Jan. 3, 1956 W. M. WEBSTER 2,729,445

SPIRAL PAPER FOLDING DEVICE

Filed Nov. 5, 1952 2 Sheets-Sheet 1

FIG-1

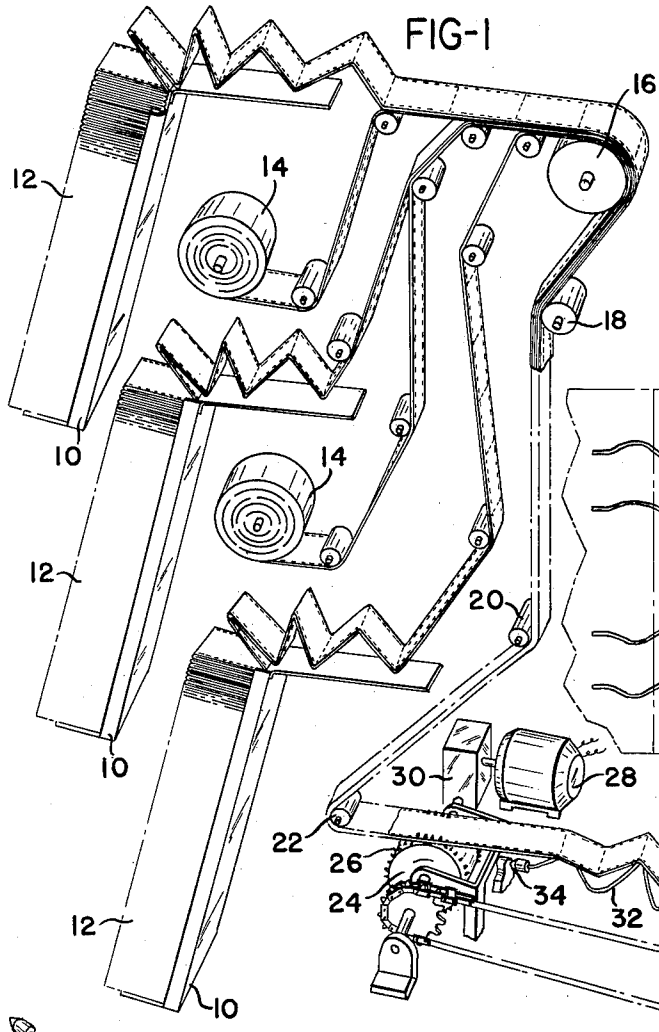


FIG-11

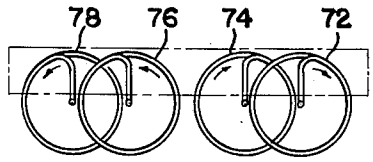
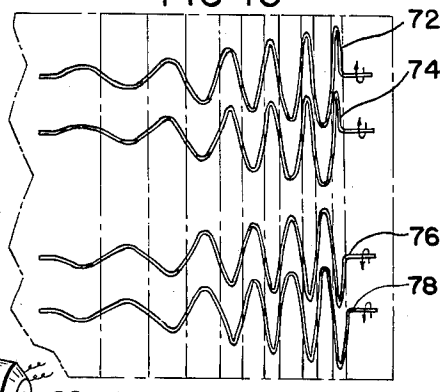


