May 9, 1939. F. S. SCHADE 2,157,270

APPARATUS TO MAKE METAL REINFORCED LOOSE-LEAF PAPER SHEETS

Filed April 1, 1937 6 Sheets-Sheet 1

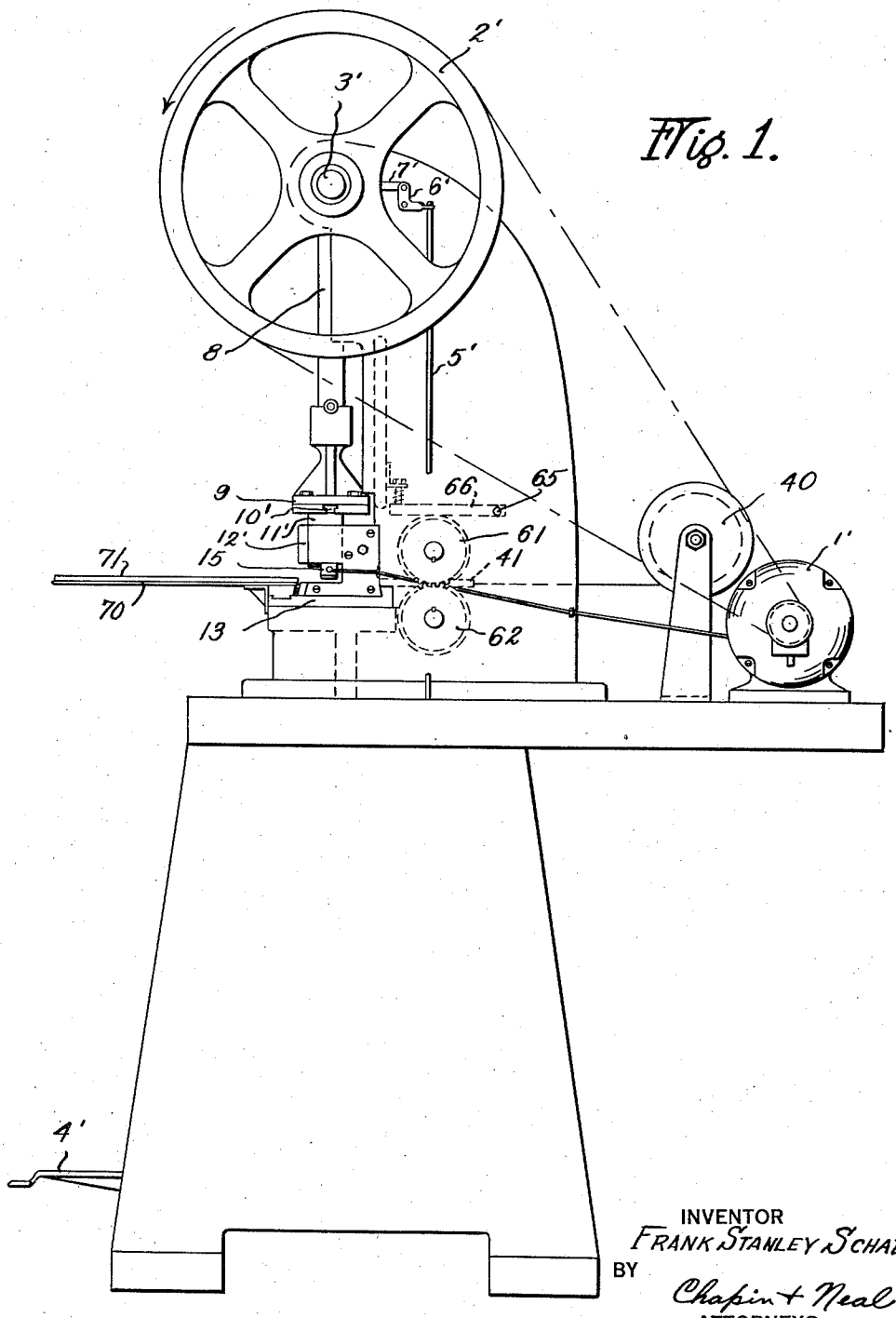


Fig. 1.

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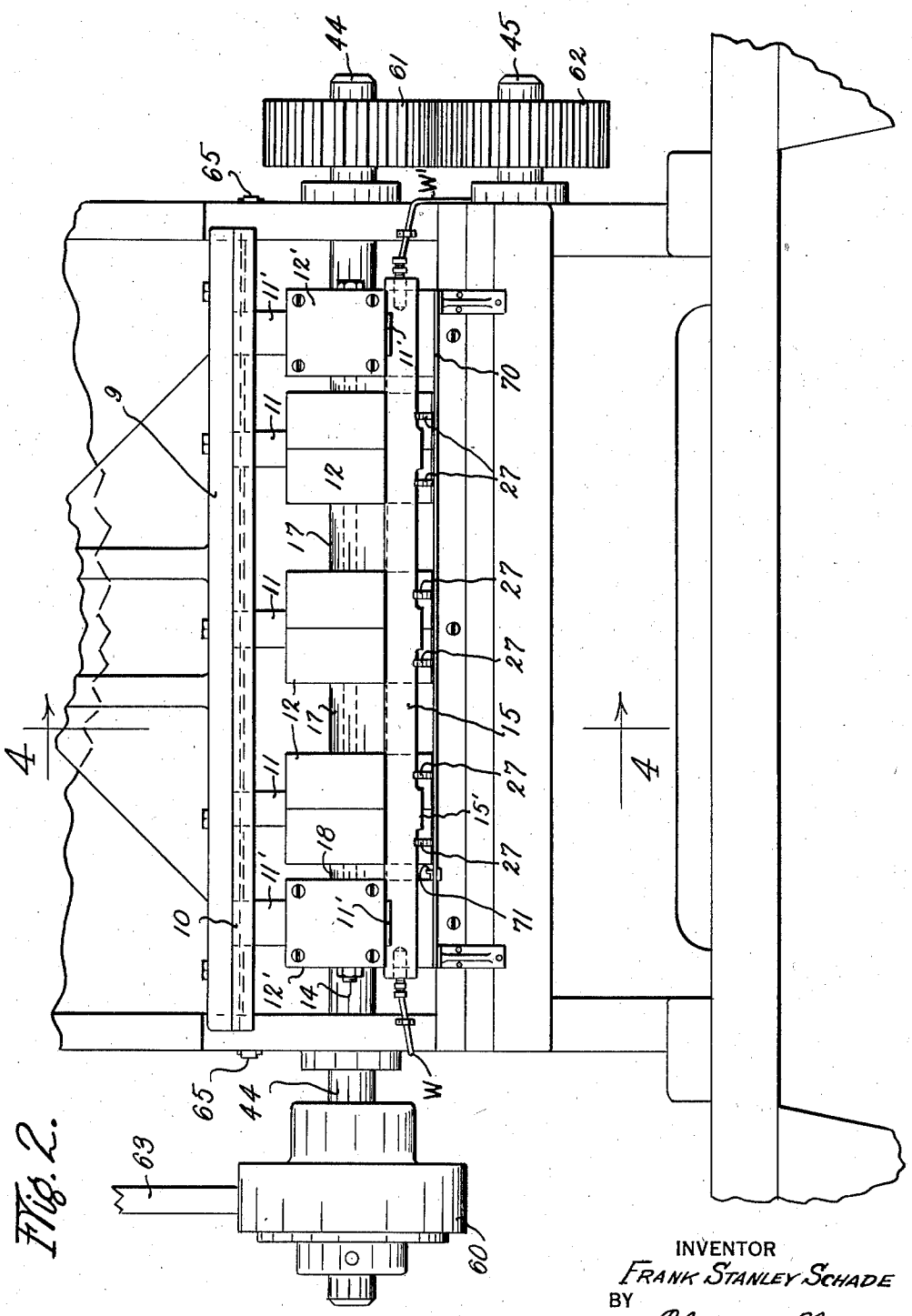


Fig. 2.

