Oct. 11, 1949. J. W. THORPE ET AL 2,484,390

APPARATUS FOR FOLDING PAPER AND LIKE MATERIAL

Filed Feb. 25, 1949 6 Sheets-Sheet 1

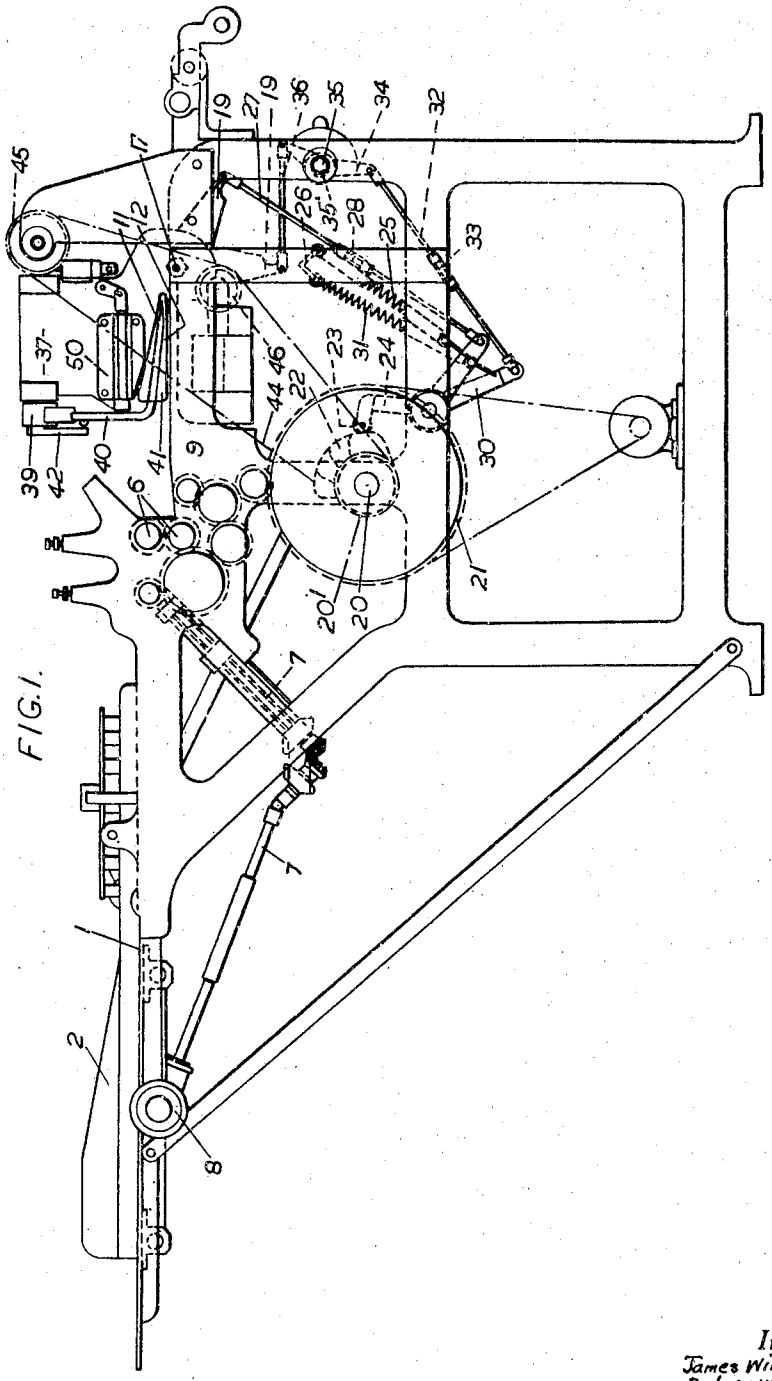


FIG. 1.

