Nov. 29, 1955 A. M. URQUHART 2,724,934

TILT BELT GRINDER

Filed June 15, 1953 5 Sheets-Sheet 1

Fig. 1.

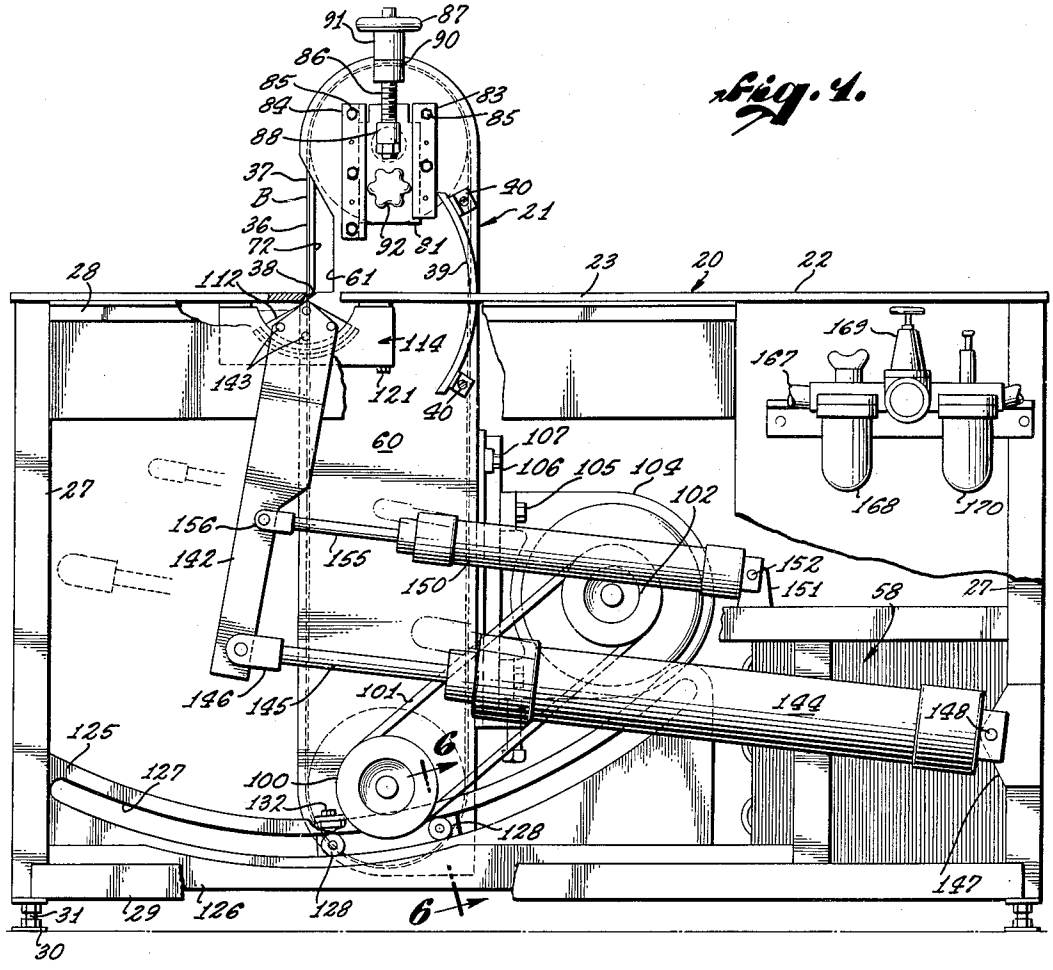


Fig. 4.

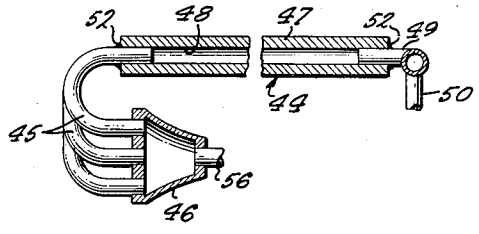
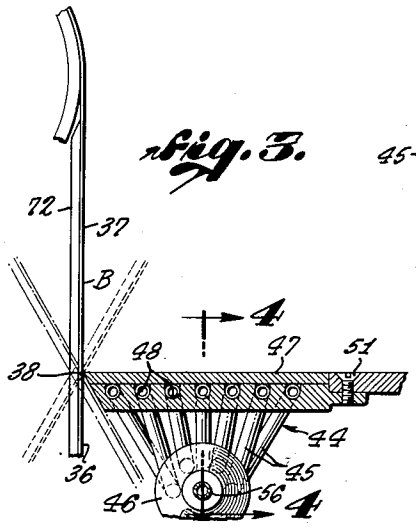


Fig. 3.



ARCHIBALD M. URQUHART,
INVENTOR.

BY George V. Smyth.

ATTORNEY.

Nov. 29, 1955 A. M. URQUHART 2,724,934

TILT BELT GRINDER

Filed June 15, 1953 5 Sheets-Sheet 2

Fig. 2.

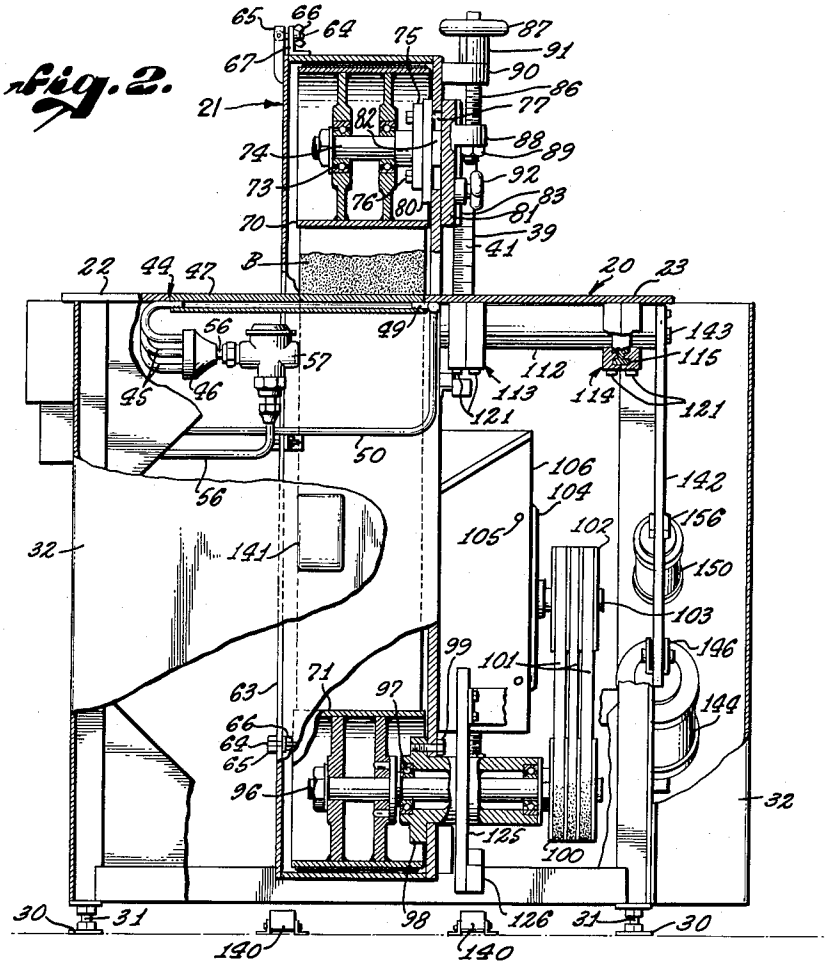


Fig. 6.