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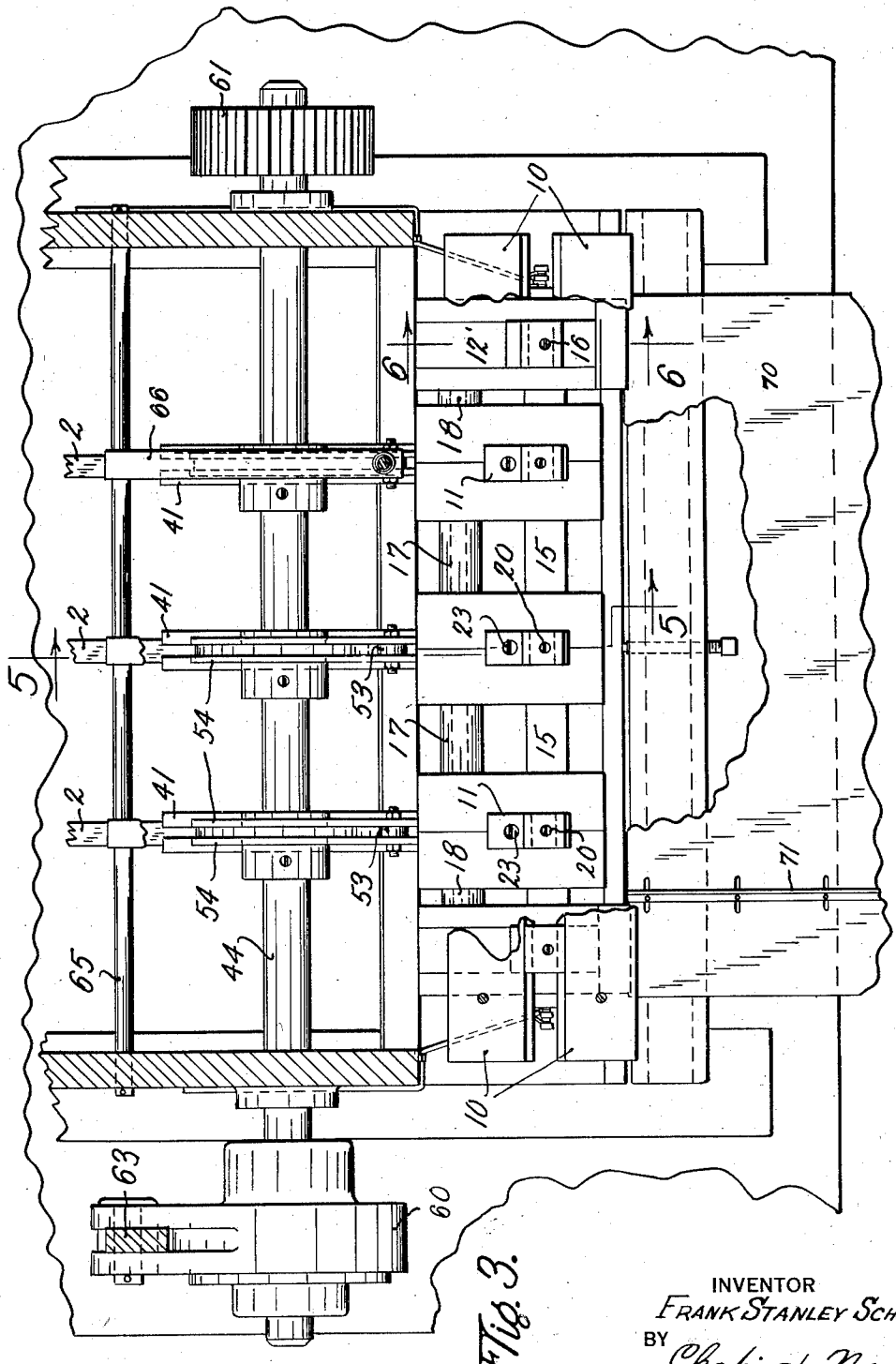


Fig. 3.

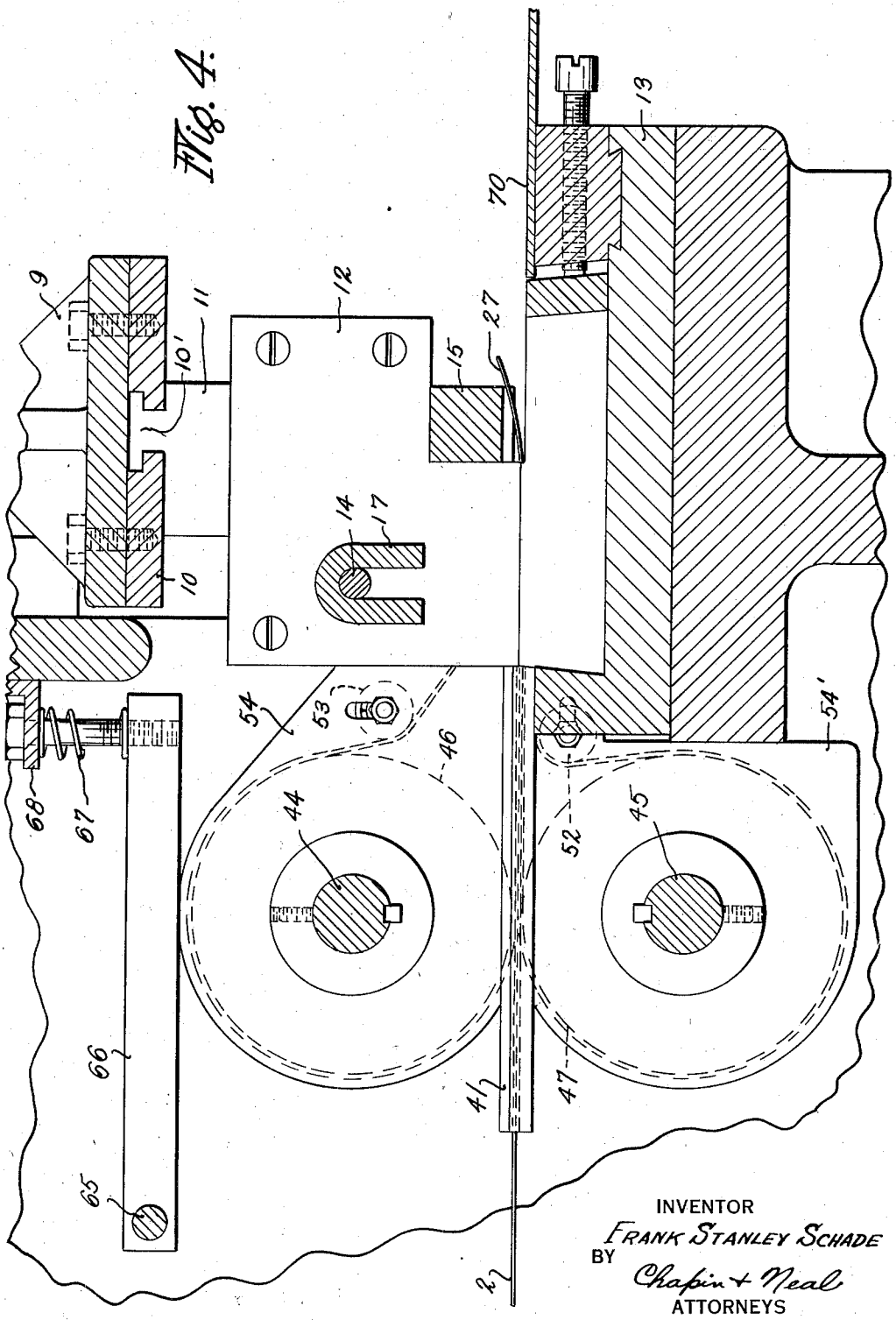
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APPARATUS TO MAKE METAL REINFORCED LOOSE-LEAF PAPER SHEETS

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Fig. 4.