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APPARATUS FOR FOLDING PAPER AND LIKE MATERIAL

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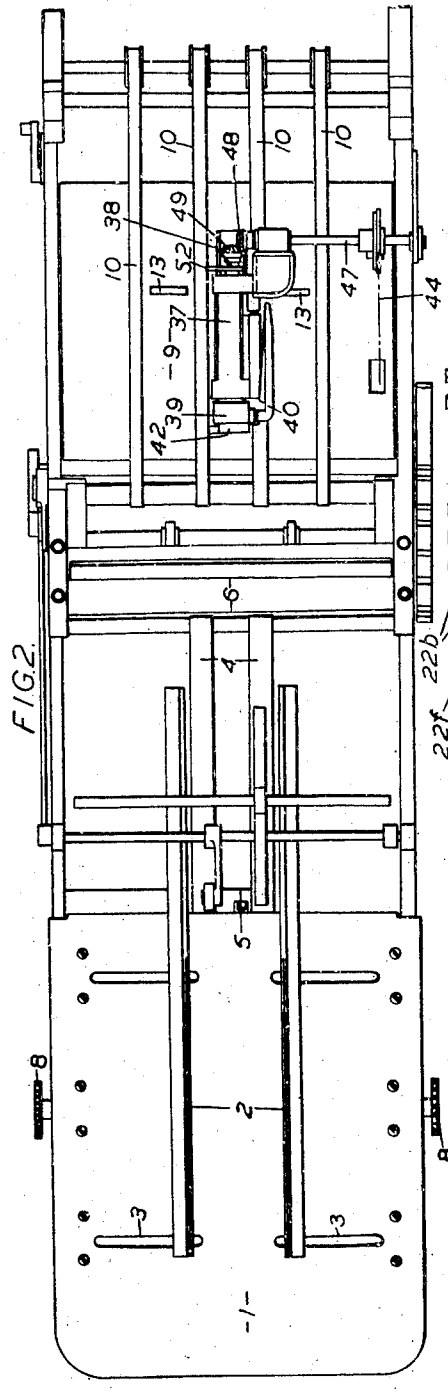


FIG.2.

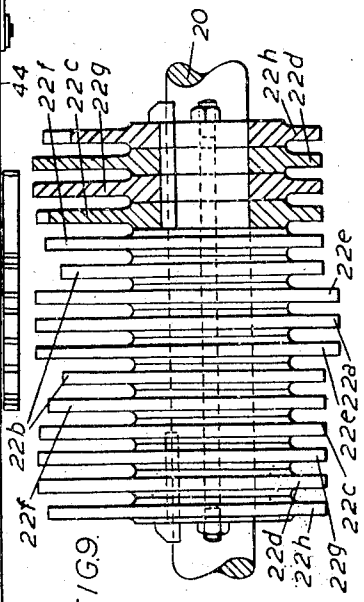


FIG.9.

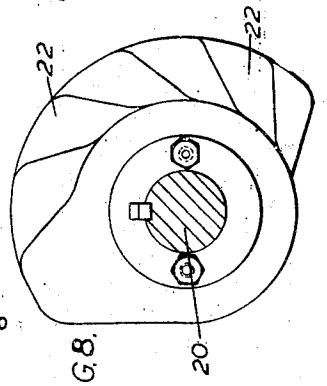


FIG.8.

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FIG.3.

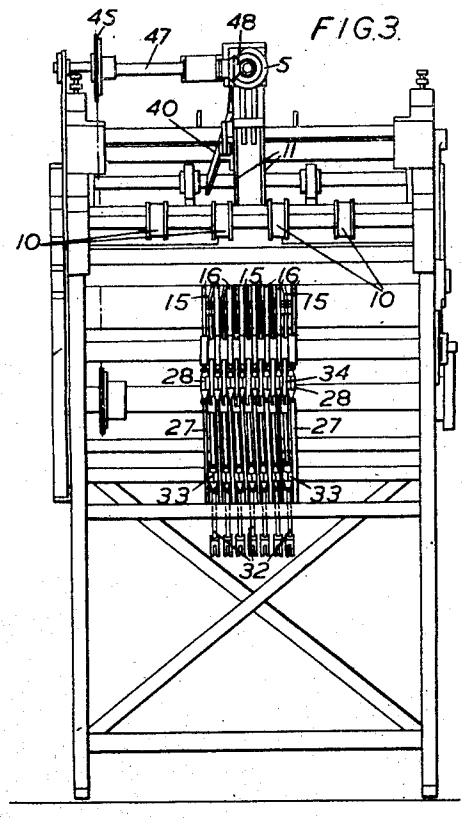


FIG.6.

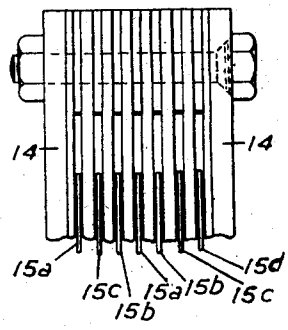
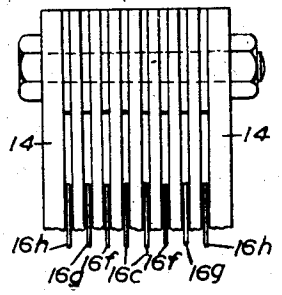


FIG.5.



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FIG.4.

