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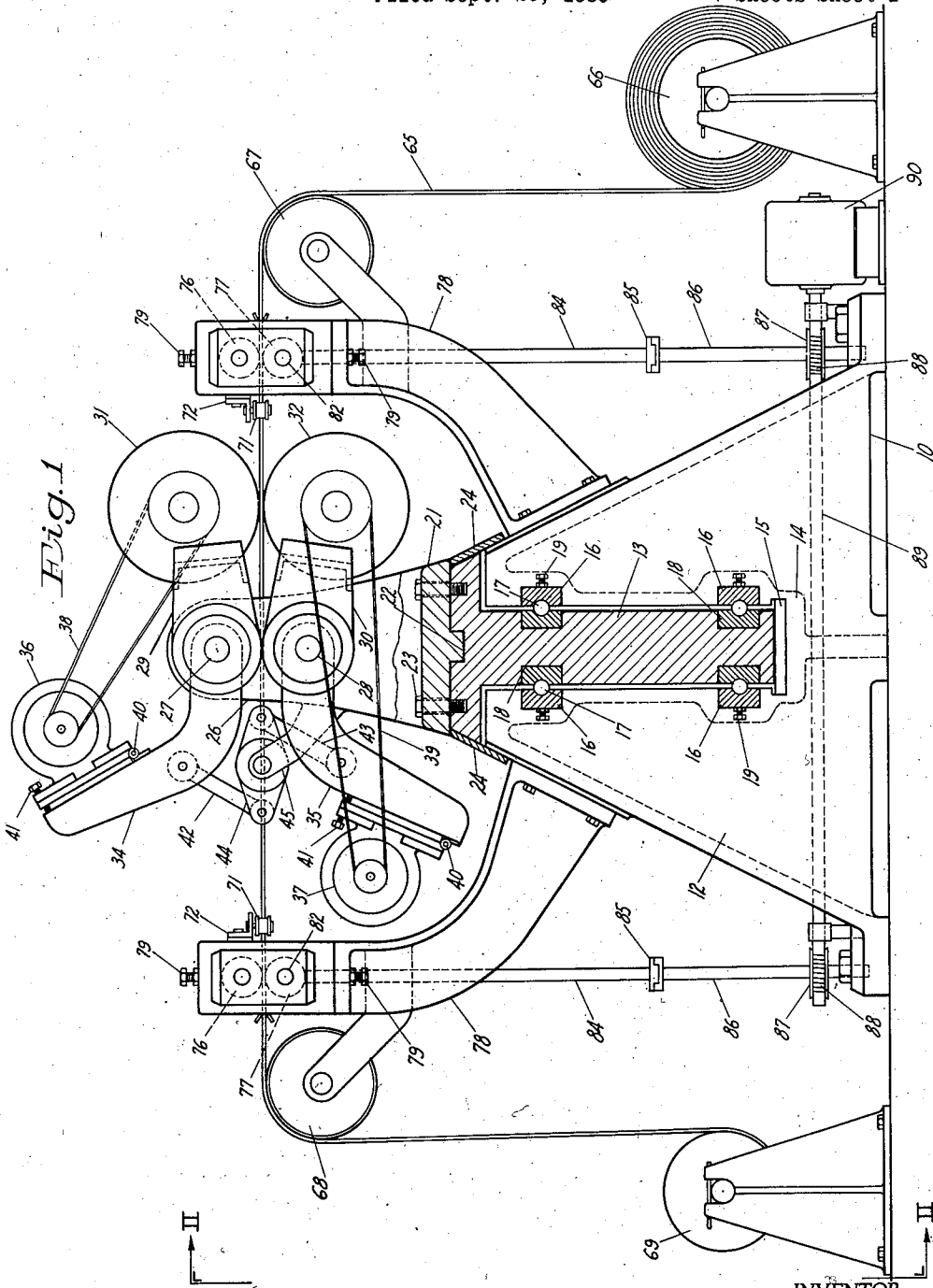
A. E. HAMILTON

2,269,197

GRINDING AND POLISHING APPARATUS

Filed Sept. 20, 1939

7 Sheets-Sheet 1



INVENTOR
Alfred E. Hamilton,
BY Archworth Martin,
ATTORNEY.

Jan. 6, 1942.

