July 12, 1966 H. A. KUBICK 3,260,029

ROTARY FOLDING ARRANGEMENT

Filed March 18, 1963

Fig. 3

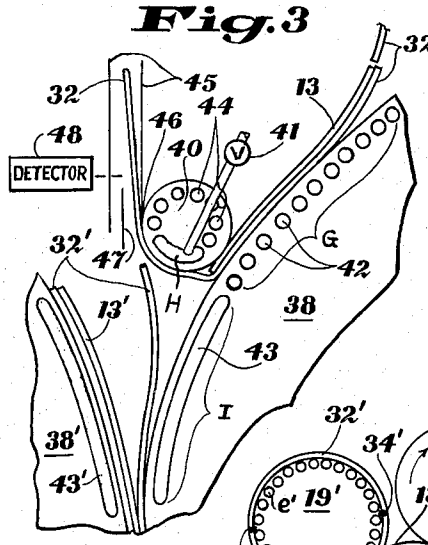


Fig. 1

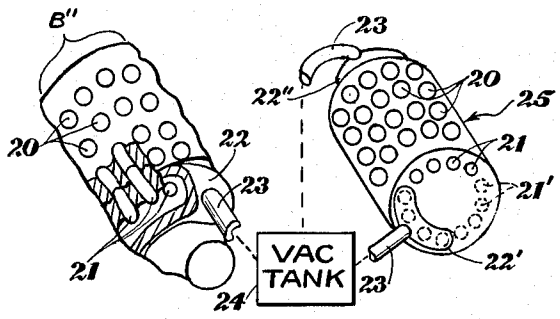


Fig. 2

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ROTARY FOLDING ARRANGEMENT

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This invention relates to a rotary folding arrangement and, more particularly, to a method and apparatus for wrapping individual sheets of film material.

In the art of photographic film packaging, apparatus is operated in an environment having little or no light, whereby visual inspection during operation is restricted or non existent. Because of this, misalignment, curling of film, etc., of the web being transported may result in severe jamming problems before being discovered. It is, of course, a goal in this art to make the automatic equipment in such a way that the possibility of jamming during high-speed operation is substantially eliminated. One folding equipment that has been operated successfully for several years utilizes a plurality of vacuum rollers which receive and carry X-ray film sheets through a plurality of tortuous paths to a loading platform. The machine also receives protective wrapping paper which is folded therein over the X-ray film prior to the film being stacked for future handling.

One particular arrangement of such equipment suffered from a problem of jamming when the X-ray film happened to be particularly curly. The curliness of X-ray film is dependent on many factors, including the thickness of the emulsions on the films, the humidity and temperature of the operation, etc., not all of which are precisely predictable at all times.

Therefore, an object of the present invention is to provide a reliable automatic high-speed rotary folding and wrapping arrangement.

In accordance with one embodiment of the present invention, X-ray film is chopped into sheets and presented to a first vacuum roller with it flowing from this roller to a pair of rollers so that alternate sheets take different but symmetrical paths through the machine. During the travel of the X-ray film through the machine, a porous wrapping paper is laid over each film with a lead portion of the porous paper, having approximately the same area, traveling in front of each film sheet. This leading portion is raised, compared to the relatively straight-line path of the sheet and film, by a small diameter intermittently activated vacuum roller and directed into a chute having no vacuum attachments. Because of the small diameter of the roller and the reduced adherence of the sheet in the chute, the vacuum securing the remaining portion of the porous paper and the film sheet itself is more easily able to pull the paper and film sheet to the folding region without excessive bending of the film.

The subject matter which is regarded as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as to its organization and operation together with further objects and advantages thereof will best be understood by reference to the following description taken in connection with the accompanying drawing in which:

FIG. 1 illustrates a schematic diagram of the present invention;

FIG. 2 is a detail view of typical vacuum rollers; and

FIG. 3 is a detail view of a portion of the present invention illustrated in FIG. 1.

