April 12, 1932. C. H. DERBY 1,854,021

MACHINE FOR FLEXING SHEET ABRASIVES

Filed July 11, 1930 3 Sheets-Sheet 1

Fig. 1

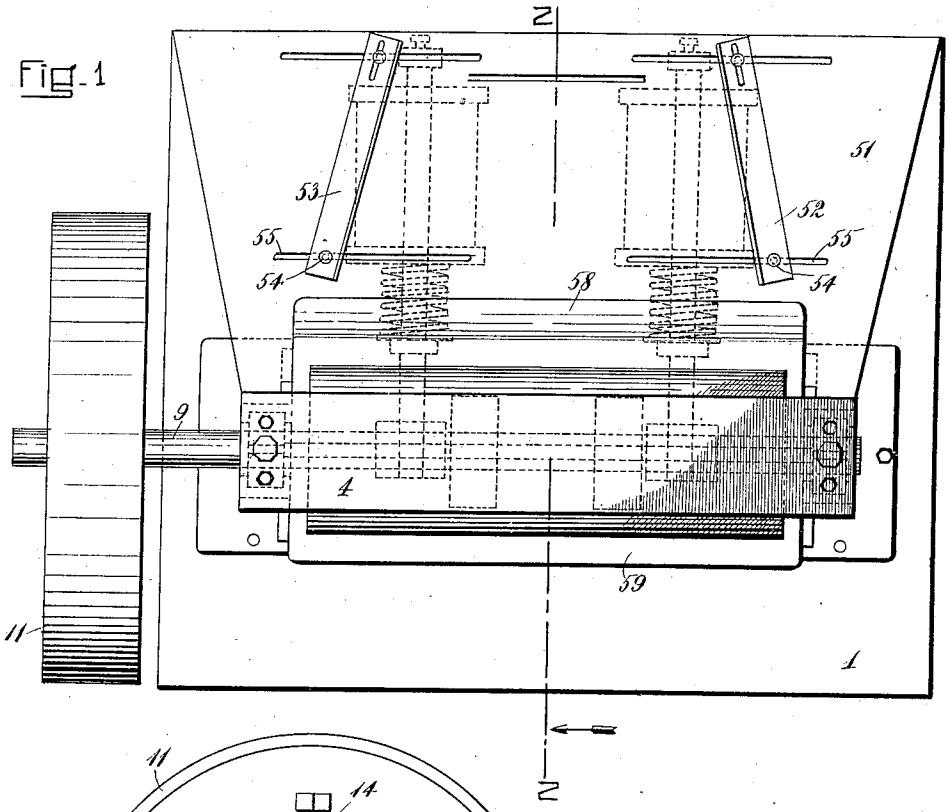
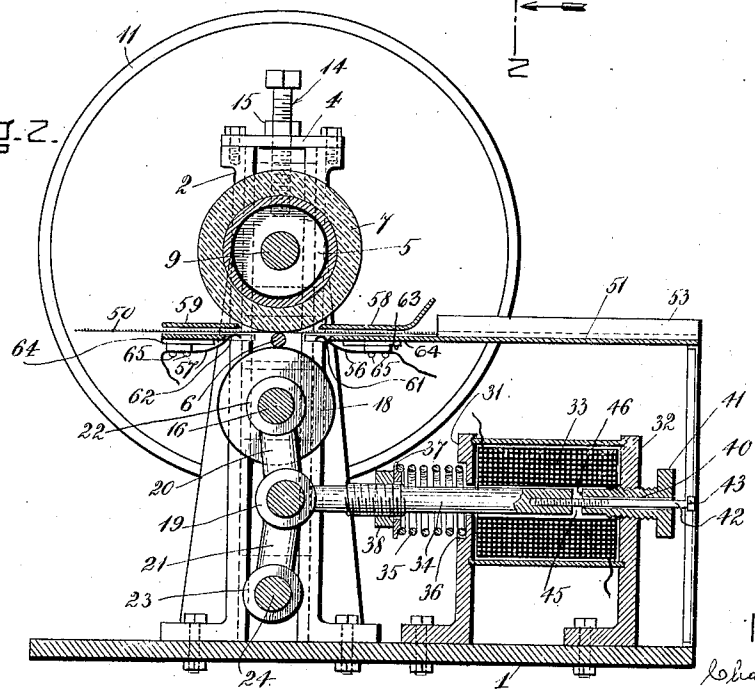


Fig. 2.