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APPARATUS TO MAKE METAL REINFORCED LOOSE-LEAF PAPER SHEETS

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Fig. 5.

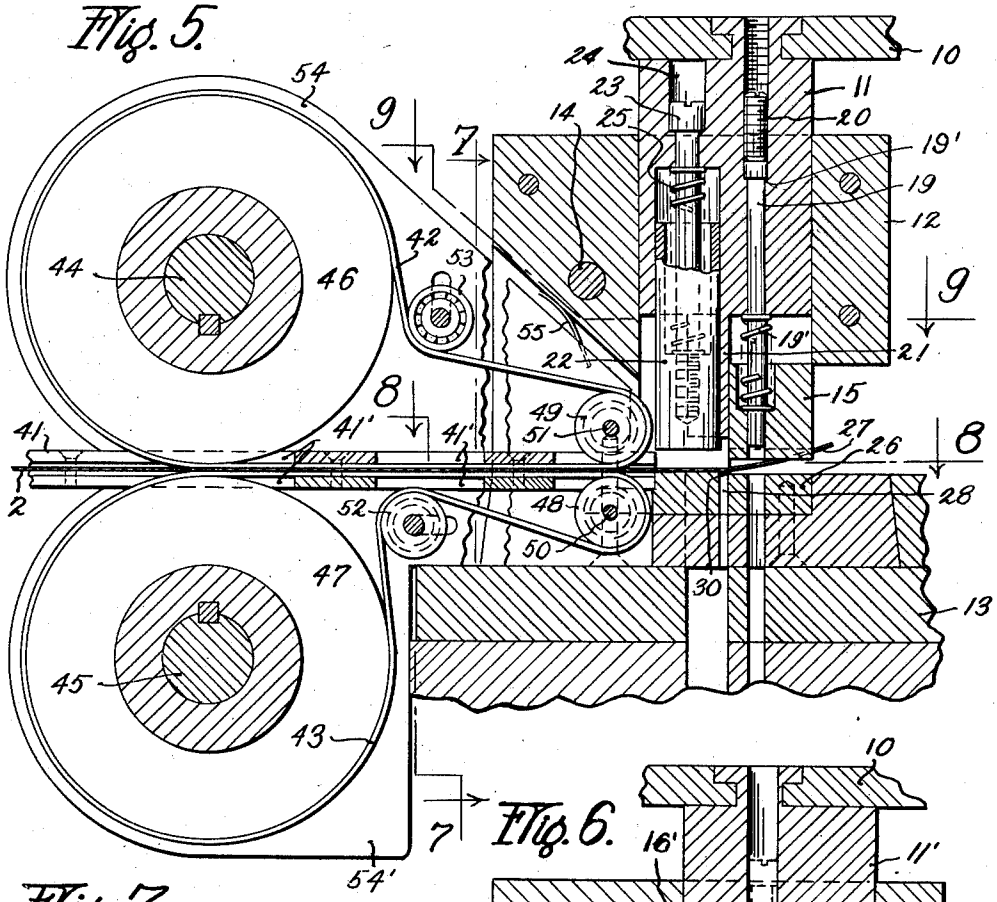


Fig. 6.

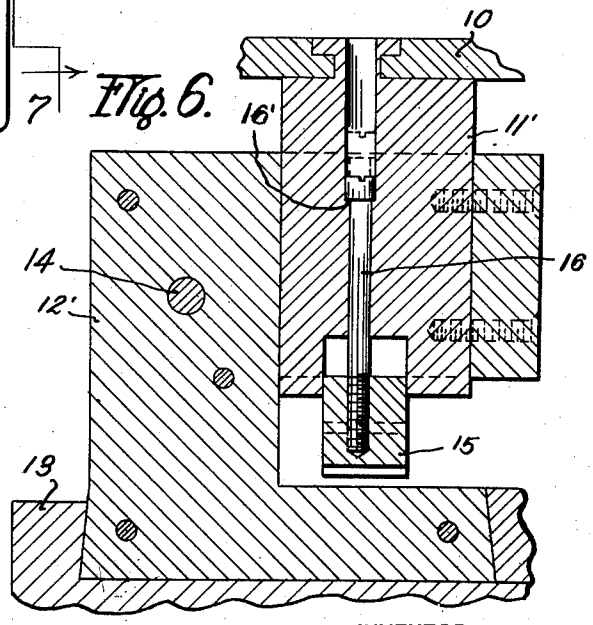
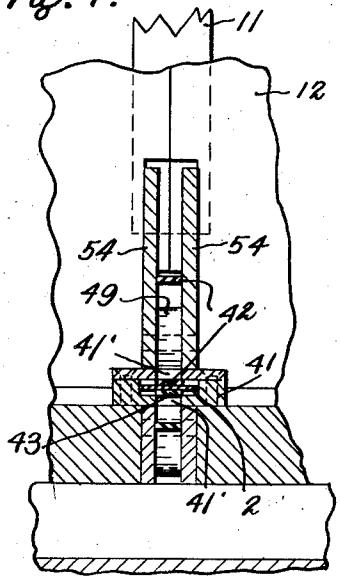


Fig. 7.



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Fig. 8.

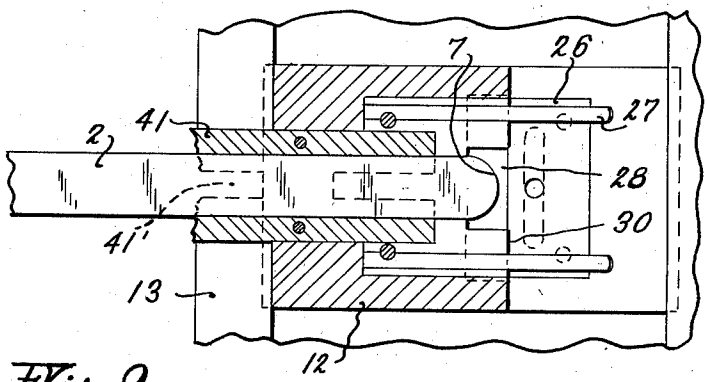


Fig. 9.

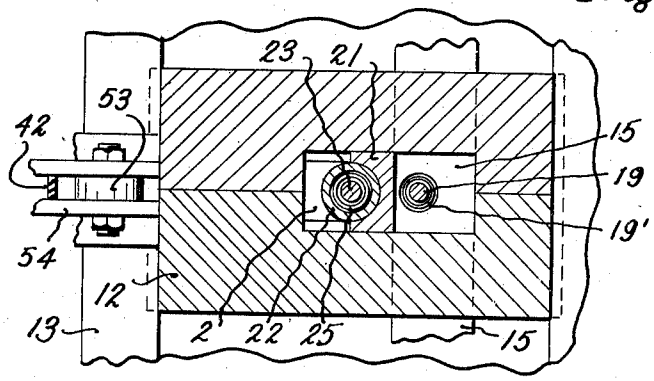


Fig. 10.