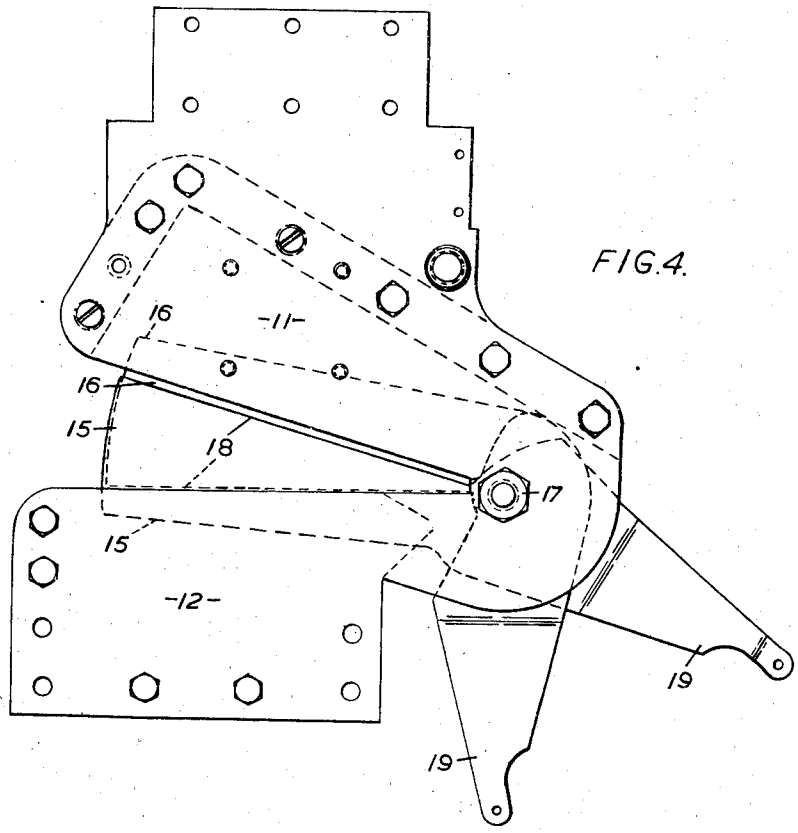


FIG.13.

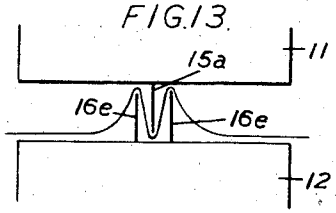


FIG.14.

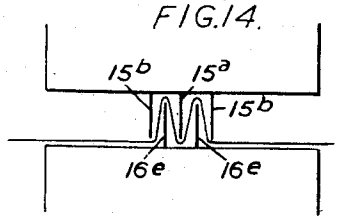
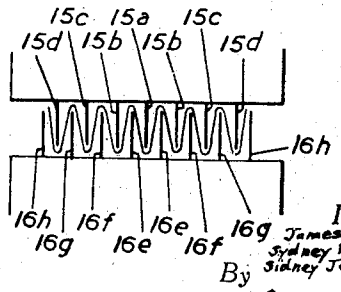


FIG.15.



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APPARATUS FOR FOLDING PAPER AND LIKE MATERIAL

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FIG. 7.

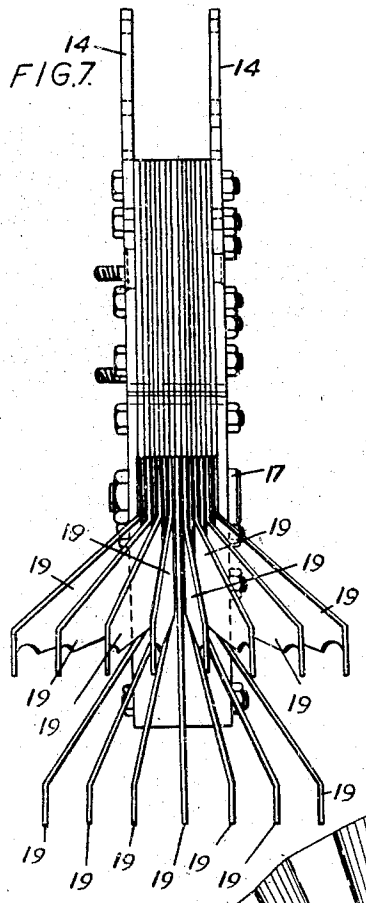


FIG. 17.

