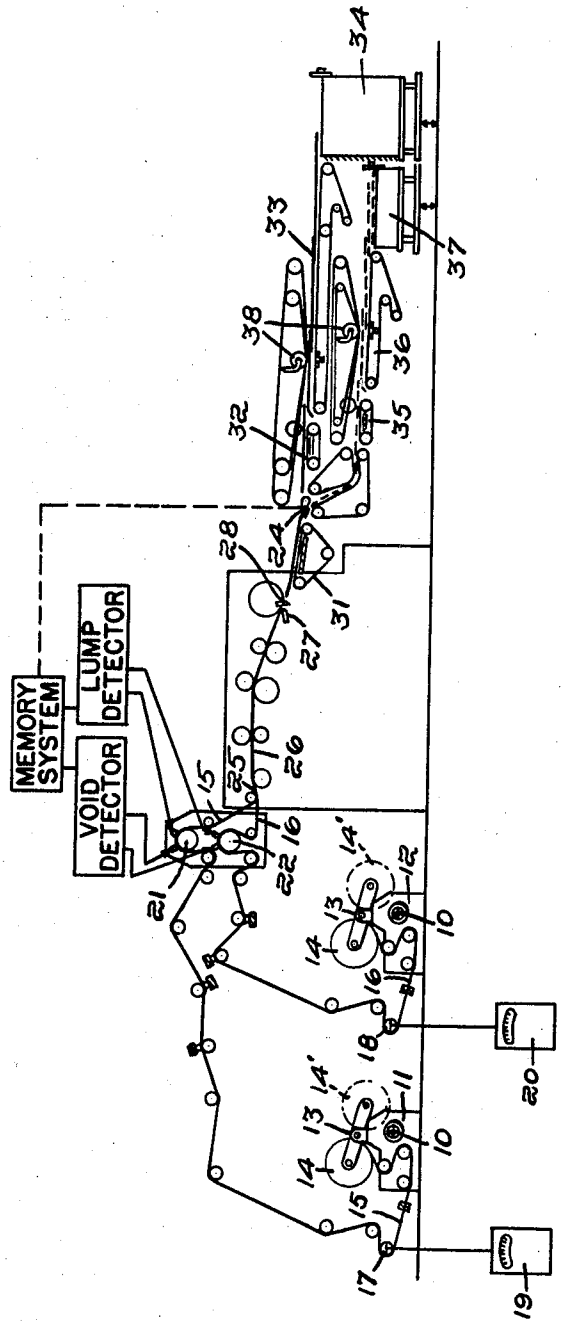
March 3, 1970 S. F. AUSTIN 3,498,165

PROCESS FOR CUTTING UNIFORM SIZE SHEETS FROM A CONTINUOUS MULTILAYER WEB

Filed Jan. 16, 1967 2 Sheets-Sheet 1

Fig. 1.