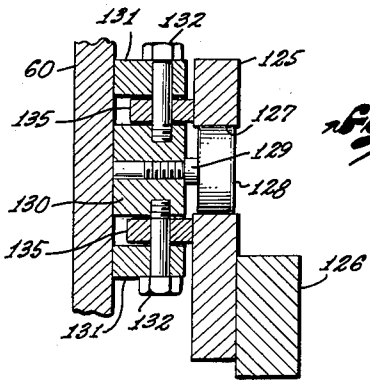
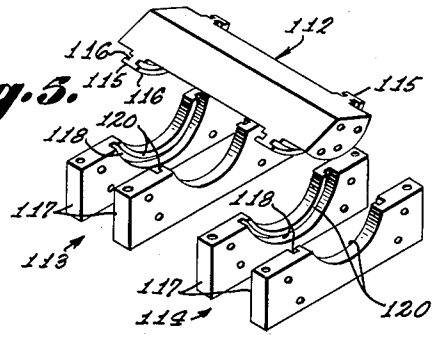


Fig. 5.



ARCHIBALD M. URQUHART,
INVENTOR.

BY George J. Smyth.

ATTORNEY.

Nov. 29, 1955 A. M. URQUHART 2,724,934

TILT BELT GRINDER

Filed June 15, 1953 5 Sheets-Sheet 3

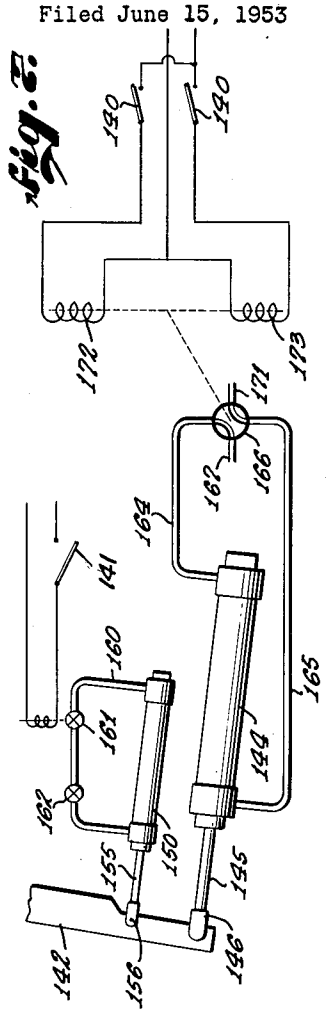


Fig. 2.

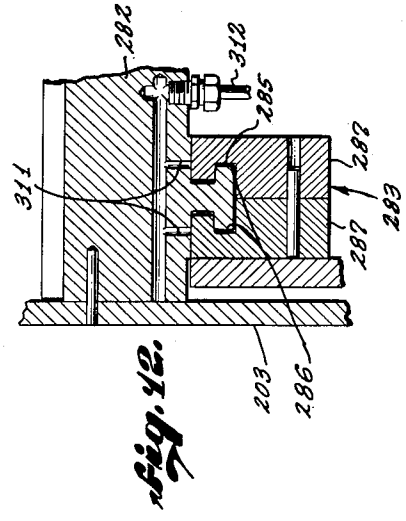


Fig. 12.

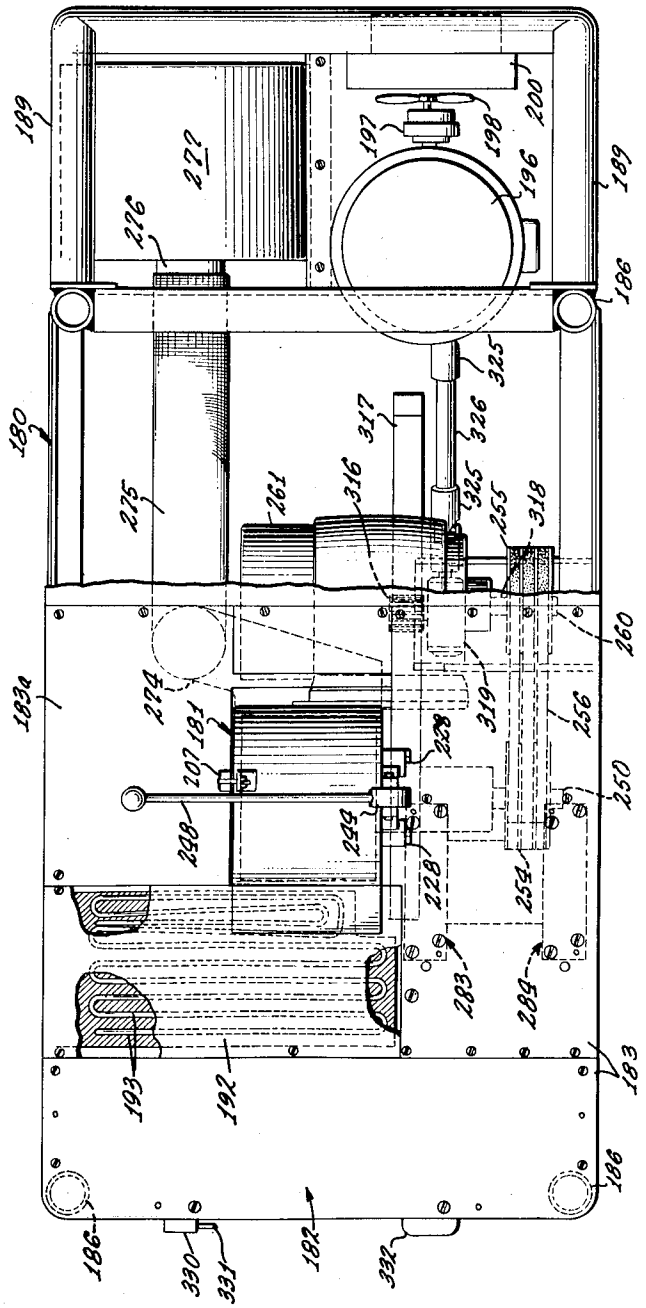


Fig. 14.

ARCHIBALD M. URQUHART,
INVENTOR.

BY George J. Smyth

ATTORNEY.