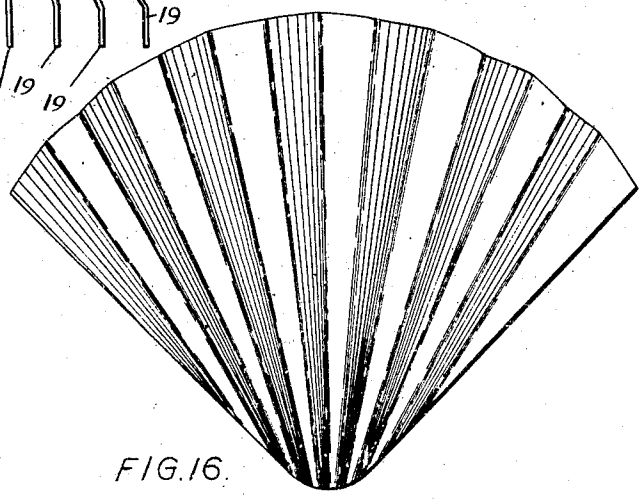
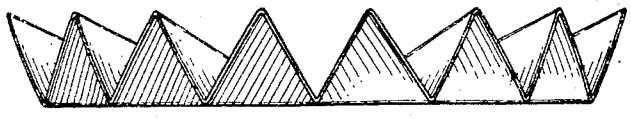


FIG. 16.



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APPARATUS FOR FOLDING PAPER AND LIKE MATERIAL

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FIG.10.

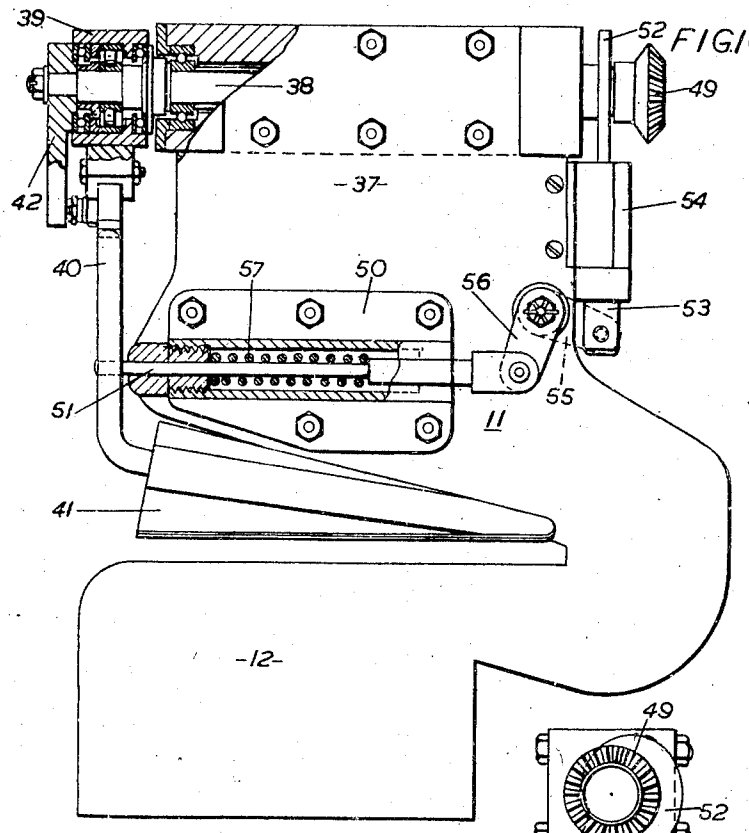


FIG.11.

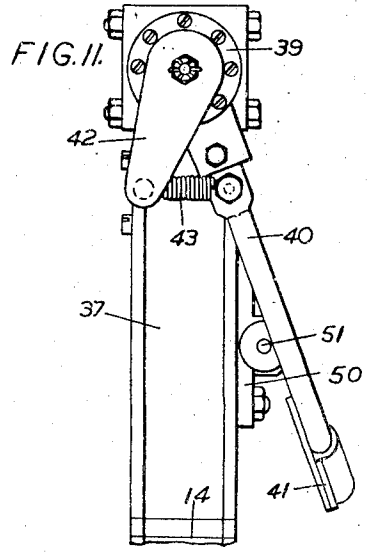
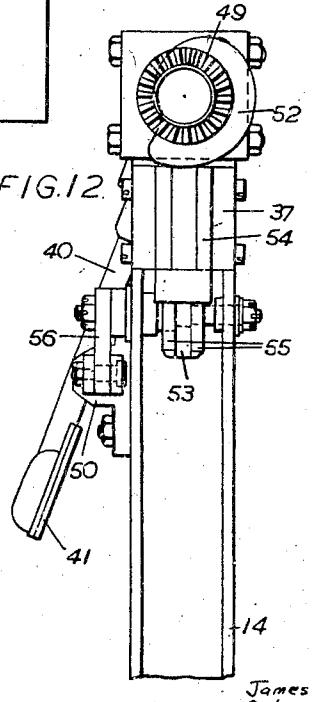


FIG.12.



