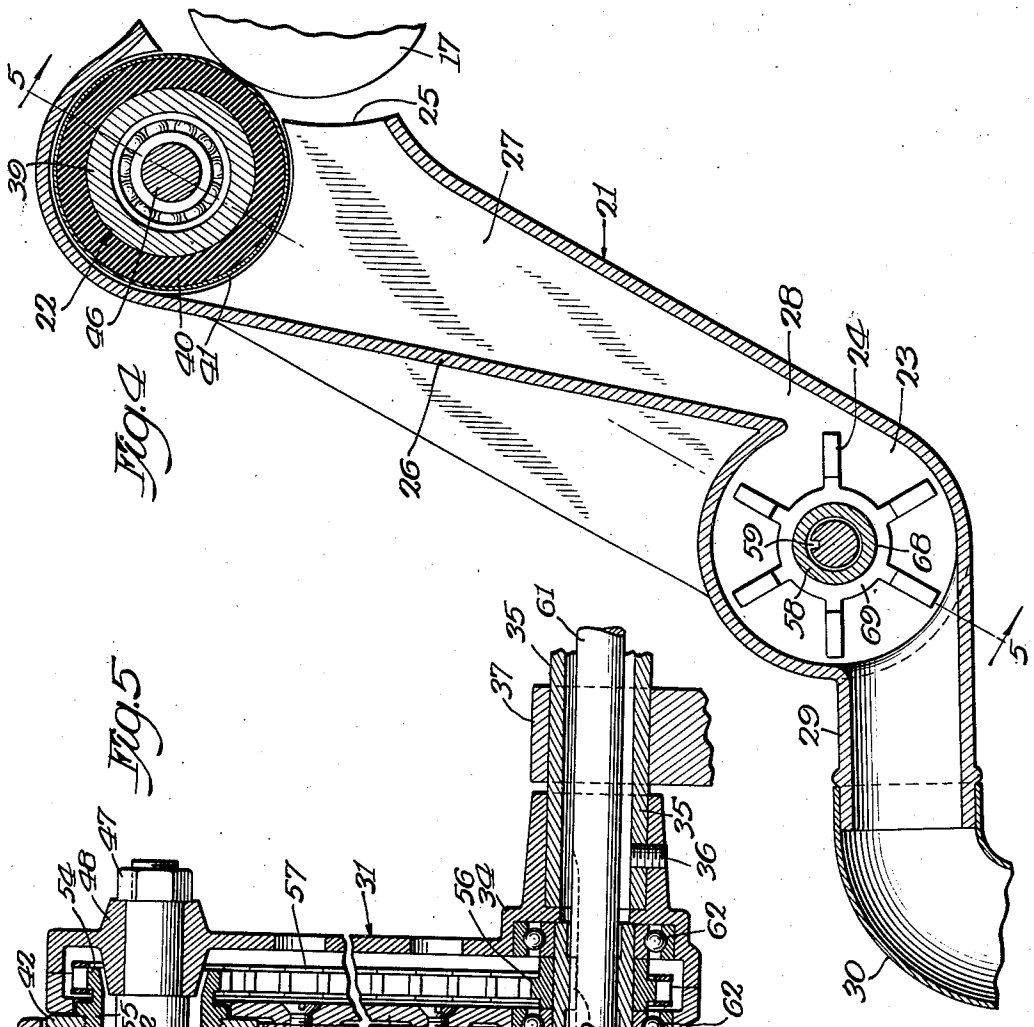


Fig. 4

Fig. 5

Inventor:
Herman W. Zimmerman
By Davis, Macauley, May, Lindsay & Smith Attys.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR FINISHING CIRCULAR OBJECTS

Herman W. Zimmerman, North Chicago, Ill., assignor to Automotive Maintenance Machinery Co., North Chicago, Ill., a corporation of Illinois

Application January 4, 1936, Serial No. 57,483

8 Claims. (Cl. 51—50)

My invention relates to apparatus for finishing circular objects, and it has to do more particularly with a tool well suited for finishing pistons, axle shafts, parts of valves, and the like.