Nov. 29, 1955 A. M. URQUHART 2,724,934

TILT BELT GRINDER

Filed June 15, 1953 5 Sheets-Sheet 4

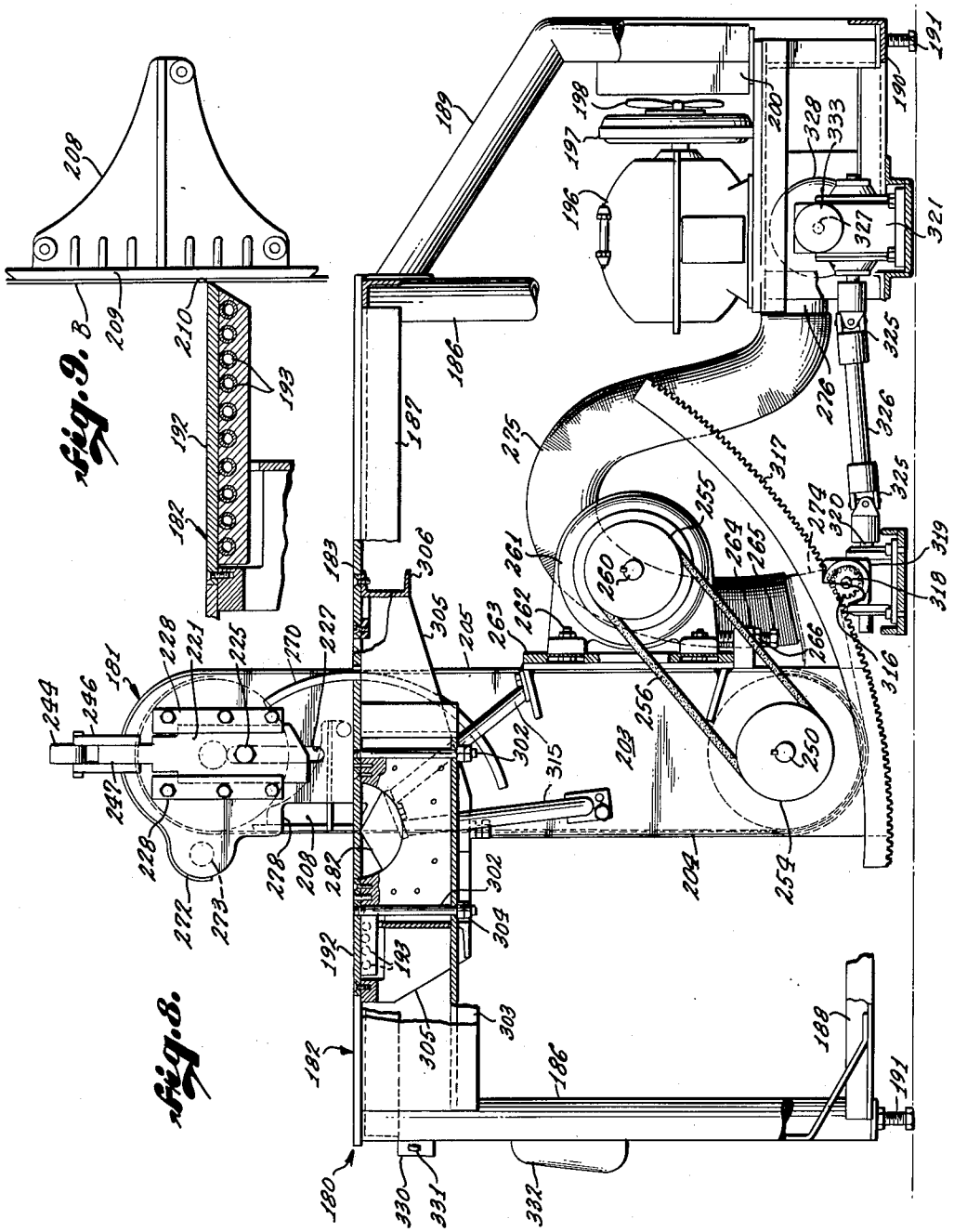


Fig. 8.

Fig. 9.

ARCHIBALD M. URQUHART,
INVENTOR.

BY George J. Smyth.

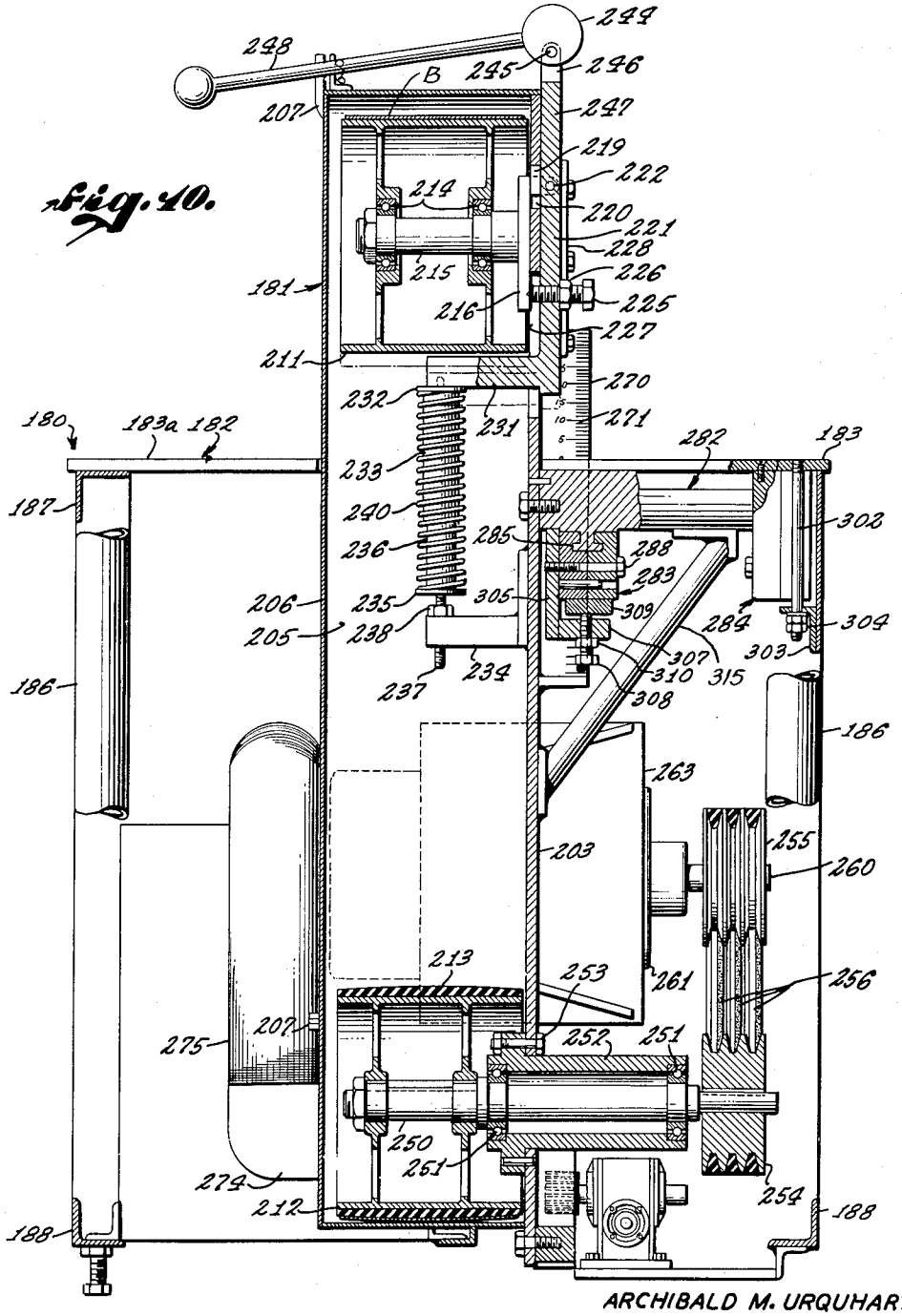
ATTORNEY.

Nov. 29, 1955 A. M. URQUHART 2,724,934

TILT BELT GRINDER

Filed June 15, 1953 5 Sheets-Sheet 5

Fig. 10.



ARCHIBALD M. URQUHART,
INVENTOR.

BY George V. Smythe.

ATTORNEY.

United States Patent Office 2,724,934 Patented Nov. 29, 1955

2,724,934

TILT BELT GRINDER

Archibald M. Urquhart, El Segundo, Calif., assignor of one-half to Sierra Machinery Co., Inc., Reno, Nev., a corporation

Application June 15, 1953, Serial No. 361,605

16 Claims. (Cl. 51—142)

This invention relates to grinders for abrasive action on work pieces and more particularly refers to an apparatus that incorporates an abrasive belt to carry out the grinding operation. The invention contemplates the provision of a work supporting surface to support work pieces and the further provision of means to vary the angle of the abrasive belt relative to the work surface.