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Patented Oct. 11, 1949 2,484,390

UNITED STATES PATENT OFFICE

2,484,390

APPARATUS FOR FOLDING PAPER AND LIKE MATERIAL

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Application February 25, 1949, Serial No. 78,342
In Great Britain February 24, 1948

9 Claims. (Cl. 93—86)

1

This invention is concerned with improvements in apparatus for folding paper and like material.

According to the present invention there is provided a folding machine for paper and like material comprising an upper and a lower jaw serving to receive therebetween a piece of paper to be folded, and each having movably mounted therein a plurality of folding blades, means being provided for moving a first folding blade from one of said jaws into contact with a piece of paper to be folded and thereafter subsequent folding blades from said other jaw and said one jaw alternately so as to produce a series of folds with adjacent folds on opposite sides of the said piece of paper.

Apparatus according to this invention preferably comprises a table or base upon which said jaws are mounted and in order to enable a succession of pieces of paper to be rapidly folded we prefer to incorporate means such as endless bands or belts which serve to convey individual pieces of paper into the nip of said jaws for the folding operation. In order to ensure that a piece of paper fed into the nip of the jaws remains in position during the folding operation and is not displaced by the motion of said endless bands or belts we may provide suitable stop members on said base or table which serve to retain the piece of paper square to the jaws during the commencement of the folding operation.

The said jaws which may be of any convenient shape each house a number of folding blades which are slidably mounted side by side therein so that each blade can move out of the jaw in which it is housed and then back into the jaw after the folding has been effected.

We prefer to provide an odd number of folding blades in one jaw for example the upper jaw and an even number of blades in the other jaw so that in operation the centre blade in said upper jaw may be caused to move down into contact with the paper to be folded, the first fold being produced by two blades moving upwardly from said lower jaw one on each side of said centre blade, so as to make the first fold in the paper about said centre blade. Subsequent folds may then be produced by successive pairs of blades in the upper and lower jaws moving downwards and upwards respectively closely adjacent to and outside of the preceding blades so as to fold the paper about the preceding blade. Thus a piece of paper having an equal number of folds on either side of the first fold may be produced.

It will be understood that we may if desired arrange for the first folding blade to move upwardly from the lower jaw in which case the first blade will urge the paper upwardly between, two blades in the upper jaw which will be caused to move downwards so as to form the first fold.

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The said folding blades which may be of any suitable material are preferably of generally segmental shape and the blades in both jaws are preferably mounted on a common shaft for all the blades. The pivot point of the blades is preferably so disposed with respect to the folding edges of the blades that these will form a series of folds radiating from the edge of the paper.

To control the operation of said folding blades we prefer to provide cam means adapted to be driven by any convenient source of power such as an electric motor. Preferably a single camshaft is provided having a plurality of cams thereon, one cam cooperating with each blade and serving to move its associated blade in the required sequence with respect to the other blades.

In order to transmit the motion of said cams to the folding blades we may provide cam followers having push or pull rods associated therewith said push or pull rods being coupled to the folding blades and preferably having spring means associated therewith which serve to return the blades into the jaws as required.

In order to enable the spacing apart of adjacent folds to be varied we may provide means for varying the throw of the folding blades in either jaw.

Thus for instance we may provide an eccentric shaft which carries a part of the transmission between said cams and said upper or lower blades, variation of the eccentricity of said shaft serving to vary the throw of the appropriate blades.

During the folding operation we prefer to arrange for the cam means to retain the folding blades which produce the initial fold in the paper in contact therewith, until after the folding operation is completed, in order to avoid the partly folded paper becoming deformed. The blades which form the subsequent folds are therefore withdrawn after completing their folding operation in the order in which they originally moved so that ultimately the folded paper will be gripped only by the three blades which formed the first fold, said blades being withdrawn as withdrawal means to be further described come into operation.

Means are provided for the rapid withdrawal or removal of folded papers from said jaws at the end of said operation and we prefer to provide an

ejector member which is adapted to move between the two jaws so as to sweep folded papers out to one side of said jaws. Preferably said ejector member is mounted on the upper of said jaws means being provided for rotating said member around the upper jaw so that it passes between the upper and lower jaws to remove folded papers. Driving means such as a chain drive may be provided for said extractor member, which drive may be coupled to the said cam shaft. We prefer to provide means which cause said extractor member to move at greater speed during the actual paper extracting movement than it does between successive extracting movements. Thus we may provide spring means associated with said extractor member which serve to provide an accelerated motion of the said member whilst it passes between the jaws and removes the folded paper. Preferably also stop means are provided which hold said extractor member in position for an extraction movement said stop means being withdrawn to allow the said member to move under the influence of said spring means at the appropriate instant for the extraction to take place.