One of the objects of my invention is to provide an improved structure of the foregoing character which is simple in construction, is inexpensive to manufacture, and is highly efficient in operation.

Another object is to provide a tool for finishing pistons and other circular objects which is particularly suited for use in automotive service shops, garages, and the like.

A more specific object is to provide an improved tool for finishing objects of the character hereinabove mentioned, the structure including turning and grinding means separately adjustable toward and from the work to first turn and then quickly finish the same to the desired finish without changing the position of the work.

A further object is to provide a finishing unit for carrying out the foregoing objects which is of a character well adapted for applying a fine polished finish to the outer surface of a circular object regardless whether such surface is irregular in shape, or is full surfaced, or has cut-outs therein, or whether the object is truly circular or out-of-round in cross section or tapered somewhat in axial direction.

Another object is to provide finishing means for a unit of the foregoing character that may be easily and quickly adjusted toward and from the work while the structure is in operation, the finishing means being freely supported against the work and being capable of self-adjusting itself to the work for finishing objects having different diameters and different cross-sectional shapes.

An additional object is to provide an arrangement wherein a freely supported and rotative finishing member may be brought into finishing engagement with the rotating work, the finishing member being so constructed and arranged that it closely hugs the work surface to be finished without material vibration relative thereto whereby a fine polished finish is applied to the work.

Other objects are to provide a tool of the foregoing character that embodies a minimum number of parts arranged to provide a faster finishing operation with lesser operating cost; to eliminate expensive power feed equipment parts; to provide a tool adapted to simultaneously finish all or a substantial part of the work surface at one time, which tool includes a finishing member of sufficient length to bridge cut-outs in the work insuring a better and uniformly-finished surface; to provide a finishing tool wherein the pressure of the finishing means against the work may be readily controlled manually or otherwise; and to provide novel means for carrying abrasive dust, grinding particles, and the like, away from the work and for storing the same, the arrangement being such that the operator as well as the moving parts of the structure are protected from the bad effects of the abrasive dust, etc., and the speed of the finishing operation is increased with an improved finished surface.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings, wherein,

Figure 1 is a side elevational view, partially in section, of a portion of one form of apparatus embodying my invention;

Fig. 2 is a section taken substantially on line 2—2 of Fig. 1;

Fig. 3 is an enlarged perspective, disassembled view of the abrasive member and its supporting head shown in the previous figures;

Fig. 4 is an enlarged section taken substantially on line 4—4 of Fig. 1, and also a section taken substantially on line 4—4 of Fig. 5; and

Fig. 5 is a section taken substantially on line 5—5 of Fig. 4.

Referring to the drawings, the machine structure that I have chosen to illustrate my invention includes a bed portion 10 (Fig. 1) supporting a head stock 11 and a tail stock 12. The head stock supports a spindle 13 adapted to be rotated at high speed by any suitable power means such as a motor (not shown) through a pulley structure 14. The tail stock 12 supports a centering spindle 15 having a centering member 16, and this centering spindle is adjustable toward and from the spindle 13 by suitable mechanism (not shown) operable under the control of the hand wheel 16a for holding and centering the work.

I have illustrated my invention as adapted for the finishing of a piston 17 (Figs. 1 and 2) of the full-surfaced, cylindrical type. It will be understood, however, that my invention is equally well adapted for finishing various other kinds of pistons, including those having cut-out portions therein, those having oval-shaped skirts, and those having slightly tapered skirts. It is also to be understood that my invention is equally well suited for the finishing of various other circular objects, including axle shafts, valve parts, and the like, as above first stated.