One problem in the construction of a grinding apparatus of this general character is to prevent excessive heating of the work pieces and of the apparatus itself by the friction involved in the abrasive action on the work pieces. This problem is solved in part by using an abrasive belt which by its motion tends to dissipate generated heat. A feature of the preferred practice of the invention, however, is that this problem is completely solved by a cooling system to absorb heat from the work supporting surface in the region of the traveling belt. Preferably the cooling system is a refrigeration system having an evaporator unit adjacent the work supporting surface of the apparatus.

A second problem is to provide an arrangement for supporting the running belt at various angles relative to the work supporting surface in such manner as to facilitate precision in the grinding of work pieces. In this regard a feature of the invention is the concept of using a tilt structure on which the belt is mounted and which rotates about an axis located substantially at the line of intersection of the abrasive surface of the belt with the plane of the work supporting surface. In the preferred practice of the invention the work surface terminates in a relatively sharp straight edge substantially at this line of intersection and the tilt structure carries an arcuate scale intersecting the plane of the work supporting surface to indicate the angle of the traveling belt relative to the work supporting surface.

A third problem is to pivotally mount the tilt structure in such manner as to facilitate replacement of the abrasive belt when required. The solution afforded herein is to pivotally support the tilt structure from one side only, the other side being clear to permit a belt to be installed or removed with maximum convenience and minimum delay. Preferably means is included to keep the belt normally under tension and a feature of certain practices of the invention is the provision of quickly operable means to release such tension thereby to facilitate the removal of one belt and the installation of a replacement belt.

A fourth problem is to keep the pivotal mounting means for the tilt structure below the plane of the work supporting surface at all angles of the tilt structure, thereby to avoid interference with work pieces on the work supporting surface along the axis of rotation of the tilt structure. In this regard, the invention is characterized by the use of a trunnion on the tilt structure and a cooperating stationary bearing member, both of which members have the cross sectional configuration of a segment of a circle of an arcuate extent of less than half of the circle. By virtue of this semi-circular configuration, the axis of the bearing may be in the plane of the work supporting surface with all of the structure of the bearing below the plane. A feature of the bearing arrangement in the preferred practice of the invention is the provision of cooperating arcuate shoulders on the two members to prevent separation of the trunnion member from the bearing member.

A fifth problem is to adapt such an apparatus for the rapid grinding of work pieces on which the desired ground surfaces of the work piece progressively change in angle along the work piece. To process such a work piece the angle of the tilt structure must be progressively changed as the work piece is progressively shifted on the work supporting surface relative to the abrasive belt. For accurate grinding, both of the operator's hands are required to hold the work piece in position, neither hand being free to change the angle of the tilt structure. The problem is met, first, by providing power means to vary the rotary position of the tilt structure and, second by providing remote control means operable by movement of the operator's leg to change the tilt angle by small increments as the operator manipulates the work piece relative to the abrasive belt. The power means is, of course, reversible and preferably is adapted to be set in advance to operate in either of the two opposite directions of tilt change. The preferred practice of the invention is further characterized by the inclusion of automatic means to releasably hold the tilt structure at any angle to which it may be adjusted.

A sixth problem is to prevent the accumulation on the work supporting surface of particles released by the abrasive action and to keep such particles from being released into the atmosphere. In this regard, the preferred practice of the invention is further characterized by the use of a blower system to remove the particles, the blower system including a shroud on the tilt structure enclosing the traveling belt.

The features and advantages of the invention entering into the solution of these various problems may be understood from the following detailed description of preferred embodiments of the apparatus considered in conjunction with the accompanying drawings.

In the drawings, which are to be regarded as merely illustrative:

Figure 1 is a side elevation of one embodiment of the invention with parts broken away to reveal concealed structure;

Figure 2 is a front elevation of the same embodiment of the invention with parts broken away and other parts shown in section;

Figure 3 is a fragmentary sectional view to indicate the manner in which the angle of the traveling belt changes relative to the work surface when the tilt structure is rotated to various positions;

Figure 4 is a fragmentary section taken as indicated by the line 4—4 of Figure 3;

Figure 5 is an exploded perspective view of the essential parts of the structure for pivotally supporting the tilt structure;

Figure 6 is an enlarged fragmentary section taken as indicated by the line 6—6 of Figure 1;

Figure 7 is a diagram illustrating the arrangement for controlling the angle of the tilt structure in the first embodiment of the invention;

Figure 8 is a view partly in side elevation and partly in section showing a second embodiment of the invention;

Figure 9 is a detail, partly in section and partly in side elevation, showing the structure in the region in which the traveling belt intersects the plane of the work supporting surface in the second embodiment of the invention;

Figure 10 is a view of the second embodiment of

the invention, partly in front elevation and partly in section;

Figure 11 is a plan view of the second embodiment of the invention with parts broken away, and

Figure 12 is an enlarged fragmentary section of the bearing structure for the tilt structure in the second embodiment of the invention.

The working parts of the first embodiment of the invention illustrated by Figures 1 to 7 are carried in part by a fixed base structure, designated as a whole by numeral **20**, and in part by a tilt structure, designated as a whole by numeral **21**. These two structures make take various forms in various practices of the invention.

The base structure **20** has the general character of a work table and has a horizontal work supporting surface **22**, which work supporting surface is provided by a plurality of top plates **23** lying in a common plane. The base structure **20** includes upright angle members **27** at the four corners which are interconnected by frame elements including upper horizontal angles **28** and lower horizontal angles **29**. Preferably this frame structure is supported by four adjustable legs at the four corners, each of which legs comprises a foot pad **30** on an adjustable screw **31**. Preferably the framework of the base structure **20** is closed on all sides by a heavy sheet metal housing **32** that is suitably attached to the framework.

The tilt structure **21** carries an endless abrasive belt B and causes the belt to travel in a straight run or operating path **36** at the front of the tilt structure with the abrasive surface **37** of the belt facing forward as shown in Figure 2. Preferably the work supporting surface of the base structure **20** provided by the plates **23** terminates closely adjacent to the forward abrasive surface **37** of the belt B and preferably the plate material is beveled to form a relatively sharp edge **38**. It is contemplated that the tilt structure **21** will be mounted on the base structure **20** to rotate about an axis in the region of the intersection of the operating run or path **26** of the belt and the plane of the work surface **22** of the base structure. In the preferred practices of the invention as exemplified by the present embodiment, the axis of rotation of the tilt structure **21** substantially coincides with the intersection of the abrasive surface **37** of the belt and the plane of the work supporting surface **22**, and the beveled edge **38**, which is in that plane, is substantially at this intersection. Thus, in effect, rotation of the tilt structure **21** rotates the abrasive surface **37** of the belt about the beveled edge **38**.

Preferably a suitable scale or index means is provided to indicate the angle of adjustment of the tilt structure. Such a scale may, for example, be in the form of an arcuate bar **39** concentric to the axis of rotation. The bar **39**, as best shown in Figures 1 and 2, is mounted on the side of the tilt structure by suitable brackets **40**, and the top of the base structure **20** is apertured to clear the bar. The bar **39** may be marked with a graduated scale **41** (Figure 2) to be read with reference to the work supporting surface **22**, the scale being calibrated in terms of degrees of rotation.