The drive for said extractor member or withdrawing means may include a chain and sprocket or other suitable drive from the source of power e. g. an electric motor which operates said folding blades and it will be understood that suitable timing mechanism will be provided to enable the operation of the withdrawing means to be coordinated with the folding operation.

The folding apparatus according to this invention has been found to be particularly suitable for producing fluted or pleated filter paper, which consists of a circular sheet of filter paper folded in half and then provided with a plurality of folds radiating from the folded edge, the adjacent folds facing in opposite directions. In order that the invention may be well understood a preferred embodiment thereof will now be described by way of example only as an attachment to a known folding machine which serves to make the first diametral fold in the circular sheet of paper, although it will be clearly understood that it is within the scope of this invention to provide apparatus for producing a plurality of folds in a piece of paper or like material without using such apparatus as an attachment to any known folding machine.

In the accompanying drawings:

Figure 1 shows a side elevation of folding apparatus according to the invention attached to a folding machine of known type.

Figure 2 shows a plan view thereof.

Figure 3 shows an end elevation thereof.

Figure 4 shows to an enlarged scale a side elevation of the folding jaws.

Figure 5 is a partial plan view of the left end portion of the lower jaw of Figure 4.

Figure 6 is a partial plan view of the left end portion of the upper jaw of Figure 4 as seen looking upwardly.

Figure 7 is a rear elevation of the folding jaws as seen when viewing Fig. 4 from the right.

Figure 8 is an end elevation of the cam shaft.

Figure 9 is a sectional view of the sam shaft.

Figure 10 is a side elevation of the folding jaws showing the extraction mechanism thereon in part section.

Figure 11 is a front elevation of Figure 10.

Figure 12 is a rear elevation of Figure 10.

Figures 13, 14 and 15 show diagrammatically successive stages in the folding operation, and

Figures 16 and 17 show an end view and plan view respectively of a piece of paper folded by apparatus according to the invention.

Referring to Figures 1 to 3 there is shown a folding machine which serves to make a single fold in pieces of paper passed therethrough. The machine comprises a table 1 having guides 2 which are adjustably mounted in slots 3 in order to accommodate paper of varying width. Endless tapes 4 are provided which serve to feed pieces of paper, fed thereonto by a pick up mechanism 5 into the assembly of folding rollers 6. Where it is desired to carry out the folding operations to be later described to circular sheets of filter paper it is of importance that the above decribed folding machine makes it fold diametrally of the sheet whatever the size thereof, so as to deliver a folded sheet of semicircular form. For this purpose adjustment means generally indicated at 7 are provided to enable the folding mechanism to be adjusted to suit varying sizes of paper. Hand-wheels 8 are provided at each side of the table 1 which serve to adjust the distance apart of the guides 2 and at the same time to effect the appropriate adjustment of the folding mechanism.

Mounted adjacent the table 1 of the said folding machine is a table 9 for the folding apparatus according to the invention, endless bands 10 are provided which receive the once folded papers of semi circular shape from said machine and convey them singly with their straight edges foremost into the nip of an upper and lower jaw 11 and 12 mounted on said table 9.

On either side of said lower jaw 12 a stop member 13 is provided against which the edge of the paper bears when it is in the nip and which thus prevents the paper being dislodged or displaced by the continued movement of said endless bands 10.

The said upper and lower jaws 11 and 12 comprise casings 14 (Figs. 4 to 7) within which upper and lower folding blades 15 and 16 are mounted side by side, there being an even number e. g. 8 blades 16 in said lower jaw 12 and an odd number, e. g. 7 blades 15 in the upper jaw 11.

The said blades 15 and 16 which are of thin metal sheet and are of segmental shape are disposed side by side in the appropriate jaws and are pivotally mounted so that the blades in opposite jaws may be moved towards and away from each other as required. A single shaft 17 is provided on which all the blades are mounted, and this shaft has its centre slightly offset from the folding edges 18 of the opposed blades in each jaw.

As will be seen from Figures 4 to 7 the blades 15 and 16 have portions 19 which extend beyond the folding edges 18, which portions serve for the operation of the blades in a manner to be further described. As will be seen from Figure 7 the centre upper blade 15*a* in the upper jaw 11 is substantially plane while the other upper blades 15*b*, 15*c* and 15*d* and all the lower blades 16*e*, 16*f*, 16*g* and 16*h* have outwardly bent portions 19 which enable them to be coupled to actuating mechanism as hereinafter described.

Mounted beneath the table 9 is a cam shaft 20 which is driven by a toothed wheel 21 which takes its drive from any suitable prime mover. The said cam shaft has fifteen cams 22 mounted thereon, one cam for each of said folding blades 15 and 16.