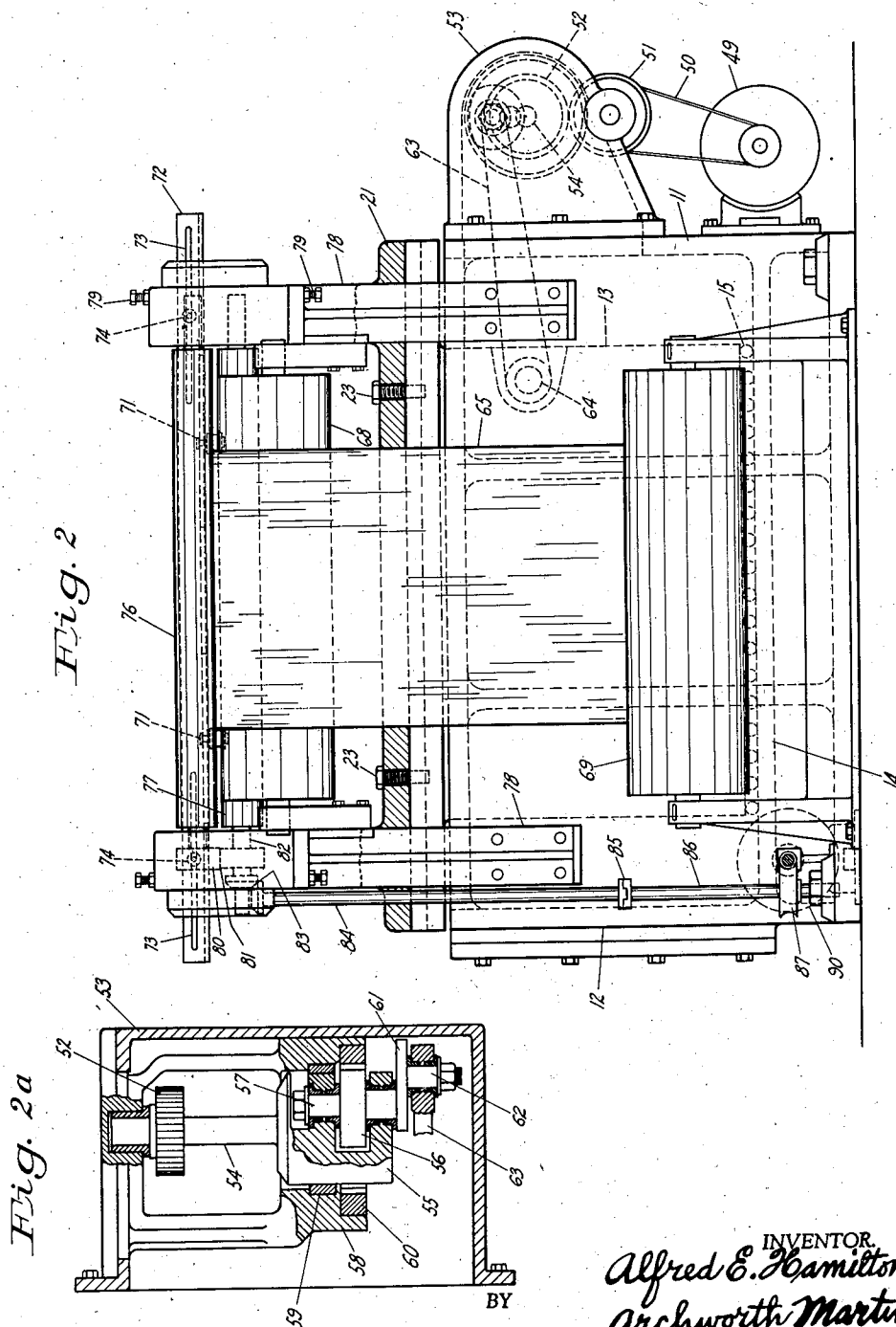
A. E. HAMILTON

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INVENTOR.
Alfred E. Hamilton,
Archworth Martin,
 ATTORNEY.

Jan. 6, 1942.

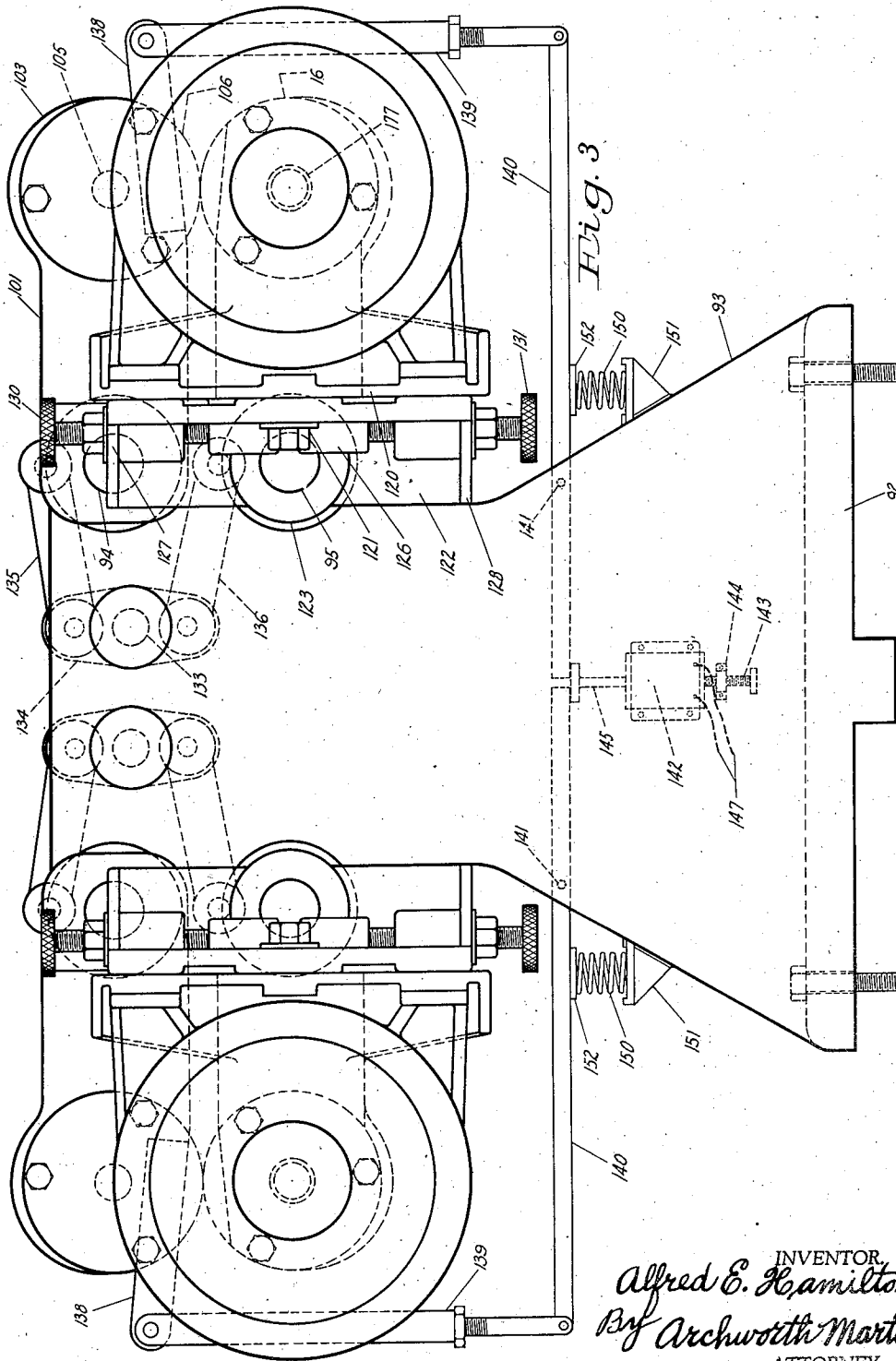
A. E. HAMILTON

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7 Sheets-Sheet 3



INVENTOR,
Alfred E. Hamilton,
By *Archworth Martin,*
ATTORNEY.

Jan. 6, 1942.