FIG-10



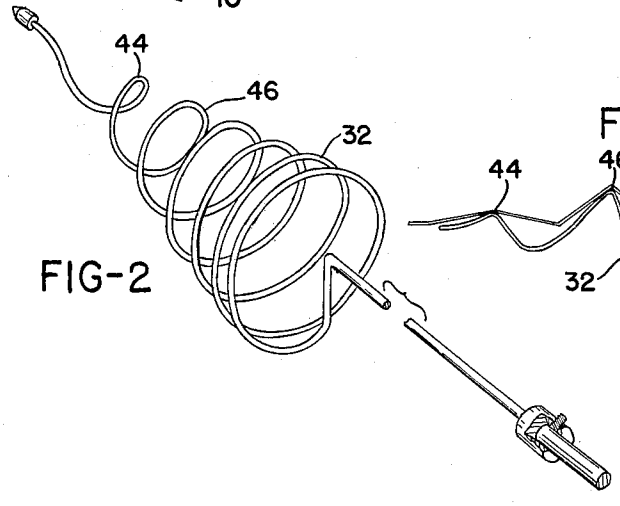
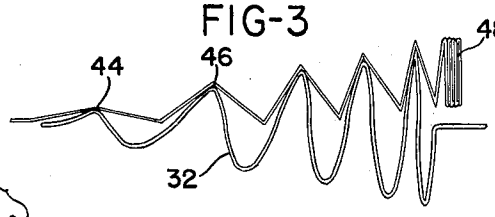