Motion is transmitted from the cam shaft 20 to the lower blades 16 in the following manner. A cam follower 23 mounted in bell crank lever

24 is maintained in contact with the cam surface by means of a spring 25 anchored to an angle iron 26 at one end and connected at its other end to the end of the bell crank lever remote from the follower 23. Connected to the bell crank lever 24 is a pull rod 27 the length of which can be adjusted as at 28 and which is connected to the portion 19 of the lower blade 16 (see Figure 1).

Motion is transmitted to the upper blades 15 from cam shaft 20 through cam followers mounted on further crank levers 30, springs 31 being provided to maintain the followers in contact with the cam surfaces. Pull rods 32, whose lengths are adjustable as at 33, connect the said levers 30 to further crank levers 34 which are mounted on an eccentrically mounted shaft 35. The other ends of said crank levers 34 are connected to further pull rods 36 which are connected to the portions 19 of the uper blades 15.

The profiles of the cams 22*a*, *b*, . . . *g*, *h*, and the timing are so arranged that when a sheet of filter paper folded once into a semicircle is presented in the nip of the jaws 11 and 12 the centre or first folding blades 15*a* in the upper jaw 11 will move down into contact with the paper whilst two blades 16*e* from the lower jaw 12 move upwardly one on each side of the first folding blade 15*a* so as to complete the fold about said first blades 15*a* (Fig. 13) further pairs of blades then move downwards and upwards in succession each blade forming a fold in the hitherto unfolded portion of the paper about the preceding blade on the same side of the first folding blade (see Figs. 14 and 15). Due to the slight offsetting from the folding edge 18 of the centre of the shaft 17 for the blades the folds produced will radiate from the central part of the original diametral fold (see Figs. 16 and 17). The three blades 15*a*, 16*e* forming the first fold are maintained in position whilst the subsequent folding blades complete their folding action and are then withdrawn in the order in which they originally moved, the paper thus being held by these three blades and blades 16*h* at the end of the operation. The blades 15*a*, 16*e*, and 16*h* are then withdrawn as extraction means for the folded paper, to be further described, come into operation.

In order to vary the spacing of the folds in the paper the pull rods 32 associated with the upper folding blades 15 are of adjustable length and the said crank levers 34 which actuate the upper folding blades are mounted on the shaft 35 which can be eccentrically adjusted so as to vary the stroke of the upper blades and thus vary the spacing apart of the folds. The end portions of the shaft 35 are journalled in the machine frame as shown in full lines in Fig. 1. The intermediate portion of the shaft 35 is eccentrically offset from the end portions thereof, in the nature of a crank, as indicated by the dotted line 35' in Fig. 1. It will be seen that by such a structural arrangement the shaft 35 may be rotated about the axis of its end portions and thus change the position of the axis about which the cranks 34 rotate. This adjustment effects a change of the range of movement of the upper blades and may be resorted to to alter the spacing between finished folds.

An extractor mechanism (Figs. 10 to 12) is provided for the rapid removal of the folded paper from the said jaws 11 and 12. Mounted on the upper jaw 11 is an extractor head 37, a drive shaft 38 is journalled in the head 37 and carries a bearing 39 thereon to which is attached an extractor arm 40 having an extractor blade 41 at its end. A crank arm 42 is rigidly attached to said drive shaft 38 and has a tension spring 43 attached thereto, the other end of said spring 43 being attached to the extractor arm 40 so that upon rotation of said drive shaft 38, the bearing 39, arm 40, and blade 41 will be caused to rotate by the tension of said spring.

Drive is transmitted to said shaft 38 from a pinion 20' on said crank shaft 20 by chain 44 to a sprocket 45, a jockey wheel 46 being provided. From sprocket 45 the drive is transmitted via shaft 47 and through two bevel wheels 48, 49 to shaft 38.

In order to ensure that the extraction operation is effected as rapidly as possible upon completion of the folding operation means are provided for holding the extractor arm 40, and blade 41 in position adjacent the jaws 11 and 12 until the instant when blades 15*a*, 16*e* and 16*h* are withdrawn.

On the side of the extractor head 37 a housing 50 is disposed, a stop member 51 having a compression spring 57 there around is slidably mounted in said housing 50, so that in the position shown in Figs. 10 and 11 it will obstruct movement of arm 40 and prevent blade 41 from passing between jaws 11 and 12.