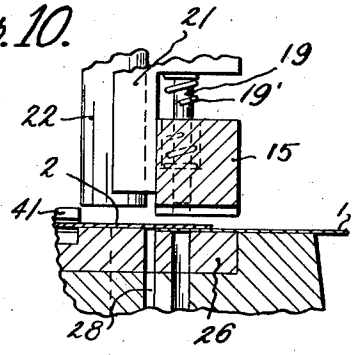


Fig. 13.

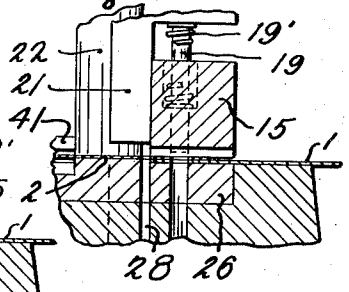


Fig. 11.

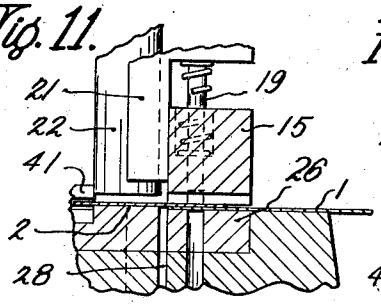


Fig. 12.

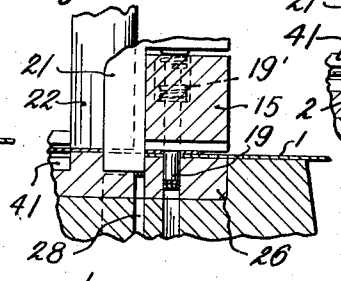


Fig. 14

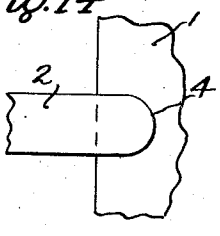
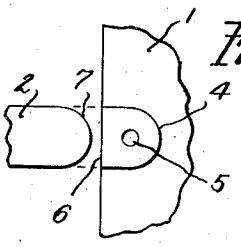


Fig. 15.



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Patented May 9, 1939

2,157,270

UNITED STATES PATENT OFFICE

2,157,270

APPARATUS TO MAKE METAL REINFORCED LOOSE-LEAF PAPER SHEETS

Frank Stanley Schade, Holyoke, Mass., assignor to National Blank Book Company, Holyoke, Mass., a corporation of Massachusetts

Application April 1, 1937, Serial No. 134,377

13 Claims. (Cl. 93—1)

This invention relates to a machine for making improved paper sheets for loose leaf book pages. The preferred form of the product, a loose leaf sheet with a special kind of binder hole reinforcement, is disclosed in my Patent 2,059,148, granted October 27, 1936. According to my present invention I provide a machine to make said product at a very low cost and thus increase its utility.

As far as I know there is no machine of the prior art which will function to make my special product in a commercial manner. To make it by hand is quite expensive. The product being new and useful, as disclosed in my issued patent, I have found that to make it commercially, a special machine is needed. The disclosure herein is a machine by which my product invention may be made in the most efficient way.

The present application is a continuation in part of my previous machine application, "Apparatus for making loose leaf book sheets," Serial No. 753,111, filed November 15, 1934.

Referring to the accompanying drawings,

Fig. 1 is a side view of the machine;

Fig. 2 is a front view with parts cut away;

Fig. 3 is a top view with parts cut away;

Fig. 4 is a sectional view on 4—4 of Fig. 2;

Fig. 5 is a sectional view of assembled elements on line 5—5 of Fig. 3;

Fig. 6 is a detail section at line 6—6 of Fig. 3;

Fig. 7 is a detail section on line 7—7 of Fig. 5;

Fig. 8 is a detail section on line 8—8 of Fig. 5;

Fig. 9 is a detail section on line 9—9 of Fig. 5;

Figs. 10 to 13 inclusive are detail views of similar character showing the progress of tool application in doing the work of the machine; and

Figs. 14 and 15 are detail views of the material operated on by the machine at different stages.

The primary work is first to register the tab end of an exceedingly thin narrow metal strip 2 over a binding hole location on loose leaf sheet 1, as in Fig. 14. Then to fasten the overlapping tab end to the sheet, make the binding hole 5 through the sheet and tab, cut off the latter in exact alignment with edge 6 of sheet 1, and also cut out a portion of strip 2 back of the sheet edge so as to shape the forward end of the strip to correspond with the curve at the forward edge of the applied tab. The curves 4 and 7 in Fig. 15 are the ones made to correspond. The area bounded by the straight edge 6, the curve 7, and the parallel lines defining the edges of strip 2, is the area of a waste piece in my operations.

Considering the primary work just described, the machine is arranged to do this work simultaneously at spaced binding hole locations on the margin of each paper sheet 1. Thus, when a paper sheet is placed in position for the machine to operate, the automatic operation is to do the work described in applying metal reinforcements to the paper as shown in Fig. 15, and to do it at that number of binding hole locations as may be desired. In the arrangement of the machine disclosed I have provided for simultaneously applying three metal reinforcements for three binding holes on each sheet of paper treated by the machine.

Referring to the machine illustrated in Fig. 1, it is driven by motor 1' belted to pulley 2', loose on shaft 3'. On this shaft there is a clutch, not shown, put into and out of operation by means controlled by the position of foot treadle 4'. The action here is that of the well known punch press. When the operator presses down on treadle 4', it puts the clutch in operation to rotate shaft 3' as long as the treadle is down to hold pin 7' out by the connections indicated at 5' and 6' with the treadle. When treadle 4' is released it rises, there being a spring to raise it, and the clutch is released but only after a complete revolution of shaft 3'. When the operator wants the machine to move through one cycle of operations, he presses his foot on treadle 4'; shaft 3' rotates once and stops where it began, assuming that the foot is taken off of treadle 4' in time. This single revolution raises and lowers the vertical rod 8 once. The rod 8 carries a crosshead 9 on which tools are mounted, as I will later describe. This means to raise and lower a tool-carrying head, as is the fashion in punch press work for one cycle of operations, is very well known and for that reason I have not described all the detail of such means, enough being shown in Fig. 1 to indicate my use of such a mechanism.

The crosshead 9 of Fig. 1 is also shown in Fig. 4. Guide plates 10 are fastened to the crosshead 9 and the guide slot 10' formed by plates 10 receive and support a plurality of tool holders 11. There are three tool holders shown on the crosshead, see Fig. 2. Each one is mounted, see Fig. 5, with a T-head slidable horizontally for adjustment while supported on plates 10. When crosshead 9 is raised and lowered, all three work holders 11 will be raised and lowered.

Each work holder 11 is mounted to slide in a vertical opening through a relatively stationary block 12, one for each work holder. Each block 12 is slidably supported in a dovetailed guide on a table 13 of the machine frame, see Figs. 1 and 4. They slide also on horizontal rod 14 which extends horizontally through all of them. This rod 14

has a spacing function later to be described. Blocks 12 are made in halves for convenient assembly and disassembly in relation to tool holders 11. The halves of each block are bolted together as indicated in Fig. 4.

Bar 15, see Figs. 2 and 6, is a heater and presser bar, the function of which will be described, and is carried at each end by a rod 16 at such end. Rod 16 is mounted to slide vertically in a tool holder 11' similar to the tool holders 11, and also hung from plate 10. This tool holder 11' is mounted in a block 12' similar to blocks 12. Fig. 2 shows the bar 15 extending through all the blocks 12 and between the two blocks 12', one at each end of the bar 15. Ignoring other operations for the moment, it will be seen that as the crosshead 9 is raised and lowered, the two tool holders 11' will be raised and lowered. When lowered, the bar 15 moves down against the table to contact the material to be worked on. After bar 15 comes to rest, there is a lost motion (see Fig. 6), due to the head of rod 16 being free to remain stationary while its holder 11' can keep on moving down. The same action takes place in each work holder 11'. When crosshead 9 lifts work holders 11', the bar 15 remains stationary until the head of rod 16 is picked up to move with it by the shoulder 16' at the bottom of the recess, as indicated in Fig. 6. In this figure, full and dotted line positions for the head of rod 16 indicate the lost motion mentioned.

