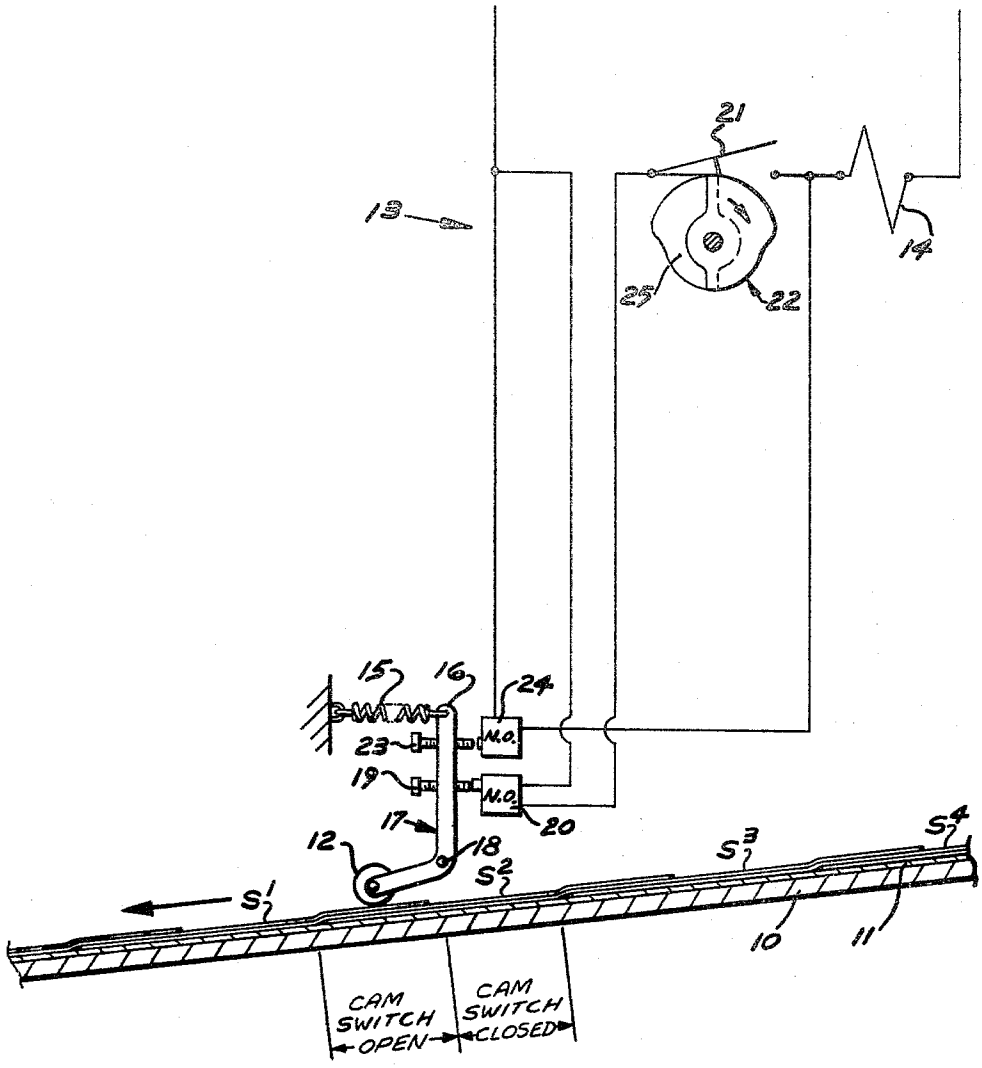
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SHEET DETECTOR

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INVENTOR

JACK E. VANDEMAN

BY William Weigl

ATTORNEY

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SHEET DETECTOR

Jack E. Vandeman, Berea, Ohio, assignor to Harris-Intertype Corporation, Cleveland, Ohio, a corporation of Delaware

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This invention relates to mechanism for detecting inaccuracies in the positions of sheets in a travelling lapped stream and in the thickness of various sections of the stream of sheets.

In the type of sheet feeder in which sheets are fed in underlapped stream fashion to a printing press or the like, the top surface of the stream has alternate thick and thin sections moving past a given point or points. The thick and thin sections are formed by the way the sheets are lapped. For purposes of this application, I prefer to designate those sections where an edge of a sheet overlaps one or more other sheets as "lap" sections, and those portions of the stream of sheets between the "lap" sections as "stream" sections.