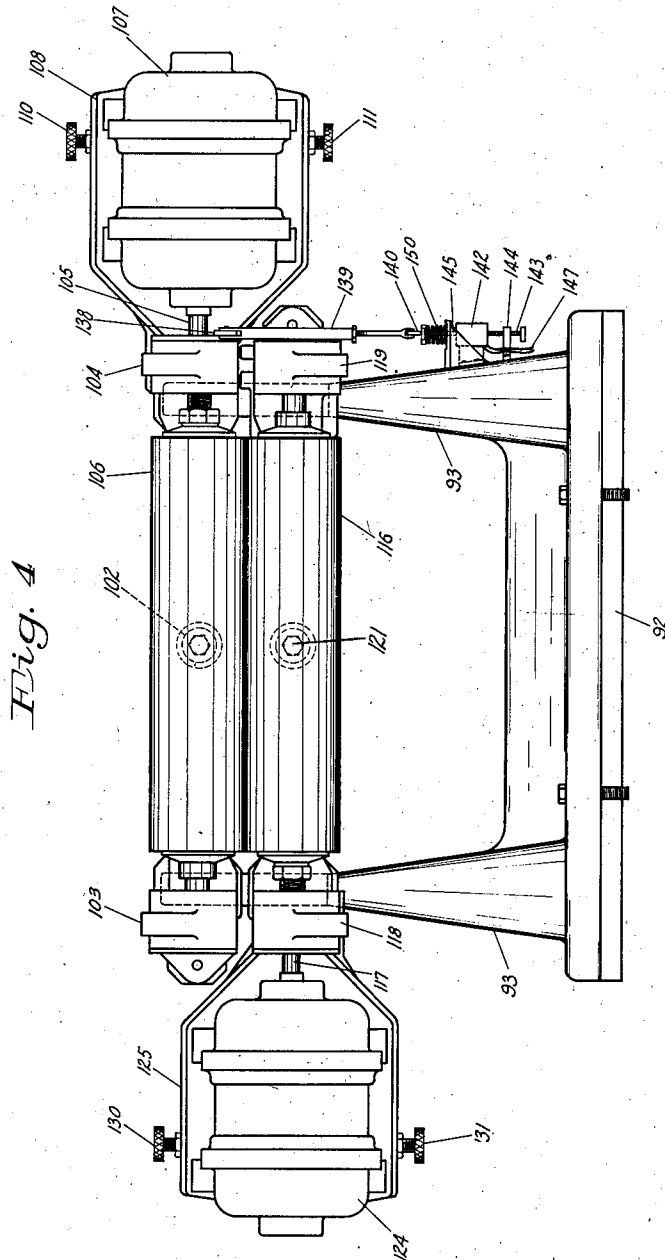
A. E. HAMILTON

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INVENTOR.
Alfred E. Hamilton,
BY *Archworth Martin,*
ATTORNEY.

Jan. 6, 1942.

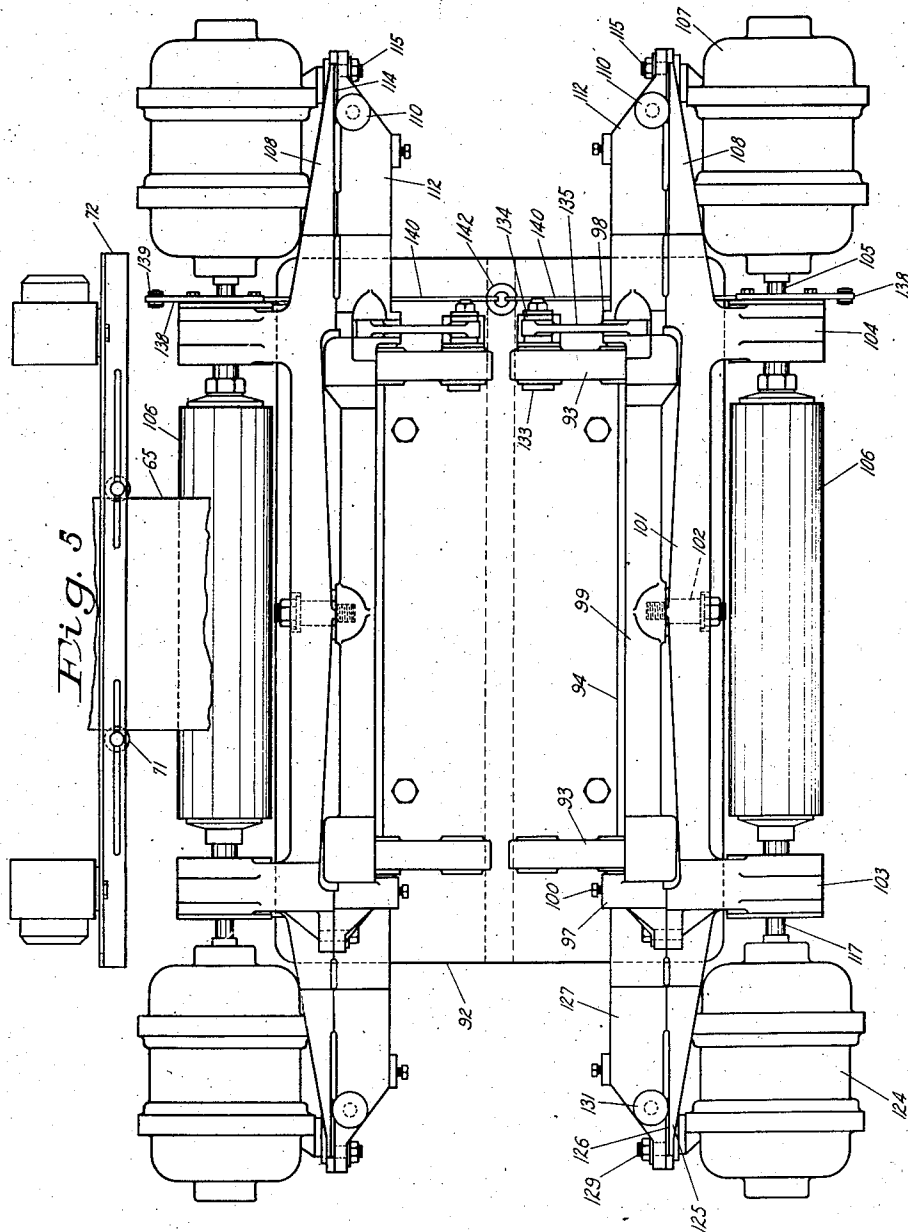
A. E. HAMILTON

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7 Sheets-Sheet 5



BY

INVENTOR.
Alfred E. Hamilton,
Archworth Martin,
ATTORNEY.