Referring now to the drawing in which like numbers refer to similar parts, I have shown in FIG. 1 a film chopper **10** receptive of an endles web **11** of X-ray film having a width equal to a dimension of the finished product, such as 10". The film chopper **10** chops the web

11 into film sheets **13** and **13'** having a length of 20", for example. As the film sheets **13** and **13'** leave the film chopper **10**, they are received by a first vacuum roller **12** having a continuous vacuum applied to a surface region A indicated by a row of circles. The continuous vacuum carries the film sheets over a second roller **15** having a continuous vaccum region B (shown as circles). The vacuum of the region B carries the film sheets **13'** to a roller **15'** which is provided with an intermittent vacuum region C' (as indicated by semicircles) synchronized with the chopper **10** to receive alternate film sheets from the roller **12**. The roller **15** is also provided with an intermittent vacuum region C, which carries the remaining alternate film sheets **13** to a roller **17** having intermittent vacuum region D. Thus, the film sheets **13** travel to the region of the envelope chopper roller **19**.

The vacuum rollers **12**, **15**, etc., may be activated to constrain the film sheets by one of several arrangements presently known in the web handling art. By way of example, in FIG. 2 I have shown a roller section B", which is continuously supplied with a vacuum at its surface through radial holes **20**, which are coupled by long axial holes **21** to an arcuate vacuum nozzle **22**. The nozzle **22** is coupled by suitable piping **23** to a vacuum tank **24**. So long as there is vacuum in the tank **24**, the holes **20** will grasp and constrain any film, paper, webs, sheets, etc., that are thereover.

An intermittent vacuum drive is also illustrated in FIG. 2 where a roller **25** is provided with similar radial holes **20** about its periphery. However, only a portion **21** of the axial holes **21** and **21'** are drilled completely through the near end of the roller **25** whereby they may be evacuated by an arcuate vacuum nozzle **22'** in an intermittent vacuum region of the nozzle **22'**. As illustrated in FIG. 2, the radial holes **20** covering approximately half of the surface of the roller **25** may be evacuated by the nozzle **22'**. If, at the same time, it is necessary to have continuous activation in another region of the roller **25**, a second arcuate nozzle **22"** may be coupled to the other end of the roller **25**, where all of the axial holes **21** are open thereto. If it is necessary to have selective continuous operation of the vacuum in the region of the nozzle **22'**, the axial holes **21'** (dashed lines) may be brought out at a different radius to pass under a second arcuate nozzle (not shown) under the control of a valve. By such arrangements, sheets may be selectively transferred from roller to roller in a preselected tortuous path.

When handling paper or film of predetermined dimensions in the maner of the present invention, it is most practicable to have rollers with peripheral dimensions equal to 1, 2, 3, etc., times the length of the sheets of material being handled. If a roller has a periphery equal to two sheet lengths, alternate sheets may be handled by having half of the roller activated in one section, e.g., nozzle **22'**, FIG. 2. It is also feasible by slightly more complex arrangements, to have the axial holes **21** selectively receptive of vacuum by having an arrangement generally similar to that illustrated in FIG. 2 and providing several control valves in the vacuum nozzle system. Usually, in arrangements where it is necessary to sort sheets of various quality, adjacent regions of the axial holes **21** will be engaged by nozzles positioned at slightly different radius. In some embodiments of these vacuum rollers, several overlapping rows of radial holes **20** are provided whereby one or more of these rows may be selectively activated.

Referring again to FIG. 1, at the same time the film **11** is being supplied to the film chopper **10**, a porous wrapper paper web **28** is being supplied to a roller **29**. The roller **29** is preferably of a peripheral dimension equal to that of one film sheet length and provided with a pressure bar

30, which co-operates with a pressure bar 31 on the roller 19 to crease each sheet 32 of the paper at a first location, and co-operates with a cutter blade 34 to cut the paper into sheets at a second location. As a result, each sheet 32 is provided with a crease equidistant from successive cuts. The sheets 32 are carried by a continuous vacuum region E to the mating surfaces between the rollers 17 and 19. A similar continuous vacuum region *e* conveys the sheets 32 to the roller 17.