FIG-2

FIG-3



INVENTOR.
WILLIAM M. WEBSTER
BY Toulmin & Toulmin
ATTORNEYS

Jan. 3, 1956 W. M. WEBSTER 2,729,445

SPIRAL PAPER FOLDING DEVICE

Filed Nov. 5, 1952 2 Sheets-Sheet 2

FIG-4

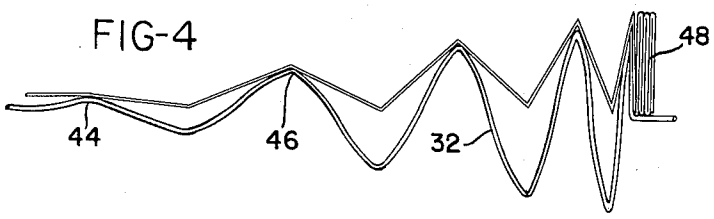


FIG-5

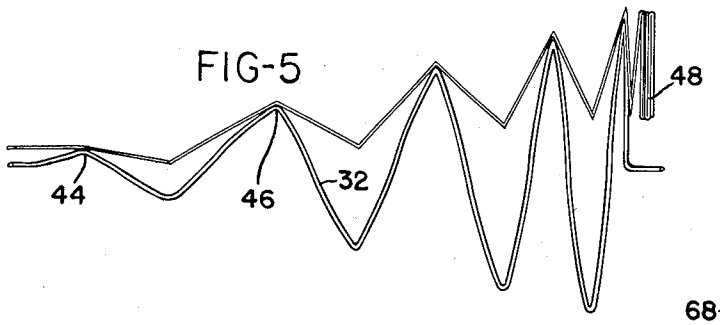


FIG-6

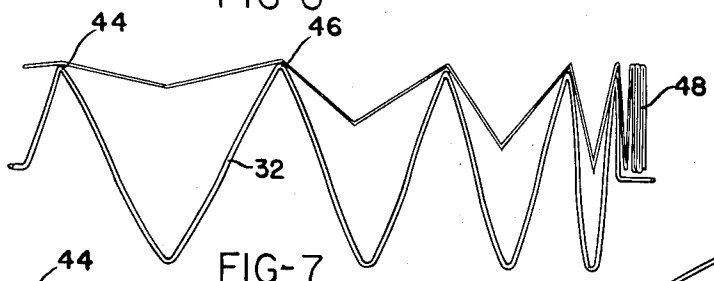


FIG-7

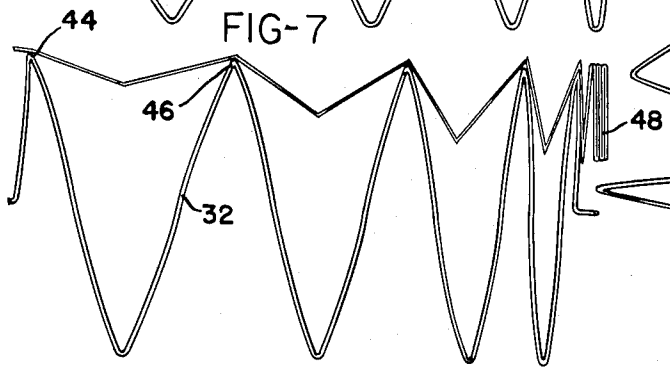


FIG-8

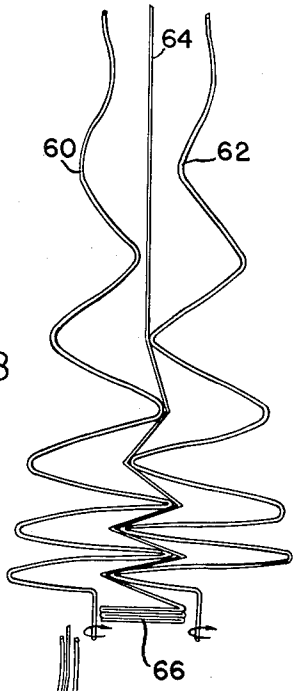
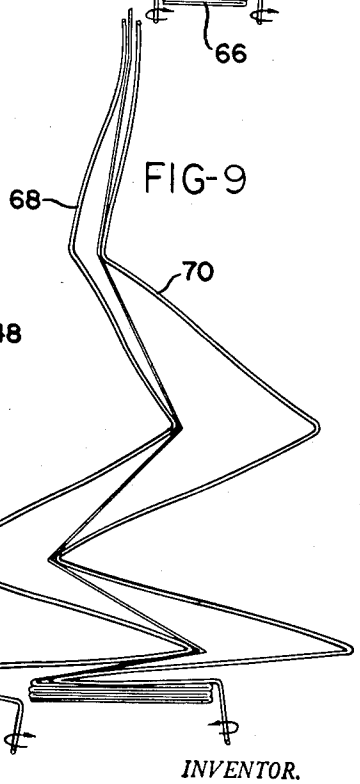


FIG-9



INVENTOR.
WILLIAM M. WEBSTER
BY Toulmin & Toulmin
ATTORNEYS

United States Patent Office

2,729,445

Patented Jan. 3, 1956

2,729,445

SPIRAL PAPER FOLDING DEVICE

William M. Webster, Miamisburg, Ohio

Application November 5, 1952, Serial No. 318,777

4 Claims. (Cl. 270—39)

This application relates to a method and apparatus for folding continuous forms or continuous strips of paper or the like into a folded pack. In particular, this invention relates to a method and apparatus for folding single strips or sets of continuous forms into packs such that substantially any width of form can be handled as well as any weight of paper from a heavy paper to very thin papers.

In the art of printing continuous forms, it is customary to perforate the forms simultaneously with the printing thereof, or otherwise to provide lines of weakness across the forms which will subsequently provide the tear lines for separating the forms. It is also common practice to punch holes along the sides of the forms either at the time of printing or in a subsequent operation.

The forms when taken from the press may be wound into a roll, but are preferably stacked up as a folded pack. Thereafter, in order to make the forms up into form sets, they are interleaved with carbon and again stacked up in the form of folded packs.

The particular object of the present invention is to provide an improved method and apparatus for continuously folding continuous forms, either singly or in sets, in an extremely rapid and efficient manner.

Another object is to provide a method and apparatus for folding continuous forms which can handle substantially any size and weight form, even extremely thin and easily crumpled papers.

A still further object is the provision of a method and apparatus for folding continuous forms into packs which is positive in operation, thereby forcing the continuous forms into the proper sized pack.

A still further object of this invention is the provision of a folding device for fan folding continuous forms which can readily be attached to any device through which the continuous forms are run such as a printer or a perforator.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a perspective view of an apparatus constructed according to my invention, showing a plurality of continuous forms being interleaved with carbon sheets and folded into a pack;

Figure 2 is a perspective view of one form which the novel folding element according to my invention can take;

Figure 3 is a side elevation drawn more or less diagrammatically of the folding elemnt;

Figure 4 is a view like Figure 3 and shows a similar folding element in which the folded pack is substantially half the diameter of the folding element;

Figure 5 shows a folding element like Figure 4 arranged to fold a pack substantially smaller than half the diameter at the large end of the folding element;

