May 3, 1960 | R. F. PENDERGAST | 2,934,863

SANDING MACHINE

Filed Oct. 21, 1957 | 2 Sheets-Sheet 1

Fig. 1

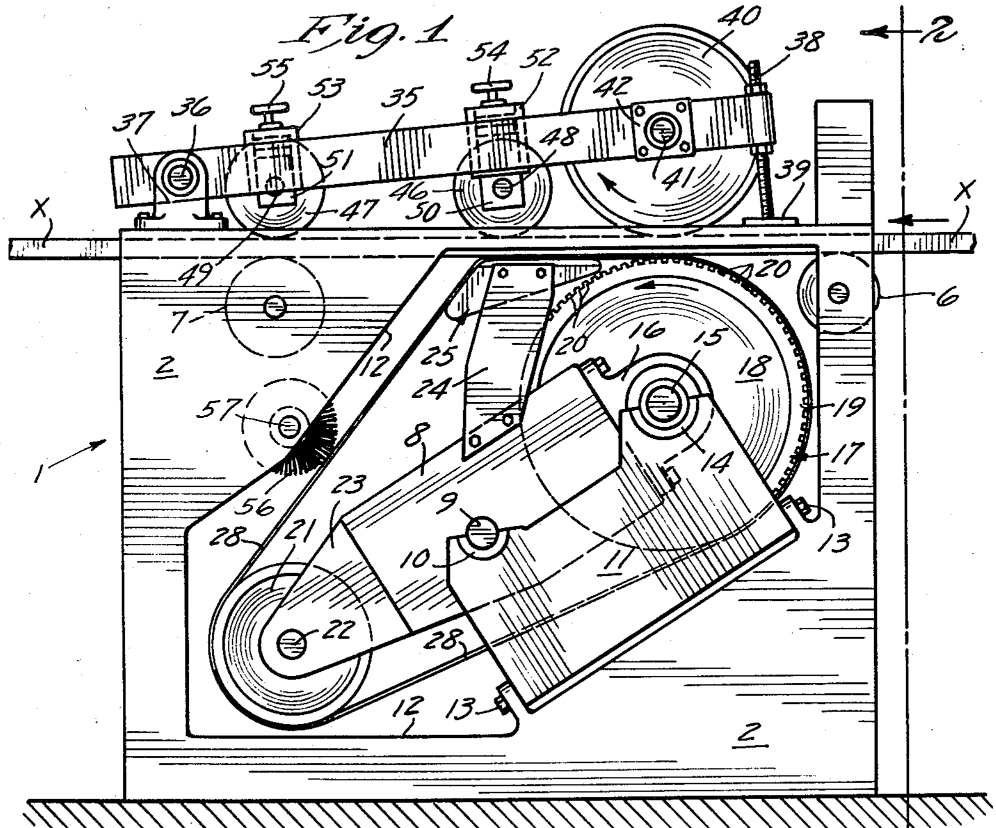

Fig. 2

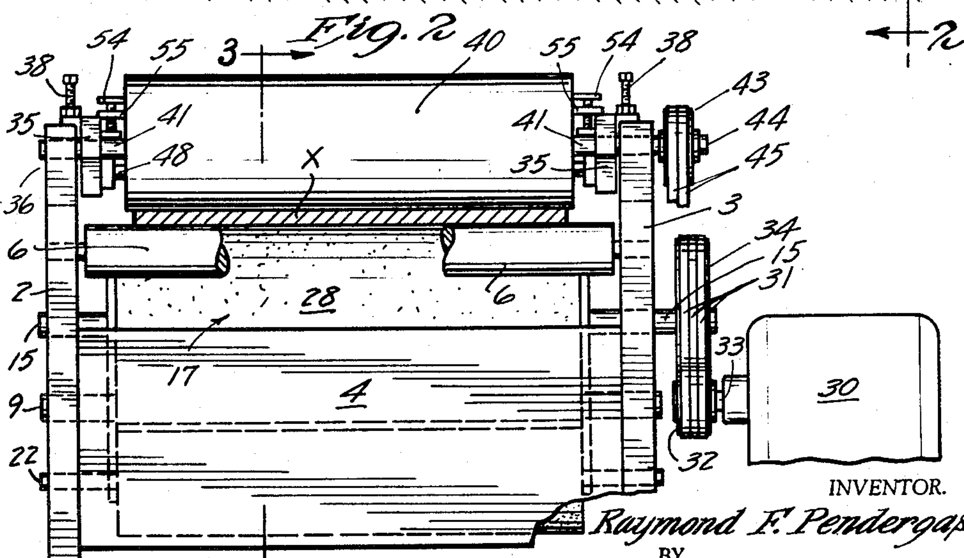