The piston 17 is carried by the spindles 13 and 15 in properly centered position, and it is preferably rotated at high speed. The outer surface of the piston 17 may first be turned down by suitable means including a cutting tool 18 (Fig. 2) which is suitably supported by bed-carried frame member 19. The cutting tool 18 is adapted to be adjusted toward and from the piston by a suitable hand wheel 20 and intermediate adjustment connections (not shown). Any suitable mechanism (not shown) may be employed for feeding the cutting tool 18 longitudinally or axially of the piston as the turning operation is carried on. When the turning operation is started, the cutting tool 18 is adjusted into proper engagement with the piston and such tool is adjusted out of engagement (Fig. 2) when the turning operation is completed.

Excellent results may be obtained in the turning operation by rotating the piston at high speed and by imparting a slow, longitudinal or axial feed to the cutting tool 18. In this operation, the desired shape and dimensional requirements may be carried out and the piston may take sufficiently bright and smooth finish to satisfy, in some cases, the requirements of a finally finished piston; but, in other cases, for example cast iron pistons, this turning operation imparts a dull finish, which is objectionable in pistons furnished, particularly, for automotive service requirements. According to my invention, the foregoing objectionable condition is easily avoided with a minimum of expense and the desired bright and smooth finish in the completed object is insured, regardless of the kind of material from which it is formed.

More particularly, and to the foregoing end, I employ a novel finishing unit that may be quickly thrown into operation immediately following the turning operation without disturbing the piston mounting employed in the turning operation and without interfering in any way with the turning operations. One form of finishing unit for carrying out my invention is shown in the drawings (Figs. 4 and 5), and it includes an elongated casing 21 in the upper end of which is mounted a finishing cylinder 22. The lower end of the casing 21 is formed to provide a cylindrical chamber 23 in which there is mounted an exhaust fan 24. The upper end of the casing 21, adjacent the finishing cylinder 22, is shaped similarly to such cylinder so as to closely enclose the same, and the forward upper end portion of this casing is provided with an enlarged opening 25, the walls of which are formed in a semi-circular fashion so that the periphery of the finishing cylinder 22 may project therebeyond and into engagement with the piston 17. The casing 21 is provided with a rear wall 26 that tapers inwardly and downwardly from the cylinder 22 toward the fan chamber 23, providing a vacuum chamber 27 of V-shape in cross-section which is connected to the fan chamber 23 by a relatively narrow opening 28 that facilitates the suction action set up by the fan 24, as will be well understood. The casing 21 is further provided with a tubular extension 29 leading from the fan chamber 23 for discharge from the latter, and this extension supports a receptacle or bag 30 formed of fabric or other suitable material for receiving and storing abrasive dust, grinding particles, and the like, discharged thereinto by fan 24.

The casing 21, at one side, supports a sprocket housing 31 having an inner wall 32 secured to the casing 21 by screws 33. The lower end of the housing 31 is provided with an enlarged hub-like portion 34 which is fixedly secured to a tubular supporting shaft 35 (Figs. 1 and 5) by a set screw 36. The tubular shaft 35 is carried by a pair of spaced bearings 37, 38 mounted upon the machine bed 10 in any suitable manner. This shaft 35 is so mounted in the bearings 37, 38 that it is free to both rotate and slide longitudinally therein; whereby the casing 21, and the finishing unit as a whole, is mounted so that it may manually be swung into the operative piston finishing position of Figs. 2 and 4 or it may be rotated rearwardly to an inoperative position, as when the turning operation is being carried on, as shown in dotted lines in Fig. 2. The longitudinal slide adjustment of the shaft 35 permits the finishing unit to be adjusted or reciprocated manually back and forth along the axis of the work for certain finishing operations and/or when finishing objects of greater length than the cylinder 22.

The finishing cylinder 22 (Fig. 5) takes, preferably, the form of a cylindrical metallic head 39, upon the outer surface of which is mounted a thick cushion support sleeve 40 formed of rubber or other suitable resilient material. A cylindrical, seamless and flexible abrading element 41, which may be formed of any suitable abrasive material (such as cloth or paper), is mounted over the cushion sleeve 40 and is securely held in position thereon as will be described hereinafter. The abrading surface of the element 41 is, preferably, of a character adapted to apply a finished surface to the work without material corrective-grinding action, since size and shape requirements may be met in the turning operation. However, it is to be understood that the character of the abrading element may be varied for certain uses and to accomplish a substantial grinding action.