Jan. 6, 1942.

A. E. HAMILTON

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Fig. 6

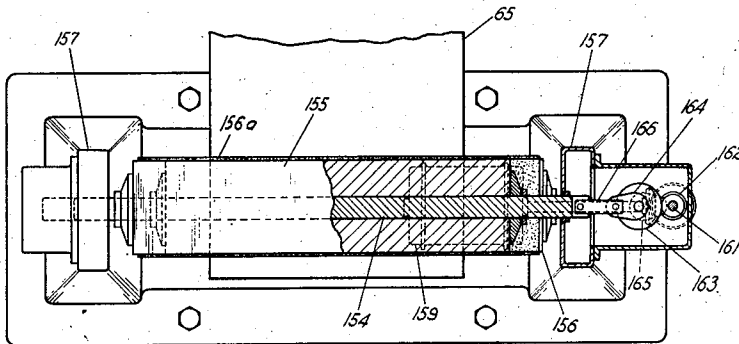


Fig. 7

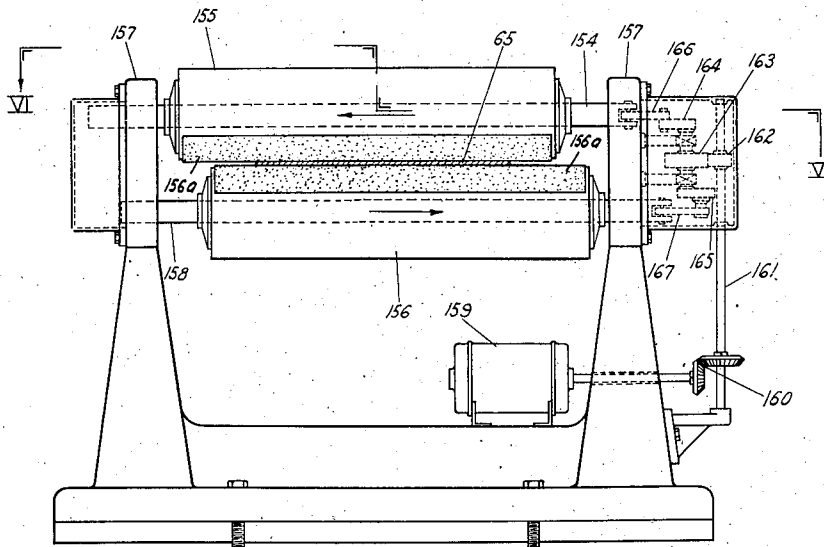
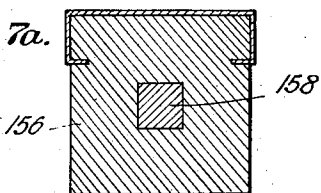


Fig. 7a.



INVENTOR.
Alfred E. Hamilton,
BY *Archworth Martin,*
ATTORNEY.

Jan. 6, 1942.

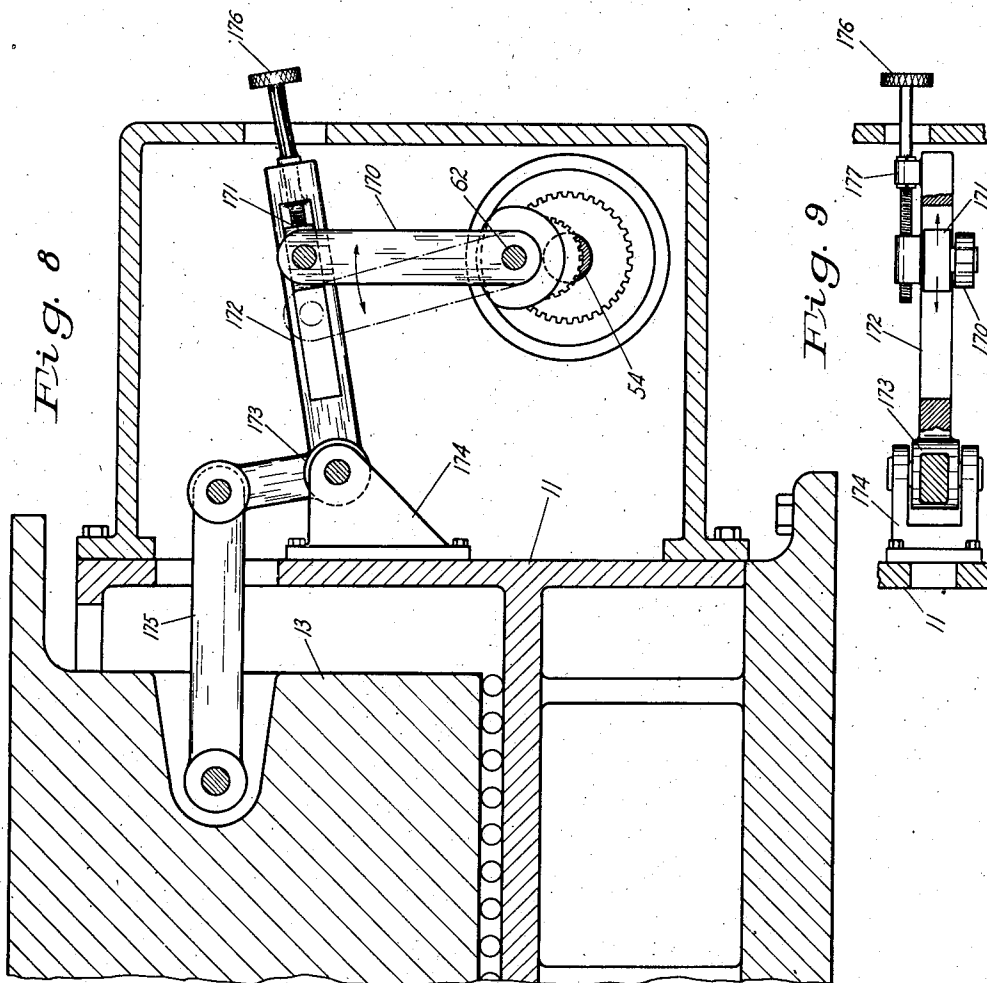
A. E. HAMILTON

2,269,197

GRINDING AND POLISHING APPARATUS

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7 Sheets-Sheet 7



BY

INVENTOR
Alfred E. Hamilton,
Archworth Martin,
ATTORNEY.

