Oct. 14, 1958 C. B. ROWLAND 2,855,830

PAPER FOLDING MACHINES

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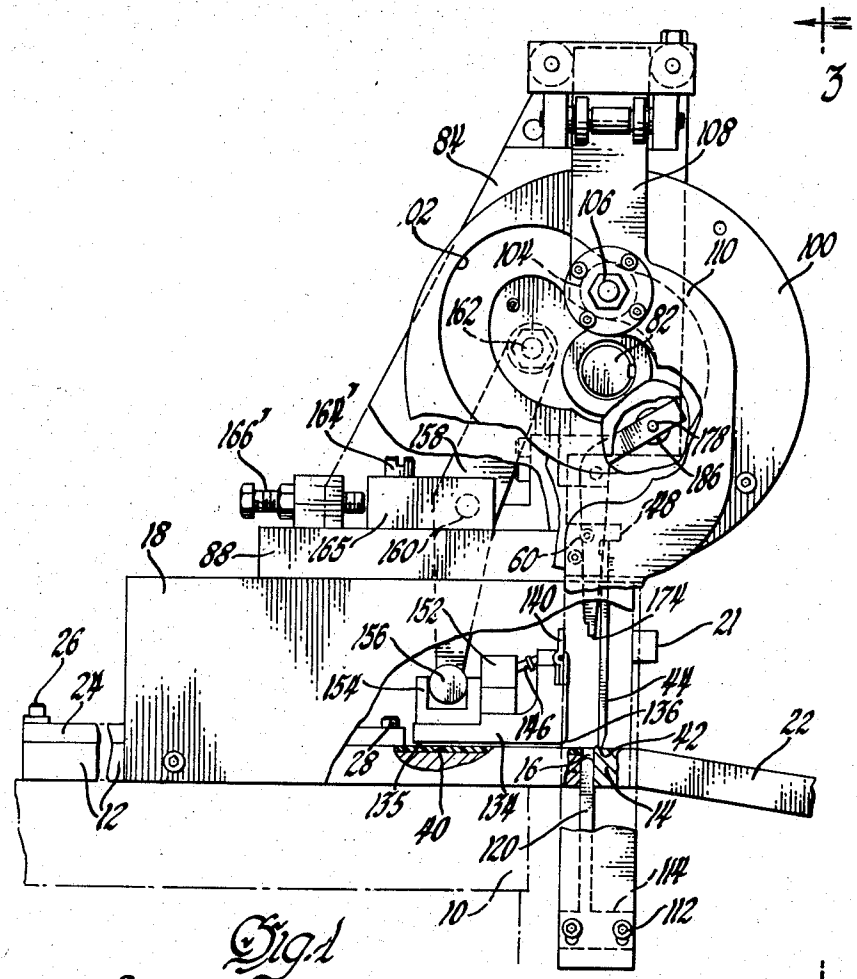