As heretofore stated, it is further contemplated that a cooling system will be provided in the preferred practices of the invention to absorb heat created by the abrasive action of the belt B on work pieces. Any suitable cooling system may be employed for this purpose. In the present embodiment of the invention, the cooling system is a refrigeration system which includes an evaporator or cooling unit **44** best shown in Figures 3 and 4. The unit comprises a series of coils **45** which extend from a manifold **46** to two-plate member **47**, the two-plate member forming the portion of the work surface **22** in the region immediately in front of the belt B. The two-plate member **47** is provided with fluid passages in the form of bores **48** to receive the refrigerant from the coils **45** and these passages are connected by corresponding return flow tubes **49** with a return flow pipe **50**. The two-plate member **47** is removably anchored to the adjacent top plates **23** by suitable screws **51** and the various tube ends are bonded to the two-plate member in a fluid-tight manner by welding as indicated at **52** in Figure 4. In a well known manner, a motor driven compressor (not shown) is connected by a tube **56** to an expansion valve **57** (Figure 2) that discharges into the manifold **46**, and the return flow pipe **50** from the cooling unit is connected to the usual condenser **58** (Figure 1).

The tilt structure **21** includes a heavy side plate **60** which serves not only as a frame member to support the various parts, but also serves as one side of a shroud. The shroud encloses the belt B on all sides and is provided with a window **61** to expose the operating run of the belt in the region of the beveled edge **38**. The shroud structure includes a wall member **62** that extends from the lower edge of the window **61** around the front, bottom, back and top of the tilt structure and also includes a side wall member **63** opposite from the heavy side plate **60**. This side wall member **63** is removable and is normally held in position by suitable releasable fastening means. As shown in Figure 2, the fastening means may comprise screws **64** pivotally mounted on brackets **65** on the removable wall member **63**, which screws carry wing nuts **66** to engage slotted clips **67** on the permanent wall member **62**. A feature of this embodiment of the invention is that this side of the tilt structure **21** is clear and unencumbered so that it is merely necessary to loosen the wing nuts **66** and remove the side wall member **63** to make the entire interior of the tilt structure accessible for quick removal and replacement of the abrasive belt B.

The belt B is looped around an upper idler drum or pulley **70** and a lower driven drum or pulley **71**, and preferably the operating run **36** of the belt is backed by suitable structure such as a backing plate **72** (Figures 1 and 3) that is fixedly mounted on the heavy side plate **60** inside the shroud. The upper pulley **70** is mounted by suitable bearings **73** on a spindle **74** that is integral with a base plate **75**. The base plate **75** that carries the spindle is mounted by screws **76** on a slide assembly that is movable in an upright slot **77** in the heavy side plate **60**. This slide assembly includes an inner plate **80** on the inner side of the slot and an outer slide member **81** which is connected to the inner plate by a block **82** in the slot **77**. The outer slide member **81** is guided by two slide rails **83** and **84** that are mounted on the outer side of the heavy side plate **60** by suitable screws **85**.

The outer slide member **81** may be controlled by a screw **86** having an operating handle **87**, and for this purpose the slide member **81** is formed with an ear **88** that is threaded for engagement by the screw. Preferably a lock nut **89** is mounted on the lower end of the screw. The screw **86** is freely rotatable in an ear **90** on the heavy side plate **60** and is of enlarged diameter at its upper end as indicated at **91** for engagement with the upper side of the ear. Preferably, a clamping screw **92** having an operating knob, as shown, is mounted in the outer slide member **63** for retractible engagement with the heavy side plate **60**. This screw **92** serves to releasably retain the slide assembly in adjusted position as a further precaution against loosening of the belt B. It is apparent that this arrangement for varying the spacing of the upper pulley **70** from the lower pulley **71** permits corresponding variation in the dimensions of belts used with the apparatus and makes it possible to place a belt under whatever tension may be desired.

The lower drive pulley **71** may be mounted on a shaft **96** that is journaled by suitable bearings **97** in a cylindrical bearing member **98**. The bearing member **98** extends through the heavy side plate **60** and is attached thereto by suitable screws **99**. The outer end of the shaft **96** carries a sheave **100** which is operatively connected by a

multiple V-belt **101** with a drive sheave **102**. The drive sheave **102** is mounted on the shaft **103** of a suitable motor **104**. As best shown in Figure 1, the motor **104** is mounted by screws **105** on a base casting **106** and the base casting **106** is, in turn, mounted on the outside of the tilt structure shroud by suitable screws **107**.

The tilt structure **21** may be pivotally mounted on the base structure **20** in various ways in various practices of the invention. In this instance, the tilt structure is pivotally supported entirely from one side so that the opposite side may be free and unencumbered to permit quick replacement of a belt in the manner heretofore described. A feature of the illustrated construction is the manner in which the tilt structure is mounted for rotation about the beveled edge **38** as an axis without any portion of the pivotal mounting structure extending above the plane of the work supporting surface **22**. Such an arrangement permits full freedom for use of the work surface **22** on both sides of the tilt structure **21**, as well as in front of the tilt structure.

In the present construction, the tilt structure **21** is supported entirely by a single journal body or trunnion member **112** which is rigidly mounted on the heavy side plate **60** of the tilt structure. It is contemplated that the trunnion member will have the cross-sectional configuration of a segment of a circle having an arcuate extent of less than 180°, the segment being truncated to space the trunnion member radially away from the pivot axis along the beveled edge **38**. It is further contemplated that the trunnion member **112** will be journaled by at least one bearing member that is also segmental in cross sectional configuration and has an arcuate extent of not more than approximately 180°. It is apparent that with such a segmental trunnion member mounted in a segmental bearing member, both members may be positioned below the plane of the work supporting surface **22**, without the trunnion member rocking into the plane of the work supporting surface throughout the required range of pivotal movement of the tilt structure **21**. Since both the trunnion member and the associated bearing member lie below the horizontal plane of the axis of rotation of the tilt structure, the problem presents itself of maintaining the trunnion member in seated engagement with the bearing member. For this purpose, the two members are provided with mutually engaging arcuate shoulders and for this purpose preferably one of the members is formed with an arcuate groove to receive an arcuate flange of the other member. Various specific constructions may be employed to carry out this concept.

In the present embodiment of the invention, as may be seen in Figure 2, the trunnion member **112** is journaled in an inner bearing member **113** close to the tilt structure **21** and in an outer bearing member **114** close to the side of the base structure **20**. As best shown in Figure 5, the trunnion member **112** is formed with two arcuate ribs **115** corresponding to the two bearing members **113** and **114** and each of these ribs is grooved to form a pair of arcuate peripheral flanges **116**. Each of the two bearing members **113** and **114** is of split construction, being formed of separable sections **117**. Each pair of the separable sections **117** forms an arcuate groove **118** to receive the corresponding rib **115** of the trunnion member and the groove **118** is formed with overhanging arcuate walls or flanges to engage the rib flanges **116**. Thus, the rib flanges **116** and the overhanging walls or flanges **120** of the bearing members constitute arcuate shoulders in mutual engagement to maintain the trunnion member **112** seated in the two bearing members **113** and **114**. The separable section **117** of each bearing member are held together by suitable screws and each of the sections is attached to the underside of one of the top plates **23** by suitable bolts **121**.

If desired, means in addition to the trunnion **112** and the two bearings **113** and **114** may be provided to guide and support the tilt structure **21** in its movement about its axis of rotation. For this purpose, guide means in the form of a heavy upright plate **125** may be mounted inside the base structure **21** and supported by a heavy horizontal frame member **126**. The upright plate **125** is provided with an arcuate slot **127** concentric to the axis of rotation to receive a pair of rollers **128** carried by the tilt structure. As shown in Figure 6, the two rollers **128** are mounted on spindles **129** carried by a block **130** and the block **130** is attached to ears **131** that are fixedly mounted on the heavy side plate **60** of the tilt structure. In the construction shown, the block **130** is secured by suitable screws **132** that extend through the ears **131** and through shims **133** into threaded engagement with the block.