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Fig. 3

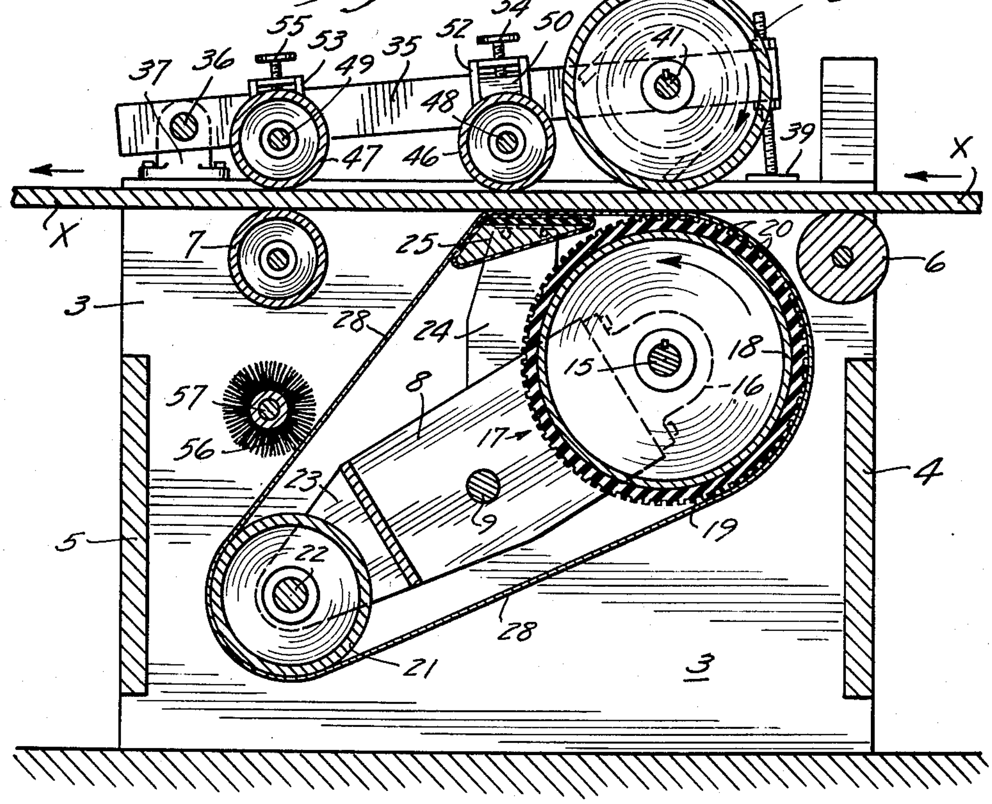


Fig. 5

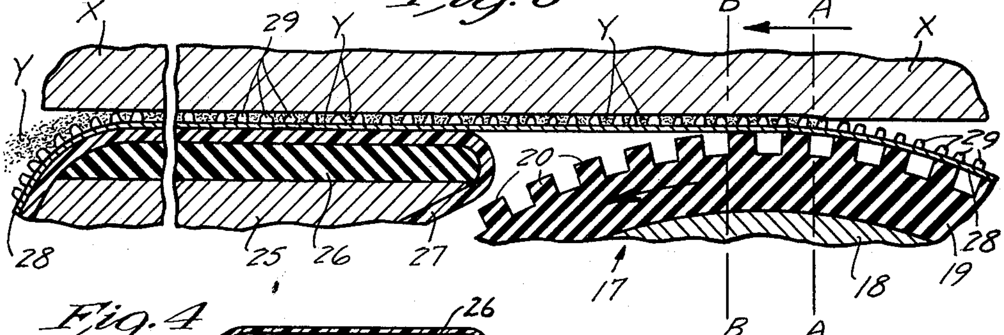
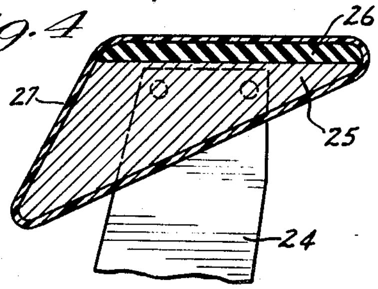