Fig. 1

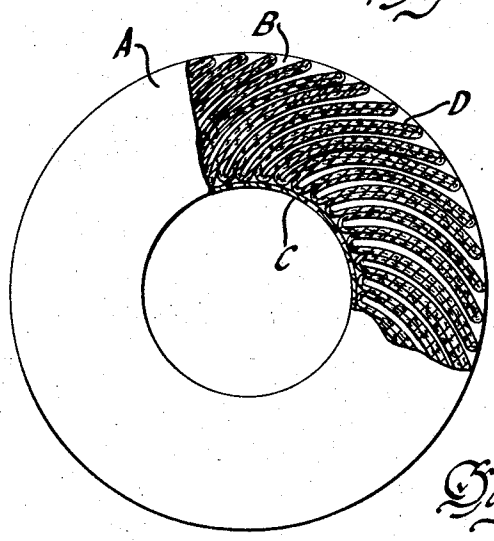


Fig. 2

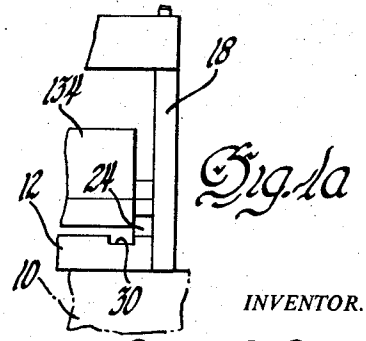


Fig. 1a

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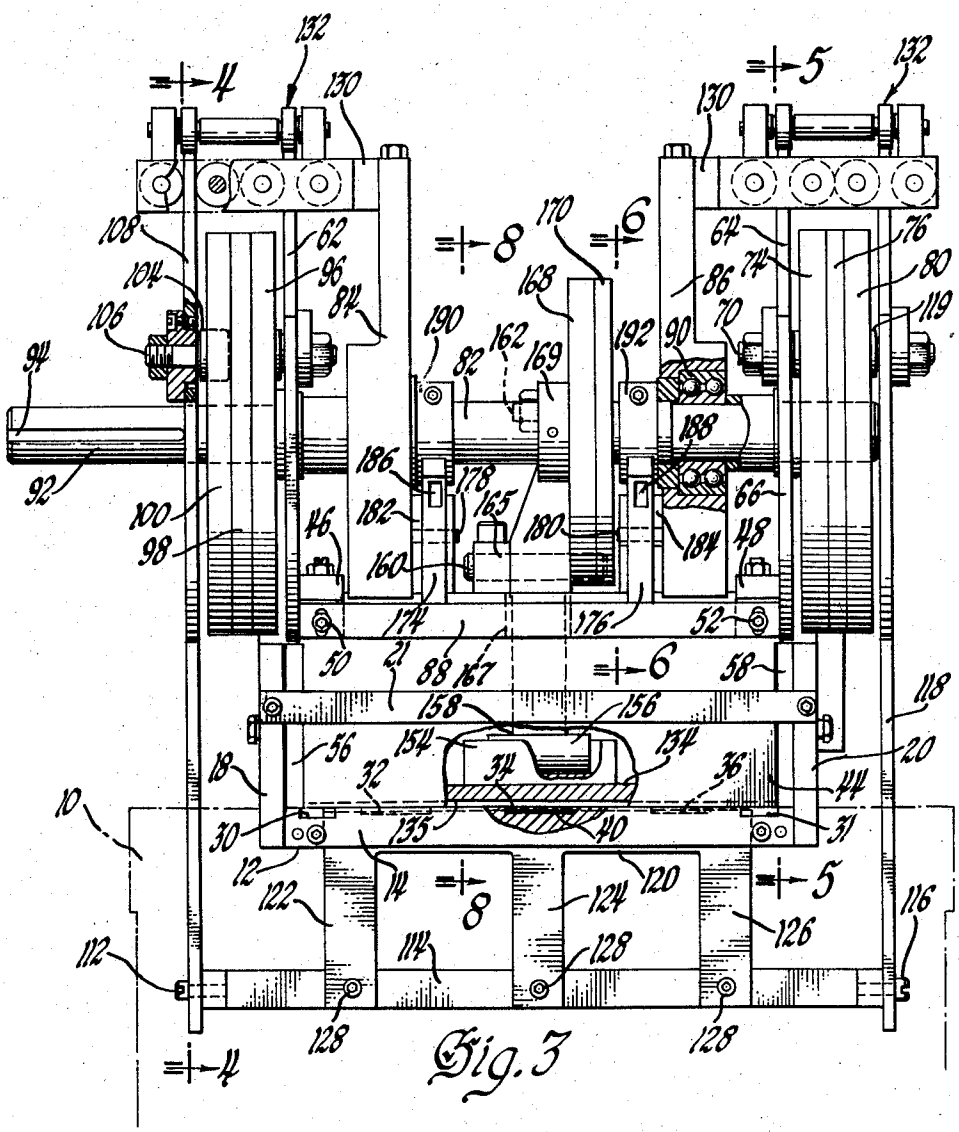


Fig. 3

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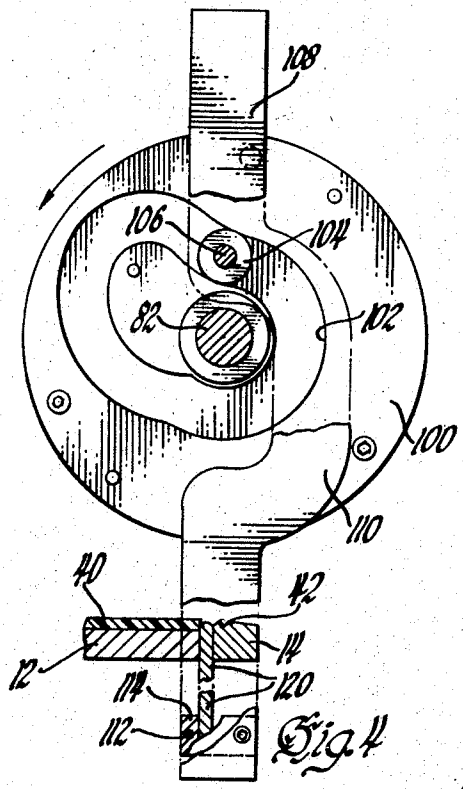