So the action, during each complete cycle of operations started by pressing the foot pedal 4' and releasing it, is to lower bar 15, so it comes to rest on the material before the crosshead finishes its down stroke and bar 15 stays on the material until the crosshead has gone part way on its up stroke. The purpose is to time the action of the tools in the cycle of operations and this action of the tools will be explained.

The arrangement of the tool holders 11 and 11' that are mounted to move with crosshead 9 is such that they can all be very conveniently adjusted for differently spaced operations. For example, in Fig. 2, tool holders 11 and their blocks 12 are held spaced from one another by U-shaped spacer members 17. One of these is shown in section in Fig. 4, simply hung loosely on bar 14. Smaller spacer members 18, seen in Fig. 2, space the blocks 12 that are adjacent blocks 12' from the latter.

If all the spacer members 17 and 18 are simply lifted off rod 14, a different spacer can be used to give a different spacing. The machine is flexible with relation to spacing and also with relation to the number of sets of tools that can be used. It is clear that by taking the nut off rod 14, unscrewing the support of rod 16 from the opposite end of bar 15, the parts 11', 12', and bar 15 can be taken off at one side of the machine, the left-hand side in Fig. 2. Then sets of tools, with their holders 11 and blocks 12, can be taken off or put on by simply sliding them into or out of place. When the desired arrangement is made, a bar 15, or another like one, can be put in place as parts 11' and 12' were, and slid back into position from the side of the machine.

The arrangement described is useful because in reinforcing loose leaf sheets, different numbers of holes and different spacings occur in practice. By my arrangement one machine can be made to conveniently take care of a wide range of variations in the work.

The tools which are desirable for applying metal reinforcements to the paper binding holes will now be described in more detail as specifically disclosed.

A set of coordinated tools is shown in considerable detail in Fig. 5. I have already described the bar 15 and its general action. This figure shows how the bar 15 passes through in association with each set of tools operating at one station to apply one metal reinforcement. The tools at each of the three stations may be exactly the same.

A hole punching rod 19 is rigidly mounted in holder 11, being held in place by an adjusting screw 20 screwed down to seat the head of rod 19 against the shoulder 19' as indicated in Fig. 5. Rod 19 passes through bar 15 and a spring 19' coiled on the rod between a shoulder of holder 11 and seated in a recess of bar 15 tends to hold the latter down. Holder 11 is also provided with an integral die punch 21. The bottom or cutting-out area of this die punch (see Fig. 9) has the shape of the waste piece, indicated in Fig. 15, as the part to be cut out of strip 2.

A stripper member 22 is mounted in a recess of holder 11. It is supported by rod 23 having a head to engage a shoulder at bottom of recess 24, and a spring 25 coiled around it between the bottom of its recess and the head of the stripper. Fig. 5 shows what the arrangement is. The rod 23 at the bottom is screw-threaded into the stripper 22 to hold the parts as shown in said figure. After the stripper contacts the work, tool holder 11 may keep on moving down due to the lost motion provided and the spring 25 will be compressed. And when tool holder 11 starts to move upwardly, the compressed spring 25 will still hold the stripper 22 hard pressed against the work until there is enough movement to release the spring and at last lift the stripper by engagement of the head on rod 23 with its shoulder. The arrangement is useful for timing the action of the stripper and for giving its character of action. The stripper 22 is fitted tightly against the adjacent surface of die punch 21 but such surfaces are of course relatively movable in the action of the parts for one will be stationary for some of the time that the other is moving.

In Fig. 5 the table plate of the frame is 13, on which the block 12 is mounted in dovetail adjustable fashion, as before described. A die plate 26 (see Fig. 8) is mounted in block 12 to underlie the tools of work holder 11. In die plate 26 there is the female die part for hole punching tool 19 and there is an opening for the small disks from cut holes to drop away, as will be obvious. Plate 26 (see Figs. 5 and 8) has a small shoulder 30 to register the edge of the paper with relation to the hole punching tool. And springs 27 are provided to guide the paper edge to the shoulder when, as in Fig. 5, the paper is to be fed from the right. The locating shoulder 30 is directly under and in line with the left-hand edge of bar 15. Just back of the shoulder is the opening 28 (see Fig. 8), the upper edges of which are shaped to fit and serve as the female die part for die punch punch 21. It is to be understood that opening 28 exactly receives with a tight fit the punch 21. The opposing areas of the parts 21 and 28 are crescent-shaped in plan, except at the straight edge, and the latter is to correspond with the paper margin or straight edge, as indicated in Figs. 8 and 9.

Assuming the parts in the position of Fig. 5, that a paper sheet 1 has been fed to locate its edge on shoulder 30, that the thin metal band 2 has been projected over the paper margin in

the position of Fig. 14, one cycle of operations for the tools in holder 11 will be described. At the start of the down movement of holder 11, the paper sheet 1 and metal band 2 are in the relative positions of Fig. 10 with respect to the tools. Bar 15 reaches the work first and contacts the metal, as in Fig. 11. It is a heavy bar of metal and it is electrically heated by any suitable electrical heating means as for example a sufficient length of resistance wire mounted interiorly of bar 15, the circuit connections for which are W and W' indicated in Fig. 2, but any obvious well known way for keeping a bar heated will do. Bar 15 contacts only the tab end of the thin metal band—that is, only the part overlapped with the paper. The under side of the metal band or strip 2 is coated with thermo-plastic cement—see my product patent referred to above. The heat and pressure act to activate the cement, the metal being very thin, and to immediately cement the metal to the paper in a perfectly flat manner. As holder 11 continues to come down, spring 19', see Fig. 12, is compressed to increase the pressure of bar 15. As spring 19' is being compressed, the binding hole is punched through the metal reinforcement area and the paper, by punch 19. Slightly after this action the die punch 21 acts to cut out the waste piece back of the straight edge of the paper. The disk cut out by punch 19 and the waste piece cut out by die punch 21 are indicated in Fig. 12 by the small sections immediately under the bottoms of the punching parts in that figure. The scale for the sections of paper and metal materials is exaggerated and it should be understood that the material of both is very thin, the metal being thinner than the paper.

There are a number of reasons for cutting out a waste piece from the metal as I do back of the straight edge 6 of the paper. One advantage relates to the heat applied to activate the cement. Although the time of heating is short, the metal is a good conductor and very thin, and, so far as the heat may spread to any metal in the strip beyond the back of the paper edge, it is a detriment as it will start the cement activity and offer difficulty in again sliding the metal into overlapping relation to the next paper sheet without delay. By cutting off a waste piece, the metal band is better prepared to supply metal for the next operation, both for the heat reason mentioned and for others which I will refer to later.

Referring to the operations of the tools, as indicated in Figs. 10 to 15, and the arrangement for moving these tools as indicated in Fig. 5, a summary of the steps and their relation, in both the down and up strokes of the crosshead 9, is as follows:

The bar 15 first makes pressure and heating contact with only that area of metal overlapped with paper sheet 1, see Fig. 14. This pressure is increased by compression of spring 19'.

Slightly after bar 15 comes to rest, the stripper 22 makes contact to hold the metal 2 on an area a little back of the paper. This pressure is increased by compression of spring 25.