Figure 6 is a view like Figure 4 but shows a folding element which is cylindrical in outline;

Figure 7 is a view like Figure 5 but shows a folding element cylindrical in outline;

Figure 8 shows two folding elements arranged side-by-side and rotating in the same direction, with the continuous form to be folded extending therebetween so that the form is positively folded in both directions;

Figure 9 is a view like Figure 8, but shows the folding elements arranged so that one is a right-hand spiral and the other is a left-hand spiral, so that the folding elements rotate in opposite directions;

Figure 10 is a plan view looking down on top of an arrangement wherein a plurality of the spiral elements are employed for folding extremely wide forms; and

Figure 11 is an end view looking in from the right side of Figure 10 showing the directions of rotation of the spiral folding elements, so that the form being folded is in tension transversely and thus has no tendency to buckle.

Referring to the drawings more in detail, in Figure 1 there is illustrated a plurality of racks or supports **10** in which the folded packs **12** are placed. The folded packs are printed and perforated and punched along their side edges and may come directly from a printing press or may be first printed and thereafter punched and perforated on a special machine before being placed in the racks **10**.

The several continuous forms **12** are to be interleaved with carbon sheets to form a set of continuous multiple forms, and to this end there is provided the rolls **14** of carbon, which is preferably punched along the side edges, although this operation can be dispensed with in many instances.

The several continuous forms and the interleaved carbon are brought together and passed over the idler rollers **16**, **18**, **20** and **22**, arranged according to any desired or suitable pattern, and then pass over the pinwheel driving member **24**. The pinwheel driving member has pins **26** that register with the punched holes along the sides of the continuous forms and the carbon interleaved therewith and a positive driving of the forms and carbon thus obtains.

A drive motor **28** drives the pinwheel roll **24** at a suitable speed through the gear reduction **30**.

According to the present invention, the interleaved and aligned form sets pass from pinwheel roll **24** to an elongated spiral element **32** having one end rotatably supported at **34**, and its other end rotatably supported at **36**. The gear means **38** and **40** and chain drive **42** interconnect spiral folding element **32** with pinwheel roll **24**, so that they operate in absolute synchronism at all times.

The spiral folding element **32**, and which is shown in somewhat more detail in Figures 2 and 3, consists of an element having a spiral working surface thereon, which surface increases in diameter from left to right, while at the same time the pitch of the spiral decreases. The spiral is selected so that the distances between adjacent peaks, such peaks being indicated by reference numerals **44** and **46** in Figure 3, are spaced apart a distance not substantially greater than two form lengths at the point of introduction of the continuous forms to the spiral for the start of the folding operation, while toward the end of the spiral, the spacing between the adjacent peaks decreases to the point where the forms are thrown into a relatively sharply folded condition, whereby they will stack up into the pack **48**. Pack **48** may advantageously be received on a platform **50**, or on a conveyor belt, or on any other suitable receiving means.

Inasmuch as the synchronizing of the movement of the form set with the rotation of the spiral folding ele-

ment is extremely important, it may be desirable to provide means for tilting the axis of the spiral downwardly from a horizontal position, so that there will be a certain gravitational effect tending to deliver the forms downwardly over the spiral folding element, so that the weakened transverse perforation lines therein will be properly engaged by the working surface of the spiral folding element and be properly folded.

For this purpose, the right end of the spiral folding mechanism may be supported on a bracket means **52** comprising a slot **54** that is slidable over a clamp screw **56** carried by the stationary frame part **58**. By availing of this adjustment, the spiral folding element can be tilted to any desired angularity from the horizontal, whereby the device can be accommodated to forms of different size. It will be understood, of course, that the gears **38** could be change gears, or other speed varying means could be provided in the driving connection between pinwheel roll **24** and the spiral folding element, so that for forms of varying lengths, the desired synchronization of the spiral folding element with the forms could be obtained.