Fig. 4

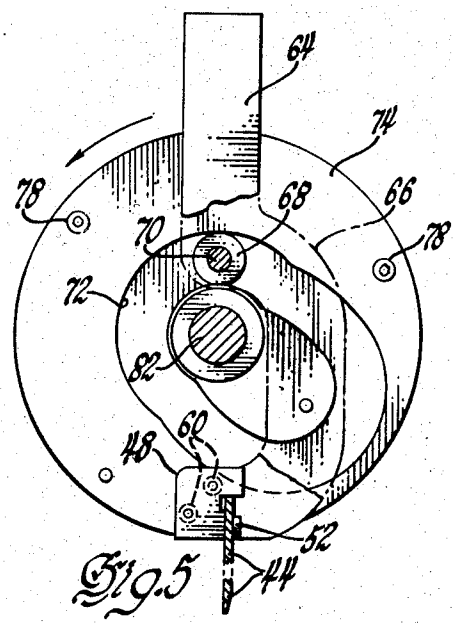


Fig. 5

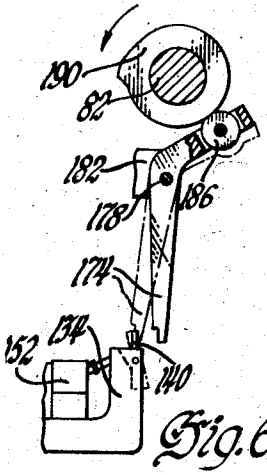


Fig. 6

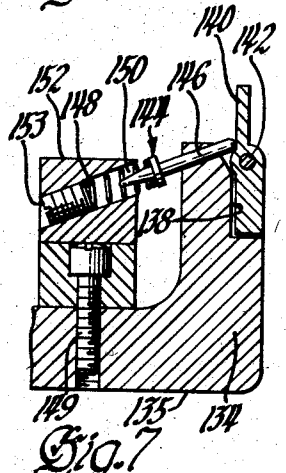


Fig. 7

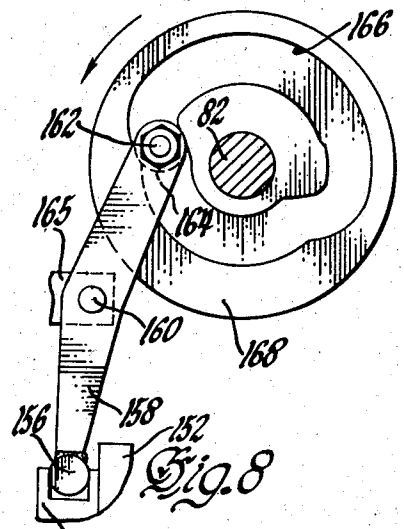


Fig. 8

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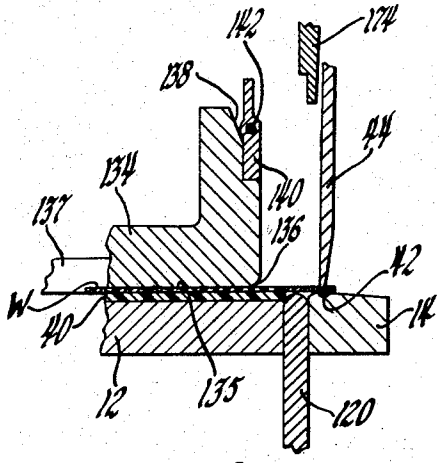


