June 3, 1941. H. R. HERCHENRIDER 2,244,536

APPARATUS FOR AND METHOD OF SURFACING METALS, ETC.

Filed Oct. 30, 1937 2 Sheets-Sheet 1

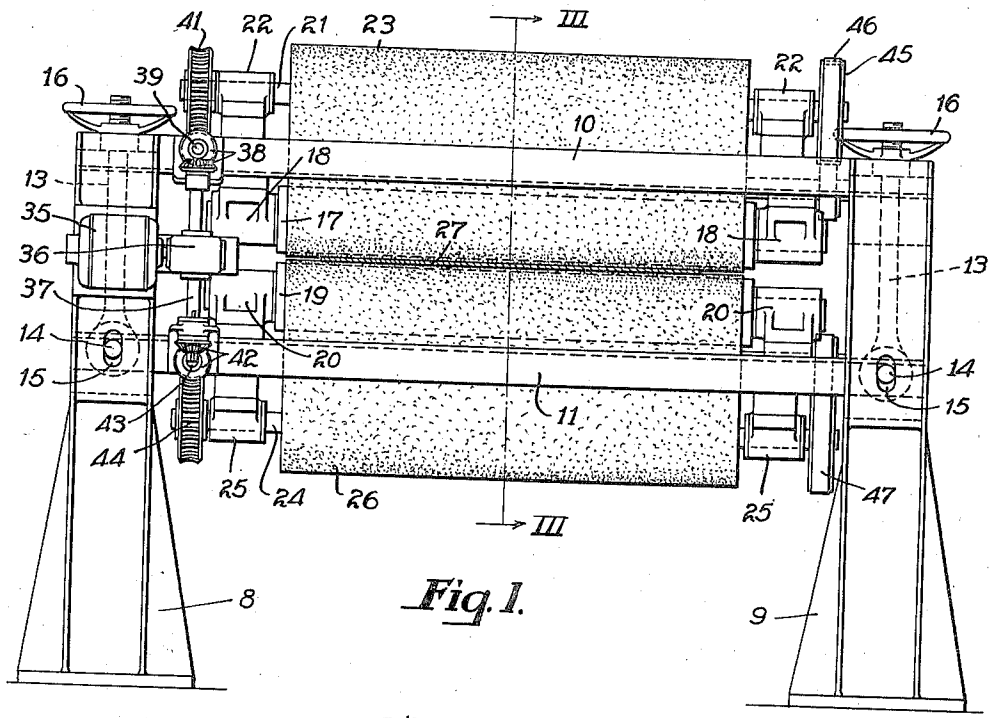



Fig. 1.

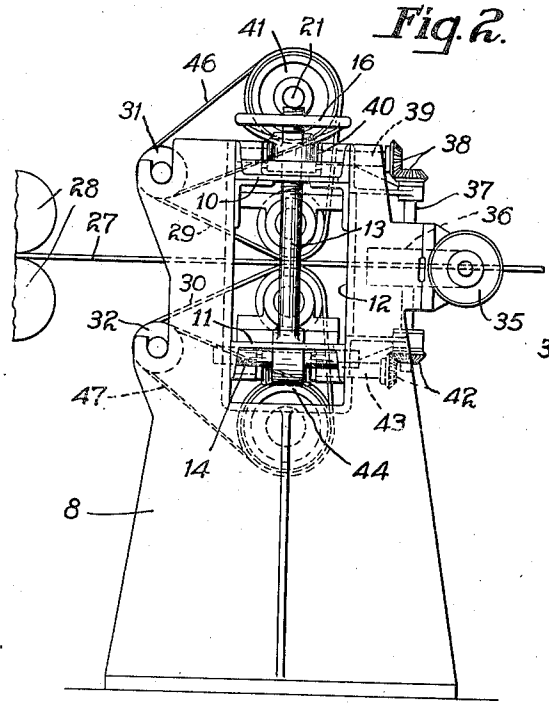



Fig. 2.