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MACHINE FOR FLEXING SHEET ABRASIVES

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Fig. 3.

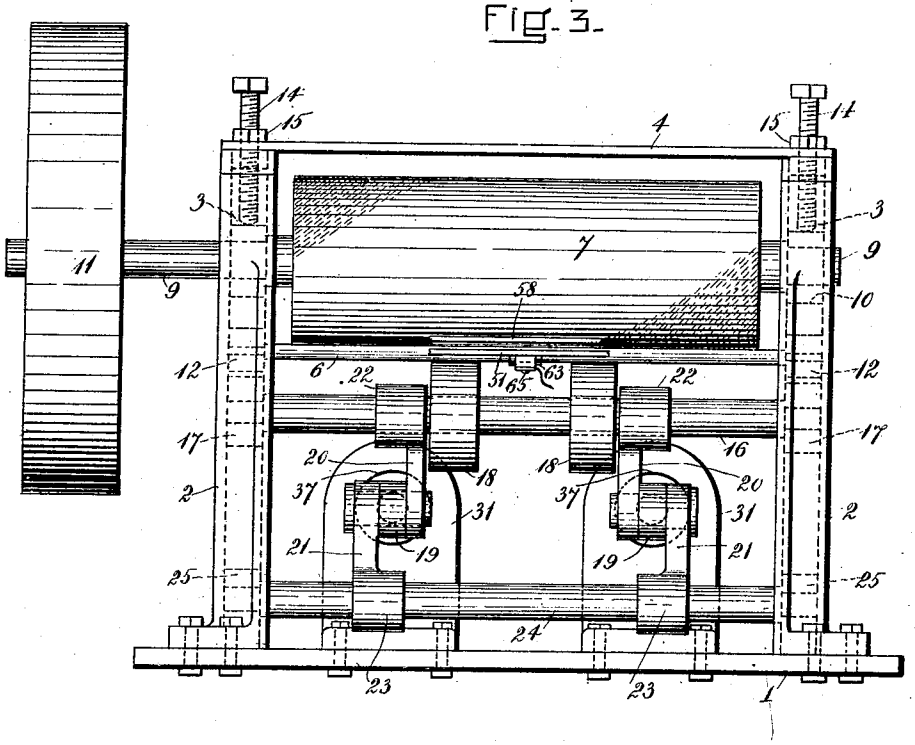
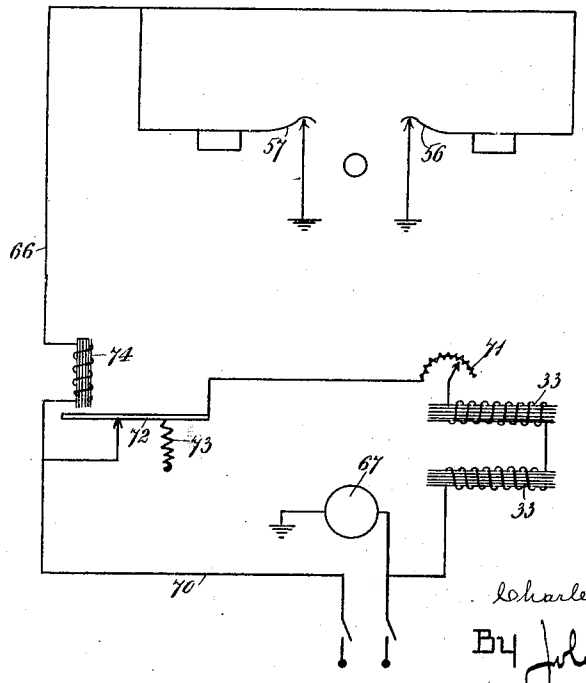


Fig. 4.



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MACHINE FOR FLEXING SHEET ABRASIVES

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Fig. 7.