The timing of the location of the cutter blade 34 is such that the wrapping paper sheet 32 leads the film 13 by a full film sheet length. Since film sheets are usually not porous, the paper is not constrained by any vacuum holes 20 which are completely and directly covered by the film 13. Therefore, the handling of paper is accomplished by constraining the paper separately (rollers 17 and 19) or by constraining the paper sheet 32 and constraining the film sheet 13 through the porous paper (roller 38 below).

The conveying of both the film sheets 13 and the paper sheets 32 commences on the roller 17. First, the wrapping paper sheet 32 is received by the continuous vacuum region F of the roller 17. With the paper leading the film sheet 13 by a full film sheet length, it is, at all times, under control, despite the fact that the later-received film sheet 13 blocks the vacuum of the vacuum region F from the trailing half of the paper sheet 32. The roller 17 conveys the film and the paper to one of the main folding rollers 38, whereupon the vacuum region G engages the porous paper continuously and, when present, engages the film sheet 13 through the porous paper.

An intermittent vacuum region H of a roller 40 engages the leading portion of the porous paper 32 every second revolution thereof. Alternate revolutions of the roller 40 engage the film sheet 13 with the vacuum region H being inactivated by a valve 41 (FIG. 3). In practice, I prefer to have the valving action actually accomplished by a two-pitch roller such as 15 having a vacuum region C. The size of the roller 40 may be reduced to ⅔ of the length of the film sheets 13 so that it may be activated only every third revolution. However, I have not found this necessary. The peripheral dimension of the roller 40 is reduced so that any curliness of the film sheet 13 will not materially change the adherence thereof to the roller 38. Use of the roller 40 in addition to the roller 17 is further advantageous because of the fact that the film 13 tends to follow a transporting roller 38 rather than a transfer roller 40.

Referring now to FIG. 3, where the region of the take-off roller 40 is shown in greater detail, the apertures of the axial holes 42 of the roller 38 are approaching a vacuum nozzle 43. Under the nozzle 43 there are no axial apertures so that the wrapper paper 32 has been freed to be constrained by the axial holes 44 of the roller 40. Thus, the paper 32 has been directed into a vertical slot chute 45 which has stripper fingers 46 at its lower end to assure stripping of the paper sheet 32 from the roller surface. No vacuum or other constraining force is applied to the lead portion of the paper sheet 32 at the instant the film sheet 13 reaches the point illustrated in FIG. 3. It should also be noted that with a simple vacuum aperture construction, not using overlapping apertures 20, the holes 42 are covered by a means (not illustrated) to allow constraining of both the paper and film in the region G by a nozzle (of the type illustrated at 22″ in FIG. 2) on the far side of the roller 38.

Also indicated in FIG. 3 are the film sheet 13′, which has traveled over the symmetrical rollers 15′, 17′, 38′, 40′ (FIG. 1) and the wrapper paper 32′. The travel of this film and its wrapper are being controlled by a vacuum nozzle 43′ co-operating with the roller 38′. As the rollers 38 and 38′ continue their cycle, the film sheet 13 will move into the lower position immediately behind the film sheet 13′ to complete the folding operation. It should be noted that portions of the porous papers 32 and 32′ reside in the chute 45 at the same time. In order to prevent damaging engagement therebetween, I have provided a separating means in the form of a separator 47.

In order to promptly detect failure of either of the porous papers 32 or 32′, I have also provided an infrared detector 48 which projects a beam of infrared light against paper extending above the separator 47. The detector is positioned to provide a beam which will, under normal operating conditions, continuously engage either paper 32 or paper 32′.