When the above two pressure area contacts are made by the presser and stripper members, the punch 19 makes the binding hole and immediately after that the die punch 21 cuts out the waste piece while substantial areas in front and back of such waste piece are very firmly held by bar 15 and stripper 22 which are dwelling under spring pressure as the punching tools are doing their work.

From the position of Fig. 12, crosshead 9 starts to move upwardly, but bar 15 and stripper 22 stay in contact with the work, being held to place by springs 19' and 25 during a definite time and until punch 19 and die punch 21 are definitely raised above the metal band and paper. This is important particularly for safely stripping die punch 21 from the work and to insure against the chance of the cut edges of the very thin metal curling up as the die punch 21 is withdrawn from the cut-out area of the waste piece. The cutting of a rounded back edge of the waste piece, Fig. 15, leaves a rounded front edge for the tab end of metal band 2. This has the advantage in successive operations of always overlapping a rounded tab end of metal on the paper, such rounded form avoiding corners in the paper area, which corners if present on the very thin metal reinforcement wafer offer more danger of working loose, turning up, and marring the product in use.

The dwell of bar 15 in contact with the metal band not only helps the work of the punching tools, but also gives time for the heat of the bar to activate the thermo-plastic cement for fastening the metal tinsel material to the paper.

After stripper 21 and bar 15 dwell under pressure just long enough to accomplish their function in relation to the other tools, they are raised slightly above the work at the last small part of the upstroke of crosshead 9. These parts 21 and 15 are the first of the group of tools to move down and contact the work and the last to move up out of contact with the work. The whole arrangement of the tool combination on the crosshead has a highly desirable function for each element and an efficient timing relation for the action of the group for the desired method of procedure in making the improved product.

An important feature of my present invention is in the means for intermittently feeding the forward or tab end of the metal band or strip 2, in position for the tool combination above described to make and fasten the metal reinforcement wafers at the binding hole locations of the paper sheet.

The metal band is of an extreme thinness, as needed to make my improved product. This offers one difficulty in handling it automatically in the machine. The metal band as I use it is coated on one side with thermo-plastic cement, and this cement is put on and cooled before the band is supplied to the machine. Such procedure has the advantage that no means is necessary in the machine for manipulating liquid adhesives or moistening devices, which are generally troublesome operations. But the very thin metal I use with the thermo-plastic cement already applied on one side presents other difficulties. The cement even though dry makes it difficult to slide the metal on a guide. There appears to be somewhat the same resistance acting as when rosin is put on a violin bow and drawn across a string. Whatever the reason is, I have found real difficulties in my experimental work in finding a way to satisfactorily manipulate the material by automatic means in a machine to make my product. I will now disclose the best known means for the purpose and one which I have reduced to actual practice for factory operation.

Referring to Fig. 1, a spool 40 is lined up to feed metal to each group of tools. The strip 2, its under side carrying a cold coating of thermo-plastic cement, feeds into guide 41. The latter is better shown in Figs. 5 and 8. It guides

strip 2 into position for belts to push it along the level of plate 26, see Fig. 11, and into level contacting position with the top surface of paper 1 when the paper is squared against shoulder 30 of plate 26, see Fig. 5.

A cross-section of the guide 41 is shown in Fig. 7. It is of two-piece construction and rectangular in shape, with slots or openings 41' cut in the top and bottom at intervals. Through these openings belts 42 and 43 are fed to engage above and below strip 2, move it in the guide 41, carry it positively almost to position, and finally push it into the level position above stated with respect to die plate 26 and paper 1.

As seen in Fig. 5, the belts 42 and 43 are carried by pulleys 46 and 47 on shafts 44 and 45. Much smaller pulleys 48 and 49 also carry the belts very close to the position where the cutting work is done, on die plate 26. Adjustable ball bearing belt tensioning rolls 52 and 53 are provided in the positions shown. To carry these tensioning rolls and particularly to hold small pulleys 48 and 49 in position close to the final point of delivery for strip 2, I provide a special arrangement. The block 12 has a cavity, extending from the left-hand vertical wall to the vertical opening in which tool holder 11 slides up and down. On each side of pulley 46 I provide a stiff plate 54. It is a stationary plate hung loosely so as to swing on shaft 44 with a little vertical play on the shaft. This plate is pressed downwardly by its leaf spring 55. There is one plate on each side of the belt. As seen in Fig. 5, the plate 54 acts as a guard for pulley 46, the outer margin being positioned to prevent sidewise movement of belt 42 on the pulley. Plate 54 extends forwardly into the cavity of block 12, and with its companion plate serves to mount shaft 51 and pulley 49. This arrangement also guards against sidewise play of belt 42 on not only both pulleys 46 and 49 but also in the path of its upper flight between the pulleys. Tension roll 53 is adjustably mounted between the companion plates 54. The adjustability is secured by moving the roll 53 vertically from one adjustment to another, and fastening the shaft of roll 53 in the particular adjustment wanted. This provision for vertical adjustment is clearly indicated in Fig. 4 by reason of the slot in plate 54 of that figure where the shaft of roll 53 is received by the plate at the end shown. The bottom edge of each plate 54 rests on the top surface of guide 41, being held down on such surface by the spring 55, see Figs. 5 and 7.

The belt 42 is made of rubber, preferably strengthened by cord or fabric in the center, and it is, therefore, elastic transversely. It meets strip 2 in the vertical line of shafts 44 and 45, at the same line where a like belt 43 meets the under side of the strip. The two belts preferably squeeze strip 2 between them, they being elastic and spreading slightly due to the pressure from pulleys 46 and 47 on shafts 44 and 45 which will not spread as the strip 2 and belts 42 and 43 pass between them.

Belt 43 runs along the bottom of guide 41 in a perfectly level manner, having plenty of support. Belt 42 rides exactly in line with the bottom belt but on top of strip 2. As seen in Fig. 7, the belts are about one-third the width of the strip. They are held under tension to travel in a perfectly flat horizontal fashion and pressed tightly against both sides of the strip 2 and carry the strip with a very firm hold on it for a substantial distance. This is for the purpose of making certain that the forward end of the exceedingly thin strip 2 is projected in a perfectly flat level fashion into exact registering position with relation to paper 1 and also with relation to die punch 21 and stripper tool 22 which are back of the paper edge. It will be noted that to do the work desired on the end of strip 2, according to my preferred method of procedure, it is necessary to project the very thin strip 2 a distance more than the amount of the tab end overlapping the paper margin. An additional length is necessary for the die punch and stripper 22 areas. The pressure and heater bar 15 which also acts as a stripper for hole punch 19 works on the area of the paper overlapping portion. So it will be seen that while I have combined the tools to a considerable extent, there is still the necessity of a strip area back of the overlapping portion for the full working of the tools in holder 11.

Strip 2 leaves the support of belts 42 and 43 at the vertical line of shafts 50 and 51, Fig. 5. It bridges the very small gap between this line and the back edge of supporting die plate 26. From this edge it slides in contact with flat plate 26 just the distance required for stripper 22 and die punch 21, and then slides further just the distance desired to overlap the paper margin and slides on that margin the distance required for pressure bar 15. In the sliding movement the strip is part on die plate 26 and part on paper 1. The result of the arrangement is that the strip 1 is positively projected accurately and flat just the distance desired and in the exact position desired, whenever shafts 44 and 45 are turned for a measured movement of the strip.