Fig. 4



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SANDING MACHINE

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Application October 21, 1957, Serial No. 691,223
11 Claims. (Cl. 51—141)

My invention relates to an improved method of and apparatus for imparting smooth finishes to substantially flat surfaces of workpieces of fibrous non-metallic material such as wood and the like.

Heretofore, in achieving fine smooth finishes to flat surfaces of boards, panels and the like of wood and related materials, it has been customary to subject the workpiece to successive abrading devices of various degrees of cutting or abrading action, the first of the devices having relatively coarse abrasive particles and imparting a correspondingly coarse cutting action on the engaged surface of the workpiece, successive devices having progressively finer abrasive particles and imparting correspondingly progressively finer abrading action to the workpiece until the desired finish is obtained. Usually, the abrading devices are in the nature of drums or endless belts having the abrasive material adhered thereto. In some instances, a combination of drums and belts is employed, the coarser cutting or sanding being performed by an abrasive drum, and the finer finishing being accomplished by the use of an endless belt equipped with relatively fine abrasive particles.

An important object of my invention is the provision of a method of imparting a smooth finish to a flat surface of a workpiece as set forth, which requires the use of but a single abrasive belt to perform both the rough cutting or abrading and fine finishing operation on the workpiece.

Another highly important object of my invention is the provision of a method, as set forth, which require but a single pass of the workpiece through a machine equipped with a single abrasive belt to achieve both the rough cutting and final fine finishing operation.

To the above ends, I cause a wide endless abrasive belt to be moved in a given direction at relatively high speed and a workpiece having a wide surface to be finished to be moved in the same direction at a relatively low speed, while causing working pressure to be imparted to said belt against said surface of the workpiece at a given first zone to effect an initial cut on said surface and remove finely divided particles of fibrous material therefrom, causing working pressure to be imparted to said belt at a second zone in following relationship to the first zone against said surface of the workpiece to effect a final finishing operation on said surface, and discharging said particles from the first zone to the second zone to substantially fill the spaces between the abrasive particles on the belt and provide a burnishing medium for said surface of the workpiece at the second zone, immediately beyond which the belt is directed away from the workpiece. In other words, at the first zone, material is removed from the surface of the workpiece to approximately the depth of the abrasive particles. Inasmuch as the belt and workpiece are traveling in the same direction, the relatively fast speed of the abrasive belt causes the finely divided particles of fibrous material cut from the workpiece at the first zone to accumulate at the second zone to an extent that the particles of fibrous material fill the spaces between the abrasive particles to a point where only the outer ends or tips of the abrasive particles project outwardly beyond the accumulated fiber particles to perform a very fine cutting operation on the surface of the workpiece. Not only do the particles of fibrous material act as a cushion between the workpiece surface and the abrasive belt, but they further operate as a burnishing medium against said workpiece surface to impart a smooth finish thereto.

Still another object of my invention is the provision of a machine which, using a single endless abrasive belt, performs both rough cutting and fine finishing operations on a workpiece surface during a single passage of the workpiece through the machine.

Another object of my invention is the provision of a machine as set forth which operates as a drum sander to perform the rough cutting operation on the workpiece, and as a belt sander to perform the finishing operation thereon.

The above and still further highly important objects and advantages of my invention will become apparent from the following detailed specification, appended claims, and attached drawings. Referring to the drawings, in which like reference characters indicate like parts throughout the several views:

Fig. 1 is a view in side elevation of a machine belt in accordance with my invention and adapted to carry out my novel method;

Fig. 2 is a view in end elevation, as seen from the line 2—2 of Fig. 1, some portions shown in section, and on a reduced scale;

Fig. 3 is an enlarged vertical section taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged fragmentary view corresponding to a portion of Fig. 3, showing the platen of my novel apparatus; and

Fig. 5 is a greatly enlarged fragmentary view corresponding to a portion of Fig. 3, some parts being shown on an exaggerated scale.