Referring again to FIG. 1, a vacuum region J carries the wrapped film sheets 13 and 13′ to a stacking region indicated by a receptacle 50 where the wrapped film sheets are collected. Above the receptacle 50 are stripping fingers 52 which assure that the wrapped film is separated from the roller 38.

While I have shown and described particular embodiments of the present invention, other modifications may occur to those skilled in this art. I intend, therefore, to have the appended claims cover all modifications which fall within the true spirit and scope of my invention.

I claim:

1. A rotary folding machine comprising:
a first vacuum roller arranged to receive a substantially continuous flow of adjacent nonoverlapping film sheets;
a first pair of vacuum rollers co-operating with said first roller to direct alternate film sheets into a first tortuous path and the remaining film sheets into a different tortuous path, said paths having a predetermined related length;
a second pair of vacuum rollers, one in each of said paths and each receptive of a wrapper paper sheet substantially twice as long as said film sheets and receptive of said film sheets traveling said tortuous paths in a timed relationship such that the film sheets are covered by only the latter half of said paper sheets;
a pair of folding vacuum rollers, one in each of said paths receptive in a synchronized spacing of said paper sheets with the film sheets thereover, each of said folding rollers carrying the leading portion of said paper sheets to a predetermined location respectively and there releasing it; and
a pair of substantially smaller diameter vacuum rollers, each located at one of said predetermined locations and each engaging one of said leading portions respectively to raise said one leading portion from said folding rollers, but not to engage the film sheets, whereby said folding rollers pull the film sheets from one tortuous path and then the other through a creasing region to fold the wrapping paper thereover.

2. A rotary folding machine comprising:
a first vacuum roller arranged to receive a substantially continuous flow of adjacent nonoverlapping film sheets;
a first pair of vacuum rollers co-operating with said first roller to direct alternate film sheets into a first tortuous path and the remaining film sheets into a different tortuous path, said paths having a predetermined related length;
a second pair of vacuum rollers, one in each of said paths and each receptive of a wrapper paper sheet substantially twice as long as said film sheets and receptive of said film sheets traveling said tortuous paths in a timed relationship such that the film sheets are covered by only the latter half of said paper sheets;
a pair of folding vacuum rollers, one in each of said paths receptive in a synchronized spacing of said paper sheets with the film sheets thereover, each of said folding rollers carrying the leading portion of said paper sheets to a predetermined location respectively and there releasing it;
a pair of substantially smaller diameter vacuum rollers,

each located at one of said predetermined locations and each engaging said leading portions respectively to raise said leading portion from said folding rollers, but not to raise the film sheets; and

means for releasing said leading portions from the influence of said smaller diameter rollers, whereby said folding rollers pull the film sheets from one tortuous path and then the other through a creasing region to fold the wrapping paper thereover.

3. A rotary folding machine for folding porous paper over film sheets received from different tortuous paths in a predetermined sequential relationship, comprising:

a pair of folding vacuum rollers, one in each of the paths and receptive of porous paper sheets with the film sheets over the latter half thereof, each of said folding rollers transporting the leading portion of said paper sheets to a predetermined location respectively and there releasing it;

a pair of substantially smaller diameter vacuum rollers, each located at one of said predetermined locations and each engaging the leading portions respectively to raise the leading portion from said folding rollers, but not to raise the film sheets; and

means for releasing the leading portions from the influence of said smaller diameter rollers, whereby said folding rollers pull the film sheets from one tortuous path and then the other through a creasing region to fold the wrapping paper thereover.

4. A rotary folding machine for folding porous paper over film sheets received from different tortuous paths in a predetermined sequential relationship, comprising:

a pair of folding vacuum rollers, one in each of the paths and receptive of paper sheets with the film sheets over the latter half thereof, each of said folding rollers transporting the leading portion of said paper sheets to a predetermined location respectively and there releasing it;

a pair of substantially smaller diameter vacuum rollers, each located at one of said predetermined locations and each engaging the leading portions respectively to raise the leading portion from said folding rollers, but not to raise the film sheets;

non-vacuum guide means receptive of the leading portions alternately;

separating means for preventing interference between the alternate leading portions; and

means for releasing the leading portions from the influence of said smaller diameter rollers, whereby said folding rollers pull the film sheets from one tortuous path and then the other and the leading portions from the guide means to convey the film through a creasing region and fold the wrapping paper thereover.