Preferably additional guide rolls carried by the tilt structure engage the opposite sides of the upright plate **125**. For this purpose suitable rollers may be mounted on brackets or arms extending from the previously mentioned bearing member **98** on opposite sides of the upright plate **125**. Figure 1 shows one such arm or bracket **134** carrying a guide roller **135** in rolling contact with the outer surface of the upright plate **125**.

Any suitable means may be provided for locking the tilt structure **21** to various angles of tilt about its axis of rotation but preferably suitable power means is utilized under remote control and preferably the arrangement permits control to be exercised by movement of the operator's leg so that he may change the angle of tilt of the traveling belt B without taking his hands off a work piece on the work supporting surface **22**. In the present embodiment of the invention, for example, the direction in which the power means operates to change the inclination of the tilt structure **21** is determined in advance by a pair of foot switches **140** located at the front of the machine at positions convenient for the operator. Energization of the power means to rotate the tilt structure is controlled by what may be termed a knee switch **141** which is mounted on the front of the base structure in a position to be actuated by the operator's knee.

In the construction shown in the drawings, an operating arm **142** that is attached to the outer end of the trunnion **112** by suitable screws **143**, is actuated by compressed air supplied to a power cylinder **144**. The power cylinder **144** houses the usual piston (not shown) which is connected to the operating arm **142** by a piston rod **145** that terminates in a clevis **146**. The power cylinder **144** is pivotally mounted at its rear end to a fixed bracket **147** by a suitable pin **148** to rock vertically as required to follow the arcuate movement of the operating arm **142**.

The operating arm **142** of the tilt structure is connerted in similar manner to a hydraulic cylinder **150** which is pivotally mounted on a second bracket **151** by a suitable pin **152**. The hydraulic cylinder **150** also houses a piston (not shown) which is connected to the operating arm **142** by a piston rod **155** that terminates in a clevis **156**. The manner in which the power cylinder **144** and the hydraulic cylinder **150** cooperate for control of the angle of inclination of the tilt structure **21** may be understood by reference to the diagram in Figure 7.

The two ends of the hydraulic cylinder **150**, which cylinder may contain a suitable oil, are interconnected by a by-pass tube **160** through which the liquid flows under the control of a by-pass valve **161** and a metering valve **162**. The by-pass valve **161** is normally closed to block by-pass flow and thus lock the operating arm **142** in any position to which the arm may be adjusted. The by-pass valve **161** is a solenoid valve controlled by the knee switch **141**, the valve being normally closed and the knee switch being normally open.

The opposite ends of the power cylinder **144** are connected by pipes **164** and **165** respectively with opposite ports of a 4-way control valve **166**. A third port of the control valve **166** is connected by a pipe **167** to a pressure regulator **168** (Figure 1), which regulator is

in turn connected to a suitable source of compressed air (not shown). Preferably the supply line through the pressure regulator **168** is provided with a suitable trap **169** for the removal of water and dirt and is also provided with a suitable device **170** to introduce oil into the air stream. The fourth port of the control valve **166** is connected to a pipe **171** for exhaust into the atmosphere.

The 4-way control valve **166** is a two-position valve of a well-known type that is adapted for rotation to its two alternate positions by a pair of opposed solenoids **172** and **173**. When either of the two solenoids is energized the control valve is rotated to the corresponding position and remains in that position until the other solenoid is energized. As shown in Figure 7, the solenoid **172** is controlled by one of the two foot switches **140** and the solenoid **173** is controlled by the other foot switch. Energization of the solenoid **172** places the pipe **164** in communication with the high pressure source and energization of the solenoid **173** places pipe **165** in communication with the high pressure source.

The manner in which the apparatus operates may be readily understood from the foregoing description. The motor **104** is energized under the control of a suitable switch (not shown) to drive the belt B continuously. With the tilt structure **21** inclined at the desired angle for processing a work piece on the work supporting surface **22**, the operator anticipates the direction in which the tilt structure is to be rotated for the next adjustment of the abrasive belt relative to the angle of the work supporting surface **22** and presses the corresponding foot switch of the pair of foot switches **140**. This switch action "sets" the power cylinder **144** for the anticipated rotation of the tilt structure by positioning the 4-way control valve **166** to connect one of the two ends of the power cylinder **144** with the source of compressed air. As a result, the compressed air in the power cylinder exerts force tending to rock the operating arm **142** in the anticipated direction, but the operating arm is prevented from responding to this pressure because the by-pass valve **161** is closed to prevent movement of the piston in the hydraulic cylinder **150**.

When the operator needs the anticipated change in inclination of the tilt structure **21**, he merely presses his knee against the switch **141** to open the by-pass valve **161** to release the hydraulic lock and thus permit the power cylinder **144** to shift the operating arm **142**. The metering valve **162** in the by-pass line **160** may be adjusted to regulate the responsive movement of the operating arm **142** at whatever rate may be desired. For accuracy, the rate should be relatively slow so that small changes in the tilt angle may be made with precision under the guidance of the arcuate scale **39**.

The apparatus is especially advantageous for the grinding of a surface on a work piece that progressively changes in angle relative to the work supporting surface **22**. For example, the work piece may be a flat member having one longitudinal edge which is to change progressively in angle along the length of the work piece. To carry out the required grinding operation, the operator divides the length of the work piece into small subdivisions, say, subdivisions approximately an inch or less in length, and divides the over-all change in angle into increments corresponding to the subdivisions. With such planning in advance, the operator adjusts the tilt structure to the required initial angle and presses one of the foot switches **140** in accord with the anticipated direction of change of the angle. The operator then grinds the first subdivision of the work piece in accord with the initial setting of the tilt structure and then operates the knee switch **141** to swing the tilt structure to the next angle under guidance of the scale **41** to carry out the grinding operation over the next subdivision. Thus, with both hands on the work piece, the operator is able to carry out the grinding operation progressively and accurately from one end of the work piece to another. The subdivisions may be as small as necessary to provide the progressive change in the angle of the ground surface of the work piece.

Since the work supporting surface **22** extends all around the tilt structure **21**, and since the tilt structure is of relatively small dimensions in plan, the apparatus may be used to process work pieces that are relatively extensive in length and breadth and are irregular in shape. The described bearing assembly for pivotally supporting the tilt structure makes it possible to provide such an extensive work supporting surface free from obstacles.

Whenever it is necessary to gain access to the interior of the tilt structure, it is a simple matter to remove the wall member **21** from the side of the shroud and to remove the adjacent plate of the plurality of top plate **23**. It is a simple matter, therefore, to remove a worn abrasive belt and to install a replacement belt with minimum loss of production time.

The second embodiment of the invention shown in Figures 8 to 12 comprises a base structure, designated as a whole by numeral **180**, and a tilt structure, designated as a whole by numeral **181**, these two structures being of the same general character as in the first embodiment of the invention. The work supporting surface **182** of the base structure is formed by a plurality of top plates **183** supported by a suitable frame structure. The frame structure includes four heavy tubular upright members **186** interconnected by upper horizontal angles **187** and by lower horizontal angles **188**. At the rear end of the base structure, an auxiliary framework including tubular members **189** and angles **190** is provided to support certain components of the apparatus. Preferably the base structure **180** is mounted on short adjustable legs **191** as in the first embodiment.

As best shown in Figure 9, the work supporting surface **182** immediately in front of the tilt structure **181** is provided by a two-plate member **192** that incorporates a plurality of evaporator coils **193** to absorb heat from the work supporting surface. The evaporator coils **193** are part of a conventional refrigeration system which includes a motor **196**, a compressor **197**, a fan **198**, and a condenser **200**.