Referring with greater detail to the drawings, numeral **1** indicates in its entirety a generally rectangular frame structure comprising a pair of laterally spaced upright side walls **2** and **3** connected by front and rear end wall sections **4** and **5** respectively. A pair of supporting rolls **6** and **7** are journalled at their opposite ends in the side walls **2** and **3** on horizontal axes adjacent respective ones of the front and rear walls **4** and **5**. The supporting rolls **6** and **7** have their upper portions tangent to a common horizontal plane to support a panel-like workpiece X for movement in a direction normal to the axes of the supporting rolls **6** and **7**. The workpiece X is usually of wood or a manufactured product containing a high percentage of wood fibers or the like.

A secondary frame **8** is disposed within the frame structure **1** and is mounted therein by means of a transverse shaft **9** supported at one end by the side wall **3** of the frame structure **1**, and at its other end in a cup-shaped bearing portion **10** of a plate-like supporting bracket **11**. The side wall **2** of the frame structure **1** defines an enlarged opening **12** in which the bracket **11** is disposed, said bracket being pivotally connected to the side wall **2**, as indicated at **13**, for swinging movements into and out of the plane of the side wall **2**. The bracket **11** further is provided with and upwardly opening cup-shaped bearing **14** which supports one end of a shaft **15** that is further journalled in bearings **16** on the secondary frame **8** for rotation on a horizontal axis parallel to the axes of the supporting rolls **6** and **7**. Rigidly mounted on the shaft **15** for common rotation therewith between the bearings **16** is a contact roll **17** comprising a cylindrical drum **18** on which is securely mounted a cylindrical rubber-like tire or cover **19**. The outer cylindrical surface of the tire 19 is preferably grooved to define circumferentially spaced generally longitudinally extending ridges or ribs 20. Preferably, the top surface portion of the tire 19, defined by the ribs 20, is substantially level with the plane of the top portions of the supporting rollers 6 and 7. An idler roll 21 is mounted on a shaft 22 that is journalled at its opposite ends in spaced bearing brackets 23 at the opposite end of the secondary frame 8 for rotation on an axis parallel to the axis of the shaft 15, and at a level below that of the shaft 15. A pair of bracket-like arms 24 extend upwardly from opposite sides of the secondary frame 8 at its intermediate portion, and support a platen 25 that is disposed closely adjacent the top portion of the contact roll 17. A rubber-like pad 26 overlies the platen 25, the platen 25 and pad 26 being covered by a jacket or sleeve 27 that is preferably impregnated or coated with material having a low coefficient of friction, such as graphite or the like, not shown.

The platen 25 is so disposed relative to the contact roll 17 that the top surface of the jacket or sleeve 27 is level with the top surface portion of the contact roll tire 19. A wide endless abrasive belt 28 is entrained over the contact and idler rolls 17 and 21 respectively, and the platen 25, as clearly shown in Figs. 1 and 3, the outer surface of the belt 28 being substantially covered by abrasive particles indicated at 29 in Figure 5. Rotary movement is imparted to the contact roll 17 in a counterclockwise direction with respect to Figs. 1, 3, and 5, by a conventional electric motor 30 and transmission mechanism, such as multiple belts 31 entrained over a multiple pulley 32 mounted fast on the drive shaft 33 of the motor 30, and a second multiple pulley 34 mounted fast on the projected end of the shaft 15 outwardly of the frame member 3, see Figure 2.