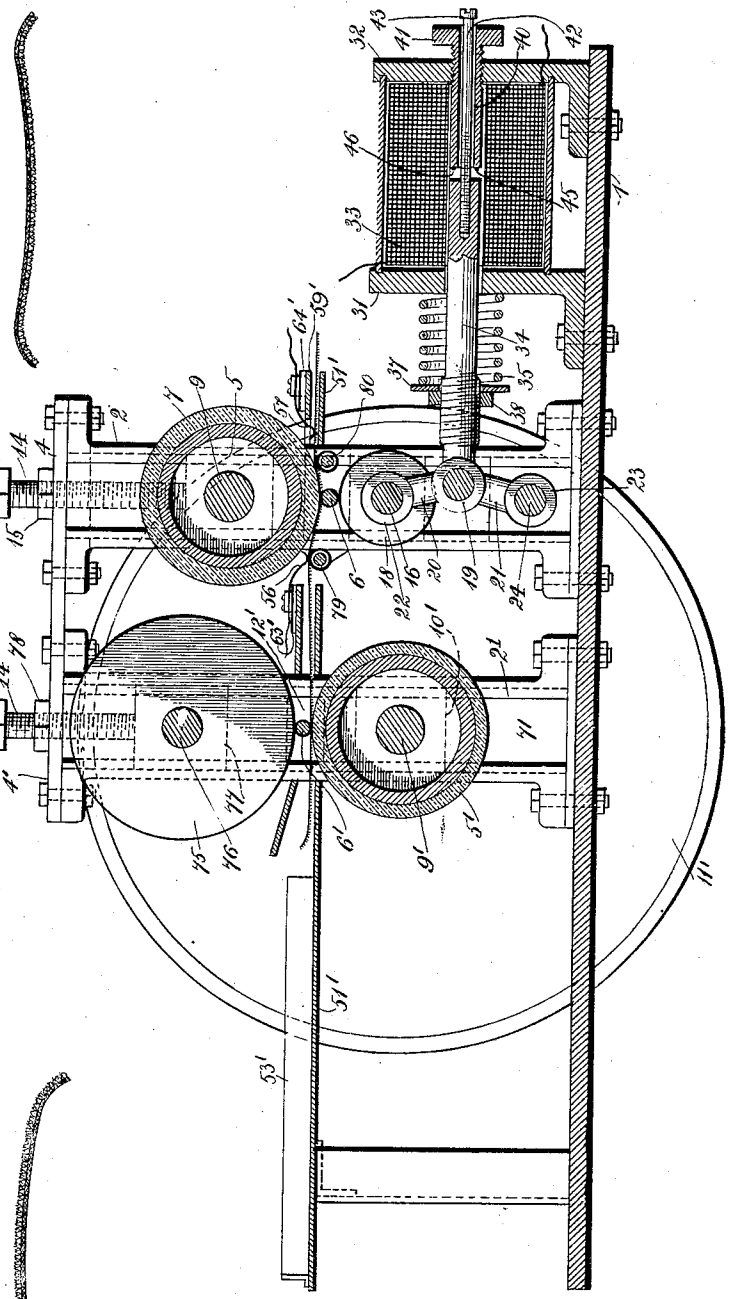

Fig. 6.

Fig. 5.

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UNITED STATES PATENT OFFICE

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MACHINE FOR FLEXING SHEET ABRASIVES

Application filed July 11, 1930. Serial No. 467,351.

The invention relates to a machine for flexing sheet abrasives of the type having a paper or cloth backing to which the abrasive is bonded by an abrasive binder such as glue. The flexing of the abrasive sheet is for the purpose of so preforming and preparing it that it may better be applied to a mounting such as a roll, wheel or drum around which it is wrapped, and in order that such application may be effected without injury to the sheet. An example of such a flexed abrasive sheet is shown in U. S. Patent No. 1,706,351 of March 19, 1929 to which attention is directed for a more detailed description of the advantages to be derived from an initially flexed or preformed abrasive sheet. As recited in said patent the initial flexing or preforming of the sheet is obtained through fracturing the binder by minute cracks relatively close together with extension generally crosswise the sheet.

The object of the invention is to provide a machine automatic in its operation and capable of treating an abrasive sheet by imparting to determinate or localized portions thereof the desired convexity or concavity, or combination of both, and this through an application of varied and predetermined pressures.

The invention can best be seen and understood by reference to the drawings in which—

Figure 1 is a plan of the machine.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 shows the machine in front elevation.

Fig. 4 is a diagrammatic plan of the electrical connections incident to the machine.

Fig. 5 is a side elevation of an abrasive sheet flexed by the operation of the machine.