The right-hand end of the head 39, as viewed in Fig. 5, is provided with a laterally extending flange 42 against which the adjacent end of the rubber cushion sleeve 40 abuts. The head 39, at its opposite end, is internally threaded to receive a nut 43 having an enlarged head 44. A washer or disc 45 of a diameter slightly less than that of the cushion sleeve 40 is interposed between the nut head 44 and the adjacent end of such sleeve so that when the nut 43 is screwed inwardly it presses against such end of the cushion sleeve and compresses the latter axially causing it to expand radially and frictionally and positively grip and secure the abrading element 41 against removal. In this way, the abrasive element 41 is yieldingly supported providing a somewhat resilient abrading surface that engages the work being finished, whereby the finishing cylinder 22 may be rotated at high speed in engagement with the rotating piston (or other work) without vibration of the freely supported cylinder relative to the work. In other words, the resilient abrading surface tends to hug the work closely so as to apply the desired fine and polished finish.

The finishing cylinder 22 is rotatably supported by a pin 46 having one end secured by a nut 47 in a boss 48 formed in the upper end of the sprocket housing 31. Suitable bearing support for the grinding cylinder is provided by internal ball bearing units 49 and 50 locked in operative position between the grinding head 39 and pin 46 by lock nuts 51 and 52 that screw-threadedly engage the inner wall of the head 39. The inward end of the cylinder-support pin 46 is threaded at 53 for reception of a lock nut 51a which secures and holds such pin against longitudinal displacement.

The finishing cylinder 32 is rotatably driven, and,

preferably, in the same direction as the piston 17, by a sprocket drive (Fig. 5) including a sprocket wheel 54 disposed in the upper end of the sprocket housing 31 and having a hub 55 screw-threaded into the adjacent end of the head 39. The sprocket wheel 54 is connected to another sprocket wheel 56 in the lower part of the sprocket housing 31 by a sprocket chain 57 disposed vertically in such housing. The sprocket wheel 56 is fixedly secured to a hub-like sleeve 58 having an internal spline projection 59 engaging in a splineway 60 within a drive shaft 61. Ball bearing units 62 are dsiposed between the hub sleeve 58 and the sprocket housing 31 for a purpose which will be obvious.

The drive shaft 61 (Figs. 1 and 5) extends laterally through the tubular supporting shaft 35 and its outward end is rotatably supported by a suitable bearing 62a mounted within a bed-carried support 63. A drive pulley 64 is mounted on the outer end of drive shaft 61 and this pulley is connected by a belt 65 to another pulley 66 driven directly from the motor 67. When the motor 67 is cut in, the drive shaft 61 is rotated and it, in turn, rotates the finishing cylinder 22 through the sprocket structure above described. While the cylinder 22 is being thus rotated, the finishing unit as a whole may be rotated about its support toward and away from the work, or it may be moved axially or longitudinally of the work, the spline connection between the sprocket 56 and the drive shaft 61 permitting of the latter adjustment without disturbing the finishing operation of the unit.

The normal looseness of the parts supporting and driving the cylinder 22 provides a slight wabble action for the cylinder 22 in axial direction so that it may adjust itself to work surfaces slightly tapered (preferably, approximately .010 taper accommodation) in axial direction.

The exhaust fan 24 is driven by the drive shaft 61. More particularly, the hub sleeve 58 is extended laterally through the hub portion 34 of the sprocket housing 31 into the fan chamber 23, where it is fixedly secured, as at 68 to the fan hub 69. By driving the fan through the finishing cylinder driving mechanism, I insure operation of the exhaust fan at all times during the finishing operation. In this way, the operator in charge of the apparatus is protected against abrasive dust and other particles released during operation, the operating mechanism is kept clean and free from such dust and particles, and the abrading surfaces are kept free from dust, etc., thereby insuring a more positive, uniform and rapid finishing operation.