A pair of supporting beams 35 each overlie a different one of the side walls 2 and 3 and are secured at their rear end portions to a transverse shaft 36 that is journalled at its opposite ends in bearings 37 one each bolted or otherwise rigidly secured to a different one of the side walls 2 and 3 of the frame structure 1, whereby the beams 35 are capable of upward and downward swinging movements. The front end portions of the beams 35 are provided with lock nut-equipped adjustment screws 38, the lower ends of which engage plate-like elements 39 on the top surfaces of the respective side walls 2 and 3, see Figs. 1 and 3, to limit downward swinging movements of the supporting beams 35 and parts carried thereby. A feed roller 40 is mounted on a shaft 41 in overlying spaced parallel relation to the contact roll 17, the shaft 41 being journalled at its opposite end portions in bearings 42, one of which is shown, said bearings each being bolted or otherwise rigidly secured to the front end portions of the supporting beams 35, as indicated in Fig. 1. The feed roller 40 is rotated in a clockwise direction with respect to Figures 1 and 3 by conventional means including a multiple pulley 43 mounted fast on the extended end portion 44 of the shaft 41, and power driven transmission belts 45, shown fragmentarily in Fig. 2 as being entrained over the multiple pulley 43, and indicated at 45. As shown, the peripheral surface of the feed roller 40 engages the top surface of the workpiece X to move the same through the machine in a direction from the right to the left with respect to Figures 1, 3 and 5.

For the purpose of properly positioning the workpiece X and guiding the same against the supporting roller 7 and the portion of the abrasive belt 28 overlying the platen 25, I provide guide elements in the nature of rollers 46 and 47, the former of which overlies the platen 25, and the latter of which overlies the supporting roll 7. The rollers 46 and 47 are journalled on respective shafts 48 and 49 for rotation on axes parallel to the axes of the supporting rolls 6 and 7, the contact roll 17 and feed roller 40. The shafts 48 and 49 are mounted at their opposite ends in mounting blocks 50 and 51 that are adjustably slidably mountde in respective guideways 52 and 53 and held in desired set positions by adjustment screws 54 and 55 respectively. Belt cleaning means in the nature of a rotary brush 56 extends transversely across the outer working space of the belt 28, the opposite end portions of the core or shaft 57 of the brush 56 being journalled in the opposite side walls 2 and 3 of the frame structure 1. Although not shown, it may be assumed that suitable means is provided for imparting rotation to the brush 56 in a direction to remove fibrous particles of material cut from the workpiece X and which may adhere to the outer working surface of the belt 28. It should here be noted that the plate-like bracket 11 may be swung outwardly on the aligned axes of the pivotal connections 13 to permit easy removal of the abrasive belt 28 when the same becomes worn, and equally easy installation of a new belt 28, through the enlarged opening 12 in the side wall 2.

As has been generally set forth above, my novel method involves the moving of the abrasive belt in a given direction at relatively high speed, and moving the workpiece in the same direction at a relatively low speed. The instant method further involves imparting working pressure to the belt against the surface of the workpiece at first and second zones to effect an initial cut on the surface at the first zone and a final finishing operation on the surface at the second zone. Although, in the machine above described and shown in the drawings, no adjustment means for raising and lowering the contact roll 17 and platen 25 with respect to the supporting rolls 6 and 7 is illustrated, it may be assumed that the contact roll 17 is set to remove a predetermined thickness of material from the workpiece X as it passes through the machine. The elasticity of the tire or cover 19, of the contact roll 17 is such that the downward pressure of the feed roller 40 on the workpiece X causes the top portion of the tire 19 to flatten slightly thereunder, resulting in a transversely extended pressure or contact area of the abrasive belt 28 against the under surface of the workpiece X that is relatively narrow in the direction of movement of the belt 28 and workpiece X. With reference to Figure 5, it will be seen that this contact area or zone extends between vertical broken lines A—A and B—B. The abrasive particles 29 exert their greatest cutting action in the narrow area between the lines A—A and B—B, cutting away from the under surface of the workpiece X finely divided particles of fibrous material or products of attrition, indicated at Y. As the particles Y are cut away from the workpiece X, they substantially fill the spaces between the abrasive particles 29 on the belt 28 so that, as the belt 28 travels over the platen 25, only the outermost ends or tips of the abrasive particles 29 project above the fibrous particles Y, which fibrous particles Y form a cushion between the platen 25 and the overlying portion of the workpiece X against downward pressure exerted by the overlying guide roller 46. As above noted, the speed of linear movement of the belt 28 is relatively high compared to the speed of feeding movement of the workpiece X. The high speed of the belt 28 relative to that of the workpiece X causes the fibrous particles Y carried over the platen 25 to effect a burnishing of the engaged under surface of the workpiece X which, in cooperation with the very fine cutting of just the tips of the abrasive particles 29 on said under surface of the workpiece X results in a smooth even surface that is ready to receive whatever protective coating is desired to be a part thereto, such as lacquer, varnish, wax or the like. In practice I have found that, with the abrasive belt 28 traveling at a linear speed of between 4,000 and 5,500 feet per minute, and the workpiece X being fed in the same direction at speeds of 30 to 100 feet per minute, highly satisfactory results have been obtained. It will be understood that the differential in speed of the workpiece and belt will vary with workpieces of different materials and hardness within the ranges of speed set forth above.