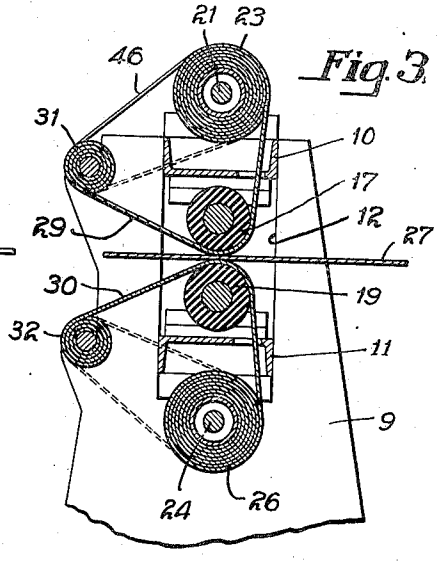



Fig. 3.

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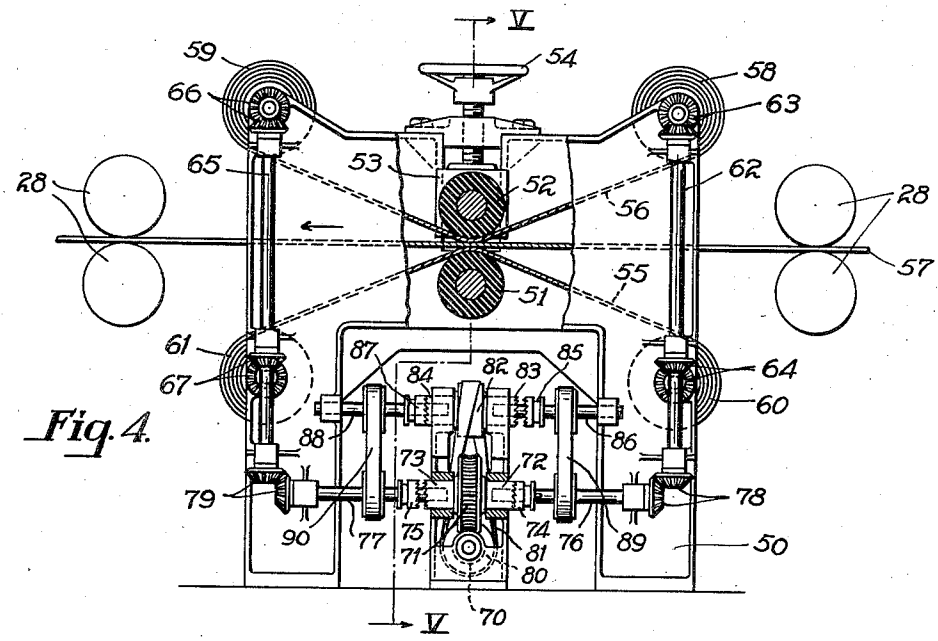



Fig. 4.

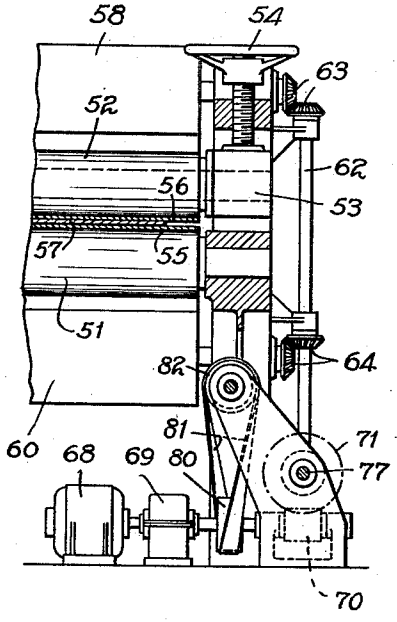



Fig. 5.