It is believed that the operation and advantages of my invention will be well understood from the foregoing. When the finishing unit is not in operation, it may be swung manually rearwardly away from the work by grasping a handle 70 at the top of the casing 21, at which time the motor 67 may or may not be at rest. When it is desired to use the finishing unit, the motor 67 may be started and the casing 21 is then swung forwardly so as to move the rotating finishing element 41 into engagement with the piston 17 (Fig. 4) which is being rotated by the spindle 13 in the same direction. It will be noted that the finishing unit is self-acting in its operative position, it being only necessary to swing the cylinder 22 or upper end of the casing 21 past center in its movement into engagement with the piston 17, so that the abrasive element 41 is held against the work under the pressure exerted by its own weight and the weight of the casing and housing 21, 31. If desired, the operator may increase or decrease the pressure of the abrading element against the work by actuating the handle 70. In this way, the finishing operation may be speeded up and, in some cases, the character of the finish may be varied.

In finishing pistons, the finishing cylinder 22 is, preferably, of a length approximately equal to the length of an average size piston (for example, approximately 4 inches), so that the entire piston surface may be ground without axial adjustment of the grinding tool (except in cases where slight axial reciprocating movement is desired for improved finishing operations). However, in cases where the piston, or other piece of work, is of greater length than the grinding cylinder, the unit as a whole may be adjusted axially of the work as the grindlng operation is carried on so that such work may be ground throughout in a substantially uniform manner. Also, in the use of a long abrading element of this character, the necessity of power feed therefor is eliminated, and likewise expensive parts that would be required for power feed operation. This feature additionally insures a faster finishing operation with a better finished surface, and it insures a longer life for the finishing element.

The grinding cylinder is, preferably, operated at a different rate of speed than the piston, but it is obvious that they may both be operated at the same speed without departing from my invention. The rotatably support feature of the grinding unit, as will be appreciated, permits the unit to be adjusted away from the work during the grinding operation at the convenience of the operator, for the purpose of making measurements and inspecting the surface of the object being worked upon. This feature also permits the finishing cylinder 22 to freely adjust itself to irregularities in the surface of the work, as well as to objects that are of oval or other out-of-round cross-section. Still further, it permits the cylinder 22 to self-adjust itself to circular objects of varying diameters.

It will also be appreciated that an object, such, for example, as a piston, may be true-ground in the use of my invention without danger of the finishing element digging into parts of the surface being ground or applying an unintentional angular grind to any parts of the surface, regardless whether the surface being ground is continuous, has cut-outs or other irregularities therein.

It is to be further understood that while I have shown only one form of structure embodying my invention, other changes in details and arrangements of parts may be made without departing from the spirit and scope of my invention as defined by the claims that follow. For example, the grinding unit may be used in connection with various forms of lathes with or without turning tools. It may be used in connection with machines capable of turning the work to a true cylindrical form, or machines capable of turning the work to an oval-shaped form, or work turned so that it tapers longitudinally of the axis thereof. The finishing unit may include work supporting means so that it may be used as a self-contained and independent unit. Also, if desired, the drive for the finishing cylinder 22 may be taken in any suitable fashion directly from the lathe or turning tool drive, instead of using a separate power means such as the motor 67.

I claim:

1. In a tool for finishing objects of the class described, a casing, a finishing cylinder in the upper end of said casing, said casing having an opening laterally of said cylinder and through which the periphery of the latter projects for engagement with the object to be finished, a suction fan in said casing, said casing being shaped to provide a suction chamber leading from said cylinder and casing opening to said fan, a receptacle carried by said casing and into which said fan discharges, and drive means including a single drive shaft for rotatably driving both said cylinder and fan.

2. In a tool for finishing objects of the class described, a casing, means supporting said casing at its one end for rotation of its other end toward and from the object, said means having its axis disposed laterally of the axis of the object, a finishing cylinder supported in said other end of said casing which has an opening through which the periphery of said cylinder projects to engage the object, an exhaust fan supported in said one end of said casing, said casing being shaped to provide a suction chamber leading from said cylinder and said casing opening to said fan, means for receiving material discharged by said fan, and a common drive means for rotating both said cylinder and fan.