It will be noted with reference to Figures 1 and 3, that the arrangement of contact roll **17**, idler roll **21** and platen **25** is such, that, as the belt **28** leaves the platen **25**, it is immediately directed angularly away from the under surface of the workpiece X. Hence, the relatively wide area defined by the platen **25** provides the area of the final finish operation on the workpiece. It will be further noted that most of the particles of fibrous material Y are thrown free of the belt **28** as it changes direction away from the workpiece upon leaving the platen **25**. However, should any of the fibrous material Y adhere to the outer working surface of the belt **28**, these fibers are removed by the rotary brush **56** upon passage of the belt thereby. Thus, as the belt **28** moves toward the top of the contact roll **17**, the abrasive surface thereof is cleaned for maximum cutting efficiency. The resilient pad **26** is sufficiently firm to support the overlying portions of the abrasive belt **28** against the under surface of the workpiece X, but is sufficiently elastic to yield slightly under varying pressures caused by inequalities in thickness of a given workpiece X from end to end, or between different workpieces of the same run.

In practice, I have found that, by using a serrated tire **19** with its ribs or ridges **20**, I have been able to use an abrasive belt **28** with finer abrasive particles **29** than could be used with a smooth surfaced tire to remove the same amount of material from the workpiece X during the roughing cut. The finer grit abrasive leaves the workpiece X in a smoother condition for final finishing at the platen **25**, and the spaces between the abrasive particles **29** become more completely and compactly filled than those of a coarser abrasive belt, if such were used. As each rib **20** approaches the workpiece, the leading edge thereof causes the overlying portion of the abrasive belt **28** to engage the workpiece with greater pressure than does the trailing edge thereof so that, in the rough cutting zone defined by the lines A—A and B—B, the greatest pressure of the abrasive particles against the workpiece surface is had in a series of transverse lines, which arrangement results in a more effective cutting operation than is possible with equal pressure on the abrasive belt against the workpiece over a relatively broad area.

It will be further appreciated that, although I have shown and briefly described a rotary brush **56** for removing fibrous material Y from the working surface of the belt **28**, other suitable means for removing the fibrous material may be utilized, such as, for instance a jet of air directed against or across the working surface of the belt.

While I have above disclosed my novel method and one form of apparatus for carrying out the method, it will be understood that the same is capable of modification without departure from the spirit and scope of the invention as defined in the claims.

What I claim is:

1. In an abrasive machine of the class described, a supporting frame structure, means for supporting and feeding a workpiece of fibrous non-metallic material in a given direction, a contact roll mounted in spaced parallel relation to the workpiece supporting and feeding means for rotation on an axis extending transversely of the direction of movement of said workpiece, a platen mounted in said frame structure rearwardly of said contact roll, said platen having a working surface the extended plane of which is tangent to said contact roll, said workpiece supporting and feeding means including a guide element opposite said platen and spaced therefrom a distance substantially equal to the distance between said contact roll and feeding means, said contact roll including a cylindrical rubber-like tire element the outer surface of which defines a plurality of closely circumferentially spaced axially extended ribs, an endless abrasive belt entrained over the ribbed surface of said contact roll and the working surface of said platen and adapted to engage a wide flat surface of said workpiece, and means for imparting movement to said feeding means in a direction to feed the workpiece from said contact roll toward said platen and guide element and for imparting rotation to said contact roll in a workpiece feeding direction and at a higher rate of peripheral speed than that of said feeding means, a portion of said belt between the contact roll and the workpiece making a transversely extending relatively narrow contact with said workpiece to effect a relatively coarse cut thereon, the length of the working surface of said platen in the direction of movement of said workpiece being substantially greater than that of said narrow contact in the same direction, the direction of rotation of said contact roll causing the finely divided fibrous material removed from the workpiece adjacent said contact roll to be discharged between the abrasive belt and said workpiece toward said platen, whereby said material forms a cushioning and burnishing medium between the platen engaged portion of the abrasive belt and said workpiece, the said platen having an angularly disposed portion directing said abrasive belt angularly away from contact with said workpiece as the belt leaves said working surface of the platen.