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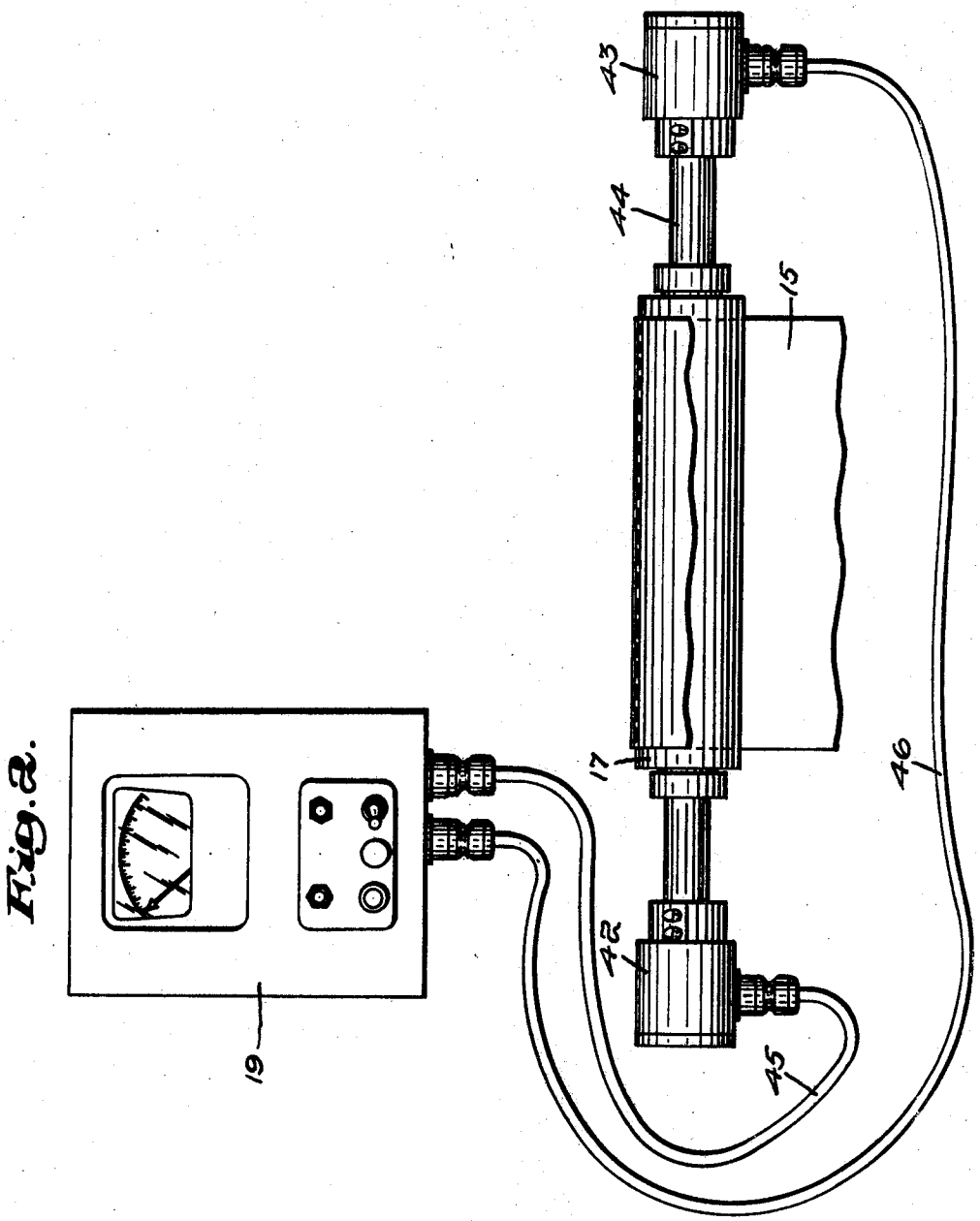

Fig. 2.

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PROCESS FOR CUTTING UNIFORM SIZE SHEETS FROM A CONTINUOUS MULTILAYER WEB

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U.S. Cl. 83—18 2 Claims

ABSTRACT OF THE DISCLOSURE

A plurality of rolls of paper or other material are unwound and merged into a multilayer running web which is cut periodically to form multilayer cut sheets. In order to assure that the final size of the individual cut sheets is uniform, the tension in the individual strands is monitored and adjusted prior to merging into the multilayer web.

This invention relates generally to web cutting processes in which a continuous web of sheet material is unwound and periodically severed to form uniform size cut sheets which are subsequently piled into a smooth edge stack of sheets suitable for subsequent processing. In particular, the invention relates to processes in which extremely thin and flexible webs such as paper are cut into sheets and the ultimate product is a stack of cut sheets with a uniformly smooth edge to the stack so that the stack can be used for printing without re-piling or edge-trimming. The method and apparatus for this general use is shown in U.S. Patent No. 3,216,296 and U.S. Ser. No. 427,663, now U.S. Patent No. 3,322,424 owned by the assignee of the present application

In the process of unwinding, inspecting and cutting thin web material to form a continuous stream of uniform size cut sheets, the objective is to achieve maximum operating speeds consistent with an acceptable final product in order that the unit cost of producing inspected and acceptably piled sheets is minimized. With apparatus of the type disclosed in the aforementioned patent, operating speeds up to 1000 feet per minute are contemplated for certain paper grades and for all paper grades the linear speed of the web through the machine is maintained as high as possible. Because of the fragile nature of the paper sheets and the web from which they are cut significant increases in linear speed for the web cannot be achieved without encountering operating difficulties that make the control of the fragile sheets difficult and thus result in no net gain in the amount of acceptable piled sheets that are produced.

One expedient which can be used to produce a significant increase in the number of sheets cut for a given linear speed is to run two or more webs unwound from two or more separate rolls through the machine at the same time. With this arrangement if the web material is separately inspected prior to being brought to a common location where a multiple layer web is formed for subsequent travel through the machine, it is possible to cut such a multiple layer web and thereby produce two, three or four times as many sheets for a given linear speed as when a single web is run through the machine. In apparatus of the type shown in the referenced patent no provision is made for separating the rejected sheets where only a single defect is found in such a multiple layer cut sheet and accordingly such processes become uneconomic if rejects occur at a high enough rate to result in the loss of a significant amount of good paper sheets. Where a quality product is being processed, however, the loss of a few good sheets with each rejected sheet depending upon the number of layers in the multiple layer strand being

cut it is not objectionable since the quantum increase in the number of finished sheets delivered to the layboy results in far higher production rates than can be achieved in any other way.