Mounted on shaft 38 is a cam 52 adapted to engage a follower 53 vertically slidable in sleeve 54. The end of follower 53 is coupled by cranks 55, 56 to the end of stop member 51. Thus upon rotation of shaft 38 cam 52 will cause stop member 51 to be moved into the path of arm 40 against the compression of spring 57, which spring 57 serves to withdraw stop member 51 at the appropriate instant represented by the profile of cam 52. The cam profile and the timing of the extractor mechanism above described is so arranged that the rotation of shaft 38 will bring arm 40 and blade 41 round to the position shown in Figure 11 whilst the folding operation of the paper is being completed at which time stop 51 prevents further movement of arm 40. Since however arm 40 is rotatably mounted on shaft 38, shaft 38 and crank arm 42 continue to rotate stretching spring 43 between said crank arm 42 and extractor arm 40. Whilst the folded paper is still held by blades 15*a*, 16*e* and 16*h* stop member 51 is withdrawn so that extractor blade 41 is drawn by spring 43 up against the outside of blade 16*h* which is immediately thereafter withdrawn together with blades 15*a* and 16*e* thus allowing spring 43 to pull extractor blade 41 sharply through the space between jaws 11 and 12 thus sweeping the folded paper out of the jaws to one side where it may be received in any suitable container (not shown).

It will be seen that when the machine is in operation, shaft 38 will rotate continuously so that after each extraction movement blade 41 and arm 40 will be carried round the upper jaw 11 ready for a subsequent extraction.

In Figures 16 and 17 a filter paper folded in apparatus as described above is shown and as will be seen the paper has a plurality of folds, adjacent folds being made on opposite sides of the paper, whilst all the folds radiate from the diametral edge about which the first fold was made.

It will be understood that only a preferred embodiment by way of example of the invention has been described above.

We claim:

1. In a machine for folding paper, having upper and lower jaws providing an opening therebetween for receiving a piece of paper to be folded,

a plurality of movable folding blades mounted in each of said jaws and movable from said jaws into said opening to interleaf said blades with the blades of one jaw alternating with the blades of the other jaw, blade moving means for moving said blades into said opening for producing a series of oppositely directed folds in said paper and for returning said blades into said jaws after said folds have been formed, the improvement which comprises, an ejector for the folded paper being mounted on a shaft continuously rotatable in one direction about an axis spaced from said opening and having an ejector member passing through said opening in a direction laterally of said jaws during a part of the rotating of said ejector, and driving means to rotate said shaft in timed relation to the movement of said blades to pass said member through said opening to eject the folded paper after said blades have been returned into said jaws.

2. A machine as defined in claim 1 in which said driving means includes means for moving said ejector portion through said opening at a higher speed than its speed during the remainder of the rotation of said ejector.

3. A machine as defined in claim 2 in which said driving means rotates at uniform speed and includes a resilient connection to said ejector and said machine includes a stop means for stopping said ejector before said member passes through said opening and means to withdraw said stop means as soon as said blades are withdrawn from said opening.

4. A machine as defined in claim 1 in which said jaws are positioned one above the other and said axis is a horizontal axis above said opening so that said ejector member is rotated about said upper jaw.

5. A machine as defined in claim 4 in which said driving means rotates at uniform speed and includes a resilient connection to said ejector and said machine includes a stop means for stopping said ejector before said member passes through said opening and means to withdraw said stop means as soon as said blades are withdrawn from said opening.

6. A machine as defined in claim 3 in which said blade moving means includes a cam shaft having a cam for each of said blades disposed thereon to first cause movement of a single centrally positioned blade into said opening from one of said jaws and then movement of pairs of blades alternately from said jaws and progressively outwardly from said first blade, said blade moving means including said cams causing withdrawal of said blades from said opening in the sequence in which they were moved into said opening, said stop means being released as soon as the outermost pair of blades is withdrawn.

7. In a machine for folding paper, having upper and lower jaws providing an opening therebetween for receiving a piece of paper to be folded, a plurality of movable folding blades mounted in each of said jaws and movable from said jaws into said opening to interleaf said blades with the blades of one jaw alternating with the blades of the other jaw, blade moving means for moving said blades into said opening for producing a series of oppositely directed folds in said paper and for returning said blades into said jaws after said folds have been formed, the improvement which comprises, means for pivotally mounting all of said blades for pivotal movement into and out of said opening about a single axis spaced from the folding portions of said blades but closely adjacent the ends thereof, and a single cam shaft having a cam for each of said blades and connections between said cams and said blades forming a part of said blade moving means.

8. A machine as defined in claim 7 in which said blade moving means includes an adjusting means for simultaneously adjusting the distance which all of the blades of one jaw move into said opening.

9. A machine as defined in claim 8 in which said adjusting means includes a bell crank in each of the connections to said blades of said jaw and an angularly adjustable eccentric shaft upon which all of said bell cranks are mounted.

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SYDNEY W. BUSSELL.
SIDNEY J. HERBERT.

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