2. In an abrading machine of the class described, a supporting frame structure, means including a feed roller journalled in said structure for feeding a workpiece of fibrous material in a direction generally normal to a radius of said feed roller, a guiding means mounted in the frame structure, and having a workpiece engaging portion in a plane substantially tangent to the surface of the feed roller; an abrasive belt moving and contact means comprising a contact roller mounted in opposed spaced parallel relation to the feed roller, a platen mounted adjacent and rearwardly of said contact roller and having a working surface in a plane substantially tangent to the surface of the contact roller and parallel to the first mentioned plane, an idler roller rearwardly of the platen and spaced from the second mentioned plane; an endless abrasive belt trained about said contact and idler rollers and over the working surface of said platen, means for imparting rotation to said feed roller in a direction to feed a workpiece from said contact roller toward said platen, and means for imparting rotation to one of the belt entrained rollers to move said belt at a higher linear speed than the peripheral speed of said feed roller, the direction of movement of said belt causing finely divided particles removed from said workpiece to accumulate on the belt and to be carried between said belt and said workpiece toward said platen, whereby said finely divided material cooperates with the platen engaged portion of said belt to impart a burnish finishing operation on said workpiece, said platen having an end portion guiding said abrasive belt angularly away from contact with said workpiece as said belt leaves said working surface, and means for removing the accumulated finely divided material from the portion of said belt leaving said platen and approaching said contact roll during movement of said belt.

3. The structure as defined in claim 2, wherein the means for removing the finely divided particles from the belt is a brush.

4. An abrading machine having frame members, longitudinally spaced workpiece supports mounted in said frame members, an abrasive belt supporting and driving roller mounted in said frame members between said workpiece supports, a workpiece opposing platen having a surface mounted in a plane tangential to said belt driving roller and common to and between said spaced workpiece supports, an abrasive belt being entrained over said belt supporting and driving roller and said platen, a driven workpiece feeding roller adjustably supported on said frame members between said workpiece supports in opposed parallel relation to said belt supporting and driving roller, adjustable workpiece engaging

means also mounted on said frame members in a plane opposed to and parallel to the plane of said platen and in tangential spaced relation to said feed roller, and means for imparting materially greater peripheral speed to said abrasive belt supporting roller than to said workpiece feeding roller whereby to produce a maximum abrading action in line with the axes of said rollers and a relatively wide tangential zone of diminishing abrading action for increasing accumulations of abraded particles on said belt between said rollers and platen.

5. The structure as defined in claim 4 including a belt return and idler roller spaced from said platen and said first mentioned plane.

6. The structure defined in claim 5, wherein the platen has an angular face directed away from said first mentioned plane to direct said abrasive belt away from a workpiece travelling over said supporting means.

7. The structure as defined in claim 5 including means located between said platen and said idler roller for removing abraded particles from said belt.

8. The structure defined in claim 4, wherein the spaced workpiece supports are a pair of spaced idler rollers.

9. The method of continuously abrading and successively buffing a sheet of wood comprising the steps of moving said sheet and an abrasive belt in adjacent parallel relation for a considerable linear extent of said sheet and in such a manner as to cause relative movement of said sheet and said belt, causing a relatively narrow transverse area of contact pressure between said relatively moving sheet and belt to effect continuous abrading of said moving sheet, progressively accumulating the products of attrition between said belt and said sheet in the region following said relatively narrow transverse area of contact pressure, and causing a relatively larger pressure contact area between said sheet, products of attrition, and said belt in said region thereby to cause a burnishing of said abraded area.

10. The method of claim 9, wherein the belt and the sheet are moved in the same direction at different speeds.

11. The structure according to claim 4, wherein the belt is below the workpiece.

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