This high production rate is not obtained without attendant disadvantages, however, since it has been found that the multiple cut sheets when delivered to the layboy do not under all conditions stack uniformly with the result that an edge trimming operation or re-piling is required in order to obtain stacks that are saleable. Accordingly, in order that full advantage may be taken of the rapid production rate offered by multiple sheet cutting, it has been found that control of the transport of each continuous web as it is unwound from the rolls and the subsequent transport of the multiple layer web to the cutting knife is required in order that the sheets which are of uniform size when severed remain of uniform size as they subsequently travel and are piled in the layboy. Various factors influence the characteristics of the process and the nature of the product being cut is, of course, significant. Thus the maintenance of relative humidity which controls the moisture content of the unrolled stock is important as well as the necessity for having a highly uniform product from roll to roll in order successfully to cut from a plurality of rolls sheets which can be stacked uniformly. When these variables have been controlled within acceptable limits as far as factory operating conditions are concerned it is still found that further control of the running web is necessary if the desired results are to be obtained. In particular it has been found that the tension of the individual webs must be monitored continuously and in a highly accurate manner and provision must be made for adjustment of the individual web tensions in order that they may be set to be approximately equal as they run as individual webs to the point where they merge to form a common multilayer web.

When operating at uniform tension the individual layers in the multi-layer web which is to be cut approach the cutting knife with substantially equal characteristics irrespective of their position in the multilayer assembly. After the multiple layer web is severed into sheets the individual sheets in the multilayer sheet perform uniformly during subsequent handling, particularly with reference to contraction since the severed sheets which are no longer in tension as part of the continuous running web contract uniformly. Accordingly, when the multiple layer sheets are delivered to the layboy, they are still of uniform size and tend to remain aligned as a single sheet as they are delivered to the layboy. Thus the multiple sheet is readily piled and jogged into a uniform edge configuration and the finished stack can be sold for printing without further processing.

Accordingly, it is the principal object of the present invention to provide a process for increasing the operating speed of paper cutting and sorting machines in which multiple sheets are passed through the process and controls are maintained which make the finished sheets cut in multiple units from a multi-layer web maintain their size and dimensional stability when freed from the tension of the web in order that a finished pile of such sheets can be stacked.

In conjunction with the foregoing object it is a further object to provide individual strand tension control in a multi-strand web with provision for adjustment to obtain the desired relation between the tensions in the individual strands for control of the dimensional stability of the cut sheets produced from the multiple layer web.

These and other objects of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a diagrammatic side elevation view showing

the roll positions and transport path for a multiple web paper inspecting, cutting and sorting machine; and

FIG. 2 is a view showing a tension measuring roll of the type useful in the practice of the invention.

Referring now to FIG. 1 a multiple strand unwinding machine is seen to comprise a first roll unwinding stand **11** and a second roll unwinding stand **12**, each fitted with a rotatable bar support **13** capable of supporting and unwinding against adjustable tension roll of paper **14**. The other extremity of the rotatable bar **13** can support a standby roll of paper **14'** with the rotation of the bars **13** in the stands **11** and **12** permitting what is termed "a flying splice" to be made to the unwound strand that is running through the machine thereby providing continuous operation as the positions **14** and **14'** are utilized to support the unwinding roll and the standby roll in alternation. The roll **14** and stand **11** supply the web **15** and the roll **14** and stand **12** supply the web **16**. Each of the webs **15** and **16** is led through a constant angle feed and take away roll arrangement relative to a tension measuring roll **17** and **18**. The tension sensing rolls **17** and **18** are described more completely hereinafter and preferably are of the type sold by the Kidder Press Company, Inc., of Dover, N.H. Each of the tension measuring rolls **17** and **18** has transducers coupled to indicating instruments **19** and **20** on which the tension in the strands **15** and **16** respectively is indicated. As described in the technical literature of the Kidder Press Company the tension measuring rolls **17** and **18** are preferably non-driven rolls with a wrap in excess of 45° and constant approach and take away angles for the webs **15** and **16** in order that actual web tension can be measured and indicated.

After leaving the tension measuring rolls the webs **15** and **16** pass through separate defect detection stations **21** and **22** where defects are detected and recorded in a memory system **23** to operate a reject gate **24**. The arrangement of memory system control for a reject gate **24** is disclosed in the referenced patent and is arranged so that the reject gate **24** lifts to reject position prior to the arrival of the head end of the defect containing sheet which is ultimately cut from the continuous web.