Fig. 9a

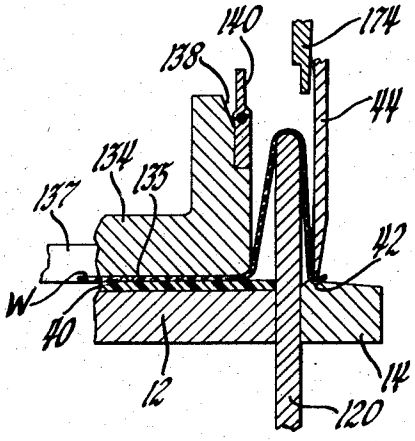


Fig. 9b

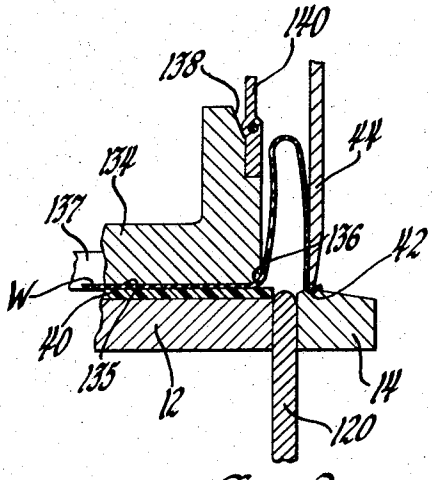


Fig. 9c

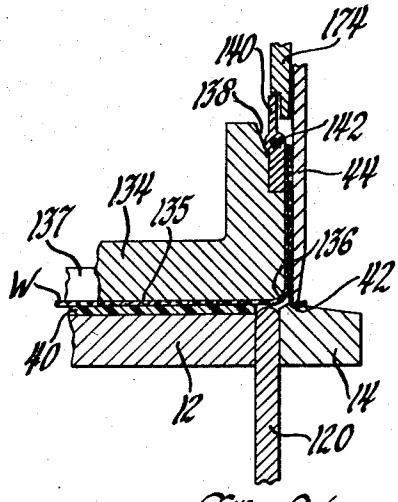


Fig. 9d

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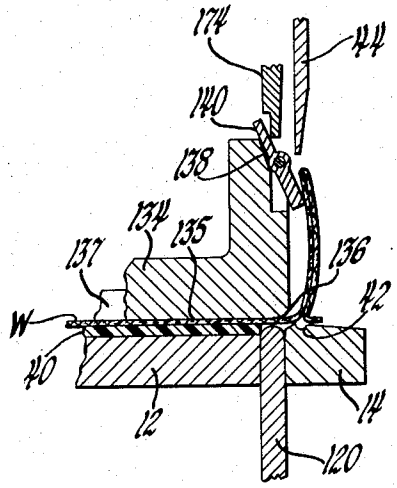


Fig. 9e

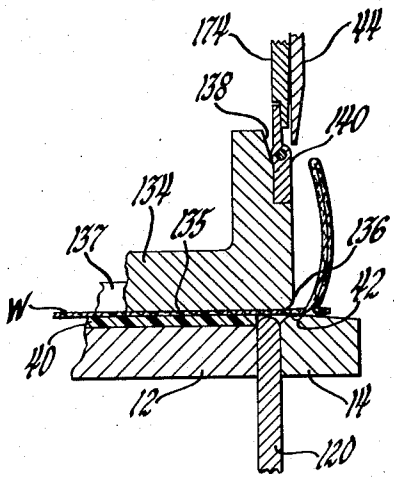


Fig. 9f

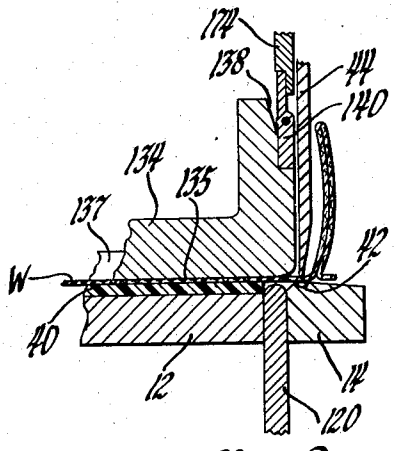


Fig. 9g

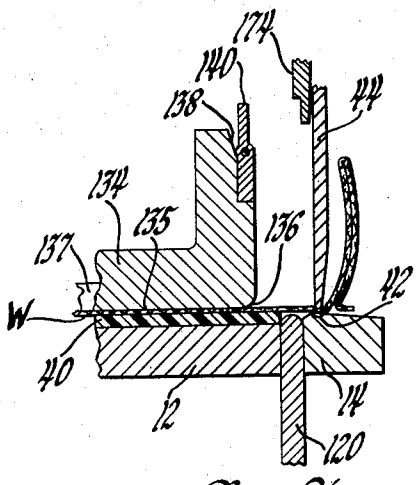


Fig. 9h

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2,855,830

PAPER FOLDING MACHINES

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Application February 1, 1956, Serial No. 562,719

9 Claims. (Cl. 93—1)

This invention relates to folding machines and more particularly to machines for folding filter paper into pleats of involute form.

In producing elements for filtering oils it is customary to wrap pleated filter paper around a perforated tube in such a way that each pleat is involute in form to gain a large filtering area. The space between adjacent and outwardly extending pleats is such as to have a large capacity for sludge—i. e.—to be receptive to considerable sludge separated from contaminated oil before the useful life of the element is over. The clarified oil flows readily from between the contacting layers of paper in each pleat and into the perforated central tube for discharge. Such flow is possible because of the texture of paper used or radial grooves formed therein and the greater fluidity of the oil when clarified. An example of such involute type filter elements is disclosed in the United States application for Letters Patent Serial No. 409,361, filed February 10, 1954 (now Patent No. 2,801,009, dated July 30, 1957), in the name of Roy L. Bowers and entitled "Filter Having Outwardly Extending Pleats." If such pleats are to be involute or curved in form after release from any constraint placed upon them, it creates a problem as to how such pleats should be folded. This problem is accentuated when it be realized that quantity production of the filter elements is the goal.

An object of the present invention is to provide a machine for folding work in the form of paper into discrete pleats each of which is curved. Another object is to provide a machine for folding paper into pleats and simultaneously stretching the paper so that each side of each pleat is curved when released from constraint.