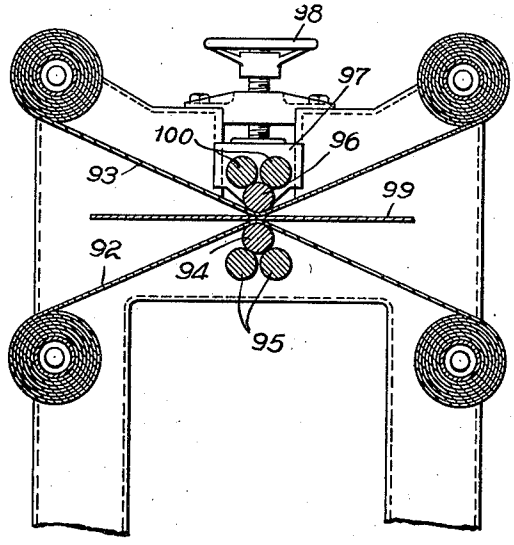



Fig. 6.

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Patented June 3, 1941 2,244,536

# UNITED STATES PATENT OFFICE

2,244,536

## APPARATUS FOR AND METHOD OF SURFACING METALS, ETC.

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Application October 30, 1937, Serial No. 171,961

14 Claims. (Cl. 51—150)

My invention relates to the art of grinding, scouring, polishing and cleaning the surfaces of metal strips or sheets. flat wire, etc.

The invention is hereinafter described as employed in the surfacing of long strips of metal such as those produced on continuous mills, but it will be understood that various features of the invention can be employed in the surfacing of other articles.

Steel strip and the like, must in most cases be given special surfacing treatment in order to render it suitable for various uses. In some instances a simple grinding and polishing thereof is sufficient. But difficulties have been encountered in effecting uniform grinding or polishing of a strip in those cases where a given area of abrasive material is applied to successive portions of a strip, because initially the abrasive action will be greater than on succeeding portions of the strip, owing to the loss of a large percentage of the abrasive effect, with the result that the strip toward its rear end is likely to be insufficiently scoured. Even in those instances where additional or new abrasive material is applied during the later stages of operation upon a strip, there is, nevertheless, non-uniformity of abrasive action, and the procedure is slower and more costly.

In other cases, it is necessary to subject the sheets to various treatments to eliminate surface imperfections. Thus, in the case of sheets which require a mirror-like finish or which are to be nickel plated, chromium plated, galvanized or tinned by either the electro-plating or dipping process, the sheets or strips are subjected to various treatments which require a long period of time and which are expensive, such treatments consisting in annealing, pickling and cold rolling to eliminate superficial surface imperfections.

When the steel strip is rolled on a cold reduction mill, the surface of the strip becomes so dense and smooth that subsequent annealing and pickling treatments do not give a satisfactory surface for "tight" galvanizing, or other plating, with the result that the coating will crack and peel from the strip. Furthermore, various alloy steels such as those of copper-bearing type etc. become discolored or stained during the annealing and pickling treatments.

One object of my invention is to provide means for subjecting the strip to a very high degree of abrasive pressure.

Another object of my invention is to provide means for continuously supplying fresh abrasive to a moving strip, and to, therefore, effect uniform scouring of the strip throughout its entire length.

Another object of my invention is to provide a means and a method whereby a larger percentage of the abrasive-coated paper or cloth can be utilized than in the case of certain methods heretofore employed.

A further object of my invention is to surface strips or sheets in such manner that plating or coating materials will tightly adhere thereto.

Still another object of my invention is to provide a method or apparatus of generally simplified and improved form for the surface treatment of metal.

Some of the forms of apparatus by which my invention may be practiced are shown in the accompanying drawings wherein Figure 1 is a front view of a grinding or scouring apparatus; Fig. 2 is an end view thereof; Fig. 3 is a view taken on the line III—III of Fig. 1; Fig. 4 is a side view partly in section of another form of apparatus; Fig. 5 is a view taken on the line V—V of Fig. 4, and Fig. 6 is a sectional view showing a modified form of the structure of Fig. 4.

Referring first to Figs. 1 to 3, I show standards 8 and 9. The standards at their upper ends are rigidly connected by a cross-beam 10. A cross-beam 11 extends across the standards 8 and 9 and is slidably supported at its ends in slideways 12 formed in the standards 8 and 9. The beam 11 is supported from the beam 10 for vertical adjustment, by means of hanger rods 13 that are connected at their lower ends to pins 14, which extend through the flanges of the cross-bar 11, the walls of the standards 8 and 9 being slotted as indicated at 15, to permit of vertical adjustments of the bar 11 and the pins or studs 14 serving to prevent axial shifting of the bar 11. The hangers 13 at their upper ends extend through the cross bar 10 and are threaded for engagement with hand wheels 16 which are supported upon the bar 10 and can be turned to raise or lower the bar 11.