The spiral folding element is illustrated in Figures 1 through 3 as a twisted wire form, and it could well be that the spiral folding element would be manufactured in this particular form. However, the illustrations in the drawings would more properly be considered by taking the spiral forms indicated to show the envelope or the working surface of the spiral folding element, because the said element could comprise a shaft with a solid metal web extending therefrom, if so desired, or the spiral folding element could be formed by turning it from solid stock. It will, thus, be understood that the representations in the drawings of the spiral folding elements are intended to reveal one form which the elements can take, as well as to indicate the location of the working surface of the several other forms in which the element could be constructed.

Figures 3, 4, and 5 show the folding element as a conical spiral with the form being folded in Figure 4 stacking up in a pack equal to substantially half the diameter of the folding element of the large end thereof.

In Figure 5, the pack which is formed is less than half the diameter of the spiral folding element at its large end, and it will be understood that the particular size of spiral selected will be determined by individual choice and the operating conditions desired.

The spiral folding elements illustrated in Figures 6 and 7 are substantially identical with those shown in Figures 4 and 5, except that the Figures 6 and 7 elements are cylindrical in outline rather than conical. The same folding action is had in both cases, with the Figure 6 folding element being shown forming a pack substantially equal to the radius of the folding element, while in Figure 7 the pack being formed is substantially less than the radius of the folding element.

It is to be noted that the arrangements of Figures 3, 5 and 7 permit the folding of different form lengths. The limiting factor in any arrangement would be that the form length should not exceed the radius of the spiral at its larger end and the pitch of the spiral at the incoming end should not be substantially greater than two form lengths for the shortest form to be folded. By adjusting these two factors, a spiral can be constructed which will handle a plurality of form lengths.

Turning now to Figures 8 and 9, there is illustrated therein arrangements whereby the form set being folded is engaged on opposite sides so that every fold formed in the set is formed positively, rather than the one fold out of every two being formed by gravity, as in the case of the previous modifications.

In Figure 8 there are two spiral conical folding elements **60** and **62** which are both right-hand spirals, and which, therefore, both rotate in the same direction of rotation. It will be evident that the spiral folding elements will overlap, so that the form **64** being fed therethrough will be forced into the proper folded condition to form the pack **66**.

In Figure 9 the conical spiral folding elements **68** and **70** are formed so that one is a right-hand spiral and the other is a left-hand spiral, and the elements therefore rotate in opposite directions, while in all other respects the same operating cycle is had that was described in connection with Figure 8. It will be evident that for the positive folding of forms in the manner illustrated and described for Figures 8 and 9, different sizes of forms could be handled by one and the same set-up spirals by adjusting the lateral distance therebetween with the limitation existing that the largest form to be folded could not exceed the maximum radius of the folding elements.

In certain instances the forms to be folded are extremely wide, and it may be desirable in such a case to engage the forms at a plurality of points across their width, so that a uniform folding action will be had. For this purpose, the arrangement of Figures 10 and 11 may be utilized, and wherein there is illustrated a first pair of folding elements **72** and **74** that run together in the manner of the folding elements in Figure 8, and a second pair of folding elements **76** and **78** which run together in the same manner, but which are of the opposite hand.

Referring to Figure 10, the continuous form being folded would lie on top of the folding element and thus be engaged thereby at four spaced points across alternate of the fold lines. By selecting the hand of the folding elements so that the points thereof which engage the forms move outwardly toward the adjacent edge of the forms, the forms will be held in tension, and thus will have no tendency to be buckled and crumple. The arrangement of Figures 10 and 11 is, thus, particularly useful for folding either extremely wide forms or for folding form sets consisting of extremely thin, and thus readily crumpled paper. The Figures 10 and 11 arrangement can be employed for folding form sets consisting of multiple copies, up to eighteen or twenty, and, therefore, form sets in which the paper is of almost tissue thinness, or can be employed for folding up even single forms or single strips of carbon tissue.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In an apparatus for folding continuous strip means of paper having equally spaced successive transverse lines of weaknesses along its length into a folded pack, means for feeding the paper in the direction of its length at a predetermined speed, means consisting of a spiral-shaped folding element adapted to receive said strip from said feeding means and support the same at spaced intervals therealong, said spiral-shaped element having working surfaces consisting of slender peaks which are adapted to contact the strip means at alternate fold lines along the length of said strip and leaving the intermediate portion of the strip unsupported, said spiral-shaped folding element decreasing in pitch from the feed-in point of said spiral-shaped element toward the discharge end thereof, means for rotating said element in timed relationship to the feed of said strip, and said spiral element being adapted to engage said strip means substantially as a point contact at said alternate fold lines whereby said strip means is caused to double upon itself at such fold lines and form a folded pack at the discharge end of said folding element.