UNITED STATES PATENT OFFICE

2,269,197

GRINDING AND POLISHING APPARATUS

Alfred E. Hamilton, Pittsburgh, Pa.

Application September 20, 1939, Serial No. 295,765

12 Claims. (Cl. 51—40)

My invention relates to grinding and polishing apparatus and is especially suitable in the grinding and polishing of strip material and sheets of material, including steel strip produced on continuous mills, and large metal sheets.

In the grinding and polishing of sheet and strip material by moving the work past abrasive and polishing rolls or blocks, trouble is experienced through the forming of streaky areas longitudinally of the surface being operated upon, because all portions of the abrading roll or block do not produce the same degree of grinding or polishing action.

My invention has for one of its objects the provision of a method and means whereby the material is ground and polished by surfacing tools which are moved upon the strips or sheets in such manner that greater uniformity of surfacing is effected than is possible with various types of apparatus heretofore employed.

An important feature of my invention resides in the provision of means whereby during traveling movement of the work past the surfacing tool or tools, the said tools are oscillated in a direction transversely of the path of travel, to thereby avoid the forming of elongated streaks on the work.

The apparatus can be employed both to preliminarily grind the work and thereafter to impart a high polish thereto, it being understood that the work can be first passed through one or more of my grinding units and then passed through other of my units where polishing and buffing operations are performed thereon. The grades of abrasive employed in the grinding units may be graduated from coarse to fine flour grades, while a higher polish will be imparted to the work by buffing rolls or the like contained in other units operated according to my invention.

The invention is useful not only in the surfacing of material such as stainless steel, whereon it is desired to produce a mirror-like finish, but is useful in preparing metal for plating operations.

Some of the forms of apparatus embodying my invention are shown in the accompanying drawings wherein Figure 1 is a side elevational view, partly in section, of a machine which contains a single pair of grinding or polishing rolls; Fig. 2 is an end elevational view thereof, partly in section, looking in the direction of the arrows II—II of Fig. 1; Fig. 2a is a sectional plan view on an enlarged scale of a portion of the operating mechanism of Fig. 2; Fig. 3 is a side elevational view of a modified form of machine which con-

tains two pairs of polishing rolls; Fig. 4 is an end view thereof; Fig. 5 is a plan view; Fig. 6 is a sectional plan view, taken on the line VI—VI of Fig. 7 and showing still another modified form of polishing elements; Fig. 7 is an end view thereof; Fig. 7a is a cross-sectional view of one of the blocks of Fig. 7, and Figs. 8 and 9 are side and plan views showing a modification of the reciprocating device of Figs. 2 and 2a.

The apparatus in one of its simplest forms is disclosed in Figs. 1 and 2, and comprises a base 10, carrying upright end frame members 11 and 12. The end members 11 and 12 are vertically slotted to receive a slide member 13. A cross member or bar 14 is carried by the members 11 and 12 and serves as a raceway for anti-friction rollers 15, upon which the slide member 13 is supported. The members 11 and 12 support bearing blocks 16 that serve as raceways for anti-friction balls 17, raceways 18 also being provided on the slide 13 for the ball bearings 17. Adjusting screws 19 are provided for adjusting the race members 16 to compensate for wear in the ball bearings.

A base plate 21 is detachably mounted upon the slide member 13 and is held in place thereon by its tongue or rib 22 that fits within a groove in the upper face of the slide member and by screws 23. Removal of the screws 23 permits a grinding or polishing unit which is carried by the base 21 to be removed and another unit substituted therefor. Shield plates 24 are provided on the base frame 11—12 to keep dust and grit out of the slide bearings.

Each end of the base plate 21 has an upstanding extension 26 and these extensions carry shafts 27 and 28, that in turn support brackets 29 and 30 respectively. These brackets 29 and 30 support surfacing rolls 31 and 32 respectively, in a manner similar to that in which the surfacing rolls of Figs. 5, 6 and 7 are supported on their respective brackets.

The brackets 29 and 30 have rearward extensions 34 and 35 respectively that serve as supports for electric motors 36 and 37, which through belts 38 and 39 drive the surfacing rolls 31 and 32 respectively. The bases of the motors are pivotally connected to their brackets as at 40, and adjusting screws 41 are provided, whereby the tension of the driving belts 38—39 can readily be adjusted.

The bracket members 29 and 30, through links 42 and 43, are connected to a counter-balancing lever 44 that is pivotally mounted upon a bracket arm 45 that projects rearwardly from one of the

upright members 26. The brackets 29 and 30 together with the motors and polishing wheels carried thereby are oscillatable on their respective shafts 27 and 28, and the members 42, 43 and 44 serve as counter-balancing elements whereby tendency of the bracket 29 to tilt on its shaft 27 through unbalanced weight is counteracted or counter-balanced by the weight of the bracket 30 and the parts carried thereby. Thus, if the distribution of weight on the bracket 29 is such as to tend to rock it in a counter-clockwise direction, and the distribution of weight on the bracket 30 is such that its center of gravity tends to rock it in a counter-clockwise direction, as would be the case if the weight of the motors 36—37 exceeds the weight of the polishing wheels, the link arrangement above described would produce a counter-balancing effect to thereby maintain the polishing rollers 31—32 in proper operative position with respect to a sheet or strip being operated upon. The counter-balancing of the surfacing rolls insures that they will bear with equal pressure against the upper and lower surfaces of the work. The rolls 31 and 32 can be held against the work by a suitable spring, or by the solenoid and one of the levers and links of Fig. 3.

The surfacing rolls 31 and 32 may have their working faces provided with any desired abrasive or polishing material. For example, they may be faced with emery or sand, or may be faced with buffing material. One form of roller which may suitably be employed is disclosed in my Patent No. 2,113,836, which shows a pneumatic roller containing a sleeve that is faced with abrasive material.

The slide 13 and the base plate 21 are reciprocable as a unit transversely of the work being fed through the machine, by means to be hereinafter described, the surfacing rolls being simultaneously driven by their motors, so that the rolls will be shifted in axial directions while they are operating upon the steel or other material.