To the above ends, a feature of the present invention is a slotted base along which work in the form of paper may be fed in a given path, the base being combined with work clamping means at one side of a base slot, a movable shoe at the other side of the slot and a blade withdrawable by way of the slot and from between the shoe and the clamping means in timed relation with reciprocation of the shoe and actuation of the clamping means.

Another feature is a staking blade and a reciprocable shoe each having rounded edges for stretching paper as the blade and shoe serve in forming pleats in the paper.

Another feature is a base for a folding machine handling paper to which paper adhesive may inadvertently be applied, the base being adapted to serve as a guide for the paper under motion and to contact the paper with a base surface material composed of polytetrafluoroethylene.

A reciprocable blade is utilized in the embodiment of the invention disclosed to serve as a means for stretching the work. In the present specification and claims, this blade is referred to as a "staking blade" as it functions much the same as the staking blades commonly used in the tanning industry for softening leather.

The above and other important features of the invention will now be described in detail in the specification and

then pointed out more specifically in the appended claims.

In the drawings:

Fig. 1 is a side elevation view of a folding machine which is one embodiment of the present invention, parts being broken away better to illustrate the construction;

Fig. 1*a* is a front or work inlet end view of a portion of the machine shown in Fig. 1;

Fig. 2 is an end view of a filter element with a part of an end plate removed and disclosing the use of filter paper folded in the machine shown in Fig. 1;

Fig. 3 is a view of the rear or work discharge end of the machine looking in the direction of the arrows **3—3** in Fig. 1 with some portions being broken away;

Fig. 4 is a view of certain operative parts and looking in the direction of arrows **4—4** in Fig. 3;

Fig. 5 is a view of other operative parts, some of which are in section, looking in the direction of arrows **5—5** in Fig. 3;

Fig. 6 is a sectional view taken generally along the line **6—6** in Fig. 3;

Fig. 7 is an enlarged view of elements shown in Fig. 6 but shown in section;

Fig. 8 is a view of a cam mechanism looking in the direction of arrows **8—8** in Fig. 3; and

Figs. 9*a* to 9*h* show enlarged sectional views of structural details depicted in Fig. 1 and illustrating the positions assumed by the parts during consecutive steps of one operative cycle of the machine in forming an involute pleat in paper.

In Figs. 1, 1*a* and 3, a folding machine representing one embodiment of the invention is shown as being mounted or supported on a marginal portion of a table **10**. The machine includes a horizontal base resting on the table top and this base consists of a main base plate **12** and a rear bar **14** spaced to define a vertical slot **16** extending across a work path. The bar **14** and slot **16** are so placed as to lie beyond the edge of the table **10** and are connected to the bottom marginal portions of two vertical side plates **18** and **20**. The rear edges of the latter are joined by a cross bar **21**. Preferably, an extension platform **22** (Fig. 1) is connected to or adjoins the rear of the bar **14** so that pleated work discharged from the machine may flow smoothly and be properly supported for subsequent handling. The platform **22** is not specifically described herein and is omitted from the showing in Fig. 2, but it should be appreciated that it may take any of various forms to suit particular requirements. Along two of the opposite parallel sides of the plate **12** is attached a guide bar such as the bar **24**. These bars are attached to the plate **12** by means of screws such as screws **26** and **28** and serve to define the path of the work between them as will further appear. The top of the plate **12** is provided with a groove **30** extending along the side of the bar **24**. A similar groove **31** (Fig. 3) is formed on the plate **12** on the opposite side thereof. Between the side grooves or the guide bars for the work the plate **12** is provided with three shallow grooves **32, 34** and **36** (Fig. 3) in which a special surface material **40** is placed. This material is retained in the grooves so that the top surface thereof is flush with the top of the plate **12**. The material is characterized by its lack of affinity for adhesives and is chemically defined as polytetrafluoroethylene and is often called Teflon. In the drawings this material is so placed on the plate **12** as to terminate at the slot **16**. If desired, the bar **14** and supplementary platform **22** may also be fitted with plastic inserts but such provision is not essential.

The upper surface of the bar **14** is provided with a groove **42** which is close to but spaced from the slot **16**. This groove is in alignment with a vertical clamping blade **44** which is slightly tapered at its lower edge with half of the upper two corners attached to supporting

blocks 46 and 48. The blade 44 is fixed to the blocks 46 and 48 by means of screws 50 and 52. The opposite and vertical marginal portions of the blade 44 are retained and guided in vertical slots formed in vertical guide pieces 56 and 58 (Fig. 3) fixed to the inside surfaces of the two side plates 18 and 20. The blocks 46 and 48 are each attached by means of screws such as the screws 60 (Fig. 5) to vertical members 62 and 64. The latter are similar in construction; and, with respect to the member 64, it may be seen from Fig. 5 that it includes a U-shaped mid-portion 66. A roller 68 is journaled on a shaft 70 fixed to the member 64. This roller extends within an endless cam slot 72 formed in a circular cam plate 74 joined to a second circular plate 76 by means of screws 78. Another cam plate 80 is fixed to the other side of the plate 76 by means of screws and the three plates 74, 76 and 80 are centrally fixed or keyed to one end of a horizontally mounted power shaft 82.