2. In an apparatus for folding continuous strip means of paper having equally spaced successive transverse lines of weaknesses along its length into a folded pack, means for feeding the paper at a predetermined speed, means consisting of a spiral-shaped folding element adapted to receive said strip of paper from said feeding means and support the same at spaced intervals therealong, said

spiral-shaped folding element having working surfaces consisting of slender peaks which are adapted to contact said strip means at alternate fold lines along the length of the strip and leaving the intermediate portion of the strip unsupported, said spiral element decreasing in pitch from the feed-in point of said spiral-shaped element toward the discharge end thereof, means for rotating said element in timed relationship to the feed of said strip, and said spiral element being driven in synchronism with said feeding means and adapted to engage said strip means substantially as a point contact at said alternate fold lines whereby said strip means is caused to double upon itself at such lines and form a folded pack at said discharge end of said folding element.

3. In an apparatus for folding long continuous strip means of paper having equally spaced successive transverse lines of weaknesses along its length into a folded pack, means for feeding said strip of paper at a predetermined speed, and means consisting of a pair of spiral-shaped folding elements adapted to receive said strip therebetween from said feeding means and engaging said strip at alternate fold lines therealong, one of said spiral-shaped folding elements engaging one alternate group of alternate fold lines along one side of said strip and the other folding element engaging another group of alternate fold lines on the other side of the strip, said spiral-shaped folding elements having working surfaces consisting of slender peaks which are adapted to contact the strip means at said alternate fold lines along the length of said strip, said spiral-shaped folding elements having a pitch which varies from a maximum at the feed-in point to a minimum at the discharge end thereof, means for rotating said folding elements in timed relationship to the feed of said strip, said maximum pitch being substantially equal to the distance between said alternate fold lines of the strip, and said spiral element being adapted to engage said strip substantially as a point contact at said alternate fold lines whereby said strip is

caused to double upon itself at said fold lines and form a folded pack at said discharge end of said folding element.

4. In an apparatus for folding continuous strip means of paper having equally spaced successive transverse lines of weaknesses along its length into a folded pack, means for feeding said strip of paper at a predetermined speed, means consisting of a spiral-shaped folding element adapted to receive said strip from said feeding means and support the same at spaced intervals therealong, said spiral-shaped folding element having working surfaces consisting of slender peaks which are adapted to contact said strip means at alternate fold lines along the length of the strip and leaving the intermediate portion of the strip unsupported, said spiral-shaped folding element decreasing in pitch from a maximum at the feed-in point of said element to a minimum at the discharge end thereof, means for rotating said element in timed relationship to the feed of said strip means, said maximum pitch being substantially equal to the distance between said alternate fold lines of said strip, and said spiral element being adapted to engage said strip substantially as a point contact at said alternate fold lines whereby said strip is caused to double upon itself at such fold lines and form a folded pack at said discharge end of said folding element.

References Cited in the file of this patent

UNITED STATES PATENTS

1,399,098	Winter	Dec. 6, 1921
1,791,569	Novick	Feb. 10, 1931
1,886,312	Stanton	Nov. 1, 1932
1,985,676	Hand	Dec. 25, 1934
2,495,994	Ward et al.	Jan. 31, 1950

FOREIGN PATENTS

604,811	Germany	Oct. 29, 1934
627,367	Great Britain	Aug. 8, 1949