The said transverse reciprocatory movements of the slide 13 which carries the surfacing rolls, together with vibratory movements thereof, are effected by mechanism that is shown more clearly in Figs. 2 and 2a, and comprises a motor 49 that may be of the variable speed type and which, through a belt or chain drive 50, drives a shaft on which a gear wheel 51 is mounted. The gear wheel 51 meshes with a gear wheel 52 contained within a gear casing 53 that is secured to the base frame of the machine. The gear wheel 52 is secured to a shaft 54 which is enlarged at 55 to form a cage for a gear wheel 56 and its shaft 57. The shaft 57 is journaled in the barrel 55 eccentrically of the shaft 54, so that it forms in effect a crank pin. A bearing sleeve 58 is rigidly mounted within the casing 53 and carries a bearing ring 59 for supporting the cage or barrel 55 that is formed integrally with the shaft 54.

A ring 60 having gear teeth is rigidly secured within the outer end of the sleeve 58. One side of the barrel 55 is cut away to permit the gear wheel 56 to mesh with the toothed ring 60, so that as the shaft 54 rotates, the gear wheel 56 will also be rotated on its own axis. The outer end of the shaft 57 has a crank extension 61 that carries a stud shaft 62. A link or connecting rod 63 is pivotally mounted at one end upon the crank pin or stud 62, and at its other end has pivotal connection at 64 with the slide member 13.

It will be seen that during rotation of the shaft 54, the shaft 57 will function as a crank pin to impart reciprocating movements to the slide 13 and that simultaneously there will be shorter vibratory movements imparted thereto by reason of the rotation of the gear wheel 16 in the gear ring 60, such rotary movements being imparted to the crank 61. This combination of short vibratory movements with the longer reciprocating movements, in directions transverse to the path of travel of the work through the machine, results in a better and more uniform polishing of the metal than would be possible with simple reciprocatory movements, thereby avoiding streakiness in grinding and polishing, or contrasting zones of light and heavy surfacing.

The machine is shown as operating upon strip steel 65 that is being drawn from an un-coiler 66, over guide rollers 67 and 68 by a coiler 69. The coilers and un-coilers may be of any suitable form well known in the art.

In order to prevent bending or lateral shifting of the strip through the transverse reciprocatory movements of the rolls thereon, I provide guide rollers 71 of spool-like form for engaging the edges of the strip. These rollers have their shafts extending vertically through slots formed in an angle bar 72 (Figs. 1, 2 and 5), and the rollers are thereby adjustable on said bar to strips of various widths. The bar 72 is in turn adjustable upon the framework of the machine and to this end is provided with slots 73 through which attaching bolts or screws 74 extend to clamp it in adjusted positions. By having the bar 72 adjustable on the framework of the machine, the rollers when set for a sheet of given width can be adjusted as a unit toward either end of the rolls by shifting the bar 72, so that substantially the entire working surfaces of the rolls can be utilized. For example, a strip of narrow width can be subjected to the surfacing action of the rolls at a zone near one end of the rolls, and when said zone becomes somewhat worn, the bar 72 can be shifted to move the guide spools 71 toward the other end of the rolls. The motors 36 and 37 can be of the reversible type and the surfacing rollers 31 and 32 can be driven either in the direction of travel of the strip, or opposite to said travel, as may be desired. If the rolls are driven in the same direction that the strip is moving, and with the peripheral speed of the rolls greater than the rate at which the strip is traveling, there will be polishing action on the strip, but to a lesser degree than if the surfacing rollers are driven in a direction opposite to the strip travel.

In order that the machine may be employed to polish sheets as distinguished from long strip steel, I provide feed rollers 76 and 77 at each end of the machine, which rollers may suitably be rubber-faced in order to reduce danger of slipping on the sheets, and which may desirably be pneumatic, of the general form shown in my Patent No. 2,113,836. The rollers are journaled in brackets 78 that are carried by the base frame of the machine, and the shaft bearings for the rollers are adjustable by means of screws 79 which will take up wear and will also vary the roll pressure. The shafts of the rollers 76 carry gear wheels 80 that mesh with gear wheels 81 on the shafts 82 of the rollers 77. Each shaft 82 has bevel gear connection at 83 with a vertical shaft 84 that, through a clutch connection at 85, is driven by a roller shaft section 86, which carries a worm gear 87. The clutches 85 will be

provided with suitable actuating mechanisms, so that they can be disengaged when strip steel is to be polished instead of sheets. Worm wheels 87 are driven by worms 88 that are mounted on a shaft 89 which is driven from a variable-speed motor 90. The motor 90 may suitably be of the reversible type, so that a given sheet can be passed back and forth through the machine.

In grinding or polishing thin sheets, the surfacing rolls 31 and 32 will ordinarily be driven so that at their points of contact therewith, their peripheries will move in the same direction as the sheet, but at a faster rate. The rollers 76-77 will in that case serve to retard the tendency of the sheet to be drawn forward rapidly under the frictional drag of the surfacing rolls. Ordinarily a strip or sheet will be subjected to successive operations by grinding and polishing rolls and a series of units of the type shown in Figs. 1 and 2 may be mounted in tandem or sequence, the rough polishing or grinding being effected on some of the machines and finishing operations performed on succeeding machines.

In Figs. 3, 4 and 5 I show a single machine or unit wherein two pairs of surfacing rolls are employed. In this arrangement the two pairs of rolls are mounted upon a base plate 92 which corresponds to the base plate 21 of Figs. 1 and 2, and which may be mounted upon a slide corresponding to the slide 13 and which also may be reciprocated in the same manner as the slide 13 of Figs. 1 and 2. Upstanding frame members 93 are provided at the ends of the base plate 92, and these two uprights serve to support the two sets of polishing mechanism which are identical in form and hence detailed description of only one set is required.

A pair of shafts 94 and 95 are journaled in the uprights 93. The shaft 94 extends through the backwardly-extending ends 97 and 98 of a bracket 99, and the bracket is non-rotatably connected to the shaft 94 by a set screw 100. A second bracket member 101 is pivotally connected at its midportion to the midportion of the bracket 99, by a screw or bolt 102 that has threaded connection with the bracket 99. The bracket 101 has outwardly-projecting bearing bosses 103 and 104 for supporting a shaft 105 that carries a surfacing roll 106 and is driven by an electric motor 107, which is carried by an extension 108 of the bracket 101. It will be seen that the surfacing roll 106 together with the brackets 101 and 99 can be oscillated as a unit with the shaft 94.