Upon leaving the inspection stations **21** and **22** the webs **15** and **16** are guided to a common roll location **25** where the webs **16** and **15** merge into a multi-layer web **26**. The multi-layer web **26** is made up of the strands **15** and **16** each tensioned by independent brake tension controls **10** on the respective stands **11** and **12**. The multi-layer web **26** proceeds with this adjusted tension through suitable positions for slitting and trimming and further guiding until the composite web **26** passes over a bed knife **27** and through the action of a rotary knife **28** is severed into uniform length sheets. The size of the sheet is controlled by the linear approach speed of the composite web **26** and the rotary speed of the knife **28**.

Subsequent to being severed the composite sheets are taken away by a take away conveyor **31** which operates at a speed slightly faster than the linear approach speed of the composite web **26** in order to develop spacing between the cut sheets. Composite sheets which have no defects pass over the lowered reject gate **24** onto a high speed conveyor **32** to an overlap conveyor **33** and are ejected into good paper layboy **34**, all of which is disclosed in detail in the aforementioned patent. In particular, the layboy **34** has an elevator control and side paddling and other arrangements in order that the stack of paper piled in the laybody **34** has uniform smooth edge alignment to produce a saleable stack of paper without further edge trimming or repiling.

Composite sheets cut from the web **26** which contain a defect in one or more of the layers are deflected by the raised reject gate **24** into an alternate path including a high speed conveyor **35** and an overlap conveyor **36** which ejects the rejected sheets into a reject layboy **37**. Details of both overlap conveyors **33** and **36** including head catching rolls **38** are shown in the referenced patents owned by the assignee of the present application.

Referring now to FIG. 2, a typical roll and transducer assembly such as that associated with web **15** is shown. The assembly comprises a smooth, roll **17** rotatably supported in bearings which are mounted in transducer assemblies **42** and **43** at either end of a shaft **44** supporting the roll **17**. The two transducers are connected by leads **45, 46** to a meter unit **47** which averages the tension sensed by the transducers **42** and **43** and indicates tension, either directly or in relative magnitudes, resulting from the tension force applied to the roll **41** by the paper web **15** passing thereover. Other forms of tension measurement could be employed but the invention has been found to operate satisfactorily with the Kidder Press Company tension indicators and this form of tension measurement is preferred for indicating the individual tension in the webs **15** and **16**. Tension in strand **16** is indicated by a duplicate set of apparatus identical to that shown in FIG. 2.

In the operation of the present invention rolls **14** are threaded through the machine as indicated. first as the single strands **15** and **16** and then as composite strands **26** subsequent to the common merging point **25**. The individual layer in the multiple strand **26** maintain their tension until cut by the rotary knife **28** and thereafter the cut multiple layer sheets freely travel through the transport system in a manner similar to single cut sheets of the prior art. In order that these sheets may be dimensionally stable, the tension in the webs **15** and **16** is adjusted to produce equal single sheets by adjusting the braking force on the rotatable axle supporting the paper rolls **14** in each of the stands **11** and **12**. This braking force can be applied, for example, by any suitable brake shoe mechanism coupled to the adjustable control **10** for adjusting the braking force supplied to control the tension in the webs **15** and **16** individually. By adjusting the braking force, the indications on the meters **19** and **20** can be brought to the desired values which may or may not correspond to equal tensions depending on the characteristics of the individual strands **15** and **16** thereby assuring dimensional stability when the multiple strand **26** is severed into cut sheets. The absolute value of the tension in the strand will vary with operating conditions and the type of material that is being processed in accordance with established standards and practice. Whatever the absolute value of tension, the ability to adjust the tension of the individual strands to the desired relation to achieve dimensional stability is provided by the separate control and measurement features of this invention.

Obviously more than two strands could be run through the machine by duplicating the parts shown.

I claim:

1. The method of cutting a continuous multiple layer web into sheets and piling the cut sheets in a uniform pile comprising the steps of

(a) unwinding separate rolls of web material to obtain the separate webs for said multiple layer web;

(b) transporting and guiding said separate webs to a common position to form said multiple layer web;

(c) sensing the tension in each of said separate webs before they reach said common position;

(d) transporting said multiple layer web from said common position to a cutting station where it is periodically severed to obtain uniform size multiple layer sheets;

(e) transporting said multiple layer sheets from said cutting station for piling in a layboy; and

(f) adjusting the tension of said separate webs to maintain selected relative tension for all of said webs as they merge at said common position and pass to said cutting station thereby assuring contraction to a uniform final sheet size for the multiple sheets cut by each operation of said cutting station.

2. The method according to claim **1** including the steps of

(a) inspecting said separate webs for defects prior to reaching said common position; and

(b) rejecting said multiple layer sheets from the path to said layboy whenever one of said layers contains a defect in order that the pile in said layboy contain only inspected non-defective sheets.

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U.S. Cl. X.R.

83—80, 106, 175, 650; 226—4, 195; 242—75.43