Fig. 6 shows in combined section and side elevation a modified type of the machine, and

Fig. 7 is a side elevation of an abrasive sheet flexed by the modified type of machine shown in Fig. 6.

Referring to the drawings:—

1 represents the bed of the machine. Bolted to the bed are spaced uprights 2, 2 each having a vertical way 3 in it and which way is open on the inner side of the upright. The uprights are connected by a cross bar 4 bolted to their tops.

Mounted to turn between the uprights are flexing rolls 5, 6, respectively. Of these the roll 5 is a relatively large roll having an outer facing of rubber 7 or other compressible and resilient material. The roll is mounted on a shaft 9 which turns within boxes 10, 10 slidably contained in the ways of the respective uprights. The shaft 9 of the roll is extended at one end and bears a driving pulley 11 to which power is applied from any suitable source for turning the roll and operating the machine.

The roll 6, arranged below the roll 5 with bearing against it, is a relatively small roll more in the nature of a heavy rod. It is preferably of steel and its ends are journaled to turn in boxes 12, 12 slidably contained in the ways of the respective uprights.

The flexing rolls are held down or maintained in adjusted position against upward movement by means of set screws 14, 14 passed through the ends of the cross bar 4 and bearing at their bottom ends against the boxes 10, 10 within which the shaft 9 of the roll 5 turns. The set screws are maintained in adjusted position by locking nuts 15 thereon turned into locking engagement with the ends of the cross bar. The flexing rolls are maintained in position in a manner to permit of pressure being brought upon the roll 6 for lifting this roll to bear hard against the roll 5 to distort the rubber face of this roll as pressure is applied. To this end there is arranged below the roll 6 a shaft 16 with ends turning in boxes 17 slidably contained in the ways of the respective uprights. The shaft 16 bears a set of wheels 18, 18 and these wheels have peripheral engagement with the flexing roll 6. Below the shaft 16 is arranged a set of toggles. Each of these toggles comprises a knuckle 19 to which are hinged links 20, 21. The outer end of the link 20 of each toggle bears a hub 22 journaled to turn on the shaft 16 while the link 21 of each toggle bears a hub 23 fixed to a shaft 24 the ends of which turn within boxes 25 at the bottom ends of the ways in the respective uprights. The angular positioning of the links of the tog-

gles is such that when the links are angularly bent to a determinate extent the flexing rolls will be maintained in position but substantially no pressure will be exerted to press the flexing roll 6 against the roll 5. As the toggles are straightened, however, pressure will be applied to lift the flexing roll 6 hard against the roll 5 and the amount of this pressure will depend upon the extent that the toggles are straightened.

Pressure is applied to the toggles for straightening them and the pressure is applied and controlled as follows: Inasmuch as the mechanism for operating the two toggles is precisely alike a description of one will suffice for both. Lying in front of each toggle and supported by bolting to the bed 1 of the machine is a set of upstanding spaced plates, 31, 32, respectively. These plates form the body of a solenoid 33, having a plunger 34 which is secured to the knuckle 19 of the toggle. Arranged upon the plunger is a coiled spring 35. One end of this spring bears against the side of the end plate 31 of the solenoid, fitting within a socket 36 therein. The opposite end of the spring bears against a washer 37 on the plunger, and backed by an adjusting nut 38. It is by means of the compression of the spring 35 that force is exerted for straightening the toggle, and so the amount of force will depend upon the extent that the spring is compressed, while the compression of the spring is obtained by the adjustment of the nut 38.

In practice it is the adjusted compression of the springs 35, 35 that is relied upon to exert force for straightening the toggles. This adjustment may be such that the toggles will be fully straightened for exerting a maximum force upon the flexing rolls or a less degree of straightening when less force will be exerted. In any event, to prevent the springs forcing the links of the toggles outwardly into angular positions beyond their straightened positions, stops are provided. The stop for each toggle is provided as follows: Arranged in the end of the air gap of each solenoid beyond the end of its plunger with threaded extension through the end plate 32 of the solenoid is an adjustable stud 40 with head 41. Having threaded connection with the outer end of the plunger with extension through the stud 40 is a bar 42 having a head 43 beyond the head 41 of the stud. This headed bar forms a stop for the plunger for as the plunger is thrown forward by the spring 35 for straightening the links of the toggle the head 43 of the bar 42 will be brought into engagement with the head 41 of the stud 40 thereby preventing further displacement of the links of the toggle.