The shaft 82 is mounted in a horizontal position and rotatably supported on two vertical brackets 84 and 86 fixed to a horizontal plate 88 which in turn rests upon and is fixed to the upper edge of the side plates 18 and 20. One of the bearings for the shaft 82 is depicted in Fig. 3 at 90. One end 92 of the shaft is provided with a keyway 94 so that a pulley may be attached thereto for driving the shaft.

Next to the vertical member 62 are three plates 96, 98 and 100 which are joined together and are similar to the plates 74, 76 and 80, as will be understood.

As the circular plates 100 and 80 are similar although to the opposite hand, the plate 100 alone is described herein. This plate is clearly shown in Fig. 4 and includes an endless cam groove 102 to accommodate a roller 104 mounted on a stub shaft 106 fastened to a vertical member 108. An intermediate portion of the latter is U-shaped as at 110 to avoid the shaft 82. The lower end of the member 108 extends downwardly and below the base plate 12 and is attached by means of screws 112 to one end of a horizontal bar 114. The other end of the bar is fixed by means of screws 116 to the lower end of a vertical member 118 similar to the member 108 and carrying a roller 119 cooperating with the cam disc 80.

A vertical staking blade 120 is slidably retained within the slot 16 and is provided with three depending tongues 122, 124 and 126 (Fig. 3). Each of these tongues is fixed by means of a screw 128 to the bar 114.

Outwardly extending from each of the vertical brackets 84 and 86 and at the top thereof is fixed a horizontal bracket 130. Each of these horizontal brackets is provided with a suitable anti-friction or roller arrangement 132 for maintaining the vertical members such as 64 and 118 or 62 and 108 against lateral displacement. Specific details regarding this roller arrangement are not described herein as it is obvious that other guiding means may be provided permitting vertical reciprocation of the vertical members referred to and as will appear as the description proceeds.

It will be noted in Fig. 1 that the work guide strips, such as the metal side strip 24, terminate a considerable distance from the base slot 16. Between the rear ends of the guide strips and the slot a shoe 134 is provided and sufficient space exists between the strips and the slot so that the shoe may be moved or reciprocated in a horizontal direction toward and away from the slot 16. The bottom surface 135 of the shoe 134 is spaced a short distance from the top surface of the base plate 12 and the Teflon strips 40, and this space is maintained by causing the extreme ends of the shoe 134 to rest upon suitable guide bars such as the bar 137 placed in alignment with the work feed guide strips and partially shown in Figs. 9*a* to 9*h*. The shoe 134 extends from one side plate 18 to the other side plate 20 and is L-shaped in cross-section. The lower rearward edge of the shoe 134 is rounded off as at 136 and the rear upper edge is centrally recessed a short distance as at 138 to accommodate a tilting blade 140. The latter is pivotally mounted on the shoe by means of a shaft 142. The recess 138 has an inclined upper wall portion permitting the upper half of the blade 140 to swing forwardly when occasion demands, as will further appear. The lower portion of the blade 140, while in its normal position, lies flush with the rear surface of the shoe 134. This normal position is retained by two spring and plunger arrangements 144 one of which is shown in Fig. 7. Each plunger arrangement includes a rod 146 with a rounded end bearing against the blade 140 above the shaft 142. The rod is slidably mounted in the upper portion of the shoe 134. A spring 148 is held in a recess 150 formed in a block 152 suitably fixed to the horizontal portion of the shoe 134 as by screws such as screw 149. A screw 153 serves as a seat for one end of the spring 148. The horizontal portion of the shoe 134 also supports a U-shaped bracket 154 which is of proper proportion to receive a cylinder 156 fixed as an integral part to the lower end of a lever 158. This lever is pivoted on a stationary pin 160 and is provided at its upper end with a stub shaft 162 supporting a roller 164. The latter extends within an endless cam slot 166 formed in a circular cam disc 168. This disc has a hub 169 and is fixed to a base disc 170 and the two discs and hub form an assembly joined to the shaft 82 for rotation therewith. The pin 160 is mounted on suitable blocks such as the block 165. These blocks are fixed to the top surface of the horizontal plate 88 by screws such as screw 164'. The position of the pin 160 may be adjusted forwardly or rearwardly prior to tightening by means of an arrangement such as the bolt and nut arrangement 166' joined to the plate 88. It will be appreciated that the plate 88 is slotted as at 167 to permit oscillation of the lever 158.