5. A rotary folding machine for folding porous paper over film sheets received from different tortuous paths in a predetermined sequential relationship, comprising:

a pair of folding vacuum rollers, one in each of the paths and receptive of paper sheets with the film sheets over the latter half thereof, each of said folding rollers transporting the leading portion of said paper sheets to a predetermined location respectively and there releasing it;

a pair of substantially smaller diameter vacuum rollers, each located at one of said predetermined locations and each engaging the leading portions respectively to raise the leading portion from said folding rollers, but not to raise the film sheets;

non-vacuum guide means receptive of the leading portions alternately;

separating means for preventing interference between the alternate leading portions; and

detector means arranged to detect the leading portions in said guide means with the position thereof being arranged in accordance with the predetermined sequential relationship so that absence of any porous paper indicates malfunction.

6. A folding method for wrapping a film sheet in a porous paper, comprising the steps of:

developing a flow of consecutively nonoverlapping film sheets;

conveying alternate film sheets in separate but symmetrical paths;

laying a wrapping paper over each of the film sheets during traversal of the paths with the leading portion of the paper being of a length substantially equal to that of the film sheets;

conveying the composite film sheet and paper toward a folding region; and

diverting by means of a substantially reduced force the leading portion of each respective paper to the middle thereof in a direction so that it partially overlaps the film sheets whereby creasing thereof results in enveloping the film sheet within the paper.

7. A folding method for wrapping a film sheet in a porous paper comprising the steps of:

developing a flow of separate and consecutively nonoverlapping film sheets;

conveying alternate film sheets in separate but symmetrical paths;

laying a trailing portion of a wrapping paper over each of the film sheets during traversal of the paths with the leading portion of the paper being of a length substantially equal to that of the film sheets;

transferring the composite sheet and paper to a next conveyor means so that the film sheet overlays the paper;

conveying the composite film sheet and paper toward a folding region;

diverting by means of a substantially reduced force the leading portion of each respective paper to the middle thereof in a direction so that it partially overlaps the film sheets; and

creasing the paper over the film sheet.

8. A folding method for wrapping a film sheet in a porous paper comprising the steps of:

developing a flow of separate and consecutively nonoverlapping film sheets;

conveying alternate film sheets in separate but symmetrical paths;

laying a trailing portion of a wrapping paper over each of the film sheets during traversal of the paths with the leading portion of the paper being of a length substantially equal to that of the film sheets;

transferring the composite sheet and paper to a next conveyor means so that the film sheet overlays the paper;

conveying the composite film sheet and paper toward a folding region;

diverting by means of a substantially reduced force the leading portion of each respective paper to the middle thereof in a direction so that it partially overlaps the film sheets; and

detecting the diverted alternate leading portions at a location normally having at least one leading portion present.

9. A rotary folding machine comprising:

first roller means arranged to receive and transport a substantially continuous flow of similar adjacent nonoverlapping film sheets;

a first pair of transport means cooperating with said first roller means to direct alternate film sheets into two separate flow paths;

a second pair of transport means, one on each of said flow paths and each receptive of a wrapper paper sheet substantially twice as long as each of said film sheets and responsive of said film sheets in a timed relationship such that said film sheets and the latter half of said paper sheets are superposed;

folding roller means receptive of said paper sheets and said film sheets from each of said paths in a synchronized spacing; and

a pair of substantially smaller diameter rollers each located to receive the leading end of each of said paper sheets and divert it from the circumference of said folding roller means and to release said leading end so that said paper sheets will be creased at the center to cover both sides of each of said film sheets.

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