A presser roller 17 is journalled at its ends in bearings 18 carried by the upper beam 10. A lower presser roll 19 is journalled in bearings 20 that are carried by the cross bar 11. Rotation of the hand wheels 16 will, therefore, result in movement of the rolls 17 and 19 toward or away from one another to vary the degree of pressure, as will be hereinafter explained. The rolls 17 and 19 may be faced with hard rubber or other suitable non-metallic material, as shown more clearly in Fig. 3, if desired, or they may be formed entirely of metal.

A shaft 21 is journalled at its ends in bearings

22 that are carried by the beam 10. The shaft 21 serves to support a reel or spool 23 upon which is carried a supply of abrasive in the form of an abrasively-coated strip of paper, cloth or the like. A shaft 24 is journalled in bearings 25 carried by the beam 11, and has a spool 26 that supports a roll of abrasive as does the spool 23. A metal strip to be polished is indicated by the numeral 27 and is advanced between the rolls 17 and 19 in any suitable manner, as by driven rolls 28. The strip 27 may be supplied to the polishing apparatus from a continuous mill, or drawn from a coil. Short sheets instead of long strips could also be fed through the apparatus in a suitable manner.

The strip 27 can be advanced at any suitable speed and frequently will be moved forwardly at anywhere from 50 feet per minute to 500 feet per minute. The abrasive strips are caused to advance gradually in the same direction as the strip moves, but at a much lower rate of speed. The abrasive paper or strips may be caused to travel at from six inches per minute to 18 inches per minute, for example, depending upon the character of abrasive employed and the rapidity with which the abrasive becomes worn through contact with the sheet. It will be understood that the abrasive strips may be caused to move at various rates of speed relative to the work being ground or polished, and that it may be moved counter to the work instead of in the same direction; also that the rolls 17 and 19 can be positively driven in order to assist in or control travel of the strips.

In setting the machine into operation, the ends of the abrasive strips 29 and 30 are drawn from the reels 23 and 26 respectively, across the opposite faces of the pressure rolls 17 and 19. These ends are then secured to take-up rolls 31 and 32 respectively, which are journalled in the standards 8 and 9. The movement of the steel strip 27 through the apparatus will tend to draw the strips 29 and 30 forwardly, and retarding means are provided for preventing the abrasive strips moving at the same rate of speed as the steel strip, whereby the relatively faster speed of the steel strip will result in an abrading or polishing action thereon by the strips.

As above indicated, the paper is fed into abrading position by the drag of the metal strip 27. The unreeling movement of the paper is controlled by a motor 35 which through a gear-reducing unit 36 drives a vertical shaft 37. At its upper end the shaft 37 has beveled gear connection 38 with a horizontal shaft 39 that carries a worm 40 meshing with a worm wheel 41 that is secured to the end of the reel shaft 21. At its lower end, the shaft 37 has beveled gear connection at 42 with a shaft 43 that through a worm gear unit 44 has geared connection with the reel shaft 24. The motor 35 is operated at such controlled speed that the abrasive strips will not be drawn too rapidly from their reels, and the rate of rotation of the motor will be controlled to restrain movement of the abrasive strips to a desired slow rate of speed relative to the speed at which the strip 27 travels.

The abrasive strip can be permitted to move at such slow rate of speed relative to the travel of the metal strip that the abrasive surface thereof will become substantially completely worn off, and the worn ends can immediately be torn off and discarded. However, in the present case, I provide the take-up reels 31 and 32 for receiving the worn portions of the abrasive strips. The reel 31 is driven from a pulley 45 mounted on the end of the shaft 21 and a belt 46 that passes around a small pulley on the end of the reel 31. The reel shaft 32 is similarly driven from the shaft 24, through a belt drive 47. The belts 46 and 47 are sufficiently loose that they constitute a friction drive for the take-up reels, so that while there is sufficient driving force transmitted to the reels 31 to take up the worn paper, such force is not so great as to tear the paper, or so great that it will tend to advance the paper too rapidly.