Here again the tilt structure **181** includes a heavy side plate **203** which is one side of a shroud having a front wall **204**, a rear wall **205**, and a removable side wall member **206** which is releasably held in place by suitable fastening devices **207**. To gain access to the interior of the shroud for the purpose of changing the abrasive belt B, it is merely necessary to remove the top plate **183***a* (Figure 11) adjacent the tilt structure and then to remove the side wall member **206**.

The tilt structure **181** may be provided with the usual means to back up the abrasive belt B adjacent the work supporting surface **182**. As best shown in Figure 9 such means may comprise a casting **208** inside the shroud having a plate portion **209** positioned in contact with the inner surface of the abrasive belt.

As best shown in Figure 9, the work supporting surface **182** of the base structure **181** terminates in a beveled edge **210** close to the abrasive surface of the belt B and the tilt structure is adapted to rotate about an axis that closely approximates the beveled edge **210**. The belt B passes over an upper idler pulley **211** and passes under a lower drive pulley **212** which preferably is encased by a rubber peripheral member **213**. The upper idler pulley **211** is mounted by suitable bearings **214** on a spindle **215** and the spindle in turn is mounted on an adjustment plate **216**. The adjustment plate **216** has a lateral projection **219** which extends through a slot **220** in the tilt structure side plate **203** and which is pivotally connected to an outer slide bracket **221** by a suitable pivot pin **222**. Threaded into the outer side bracket **221** is an adjustment screw **225** carrying a lock nut **226**.

The adjustment screw 225 extends through a lower slot 227 in the heavy plate 203 to bear against the adjustment plate 216. It is apparent that adjustment of the screw 225 controls the angle of the adjustment plate 216 about the axis of the pivot pin 222 and thus controls the angle of the axis of the idler pulley 211 relative to the tilt structure side plate 203. The outer slide bracket 221 is slidingly retained by a pair of guide rails 228 for vertical movement to vary the spacing of the idler pulley 211 from the driven pulley 212.

A feature of this second embodiment of the invention is that the idler pulley 211 is normally urged upward in a yielding manner to maintain the belt under tension with manually operable means available to retract the pulley downward whenever it is necessary to replace the belt. To provide this feature, the outer slide bracket 221 is provided with an arm 231 that extends inward through the slot 227 and carries at its inner end both a disc 232 and a downwardly extending tube 233. Mounted on the inner face of the tilt structure side plate 203 is a bracket 234 carrying a second disc 235 as well as an upwardly extending tube 236 that slidingly telescopes into the first tube 233. The disc 235 is adjustable relative to the bracket 234 and for this purpose is mounted on the upper end of an adjustment screw 237, the screw being threaded into the bracket and carrying a suitable lock nut 238. A suitable helical spring 240 surrounds the two telescoped tubes 233 and 236 in compression between the two discs 232 and 235 to urge the outer slide bracket 221 upward. The pressure exerted by the spring may be varied by adjustment of the screw 237 carrying the lower disc 235.

Downward retraction of the idler pulley 211 against the opposition of the spring 240 may be accomplished by a cam 244. The cam is in the form of disc mounted eccentrically on a pivot pin 245, which pivot pin is carried by a pair of ears 246 fixedly mounted on the shroud of the tilt structure. A finger 247 extends upward from the outer slide bracket 221 between the two ears 246 for co-operation with the cam 244. The cam 244 carries a suitable operating lever 248 which is normally in the position shown in Figures 10 and 11 with the cam 244 rotated upward away from the finger 247. When the operating lever 248 is swung 180° clockwise from the position shown in Figure 10, the cam 244 acting on the end of the finger 247 depresses the outer slide bracket 221 against the opposition of the spring 240 to permit the belt B to be removed from the two pulleys for replacement by a fresh belt.

The lower drive pulley 212 is carried by a shaft 250 that is journaled in a pair of bearings 251 in a cylindrical bearing member 252. The bearing member 252 extends through the tilt structure side plate 203 and is attached thereto by suitable means including screws 253. Mounted on the outer end of the shaft 250 is a sheave 254 which is operatively connected to a second sheave 255 by a multiple V-belt 256. The second sheave 255 is on the shaft 260 of a motor 261 which motor is mounted by suitable screws 262 to a base casting 263 on the exterior of the tilt structure. Preferably the screws 262 extend through suitable slots (not shown) in the base casting to permit adjustment of the motor relative to the base casting for the purpose of adjusting the tensioning of the multiple V-belt 256. Preferably the base casting 263 is formed with at least one ear 264 through which extends corresponding adjustment screws 265 bearing against the under side of the motor 261. It is apparent that with the screws 262 loosened the adjustment screw or screws 265 may be manipulated to change the position of the motor 261. Preferably the adjustment screws 265 are provided with suitable lock nuts 266.

The tilt structure 181 is provided with the usual arcuate index member 270 having a scale 271 thereon calibrated in terms of degrees. In this embodiment of the invention the tilt structure also includes a hood or lamp housing 272 incorporated in the shroud to accommodate a lamp 273 for illuminating the work surface in front of the belt B.

A further feature of this embodiment of the invention is the provision of a blower system to carry away particles released by the abrasive action of the belt B. For this purpose the lower closed end of the shroud that surrounds the belt is provided with a rearward extension 274 which serves as a discharge chamber and is connected to one end of a flexible suction duct 275. The other end of the suction duct 275 is connected to the intake 276 (Figure 11) of a centrifugal blower 277. By virtue of this arrangement, a continuous stream of air enters a window 278 in the shroud where the belt is exposed for its abrasive operation and the air stream sweeps downward through the shroud to draw released particles through the shroud. The circulation of air in this manner also serves the useful purpose of dissipating part of the heat generated by the abrasive action of the belt.

The tilt structure 181 is pivotally mounted on the base structure 180 by means of a trunnion member 282 and two spaced bearing members 283 and 284. The trunnion member 282 is of the same construction as the trunnion member 112 in the first embodiment of the invention and the two bearing members 283 and 284 are of the same construction as the corresponding bearing members 113 and 114 in the first embodiment. Thus, the trunnion member 282 has a flange peripheral rib 285 corresponding to each of the two bearing members and each of the two bearing members is formed with a groove 286 of the required cross-sectional configuration for engagement with the corresponding trunnion rib 285. Each of the two bearing members 283 and 284 comprises two separable sections 287 interconnected by suitable means including screws 288.

The outer bearing member 234 may be braced on two sides by threaded rods 302. The upper ends of the two brace rods 302 are threaded into one of the top plates 183 and the lower ends extending through a horizontal angle 303 carry nuts 304 for engagement with the angle.

The inner bearing member 283 is mounted on a vertical plate 305 which is braced at its rear end by a transverse channel member 306. As best shown in Figure 10, a block 307 fixedly mounted on the vertical plate 305 at its lower edge may carry an adjustment screw 308. This adjustment screw exerts upward pressure on the inner bearing member 283 by means of an interposed pressure plate 309. Preferably the adjustment screw 308 carries a suitable lock nut 310.

Preferably a lubrication system is provided for the described bearing arrangement. For this purpose the trunnion member 282 may be provided with suitable bores 311 (Figure 12) associated with each of the two bearing members 283 and 284. The bores 311 are supplied with lubricant by a flexible tube 312 and communicate with the coacting bearing surfaces as shown.

The trunnion member 282, which may be attached to the tilt structure side plate 203 by a plurality of screws 314, is preferably reinforced by a pair of diagonal braces 315. The lower ends of the diagonal braces are mounted on the heavy side plate 203 of the tilt structure and the upper ends are connected to the trunnion member 282 between the two bearing members 283 and 284.