The adjustment of the stop bar 42 may be such that its head will engage the head of the stud just when the links of the toggle are fully straightened, preventing further movement of the toggle. The adjustment of the stop bar may however be such that the displacing action of the plunger upon the links of the toggle may be stopped at any determinate point short of a complete straightening of the links. In other words, by means of the adjustable stop bars 42, 42 for the two plungers the force exerted by the springs 35, 35 upon the plungers for straightening the toggles and raising the flexing roll 6 against the roll 5 may be determined with great nicety although the tension of the springs 35, 35 may be more than ample to completely straighten the toggles. As above explained however, I prefer that the force exerted by the plungers be controlled by an adjusted compression of the springs 35, 35 and the stop bars operate as safety devices for preventing any unwarranted straightening of the toggles beyond the amount determined upon and desired.

While the force exerted upon the toggles for straightening them is exerted by means of the compressed springs 35, 35 the reverse movement of the toggles for moving their links into such angluar position as to remove all lifting force on the flexing roll 6, is obtained by exciting the solenoids to pull in their respective plungers. During this action the springs 35, 35 will become further compressed, and the power of the solenoids for withdrawing their respective plungers must be sufficient to obtain such further compression of the springs as will enable the toggles to be thrown into their inactive positions. To intensify the action on its plunger of each of the solenoids when excited the adjustable stud 40 in the end of the air gap of each solenoid beyond the end of its plunger, forms a pole piece assisting in the drawing action upon the plunger when the solenoid is excited. The stud is made of iron. When the plunger is drawn in by the action of the solenoid supplemented by the action of its pole piece the end of the plunger might contact with the end of the pole piece and, if provision was not made, the plunger might not be released when the exciting current was cut off from the solenoid due to the residual magnetism which might reside in the pole piece. To obviate any difficulty of this kind an air gap 45 is left between the adjacent ends of the plunger and pole piece, and the end of the pole piece is fitted with brass stops 46 against which the end of the plunger will contact when moved inwardly to engage the stud 40 or pole piece. Owing to the air gap and the fact that little or no residual magnetism can reside in the brass stops 46 there is little danger of the plunger being retained by the pole piece, when the exciting current is cut off.

The abrasive sheet 50 is flexed by passage between the flexing rolls 5 and 6, and the sheet is fed to pass between these rolls over

a table 51 arranged fore and aft of the line of contact between them. In order that the rolls may receive any shape of end cut of the abrasive sheets, that part of the table lying forward of the rolls is provided with right and left feed guides 52 and 53 respectively, by which the abrasive sheets may be properly lined up before being fed to the rolls. The guides are movable over the face of the table, and are retained in adjusted position by fastenings 54 which pass through slot 55 in the table.

The application of pressure by the flexing rolls to the abrasive sheet is automatically controlled as follows: Arranged fore and aft of the central line of pressure between the flexing rolls 5 and 6 are spring contacts 56 and 57 respectively. These contacts form a part of an electric circuit and each is capable of completing the circuit by engagement with contacts 58 and 59, respectively, of which the contact 58 is arranged in front of the line of pressure between the flexing rolls and the contact 59 back of the line of pressure between the rolls. The contacts 58 and 59 are in the nature of plates extending over the table and spaced therefrom sufficiently to ensure an easy passage of the abrasive sheet between the plates and the table as the sheet is fed to the flexing rolls and passed therefrom. The arrangement of the plate contact 58 is such that the contact will extend beyond the edge 61 of the table lying in front of the flexing rolls while the plate contact 59 extends beyond the edge 62 of the table lying back of the flexing rolls. Thus the spring contacts 56, 57 are enabled to have engagement with the contacts 58, 59 beyond the edges of the table. The contacts have normal engagement with one another and are broken by the abrasive sheet itself as it is fed passing between the contacts. The distance or amount that the ends of the abrasive sheet are flexed is controlled by the adjusted position of the spring contacts 56, 57 measured from the central line of pressure between the flexing rolls. To this end the spring contacts are each mounted upon a support 63 which is adjustable in a way 64 on the under side of the table and fixed thereto in adjusted position by means of a tightening screw 65.