To turn the shafts intermittently, a one-way clutch 60, see Fig. 2, is mounted on shaft 44 and the shafts are driven together by gears 61 and 62, Fig. 2. The clutch 60 has an arm pivoted to reciprocating rod 63, the latter being moved up and down by a cam (not shown) on main shaft 3' of the machine. The detail of the clutch 60 is not shown, but it is to be understood that its mechanical movement is such, as in a roller one-way clutch, that it will move shaft 44 from the beginning to end of any movement of rod 63 in one direction, but not at all when the rod 63 is moved in the opposite direction. This sort of intermittent feed in one direction only is in the nature of a pawl and ratchet movement. But clutch 60 is of that kind of clutch which is particularly designed to avoid lost motion in the direction of intended movement. Such clutch mechanism is well known and I have omitted its detail, except to point out that it will give an accurate and exactly duplicated measured movement to shaft 44 each time rod 63 moves in one direction. The timing is such that this movement is given while crosshead 9 is holding all the tools on holders 11 and 11' above the work.

As seen in Fig. 3, there are three pairs of belt feeding pulleys, one pair for each strip 2. And the belts and feeding arrangements for each strip are as described in connection with Fig. 5 at each feeding line. The belts 43 on the bottom pulleys 47 are guarded by a pair of side plates 54', like plates 54 except that the former are fitted to slide into the space between bedplate 13 and the bottom wall of guide 41 where they enter the recess in block 12. These side plates at each station serve as mounting means

for the shaft 50 of pulley 48 and the adjustable tension roll 52. The guard plates 54 in addition to being held down at the forward ends by spring 55 against the top surface of guide 41 are held down at the rear ends by a bar 66, see Figs. 1 and 4, pivoted at rod 65 extending from the main frame, and spring pressed by 67 coiled around a guide bolt loose in bracket 68 at each tool station. It should be understood that while guard plates 54 are mounted on shaft 44 their mounting is loose enough to permit play for the spring pressure to fit them yieldingly and tightly enough along the top of guide 41. The top and bottom surface of the latter are cut away sufficiently to permit belts 42 and 43 to enter and leave the guide. The top portions above this belt 42 in each guide are removable. The whole arrangement with respect to the guides, the pulleys, and the belts being lined up for coaction with the sets of tools in tool holders 11 in blocks 12, is an arrangement made so as to conveniently assemble, disassemble, and adjust the parts as a group. For example, the group of cooperating parts in Fig. 5 may be adjusted as a whole, transversely of the machine, as seen in Fig. 3. The blocks 12 with all the assembled mechanism can be moved sidewise to different lines of desired work. This flexibility of the machine for different sizes of loose leaf sheet product work is very useful in factory operation.

Referring to Fig. 3, the paper sheet 1 is laid on a feed table 70; it is squared against adjustable side guide 71, and then pushed into the machine to be simultaneously punched for binding holes and to have the binding hole locations reinforced with metal wafers cut from strips 2.

As the paper sheet is pushed in, its advancing edge meets a pair of leaf springs at each tool station. The position of these springs 27 is seen in Fig. 2, and in Fig. 5. They slant upwardly from the top edge of shoulder 30, one on each side of foot piece 15', the latter being provided to contact the metal tab overlapped with the paper in the metal heating and pressing action of bar 15. This arrangement guides the paper exactly to shoulder 30. And as bar 15 is lowered, springs 27 are moved from their slanting position toward a horizontal position and smooth out any wave in the paper due to being pushed definitely into contact with shoulder 30. The springs act with a wedging action on the top of the paper sheet to lay it down flat on die plate 26 so that foot piece 15' at each station will press the overlapping portion of the strip 2 directly against the paper over the predetermined spot for reenforcement. As the foot piece 15' does this, its heat starts to activate the thermo-plastic cement. Until this time the metal strip can slide freely on the paper, there being no moisture or active cement to stop it. That is to say, the paper is placed against shoulder 30 and on that line its edge must be in exact position to receive the feeding movement of the very thin metal strip. The latter slides over and in contact with the paper surface into exactly measured position. This it would not do satisfactorily if the cement were active or the paper or metal were moistened at this stage. Immediately after the feeding movement, presser bar 15 descends with springs 27, one on each side of contacting area 15'; flattens the adjacent area of paper if it is not already flat; and then the cement is started into activity for the first time so as to stick the overlapped areas together. The result is, as if the adhesive material were applied between these overlapped small areas at each tool working station at the instant of their being pressed together and as if both materials were free of adhesive material, while bringing them into position for adhering together. The arrangement is a great aid in the machine work for rapidly and accurately applying the metal reinforcements at the small areas of the binding hole locations.

While the machine has considerable detail, it operates very simply from the worker's standpoint. When once adjusted, a girl can feed it as simply as she can a printing press. She simply feeds a paper sheet, steps on foot treadle 4 an instant, and one cycle of operations feeds the plurality of metal strips 2, attaches the metal reinforcements at the binding hole locations by pressure, heats them to give the thermo-plastic cement its function, punches the binding holes, die punches the metal strips for the succeeding operation, and releases the paper product all finished in a very small space of time for any number of binding holes on a given sheet. As I stated above, so far as I know, there is no machine in the prior art which will make my improved product, and until the invention of the machine by me, the product had to be made by hand. Now, with the help of the machine, the product can be made at the factory so efficiently that its utility is greatly increased. The weight of the metal reinforcements of material as disclosed in my said product patent for the ordinary three-hole punched paper is forty-nine ten thousandths of an ounce, and the time I have actually used for making one sheet of the product just as I have described it herein is one-twentieth of a minute. This indicates the low cost of making the improved product as I have devised it.

Having disclosed my invention, I claim:

1. An apparatus for the purpose described including a die plate structure with a top surface divided transversely into two flat work supports at different levels, the difference between the two being only a few thousandths of an inch, guide means to locate a sheet of loose leaf book paper onto the lower work support and with its edge stopped off at the inner transverse edge of that support so as to locate the top surface of the binding margin of the sheet at substantially the same level as the surface of the higher work support, guiding means for a narrow strip of metal thinner than the paper to be pushed so as to slide along the die plate structure in contact with the upper work support and into overlapping relation onto the binding margin of said sheet as the latter is held on the lower work support with the paper edge below the sliding surface to avoid interference in overlapping the very thin materials by relative sliding and contacting movements on the die plate structure while maintaining such materials in flat condition, a hole punching tool mounted above the lower work support, another die punching tool located above the upper work support, said second tool having a shape for cutting out a waste piece of metal including a straight line to exactly coincide with the edge line of the paper sheet when positioned as stated above, two separated stripping tools above the die plate structure, one for each punching tool, timed operating means for said punching tools and strippers to cause both strippers to contact the material on both work supports before the punching tools and to stay in contact with said work until the punching tools have left the material in their operation, and cooper-

ating cutting edges in the die plate for said punching tools.

2. In an apparatus for making and applying thin metal wafers at the binding hole locations of loose leaf paper sheets and fastening them on the paper with thermo-plastic cement, the combination of a die plate on which the binding margin of a loose leaf paper sheet may be placed and means to guide a thin and narrow strip of metal covered with cold thermo-plastic cement on its under side, so the strip and the cement carried by it may be pushed across the die plate while sliding a measured distance for its end portion to overlap and contact a binding hole location on said margin when with said cement is inactive, heating means operable to press against the whole area of the said overlapped end portion on the top side of the metal strip and downwardly against the paper and die plate, to activate the cement all the way to the edges of such area and completely fasten such portion on the binding margin by cement, heat, and pressure, and a metal punch mechanism having an area to cut off said end portion from the strip and simultaneously cut off an additional short length of the strip as a waste piece immediately back of the heated end portion so as to prepare the metal strip for rapid feeding operations to supply successive wafers and avoid the danger of having the cement carried by the strip in heated condition adjacent its end edge when it is pushed over the paper for overlapped position for the succeeding operation on another paper sheet.