In this second embodiment of the invention, the tilt structure 181 is rotated from one angle of inclination to another by means of a power actuated pinion 316 in engagement with an arcuate rack 317 on the lower end of the tilt structure. The pinion 316 is mounted on a shaft 318 that extends from reduction gearing in a gear case 319. The reduction gearing in the gear case 319 is driven by a shaft 320 which is operatively connected to a second set of reduction gearing in a second gear case 321. The operative connection between the two gear cases comprises two universal joints 325 and an

intermediate shaft section 326. The reduction gearing in the second gear case 321 is connected by a shaft 327 to a suitable motor 328. It is apparent that energization of the motor 328 will actuate the pinion 316 to swing the tilt structure 281 and that the rate of rotation of the tilt structure will be desirably slow by virtue of the two sets of reduction gearing.

The direction of rotation of the motor 328 may be controlled by a reversing switch 330 (Figure 11) on the front of the apparatus, which reversing switch has an operating handle or finger piece 331 that is movable between two alternate positions. Energization of the motor 328 may be controlled by a suitable knee switch 332. Preferably an automatic magnetic brake 333 is associated with the motor 328 in a well-known manner to lock the shaft 327 against rotation automatically whenever the motor 328 is de-energized.

It will be apparent that the second embodiment of the invention will operate in the same general manner as the first described embodiment.

My description of the two embodiments in specific detail by way of disclosure and to illustrate the principles involved will suggest to those skilled in the art various changes, modifications and other departures from my disclosure that properly fall within the spirit and scope of the appended claims.

I claim:

1. A grinder of the character described having in combination: a base structure having a work supporting surface; an abrasive belt; a tilt structure to support said belt for movement of the belt longitudinally along an operating path intersecting the plane of said work supporting surface; and means pivotally supporting said tilt structure on said base structure for adjustment rotation about a fixed axis substantially coincident with the intersection of said operating path and the plane of said work supporting surface, so that all the directions of adjustment of said path radiate from substantially a single line on the plane of said work supporting surface to minimize the bodily shift of a workpiece required to maintain contact by the workpiece with said belt during wide changes in angle of the belt relative to the work supporting surface.

2. A combination as set forth in claim 1 in which said pivotal supporting means comprises a bearing assembly that is a segment of a circle in cross-section and lies entirely below the plane of said work supporting surface to avoid interference with work pieces on said work supporting surface.

3. A combination as set forth in claim 1 in which said work supporting surface of the base structure terminates in a straight edge adjacent to and parallel to said belt and in which said axis of rotation approximately coincides with said straight edge.

4. A grinder of the character described, having in combination: a base structure having a work supporting surface; an abrasive belt; a tilt structure to support said belt for movement of the belt longitudinally along an operative path intersecting the plane of said work supporting surface; and means including a trunnion member extending laterally from said tilt structure and a cooperating bearing member on said base structure for pivotally supporting said tilt structure on said base structure for rotation about a fixed axis in the region of the intersection of said operating path and the plane of said work supporting surface, said two members having a cross-sectional configuration of a segment of not more than half of a circle, said two members having cooperating arcuate shoulders to keep the trunnion member seated in the bearing member.

5. A combination as set forth in claim 4 in which the segmental configuration of the trunnion member is truncated for spacing of the trunnion member away from said axis.

6. A grinder of the character described having in combination: a base structure having a work supporting surface for the support of work pieces; an abrasive belt; a tilt structure to support said belt for movement of the belt longitudinally along an operating path intersecting the plane of said work supporting surface; means pivotally supporting said tilt structure on said base structure for rotation of the tilt structure to vary the angle of said operating path relative to said work supporting surface and cooling means mounted on said base structure to absorb heat from said work supporting surface in the region adjacent said operating path of the belt.

7. A grinder as set forth in claim 6 in which said cooling means comprises a refrigeration system having an evaporator associated with said work supporting surface.

8. A grinder of the character described in combination: a base structure having a work supporting surface for the support of a work piece; an abrasive belt; a tilt structure; pulleys on said tilt structure to support said belt for movement of the belt longitudinally along an operating path intersecting the plane of said work supporting surface; means on said tilt structure to drive said belt; means pivotally supporting said tilt structure on said base structure for rotation about a fixed axis located substantially at the intersection of said operating path and the plane of said work supporting surface; and power means to adjust said tilt structure about said axis.

9. A grinder as set forth in claim 8 which includes brake means to hold said tilt structure at different angles of adjustment relative to said work supporting surface.

10. A grinder as set forth in claim 8 which includes remote control means for said power means, said remote control means being adapted for response to movement of the leg of the operator while the operator's two hands are engaged in holding a work piece on said work supporting surface.

11. A grinder as set forth in claim 10 which includes a reversing control for said power means adapted to be set for either of two directions of tilt adjustment.

12. A grinder as set forth in claim 11 in which said remote control means is a switch adapted to be operated by contact by the knee of the operator.

13. A grinder as set forth in claim 8 in which said work supporting surface terminates in a straight edge closely adjacent to the abrasive surface of said belt and which includes cooling means to absorb heat from said work supporting surface in the region adjacent said edge.

14. A grinder as set forth in claim 8 which includes means to exert force on one of said pulleys to maintain said belt in tension and which includes manually operable means to relieve said tension to permit the belt to be removed and replaced.

15. A grinder of the character described having in combination: a base structure having a work supporting surface to support a work piece, said work supporting surface terminating in a straight edge; an abrasive belt; a tilt structure adapted to support said belt for movement of the belt longitudinally along an operating path intersecting the plane of said work supporting surface close to said straight edge; means on said tilt structure to drive said belt; means pivotally supporting said tilt structure on said base structure for rotation about an axis in the region of said straight edge to vary the angle of said operating path relative to the plane of said work supporting surface; refrigeration means including an evaporator to absorb heat from said work supporting surface in the region adjacent said straight edge; a trunnion member extending laterally from one side of said tilt structure; at least one bearing member carried by said base structure to journal said trunnion member, said two members each having the cross-sectional configuration of segment of a circle not greater than half of the circle with the trunnion member and the bearing member below the plane of said work supporting surface to avoid interference with work pieces thereon; power means to rotate said tilt structure to dif-

ferent angles relative to said base structure; means to indicate the angle of said tilt structure relative to said base structure; and a remote control for said power means.

16. A grinder as set forth in claim 15 which includes a shroud on said tilt structure to confine particles released by abrasion and which includes a blower on said base structure connected with said shroud by a flexible duct to create an air stream to carry said released particles away from said work supporting surface.

References Cited in the file of this patent

UNITED STATES PATENTS

165,762	Sawyer	July 20, 1875
747,699	Gough	Dec. 22, 1903
859,466	Silvis et al.	July 9, 1907
865,557	Arburn	Sept. 10, 1907
1,153,479	Bengler	Sept. 14, 1915
1,365,583	Brown	Jan. 11, 1921
1,798,421	Hitchcock	Mar. 31, 1931
1,974,806	Curtis et al.	Sept. 25, 1934
2,070,811	Sassen	Feb. 16, 1937
2,232,149	Tautz	Feb. 18, 1941
2,300,643	Bostwick et al.	Nov. 3, 1942
2,396,147	Bladenhofer	Mar. 5, 1946
2,401,670	Spetz	June 4, 1946
2,562,229	Bell	July 31, 1951
2,573,220	Riedesel et al.	Oct. 30, 1951
2,640,304	McEwan	June 2, 1953

FOREIGN PATENTS

647,853	Great Britain	Dec. 20, 1950