The rolls 17 and 19 preferably have faces of material which can be compressed slightly through operation of the hand wheels 16, in order to effect desired areas of contact between the abrasive strips and the steel strip. In a number of cases, this area of contact may be perhaps one-half inch in width and the presser rolls 17 and 19 may be drawn toward one another to such an extent that they will exert perhaps 700 lbs. pressure per square inch. The degree of pressure will, of course, be varied in accordance with the character of abrasive employed, and the extent to which it is desired to grind or polish the metal strips.

When the various parts of the apparatus are brought into operative position, as shown in the drawings, strip-advancing rolls 28 and the retarding motor 35 are set into operation. As heretofore explained, the retarding motor is operated at such speed that the abrasive strips will move much slower than the steel strip, and in most cases the rate of movement of the abrasive strips will be such that their abrading surfaces will be completely worn off. It will be seen that a fresh supply of abrasive is entering the pressure zone at all times during the passing of the steel strip, and that, therefore, the strip will be uniformly abraded from end to end. The steel strips will frequently be of from 100 feet in length to 1,000 feet in length, or more. Ordinarily the amount of paper or the number of turns of paper on the supply reels is not so great that there is marked difference in speed of unwinding movement of the paper as the supply becomes depleted through withdrawal, but if desired, the speed of the motor 35 can be increased slightly as the paper becomes drawn from the supply rolls.

Referring now to Figs. 4 and 5, I show a structure wherein abrasive strips may be employed for polishing metal sheets or metal strips, that may be moved by feed rolls or the like, such as the rolls 28, in either direction through the apparatus or which may be reciprocated therein. In this construction, standards 50 are provided for supporting the working part of the apparatus. A billy roll 51 is journalled in the standards, and a presser roll 52 is journalled in slide bearings 53 that are supported in the standards 50 for vertical adjustment. Screw-downs 54 are provided for adjusting the bearings 53 so that the roller 52 will be moved toward the roller 51 so as to subject the abrasive strips 55 and 56 and the steel strip 57 to desired degrees of pressure. Drums or reels 58 and 59 are provided for the upper strip 56, and drums or reels 60 and 61 are provided for the lower strip 55, these reels being mounted on shafts that are journalled in the framework in substantially the same manner as are the shafts 21 and 24. A vertical shaft 62 has beveled gear driving connection at 63 with the shaft of reel 58, and beveled gear driving connection at 64 with the shaft of the reel 60. Similarly, a shaft 65 has beveled

gear driving connection at 66 with the shaft of the reel 59 and at 67 has driving connection with the shaft of the reel 61.

A motor 68 is provided for controlling the rate of rotation of the shafts 62 and 65. The motor shaft through a reducing gear 69 and a worm 70 drive a worm wheel 71 whose hubs 72 and 73 are provided with clutch teeth. Clutch elements 74 and 75 are movable on shafts 76 and 77 respectively, into engagement and disengagement with the clutch elements 72 and 73, respectively. The shafts 76 and 77 are connected through bevel gears 78 and 79 respectively, with the shafts 62 and 65.

The shaft of the worm 70 has secured thereto a pulley 80 which through a belt 81 drives a pulley 82 whose hubs have clutch elements 83 and 84. A clutch element 85 is slidably keyed on a shaft 86 for movement into and out of driving engagement with the clutch element 83. A clutch element 87 is slidably keyed on a shaft 88 for movement into and out of driving connection with the clutch element 84. A belt drive 89 is provided between the shafts 76 and 86, and a belt drive 90 between the shafts 77 and 88.

With the parts in the position shown in Fig. 4 and the motor 68 in operation, there is connection through the clutch elements 72—74 with the reels 58 and 60, so that the strip 57 in traveling in the direction indicated by the arrow, will not draw the abrasive strips 55 and 56 from their respective reels too rapidly. In other words, the paper will be drawn from the reels at a desired low rate of speed, as heretofore explained. At this time, the reels 59 and 61 function as take-up reels, being loosely driven from the pulley 82, from which the power is transmitted through the clutch elements 84 and 87; thence through a slipping belt drive 90 to the shaft 77 and the shaft 65.