3. A grinding unit for structure of the class described, comprising a casing, a supporting shaft fixed to and extending laterally of said casing, means supporting said shaft for both rotation and longitudinal slide movement, a finishing cylinder carried by said casing, suction means carried by said casing for carrying abrasive dust, abrasive particles, cuttings, and the like, away from said cylinder, power driving means, and connections leading from said power driving means to said cylinder and suction means, some of said connections being common to both said cylinder and said driving means.

4. A grinding unit for structure of the class described, comprising a casing, a tubular supporting shaft fixed to and extending laterally of said casing, means supporting said shaft for both rotation and longitudinal slide movement, a rotatable finishing cylinder carried by said casing, suction means carried by said casing for carrying abrasive dust, abrasive particles, cuttings and the like, away from said cylinder, power driving means, and connections leading from said power driving means and passing through said tubular shaft to said cylinder and suction means, some of said connections being common to both said cylinder and said suction means.

5. A grinding unit for apparatus of the class described comprising a casing, a tubular shaft extending from one end of said casing, means supporting said shaft for both rotary and longitudinal slide movements, a finishing cylinder rotatably mounted in said casing, said casing having an opening through which the periphery of said cylinder projects, a suction fan mounted in said casing, said casing being shaped to provide a suction chamber between said cylinder and said fan and which connects with said casing opening for entry thereinto of abrasive dust, cuttings and the like, as the grinding operation is carried on, and drive means passing through said shaft and connected with said cylinder and said fan for rotating the same.

6. A grinding unit for apparatus of the class described comprising a casing, a tubular shaft extending from said casing, means supporting said shaft for both rotary and longitudinal slide movements, a finishing cylinder rotatably mounted in said casing, said casing having an opening through which the periphery of said cylinder projects, a suction fan mounted in said casing, said casing being shaped to provide a suction chamber which connects with said casing opening for entry thereinto of abrasive dust, cuttings and the like, as the grinding operation is carried on, and drive means including a rotatable shaft passing through said tubular shaft and supporting said fan, and drive connections between said shaft and said cylinder for rotating the latter simultaneously with said fan.

7. A grinding unit for apparatus of the class described comprising a casing, a tubular shaft extending from said casing, means supporting said shaft for both rotary and longitudinal slide movements, a finishing cylinder rotatably mounted in said casing, said casing having an opening through which the periphery of said cylinder projects, a suction fan mounted in said casing, said casing being shaped to provide a suction chamber which connects with said fan and also said casing opening for entry thereinto of abrasive dust, cuttings and the like, as the grinding operation is carried on, and drive means including a rotatable shaft extending through said tubular shaft into said casing, means for rotating said rotatable shaft, means for mounting said fan upon said rotatable shaft, a cylinder drive member mounted on said rotatable shaft, and connections between said cylinder drive member and said cylinder for rotating the latter simultaneously with said fan.

8. A grinding unit for apparatus of the class described comprising a casing, a tubular shaft extending from said casing, means supporting said shaft for both rotary and longitudinal slide movements, a finishing cylinder rotatably mounted in said casing, said casing having an opening through which the periphery of said cylinder projects, a suction fan mounted in said casing, said casing being shaped to provide a suction chamber between said cylinder and said fan and which connects with said casing opening for entry thereinto of abrasive dust, cuttings, and the like, as the grinding operation is carried on, and drive means including a drive shaft extending through said tubular shaft and into said casing, means for rotating said drive shaft, a cylinder driving member, means, including a member having a slide connection with said drive shaft, for mounting said cylinder driving member upon said drive shaft, said first member also serving to secure said fan to said drive shaft with the latter free to shift longitudinally relative to said fan and said cylinder driving member, and connections between said cylinder and said cylinder driving member for rotating the latter as said fan is rotated.

HERMAN W. ZIMMERMAN.