The bracket 101, and hence the roll 106, is angularly adjustable in a vertical plane by means of screws 110 and 111 that have threaded connection with an extension 112 of the bracket 99, and whose inner ends have abutting engagement with a rearward extension or boss 114 that is carried by the bracket 101. A screw or bolt 115 carried by the extension 108 of the bracket 101 extends through a vertical slot in the bracket member 112 and has a nut which is tightened to hold the bracket 101 firmly in place at various positions of adjustment on the pivot bolt 102. This nut will be loosened while making adjustments with the screws 110 and 111. Turning of the screws 110 and 111 will effect rotatable adjusting movement of the bracket 101 on the pivot bolt 102 to tilt the axis of the roller slightly in a vertical plane, so that it will bear evenly upon a strip or sheet that passes between the surfacing rolls.

The lower roll 116 is mounted on a shaft 117 which is journaled in bearings 118 and 119 that

are carried by a bracket 120 that is in turn connected by a pivot bolt 121 with a bracket that corresponds to the bracket 99. The bracket 122 has a pair of extensions 123 whereby it is supported on the shaft 95 in the same manner as the bracket 99 is supported on its shaft 94. A motor 124 is mounted on the shaft 117, and positioned in an extension 125 of the bracket 120. The bracket 120 has a boss 126 projecting between upper and lower extensions 127 and 128 of the bracket 122. The bracket extension 125 carries a bolt 129 that extends through a vertical slot in the bracket extension 127, so that the bolt and its nut can be utilized to securely clamp the bracket 120 in its various positions of pivotal adjustment on the bolt 121.

Adjusting screws 130 and 131 have threaded engagement with the extensions 127 and 128 respectively, and abut against the boss 126 of the bracket 120, so that the bracket 120 which carries the roll 116 can readily be adjusted to various tilted positions on its pivotal support 121, and it will be securely clamped in such positions by the bolt 129.

A stud or stud shaft 133 is carried by one of the stationary uprights 93 of the framework and pivotally supports a lever 134 that at its upper and lower ends is pivotally connected with links 135 and 136 respectively. The link 135 is connected at its other end with the bracket 99 which, through the bracket 101, supports the roll 106. The link 136 at its outer end has pivotal connection with the bracket 122 which, through the bracket 120, carries the roll 116. It will be seen that by this arrangement, the rollers and the brackets which support the same will counter-balance one another. Thus, while the roll 106 and its associated parts tend to rock in a clockwise direction with their shaft 94, such force is transmitted through the link 135 to the lever 134 and exerts a turning force on said lever, in a clockwise direction, with the result that the lower end of the lever 134 exerts a pull on the link 136 which tends to move the roll 116 and its associated parts in a counter-clockwise direction.

The surfacing rolls 106 and 116 may be of any suitable material as mentioned in connection with the surfacing rolls 31 and 32 of Fig. 1, each roll being driven by its own motor in the desired direction and the edges of the strip being guided by the adjustable rollers 71, as explained in connection with the description of Figs. 1 and 2. Also, the strip may be fed through a desired number of sets of surfacing rolls or sheets fed therethrough. For the feeding of sheets, I will provide power driven pinch rolls corresponding to the rolls 76 and 77 of Fig. 1.

In this instance, as in the case of the form of apparatus shown in Figs. 1 and 2, the base member 92 which will be mounted on a slide corresponding to the slide 13 of Figs. 1 and 2, can readily be removed to permit of convenient substitution of polishing units as where the surfacing rolls on the unit being used have become worn and need replacement, or where a change in the material being operated upon requires the use of surfacing rolls of another character.

In order to prevent damage in case the strip-advancing or feeding means should accidentally stop while the surfacing rolls are in operation, I provide means for quickly or automatically releasing the pressure of the surfacing rolls upon the strip. It will be understood that if a strip or sheet should come to rest while the surfacing rolls are operating, frictional heat and abrasive

wear would be developed to such an extent as to damage the sheet and perhaps also the surfacing rolls.

To this end I secure an arm 138 to each of the brackets 101. A link 139 is pivotally connected at its upper end to the arm 138 and at its lower end to a lever 140. Each lever 140 is pivotally connected at 141 to one of the uprights. A solenoid 142 is mounted for vertical adjustment upon the frame member 93. An adjusting screw 143 has threaded connection with a boss 144 on said side frame and will be turned to adjust the solenoid to various heights. The solenoid has a movable core which is provided with an upwardly-projecting extension 145 for engagement with the inner ends of the levers 140. When the solenoid is energized, its core is moved upwardly and consequently the inner ends of the levers 140 are moved upwardly. This movement of the levers on their pivots 141 exerts a down-pull on the links 139, thus rocking the brackets 101 downwardly and simultaneously, through the counter-balancing links, moving the brackets 120 upwardly, thereby moving the surfacing rolls together to engage the upper and lower faces of the work strip. The links 139 are composed of screw threaded sections which can be adjusted to vary their lengths. Also the adjustment of the solenoid 142 will vary the spacing between the upper and lower surfacing rolls and the pressure thereof upon the work.

The solenoid 142 is energized from a suitable source of power through conductors 147. As shown in Fig. 3, the solenoid is in an energized condition, to retain the member 145 in its uppermost position. If now the circuit through the conductors 147 is broken and the solenoid therefore de-energized, compression springs 150 will raise the links 139 and thus effect separating movement of the surfacing rolls, and prevent continued operation thereof upon the strip. The springs 150 are interposed between bosses 151 on the side frame 93 and pads 152 that are on the under sides of the levers 140. The circuit of the conductors 147 can be manually controlled by an operator who will immediately break the circuit if the strip comes to a stop in the machine, but I preferably will have the circuit of the solenoid in series with the circuit of a motor which drives the strip or sheet that is being polished. For example, it could be in circuit with the motor 90 of Fig. 1, in which case if the motor circuit is broken, the circuit through the solenoid 142 will also be broken, automatically.

Referring now to Figs. 6 and 7, I show an upper polishing block 155 and a lower polishing block 156, both of which are of rectangular form in cross section as shown in Fig. 7a and which are faced with abrasive material. For example, sheets 156a of sand paper or sheets of emery cloth, or felt, may be applied to the work-engaging surfaces of these blocks. The block 155 has a bar 154 extending therethrough, the ends of which are slidably supported in stationary uprights 157. Similarly, the block 156 is supported by its central bar 158 upon the uprights.