The contacts 56, 58; 57, 59 form a part of the same electric circuit or controlling circuit 66 as seen in the diagrammatic plan of Fig. 4. The circuit connecting with the electric source is completed in any suitable manner as by passage through the machine itself. The circuit is completed when either of the spring contacts 56, 57 is touching its companion contact 58 or 59 and as explained above, the contacts are normally in touch with one another, the circuit being broken only by the interposition of the abrasive sheet as it is fed through both sets of contacts simultaneously. It is preferred that an incandescent lamp 67 be placed within this circuit in order that it may be noted whether the circuit is functioning properly.

Connecting with the controlling circuit 66 and having the same electric source in an operating circuit 70 which connects with the solenoids 33, 33 for exciting them when the circuit is closed. The operating circuit is preferably provided with a rheostat 71 for standardizing its current. The operating circuit is closed by exciting the solenoids only when the controlling circuit is open. To this end the operating circuit is provided with a switch 72 controlled by a spring 73 for normally closing the switch and closing the circuit. The switch is held open by means of a relay 74 in the controlling circuit, the relay releasing the switch to close when the controlling circuit is open.

The general operation is as follows: It will first be assumed that the sets of spring contacts 56, 58; 57, 59 respectively, are arranged determinate distances away from the line of pressure between the flexing rolls, the one set in front of the line of pressure and the other set back of the line of pressure. The distances at which these contacts are set with relation to the line of pressure between the flexing rolls is commensurate with the extent of flexing of the respective ends of the abrasive sheet. The sheet is then placed upon the table in front of the flexing rolls and so positioned that its front edge will properly feed into the bight between the rolls. In attaining such position the fore end portion of the sheet will have passed between the contacts 56 and 58 breaking the engagement between these contacts. One or the other of the feed guides 52 or 53 on the table is then set in proper relation to the side edge of the sheet in order that the guide may then be standard for all the sheets subsequently fed. The machine now being in operation, the fore end portion of the sheet will pass between the flexing rolls and be flexed by the operation of these rolls, for at this time the springs 35, 35 are operating to straighten the toggles and thereby press the flexing roll 6 hard against the roll 5, thereby flexing the abrasive sheet and fracturing the binder by minute cracks relatively close together with extension relatively crosswise the sheet. The flexing continues along the sheet in an amount equal to the distance between the line of pressure between the flexing rolls and the set of contacts 57, 59 or until the fore end of the sheet reaches and passes between the contacts 57 and 59, separating these contacts and thereby breaking the controlling circuit, for the reason that the body of the sheet is then interposed between the contacts 56 and 58. With both sets of contacts thus separated and the controlling circuit broken, the relay 74 will release the switch in the operating circuit to close this circuit thereby

exciting the solenoids which compress the springs and relieve their tension upon the toggles which are allowed to assume an angular position, thereby relieving the pressure upon the flexing roll 6 and accordingly upon the sheet itself. The setting of the parts is preferably such that the springs will not be so compressed by the action of the solenoids as to so far bend the toggles that all pressure is released from the roll 6 for flexing the sheet in order that the main body of the sheet or that portion thereof lying between its end portions may receive some flexing but not the amount of flexure that the end portions receive. The sheet now progresses until the rear end of the sheet draws out from between the contacts 56 and 58 permitting these contacts to have engagement with one another. Thereupon the controlling circuit will again become completed. The operating circuit will become broken through the action of the relay and the solenoids will release the springs to act upon the toggles for straightening them and imparting pressure for flexing the rear end portion of the sheet or that portion lying between the set of contacts 56, 58 and the line of pressure between the flexing rolls. Thus the end portions and the intermediate portion of the sheet are flexed, the resulting sheet having a general configuration like that shown diagrammatically in Fig. 5. If desired the machine may be so adjustably set that no flexing of the intermediate body portion of the sheet will be obtained, only the end portions.

In the machine as above described it will be noted that the abrasive side of the sheet is in contact with the resilient one of the flexing rolls with the effect of imparting convexity to the abrasive sheet, the end portions of the sheet having a pronounced convexity with relation to the intermediate portion thereof between its ends. If desired the positioning of the sheet with relation to the resilient roll may be reversed and the abrasive side of the sheet be made to contact with the hard one of the flexing rolls, in which case the same general effect is obtained as before, but instead of a convex sheet there is obtained a concave sheet.