3. A machine of the kind in which reinforcements are applied at the binding hole locations of loose leaf sheets, said machine having in combination a die plate adapted to intermittently receive the binding margin portion of loose leaf paper sheets successively fed thereto in predetermined position and also to receive a narrow and very thin end portion of a flat metal strip carrying a coating of cold thermo-plastic cement on its under side, means to feed such a metal strip by intermittently pushing it across the top of the die plate a measured distance, and thereby place a part of the pushed portion into overlapping relation to said binding margin of the paper when already in position on the die plate, said metal strip feeding means comprising a pair of endless belt devices mounted with the bottom flight of one belt device engaging the top side and the top flight of the other belt device engaging the bottom side of said strip over a substantial length in a straight line and level with the top of the die plate, said endless belt devices including means to squeeze the belts together and against opposite sides of the strip to grip it tightly and carry it without relative slip and means to tension the whole travel of said belts so as to drive them intermittently without slip, the strip gripping flights of the belts extending to a point very close to the die plate, mechanism to intermittently drive said belts the exact predetermined amount necessary to intermittently push the metal strip in sliding contact along the die plate, and mechanism mounted above the die plate to form from the strip and apply metal wafers successively to successively fed paper sheets, said mechanism being intermittently operable in the intervals between said operations of the belt devices, all constructed and arranged for rapid automatic operations in the feeding, forming, and applying of metal wafers to paper sheet margins, and to avoid interference in such operations by slippage of the cement coated metal strip.

4. A machine of the kind in which reinforcements are made from strip material and applied at the binding hole locations of loose leaf sheets, said machine having a die plate, a feeding mechanism comprising two small idler pulleys one above the other and located immediately adjacent the die plate, two much larger and driven pulleys located one above the other at a substantial distance away from the die plate, belts with tension devices for said pulleys, a straight guide at the level of the die plate and extending between said pairs of pulleys to said die plate, a spool to supply metal strip material to said guide, said belts passing into said guide to engage upper and lower sides of said strip and carry it bodily therealong and push it across said die plate over the very short distance necessary to avoid feeding mechanism extending above the die plate in such machine.

5. In apparatus for the purpose described, the combination of a die plate and cooperating automatic tools to make and apply metal wafers to loose leaf binding margins, a supply spool for a narrow very thin metal ribbon or strip covered on one side with cold thermo-plastic cement, a ribbon guide between the spool and the die plate, mechanism to move the ribbon through the guide, said mechanism comprising a pair of driven pressure rolls one above the other and with the bight between the rolls being located centrally of the guide, a second pair of pressure rolls spaced a substantial distance forwardly of the first pair and with their bight likewise arranged in the guide, compressible elastic belts with tensioning means, said belts being arranged to be squeezed in the bight of both sets of rolls and grip the strip above and below to carry it positively between said sets of rolls, the second set being small rolls located immediately adjacent the die plate, so that as the strip emerges from the bight of these small rolls it will be positively pushed without slip across the top of the die plate, and coordinated driving means for said automatic tools and said driven pressure rolls for the latter to move intermittently in timed relation to the operation of said tools.

6. A machine of the kind having a die plate and die punching devices arranged to cooperate therewith for making and applying individual reinforcement wafers on the binding hole locations of loose leaf book sheets, and provided with means to intermittently push the end portion of narrow strip of reinforcement material flatwise over the die plate in position for the tools to operate on said end portion, said pushing means comprising a straight channel device of substantial length with its inner end terminating at the die plate, two long flat and straight pusher members in said channel and extending substantially to the die plate and arranged to engage both the bottom and top sides of the strip material to push it, devices to press said pusher members toward one another to squeeze the strip material between them, and intermittently operable driving devices for said pushers to deliver the end portion of the strip material in successively measured steps on top of said die plate solely by a straight push along the level of the top of the die plate.

7. A machine of the kind having a die plate and die punching devices arranged to cooperate therewith for making and applying individual reinforcement wafers on the binding hole locations

of loose leaf book sheets, a source of supply for narrow strip material for making said wafers, and means to feed the strip to the die plate, said means comprising upper and lower belt members to engage upper and lower sides of the strip and arranged to travel with and carry the strip in a straight line on the level with the top of the die plate and substantially to the edge of the die plate, means to press said belt members toward each other to squeeze the strip material between them, and driving mechanism for said belt members to move them intermittently between intermittent operations of said die punching devices.

8. In a machine for the purpose described, a supply for a narrow very thin metal strip coated on one side with cold thermo-plastic cement, mechanism for shaping, cutting off, and applying individual reinforcement wafers at binding hole locations of loose leaf sheets and feeding means between said supply and said mechanism, said feeding means including a guide and two endless belts with means to press on opposite sides of said coated strip to grip and carry it without slip for delivery in a straight line to a point very close to said mechanism and to push it into position for said mechanism to operate on its end portion.

9. In a machine of the character described, operating mechanism to successively shape and cut off individual thin metal wafers from the end of an intermittently fed strip of the metal and means to feed the strip to said mechanism, said means comprising two endless compressible bands with rubber surfaces mounted to engage opposite sides of the strip over a straight path, devices to compress said belts together for a tight engagement with the strip, the delivery point of the belts being arranged substantially at the entrance point of the strip passing to said mechanism.

10. The combination of a spool supply for a narrow thin strip of metal coated on one side with thermo-plastic cement, a pair of endless belts narrower than the strip, devices to press the belts together with the strip gripped between them and carry the strip without slip, mechanism for shaping, applying, and pressing individual wafers as metal reinforcements on loose leaf sheets at their binding hole locations and heating the metal during the pressure at such locations only as they are applied, said feeding mechanism being arranged to deliver the end of the strip by a straight line push from the belts over a very short gap to said mechanism.

11. The combination of a flat support for a loose sheet of book paper, a series of spaced die plates forming part of said support, a set of die punches vertically mounted above each die plate and presser and stripper means for each die punch, a spool supply of narrow strip metal coated on one side with thermo-plastic cement for each die plate, endless belt devices to engage each strip on opposite sides from each supply and deliver it in a straight line to the die plate edge and on a level with the top surface of a paper sheet lying on the die plate and push it over said paper, means associated with the presser means to heat each strip only at its overlapping position with the paper, means to intermittently drive said belt devices and to operate said die punches in timed relation alternating one with the other so as to feed said strips between operations of said die punches.

12. The combination in a machine for the purpose described, a bed-plate, a tool-carrying block adjustable on the bed-plate, a die plate in the block, a set of vertically operable punch and stripper means in the block above the die plate, an opening in one side of the block to lay the margin of a sheet of book paper flat on the die plate, an opening in the other side of the block, a pair of endless belts one above the other and projecting into said opening, small rolls mounted to guide the belt ends inside the opening to deliver strip material in a straight line substantially level with the top of a paper sheet on the die plate, means to operate said belts so as to grip a very thin metal strip on opposite sides close up to the die plate and positively project the end of the strip in a straight line over a very small gap between the belt ends and the edge of the die plate and slide such end portion over the die plate and paper margin in a flat plane to avoid bending the metal strip.

13. An apparatus for applying to sheets of paper a metallic reinforcement carrying a thermo-plastic cement and perforating the area so reinforced, comprising a bed, a reciprocating support, a heated pressure bar yieldably mounted on said support, means for feeding a length of reinforcing metal into position to be pressed against the bed by said pressure bar, a reinforcement cutter rigidly mounted on the reciprocating support in position to engage the reinforcement after it has been engaged by the pressure bar, a perforating punch rigidly mounted on the reciprocating support in position to engage the reinforcement after it has been engaged by the pressure bar, and a stripper yieldably mounted on the reciprocating support in engagement with the cutter and in position to engage the reinforcing strip prior to its engagement by the cutter.

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