At spaced points along and spaced from the upper marginal length of the tilting blade 140 are the lower ends of two depending levers 174 and 176 (see Figs. 3 and 6). These levers are pivoted on pins 178 and 180 respectively, and the pins are mounted on brackets 182 and 184 fixed to the plate 88. Each of the brackets 182 and 184 have upstanding side portions between which the corresponding lever 174 or 176 may oscillate. The upper end of each of the levers 174 and 176 is provided with a roller 186 or 188 engaging a cam 190 or 192 fixed to the shaft 82.

From the above, it should be noted that the outside pair of cam discs 80 and 100 may serve to operate the staking blade 120. The inside pair of cam discs 74 and 96 may operate the clamping blade 44. The inside cam disc 168—170 assembly is connected to the sliding shoe 134 and the two inside cams 190 and 192 are associated with the tilting blade 140.

In the operation of the machine, paper is fed from the left end of the machine, as the latter is viewed in Fig. 1. The paper is directed along the upper face of the plate 12 with its path determined by the side guide strips such as the strip 24. When making a pleated filter element, the paper is introduced with adhesive on its marginal underside portions. In order to operate the machine it is essential that the shaft 92 be rotated by some suitable power means and that the paper be introduced along the plate 12 and over the Teflon strip 40 and through the space defined by the plate 12 and the shoe 134. Operation on the work begins when the clamping blade 44 is caused to assume the position, as shown in Fig. 9*a*, to clamp a narrow transverse portion of the paper against the bar 14. Because of the action of the outside cam discs 80 and 100, the staking blade 120 is caused to rise from its lowered position to a position between the shoe 134 and the blade 44, as seen in Fig. 9*b*. As a result, the paper W is fed rearwardly from between the shoe 134 and the plate 12 and the paper is "staked" or stretched by frictional contact with the rounded upper edge of the blade 120 and the rounded edge 136 of the shoe. In this manner the paper is stretched

in such a way as to form curved pleat sides, as shown in the completed product, and sufficient paper is fed to make up one loop for one pleat. The blade **120** will then lower and the shoe **134** begins to proceed rearwardly with the loop having permanently curved and stretched sides, as depicted in Fig. 9*c*. The shoe **134** continues its rearward motion to clamp or fold the pleat against the clamping blade **44**, as seen in Fig. 9*d*. It will be noted that at this stage the tilting blade **140** and the levers **174** and **176** interengage but are of no effect. In the event that adhesive has been applied to the marginal underside portions of the work W, the pleat will remain tightly folded after release and, because of the previous staking action, the pleat will be curved, as depicted in Fig. 9*e*. Release of the pleat is gained by a forward motion of the shoe **134** and then an upward motion of the blade **44**. The motion of the shoe **134** is accompanied with an action by the cams **190** and **192** through the levers **174** and **176** to pivot the tilting blade **140** and urge the finished pleat upwardly. As a result of this completed action, the clamping blade **44** and shoe **134** are positioned to begin forming of the next discrete pleat, as seen in Fig. 9*f*. Blade **44** is now caused to lower and again clamp the work against the bar **14**—i. e.—blade **140** permits entry of the blade **44** between the shoe and the pleat, as shown in Fig. 9*g*. After this, the shoe **134** continues its forward motion and the machine parts are again positioned, as shown in Fig. 9*a* or 9*h*, but with the finished pleat on the discharge side of the clamping blade **44**, as shown in Fig. 9*h*.

From the above description, it may be seen that a machine has been provided for forming discrete pleats of curved form from a strip of paper and to perform its functions accurately and efficiently as required in volume production. In the event adhesive is used on the under marginal side of the paper, the side grooves such as the groove **30** prevent contact of the adhesive with the base plate **12** so that it does not interfere with feeding of the work. The Teflon strips **40** safeguard against the sticking of any adhesive which may inadvertently be placed on portions of the paper intermediate its margins. With a smooth feeding of the work, the paper need not possess an unduly high strength in tensions. The staking action on the paper ensures proper curvature of the pleats whether or not an adhesive is used. In some uses of the machine it is clear that adhesive may be applied to the paper after it is pleated and not before.

In Fig. 2 the filter element is of the type disclosed in the application Serial No. 409,361 (now Patent No. 2,801,009) earlier referred to. It comprises two circular and apertured end plates A and B connected by a perforated tube C around which is wound a strip of filter paper folded into a multiplicity of outwardly extending and annularly spaced pleats D. The involute form of each pleat is due to the folding technique employed in the use of the machine herein disclosed. The end margins at the interface of the two layers in each pleat D are joined by an adhesive which aids in the assembly but such adhesive is not necessary, as stated above, in the operation of the machine for the securing of properly curved pleats.