When a strip is to be ground or polished while moving in the opposite direction, the reels 59 and 61 serve as supply reels and the reels 58 and 60 as take-up reels. In such instances, the clutch elements 72 and 74 are disengaged, as are also the clutch elements 84 and 87. The clutch elements 73—75 are brought into engagement so that the motor will have the desired retarding effect on rotation of the shaft 65, while the clutch elements 83 and 85 are brought into engagement to effect driving of the shaft 62 from the loose belt 89.

In this structure, the apparatus can be so operated as to effect complete wearing out of the paper, or the paper, by reason of the reverse movement above described can be used a plurality of times, if too much of the abrasive surface has not been worn away upon the first use thereof. In other words, the grinding pressure and the rate of movement of the paper may be such as to completely wear off the abrasive upon a single movement of the paper, whereas in other instances, a light abrasive pressure may be employed.

In Fig. 6 I show a structure whereby it is possible to effect greater grinding pressure than can be secured through the use of a single pair of presser or pinch rolls, arranged as shown in Fig. 4. When a single pair of presser rolls are employed, they must be of sufficient strength to withstand the pressure forces to be applied thereto. Therefore, when it is desired to apply high pressure to the rolls, they must be of large diameter and circumference, with the result that the area of contact with the abrasive strip is greater than where rolls of smaller circumference are employed. The rolls of smaller circumference will have a narrower width of contact with the abrasive strips in directions axially of the rolls, but they will not be of sufficient strength to permit applying very heavy pressure thereto.

It will be seen that with larger size rolls, which may cause the abrasive strips to contact with the metal strip for a width of perhaps one inch, in directions axially of the rolls, a given degree of pressure applied to the rolls will not give as great square-inch pressure of the abrasive strips on the steel strip as can be secured through the use of a similar degree of pressure applied to smaller rolls which will cause a contact area of but one-half inch in width by the abrasive strips on the steel.

In order to permit of the application of high pressure to rolls of narrower width, I provide back-up rolls for the pressure or pinch rolls, as shown in Fig. 6. This structure in all other respects may be the same as the structure of Figs. 4 and 5, and the idea could also be applied to the structure of Figs. 1 to 3. The abrasive strips 92 and 93 may be driven in the same manner as are the strips 55 and 56. A presser roll 94 is journalled in the framework of the machine, as is the presser roll 51, and a pair of back-up rolls 95 are also journalled in the framework of the machine and serve to support the roll 94 against deflection under pressure. The upper presser or pinch roll 96 corresponds to the roll 52 and is journalled in a vertically-adjustable block 97 which is operated by a hand wheel 98 to effect the desired degree of pressure by the abrasive strips 92 and 93 on the metal strip 99. Back-up rolls 100 are also journalled in the bearing blocks 97, and serve to support the presser roll 96 against deflection or breakage under pressure. It will be seen that with hold-down force of a given degree, the effective abrasive pressure applied through the strips 92 and 93 upon the metal sheet will be much greater in the structure of Fig. 6 than in the structure of Fig. 4, because of the relatively smaller diameters of the rolls 94 and 96.

I claim as my invention:

1. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material and simultaneously maintaining an abrasive strip in contact with the material and effecting continuous traveling movement of the abrasive strip with the material, at a substantially lower rate of speed.

2. The method of surfacing strip material and the like, which comprises imparting traveling movement to the material, simultaneously imposing an abrasive strip against said material with pressure sufficient to cause substantial advancing force to be exerted upon the strip through frictional contact with the material, and restraining advancing movement of the strip to a rate of continuous travel substantially slower than that of the material.