In Fig. 6 there is shown a further adaptability of the machine in that provision is made for making a combination convex and concave sheet such as that shown in Fig. 7 where the intermediate portion of the sheet between its ends is made convex while the ends of the sheet are made to have a pronounced concavity. This effect is obtained by a combined primary and secondary flexing mechanism as follows: Associated with a machine of the type just described and arranged in front of the flexing rolls of the machine is another set of flexing rolls 5′, 6′ of which the roll 5′ has a covering of rubber or other resilient material like the roll 5 while the roll 6′ is a hard roll like the roll 6. The disposition of these rolls is such that the resilient roll will lie beneath the hard roll, and the flexing effect is obtained, when the abrasive sheet is run between the two rolls, by the weight of a roll 75, made more or less massive, upon the roll 6. For supporting the rolls 5′, 6′ and 75 there is bolted to the bed 1 of the machine spaced uprights 2′, 2′, each having a vertical way 3′ in it open on the inner side of the upright, while the uprights are connected by a crossbar 4′ bolted to their tops. The flexing roll 5′ is mounted on a shaft 9′ which turns within boxes 10′, 10′ contained within the ways of the respective uprights. This roll is extended at one end and bears a driving pulley 11′ through which power is applied for turning the roll. The roll 6′ arranged above the roll 5′ with bearing against it has ends journaled to turn in boxes 12′, 12′ slidably contained in the ways of the uprights. The roll 75 arranged above the roll 6′ with bearing against it is mounted upon a shaft 76 with ends journaled to turn in boxes 77, 77 slidably contained in the ways of the uprights. The roll 75 is held down by means of set screws 14′ passed through the ends of the crossbar at the top of the uprights and bearing at their bottom ends against the boxes 77 within which the shaft 76 of the roll 75 turns. The screws are maintained in adjusted position each by locking nut 78 turned into locking engagement with the end of the crossbar. In front of the set of flexing rolls 5′, 6′ and leading to the bight of these rolls is a table 51′ over which the abrasive sheet is fed. This table continues beyond the rolls and leads to the set of flexing rolls 5, 6 of the secondary flexing mechanism. This secondary flexing mechanism is like that previously described and operates in the same way. Slight structural differences may be noted between it and the machine previously described. The supports 63′ carrying the spring contacts 56, 57 are arranged in ways upon the cross plates above the table and not upon it as before. The spring contact 56 normally engages an idler roll 79 for the abrasive sheet which forms a contact member assisting in the completion of the circuit. The spring contact 57 arranged on the plate 59′ above the table normally engages the projecting end of the table, which is a little different from the construction previously described. An idler roll 80 for the abrasive sheet is also provided. The flexing roll 5 of the secondary flexing mechanism is preferably driven off the shaft of the flexing roll 5′ of the primary flexing mechanism, any suitable driving mechanism (not shown) connecting the shafts of these two rolls.

In the operation the abrasive sheet is placed on the table in front of the rolls 5′, 6′ of the primary flexing mechanism. This table is provided with a set of feed guides the

same as was the table in the construction first described. As the sheet is fed it will first pass between the flexing rolls 5′, 6′ of the primary flexing mechanism. The sheet is placed with its abrasive side in contact with the soft or resilient one of the flexing rolls and consequently as the sheet passes between the rolls the adhesive binder will be broken down and a certain convexity will be imparted to the entire sheet. The sheet thence continuing, will pass between the flexing rolls 5 and 6 of the secondary flexing mechanism. The abrasive side of the sheet will then be in contact with the hard one of the flexing rolls. The secondary flexing mechanism then functioning as in the machine first described will tend to further break down the binder at the end portions of the abrasive sheet and impart a pronounced concavity to these end portions. The secondary flexing mechanism is preferably so set that little or no pressure will be exerted upon the intermediate portion of the sheet already flexed by the primary flexing mechanism. The resulting effect is a sheet like that shown in Fig. 7 where, as explained above, the body of the sheet or portion thereof between its end portions is convex while its end portions have a pronounced concavity.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, a set of toggles for applying pressure to the rolls for obtaining the flexing operation by the straightening of said toggles, means for applying pressure to the toggles for straightening them including a set of tensioned springs, means for controlling the tension of said springs, and means limiting the straightening of said toggles when actuated by said springs.

2. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, mechanism for applying pressure to the rolls for obtaining the flexing operation and for controlling said operation including toggles, a tensioned spring for straightening said toggles, a bar connecting with the toggles upon which the spring is arranged, a backing for the spring through which the bar extends, and means for adjustably tensioning said spring.

3. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, mechanism for applying pressure to the rolls for obtaining the flexing operation and for controlling said operation including toggles, a tensioned spring straightening said toggles, a bar connecting with the toggles upon which the spring is arranged, a backing for the spring through which the bar extends, means on the bar for tensioning the spring, and means limiting the straightening of said toggles when actuated by the spring.

4. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, means whereby pressure may be applied to the rolls for obtaining the flexing operation, and mechanism for controlling the applied pressure including an electric circuit having contacts located at determinate distances forward and back of the line of pressure between said flexing rolls and arranged whereby they may be severally or together opened by the sheet to be flexed run between said rolls.

5. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, means whereby pressure may be applied to the rolls for obtaining the flexing operation, mechanism for controlling the applied pressure including an electric circuit having contacts located at determinate distances forward and back of the line of pressure between said flexing rolls and arranged whereby they may be severally or together opened by the sheet to be flexed run between said rolls, and means whereby said contacts may be set in determinate adjusted positions with relation to said line of pressure between the flexing rolls.

6. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, means whereby pressure may be applied to the rolls for obtaining the flexing operation, and mechanism for controlling the applied pressure including an electric circuit having contacts located at determinate distances forward and back of the line of pressure between said flexing rolls and arranged whereby they may be severally or together opened by the sheet to be flexed run between said rolls, a solenoid, and means whereby said solenoid may be excited when said contacts are opened by said sheet.

7. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, means whereby pressure may be applied to the rolls for obtaining the flexing operation, and mechanism for controlling the applied pressure including an electric controlling circuit and an electric operating circuit, said controlling circuit having in it contacts located at determinate distances forward and back of the line of pressure between said flexing rolls and arranged whereby they may be severally or together opened by the sheet to be flexed run between said rolls and said controlling circuit be broken only when said contacts are both open, said operating circuit having in it a solenoid arranged to be excited when the operating circuit is closed, means whereby said operating circuit will be opened when said controlling circuit is closed and said operating circuit be closed by the breaking of said controlling circuit.

8. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, means whereby pressure may be applied to the rolls for effecting the flexing operation including a device tensioned for exerting force, a solenoid having a plunger for relieving the force exerted by said tension device, and means for exciting said solenoid to relieve the pressure exerted by said tension device including an electric circuit having in its contacts arranged in front of and behind the line of pressure between said flexing rolls and arranged whereby they may be severally or together opened by the sheet to be flexed run between said rolls.

9. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, mechanism whereby pressure may be applied to the rolls for obtaining the flexing operation and controlling said operation including toggles, a solenoid having a plunger connected to said toggles, a spring on said plunger, means whereby said spring may be tensioned to exert force for straightening said toggles and applying pressure to said rolls or said force be relieved by the exciting of said solenoid, and means governed by the sheet itself for exciting said solenoid whereby determinate portions of said sheet may be flexed by the operation of said rolls.

10. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for operating the rolls, mechanism whereby pressure may be applied to the rolls for obtaining the flexing operation and controlling said operation including toggles, a solenoid having a plunger connected to said toggles, a spring on said plunger, means whereby said spring may be tensioned to exert force for straightening said toggles and applying pressure to said rolls or said force be relieved by the exciting of said solenoid, a pole piece in said solenoid beyond the end of said plunger, a headed rod extending through said pole piece and having threaded connection with said plunger, and means governed by the sheet itself for exciting said solenoid whereby determinate portions of said sheet may be flexed by the operation of said rolls.

11. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for rotating the rolls, means for pushing the rolls closer together for flexing predetermined portions of the sheet, and means governed by the sheet itself for separating the rolls to relax their pressure when other portions of the sheet than the predetermined portions pass between the rolls.

12. An apparatus for flexing abrasive sheets comprising a set of flexing rolls, means for rotating the rolls, means for producing pressure between the rolls and controlling the intensity of such pressure, and means for confining the pressure on the sheet to predetermined portions thereof and for separating the rolls to relax their pressure when other portions of the sheet are passing between the rolls.

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