I claim:

1. A folding machine comprising a base presenting a plane surface along which work in the form of paper may be fed, a slot extending through said base, a groove extending along said surface parallel with and on one side of said slot, a shoe facing said surface on the other side of said slot, a staking blade slidably mounted in said slot and having a rounded edge parallel with said surface, a clamping blade with a clamping edge aligned with and facing said groove, said rounded edge and clamping edge facing opposite directions, and means for actuating said blades and shoe in timed relation to effect clamping of work between said clamping blade and groove, formation of a loop in said work between said clamping blade and said shoe by said staking blade, and clamping of said loop between said shoe and clamping blade after said staking blade is withdrawn from within said loop.

2. A folding machine comprising a base along which work in the form of paper may be fed in a given path, a slot extending through said base, a shoe facing said base at one side of said slot and reciprocable along said path, a staking blade slidably mounted in said slot for reciprocable motion transverse to said path, clamping means at the other side of said slot, and means for actuating said clamping means, shoe and staking blade in timed relation to form discrete pleats in said paper.

3. A folding machine comprising a base along which work in the form of paper may be fed in a given path, said base being provided with a surface of polytetrafluoroethylene, a slot extending through said base, a shoe facing said base at one side of said slot and reciprocable along but in spaced relation with said path, a staking blade slidably mounted in said slot for motion transverse to said path, work clamping means at the other side of said slot, and means for cooperatively actuating said work clamping means, shoe and staking blade in timed relation to form discrete pleats in paper introduced between said shoe and base.

4. A folding machine comprising a base along which work in the form of paper may be fed in a given path, a slot extending through said base, a shoe facing said base and spaced therefrom at one side of said slot and reciprocable along said path, a tilting blade pivoted on said shoe, a staking blade slidably mounted in said slot for motion transverse to said path, work clamping means at the other side of said slot for clamping work introduced between said shoe and base, and means for cooperatively actuating said work clamping means, shoe staking blade and tilting blade in timed relation to form discrete pleats in said paper.

5. A folding machine comprising a substantially horizontal base along which work in the form of paper may be fed in a given path, a slot extending through said base, a shoe facing said base but spaced therefrom at one side of said slot and reciprocable along said path, a staking blade slidably mounted for motion from said slot and across said path, work clamping means at the other side of said slot to clamp work fed between said shoe and base, and cam means above said base connected to said work clamping means, shoe and staking blade cooperatively to actuate the said means, shoe and blade in timed relation to form discrete and stretched pleats in said paper.

6. A folding machine comprising a base along which work in the form of paper may be fed in a given path, a slot extending through said base, a shoe facing said base but spaced therefrom at one side of said slot and reciprocable along said path, a staking blade slidably mounted in said slot for reciprocable motion and transverse to said path, a clamping blade at the other side of said slot and arranged to cooperate with said base to form a work clamp, means for actuating said clamping blade shoe and staking blade in timed relation to form discrete pleats in said paper, and said clamping blade and shoe having rounded edges for engaging opposite sides of said paper.

7. A folding machine comprising a base along which work in the form of paper may be fed in a given path, a slot extending through said base, a shoe facing said base but spaced therefrom at one side of said slot and reciprocable along said path, clamping means at the other side of said slot to clamp work fed from between said shoe and said base, a staking blade slidably mounted in said slot for movement into and away from the space between said shoe and clamping means, means for actuating said clamping means, shoe and staking blade in timed relation to form a discrete pleat in said paper, and said staking blade being arranged to form a loop in the paper while said clamping means is effective and thereby feed

sufficient paper for one pleat from between the said shoe and base.

8. A folding machine comprising a substantially horizontal base along which work in the form of paper may be fed in a given path, a slot extending upwardly through said base and across said path, a shoe facing said base but spaced therefrom at one side of said slot and reciprocable along said path, a staking blade extending upwardly into said slot and vertically reciprocable therein for motion transverse to said path, work clamping means comprising a blade and a grooved portion in said base aligned with said blade and arranged at the other side of said slot, a polytetrafluoroethylene surface on said base, and cam means arranged above said base for actuating said work clamping blade, shoe and staking blade in timed relation to form discrete pleats in said paper.

9. A folding machine comprising a substantially horizontal base along the top surface of which work in the

form of paper may be fed, said base having a substantially vertical slot therein and extending in a plane transverse to the path of said work on said surface, a shoe over said surface on the in-feed side of said slot and horizontally reciprocable along said path, a staking blade in said slot with its upper edge vertically reciprocable immediately above said slot, work clamping means arranged on the work-discharge side of said slot, and means for actuating said work clamping means and staking blade in timed relation with the horizontal reciprocating movement of said shoe to stress the work between the said shoe and blade and form curved and discrete pleats in the paper and thrust them along said path for discharge.

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