3. Grinding and polishing apparatus comprising means for imparting traveling movement to strip material and the like, reels of abrasive strips supported at opposite sides of the path of said traveling movement of the material, means for causing the abrasive strips to be continuously advanced through traveling movement of said material, and means for retarding the rate at which the abrasive strips will be withdrawn from said reels, to a speed which is slower than that at which the material travels

4. Grinding and polishing apparatus comprising means for imparting traveling movement to strip material and the like, reels of abrasive strips supported at opposite sides of the path of said traveling movement of the material, means for causing the abrasive strips to be continuously advanced through traveling movement of said material, and a common motor control for retarding the rate at which the abrasive strips will be withdrawn from said reels, to a speed which is slower than that at which the material travels.

5. The method of surfacing strip material or the like, which comprises imparting traveling movement to the material, while maintaining an abrasive strip in frictional engagement therewith, on a narrow area which extends transversely of the material, and simultaneously effecting continuous traveling movement to the abrasive strip, in a path generally parallel to the path of movement of the material and at a substantially lower speed.

6. The method of surfacing strip material or the like, which comprises imparting traveling movement to the material, while maintaining an abrasive strip in frictional engagement therewith, on a narrow area which extends transversely of the material, and simultaneously effecting continuous traveling movement to the abrasive strip, in a path generally parallel to the path of movement of the material and at a substantially lower speed, the degree of frictional pressure and the relative slowness of movement by the abrasive strip being such that the major portion of the abrasive will become expended during a single traveling movement thereof on the material.

7. The method of surfacing strip material or the like, which comprises imparting traveling movement to the material, while maintaining an abrasive strip in frictional engagement therewith, on a narrow area which extends transversely of the material, and simultaneously effecting continuous traveling movement to the abrasive strip, in a direction generally parallel to the path of movement of the material and at a rate not greater than one-fiftieth of the speed at which the material travels.

8. The method of surfacing strip material and the like, which comprises the steps of bringing an abrasive strip into engagement with said material, applying pressure at the point of contact between the abrasive strip and the material, causing the material to be drawn continuously past said point of contact, and imparting continuous movement to the abrasive strip, in a path generally parallel to the path of travel of the material, to continuously renew the abrasive surface at said point of contact.

9. The method of surfacing strip material and the like, which comprises continuously applying successive portions of an abrasive strip against the surface of the material, while imparting relative traveling movement to the abrasive and the material, in generally parallel paths, the material at any given area thereof being brought into engagement with the abrasive strip but once during a surfacing operation upon the material.

10. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, an abrasive strip, means for holding the abrasive strip in engagement with the material, means for so supporting the strip that it will continuously be moved along through frictional engagement with the material, and means for retarding advancing movement of the abrasive strip to a speed substantially slower than the rate at which the material moves.

11. Grinding and polishing apparatus comprising means for imparting traveling movement to strip material and the like, means for holding an abrasive strip against the material, means for effecting continuous traveling movement of the abrasive strip in a path generally parallel to the path of travel of the material and for bringing successive portions thereof into contact with the material, and means for maintaining a predetermined differential of speed as between the material and the abrasive strip.

12. Grinding and polishing apparatus comprising means for imparting traveling movement to strip material and the like, an abrasive strip, a presser member for holding the abrasive strip against the material, a reel upon which the strip is stored previous to use and from which it is drawn for engagement with the material, means for effecting continuous withdrawal of the strip from said reel and past the presser member, in a path generally parallel to the path of the material, and means limiting the rate at which the strip can be withdrawn from the reel, to a speed bearing a predetermined relation to, but different from, the rate at which the material travels.

13. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, an abrasive strip, a presser roll extending transversely of the path of travel and positioned to maintain the abrasive strip in engagement with the material, a back-up roller for the presser roll, and means for effecting continuous traveling movement of the strip in a path generally parallel to the said path of travel at a substantially slower rate of speed than the rate at which the material travels.

14. Apparatus for surfacing strip material and the like, comprising means for imparting traveling movement to the material, an abrasive strip, a presser roll extending transversely of the path of travel and positioned to maintain the abrasive strip in engagement with the material, a back-up roller for the presser roll, and means for effecting continuous traveling movement of the strip in a path generally parallel to the said path of travel at a substantially slower rate of speed than the rate at which the material travels, the presser roll having a compressible face and the rolls being adjustable perpendicularly of the plane of the material.

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