The blocks 155 and 156 are reciprocated transversely of the work strip 66 by an electric motor 159 that, through bevel gearing 160, drives a vertical shaft 161. A pinion 162 on the vertical shaft meshes with a gear wheel 163, whose shaft is supported in suitable bearings and on the ends of whose shaft crank elements 164 and 165 are mounted. These crank elements may suitably be of the form shown in Figs. 2 and 2a, in that the

members 164 and 165 will correspond to the member 55 of Fig. 2a and the other parts provided as in Fig. 2, so as to give combined reciprocatory and oscillatory movements to the surfacing blocks 155 and 156. The members 164 and 165 operate links 166 and 167 respectively, that are pivotally connected to the ends of the bars 154 and 158. The links 166 and 167 correspond to the link 63 of Fig. 2. The crank devices 164 and 165 are circumferentially offset relatively to one another on their shaft, so that when the upper block is being moved in one direction across the work, the other block will be moving in the opposite direction.

A series of steps in the treatment of strip steel and the like can conveniently comprise the passing of a rolled strip through one or more grinding units, as herein described, to grind the surfaces of the strip to a desired smoothness; pickling the strip; running the strip through cleaning tanks to remove loose grit preparatory to polishing, and then passing the strip through polishing rolls operated as herein described. This procedure is desirable where a mirror finish is wanted, as in the case of stainless steel. Somewhat the same procedure can be followed in preparing a strip for plating. In the latter case, it usually will not be necessary to buff or give a mirror finish to the strip, because the final grinding operation thereon will ordinarily leave the strip sufficiently smooth for plating purposes. In many instances wet grinding and polishing will be employed, with the use of water or oil.

In order to prevent or overcome any tendency for polished wave lines to be formed on the work through the reciprocating and vibratory movements heretofore described, such as might occur through a pair of surfacing elements "tracking" or following the same path as those followed by preceding surfacing elements, I so arrange the reciprocating devices that certain of the pairs of surfacing elements will be given a different length of vibratory stroke than other elements.

To this end I provide means such as shown in Figs. 8 and 9 for adjusting the "throw" of the links which reciprocate the slides 13. In this arrangement the crank pin 62 of Fig. 2a has connection with a link 170 that at its upper end has pivotal connection with a slide block 171 that is carried by one arm 172 of a bell crank lever 173. The bell crank is pivotally mounted upon a boss 174 that is carried by the framework 11. The other arm of the bell crank is pivotally connected to a link 175 that is in turn connected to the slide member 13. The "throw" or distance of angular movement of the bell crank 173 is adjusted by a hand screw 176 that is journaled in a boss 177 of the arm 172. The shank of the member 176 has threaded engagement with the slide block 171 so as to shift the block along the slot in the arm 172, whereby the position of the block 171 on the bell crank will determine the distance through which the slide member 13 is reciprocated.

I claim as my invention:

1. Surfacing apparatus comprising means for imparting traveling movement to strip material and the like, a surfacing element positioned for engagement with the material and to extend across the width thereof, and means for imparting combined reciprocatory and vibratory movements to said element, in directions generally transverse to the path of travel of the material.

2. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, surfacing elements at the opposite faces of the material, means for supporting said elements against the faces of the material, and means for imparting combined reciprocatory and vibratory movements to the said elements, in directions generally transverse to the path of movement of the material.

3. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, a rotatably-mounted surfacing element disposed in position to engage one face of the material, with its axis extending transversely of the path of movement of the material, means for rotating the said element, and means for imparting reciprocatory and shorter vibratory movements to the said element in directions generally transverse to the path of movement of the material, while it is being rotated.

4. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, a supporting member positioned adjacent to the path of movement of the material, a rotatable surfacing element carried by said support in position to engage the material, a driving device on said support for rotating the surfacing element, and means for imparting reciprocatory and vibratory movements to the said supporting member in directions transverse to the said path.

5. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material relative to a surfacing element, while maintaining said element in contact with the material, and during said movement imparting combined reciprocatory and shorter vibratory movements to the surfacing element, in directions generally transverse to the path of movement of the material, the vibratory movements being of variable amplitude during each reciprocatory stroke.

6. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material past a surfacing element which always extends across the width of the material, and simultaneously with the traveling movement imparting combined reciprocatory and shorter vibratory movements to said element, in directions transversely of the path of movement of the material.

7. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material past progressively-arranged pairs of surfacing elements that engage both faces of the material, and simultaneously with the traveling movement imparting reciprocatory and vibratory movements to said surfacing elements in directions transversely of the path of movement of the material.

8. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material past progressively-arranged surfacing elements that engage the material, and simultaneously with the traveling movement imparting combined reciprocatory and

shorter vibratory movements to said elements in directions transversely of the path of movement of the material, the length of transverse movements of one of the elements being shorter than the distances another element moves.

9. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material past progressively-arranged pairs of surfacing elements that engage both faces of the material, and simultaneously with the traveling movement imparting combined reciprocatory and shorter vibratory movements to said elements in directions transversely of the path of movement of the material, the length of reciprocatory movement of some of the said pairs of elements being shorter than the movement of other pairs of elements.

10. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, a supporting member, a surfacing element carried by said member in position to engage the material, a shaft having a crank-like extension, a second shaft journaled in said extension and provided with a crank arm, a connection between said crank arm and the said supporting member, so arranged that the supporting member is reciprocated transversely of the said path of traveling movement, when the shafts are rotated, means for rotating the first-named shaft, and means for simultaneously rotating the second-named shaft.

11. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, a supporting member, a surfacing element carried by said member in position to engage the material, a shaft having a crank-like extension, a second shaft journaled in said extension and provided with a crank arm, a connection between said crank arm and the said supporting member, so arranged that the supporting member is reciprocated transversely of the said path of traveling movement, when the shafts are rotated, means for rotating the first-named shaft, means for simultaneously rotating the second-named shaft, and means for adjusting the range of lateral movement which is given to the supporting member by rotating of the said shafts.

12. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, a supporting member, a surfacing element carried by said member in position to engage the material, a shaft having a crank-like extension, a second shaft journaled in said extension and provided with a crank arm, a connection between said crank arm and the said supporting member, so arranged that the supporting member is reciprocated transversely of the said path of traveling movement, when the shafts are rotated, means for rotating the first-named shaft, and means for simultaneously rotating the second-named shaft, the said crank-like extension being of different radial length than the radial length of the crank arm.

ALFRED E. HAMILTON.