Sheet feeders which form the stream and move it along a feed table must present the lead edge of each sheet to registering mechanism with very accurate timing in relation to the printing press. If, for any reason, a sheet is advanced or retarded beyond certain limits from its proper position prior to reaching the sheet registering mechanism, serious consequences to the machinery may result, such as is well understood by persons acquainted with the art. In addition, if a double layer of sheets (e.g., two sheets stuck together and feeding as one) is fed into the machine, and if such double sheet is "on time" at the sheet registering mechanism, serious damage can also result to the machine. For example, in the case of a lithographic printing press having a rubber blanket printing against imprint receiving stock, double sheets fed at the same time through a printing nip may "smash" the rubber blanket and prevent its further usefulness.

Still another cause of occasional trouble, particularly when feeding relatively thick board material, is that mill scraps or small chunks of sheet material are sometimes left in the pile accidentally and are fed with the stream of sheets into the machine. This can also cause blanket "smash" or other damage, depending on the type of machine with which the feeder is employed.

The principal object of this invention is to provide a sheet detection mechanism capable of detecting improper or undesirable conditions in a travelling stream of lapped sheets in all sections of the stream.

Another object of this invention is to enable detection of inaccuracies in a stream of sheets in the thinner or "stream" sections between spaced "lap" sections.

Other objects and advantages will be apparent from the following description in which reference is made to the accompanying drawing.

In the drawing, I present a schematic illustration of my sheet detecting mechanism and preferred form of control circuit operating upon a stream of underlapped sheets.

According to the preferred embodiment of my invention, a member is adapted to ride on the top of a stream of underlapped sheets having alternate thick "lap" and thin "stream" sections formed in the direction of sheet travel by the manner in which the sheets are lapped. This member is arranged to continuously detect any stream thickness greater than the thickness of the "lap" section. In addition, the same or some other member will be arranged to detect any thickness of sheets greater than the "stream" or thinnest portion of the stream of sheets, but is adapted to provide such latter detection only during the time the member is riding upon what is normally supposed to be the thin "stream" section.

Referring now to the drawing, a stream of sheets may be fed from right to left along a feed table 10 by means of thin drive belts or tapes 11, a plurality of which are spaced laterally with respect to the direction of travel of the stream of sheets. The belts are conventionally continuous and uni-directional, and are trained over rollers having their upper peripheries approximately flush with the top surface of the table 10 and located at each end of the table. The stream is formed by a sheet feeder (not shown) which presents sheets to take-out rollers (not shown) just prior to their being placed onto the belts 11. At the left end of the table 10, there is conventionally found a sheet registering mechanism (not shown) which temporarily arrests each sheet in turn to register it along its front edge and one side edge. After registration, each sheet is fed into a sheet handling machine (not shown) such as a printing press. Since the mechanisms for forming the stream, registering the sheets, and handling the sheets through the machine are not a part of the present invention, they will not be further described except to have it understood that these various mechanisms are adapted to have their operation stopped when the sheet detection mechanism of the present invention detects an improper condition of a certain type in the stream of sheets. The physical detection of such condition is preferably provided by a roller 12, which through circuitry 13 to be described actuates a solenoid 14 to perform a control function which results in the tripping or stopping of the aforementioned mechanisms.

It will be noted in the drawing that the sheets in the stream have sections of double thickness followed by sections of triple thickness. The roller 12 is shown riding on a latter such section. As previously mentioned, I will herein refer to the thick sections as "lap" sections and the thin sections as "stream" sections. While my invention is demonstrated in connection with a stream varying in thickness from between two and three sheets, it is applicable also to other differences in number between the lap and stream sections.

As shown, roller 12 is riding on a lap section on the top of a sheet S^1 and has between it and the tapes 11 the thickness of two additional sheets, S^2 and S^3. This roller 12 is urged toward the table 10 by gravity and a spring 15 acting upon an arm 16 of a lever 17 rotatably supporting the roller 12. The lever 17 is pivoted at 18. It will be noticed that the roller 12 will ride up and down on the alternate lap and stream sections. It has been customary in the past to provide such means for detection only of multiple sheets, i.e., an extra sheet thickness, and this extra sheet could be detected only in a lap section. If a sheet was out-of-time in one direction, e.g., sheet S^1 being advanced an inch to the left of its proper position, the roller 12 as previously utilized had no way of determining this fact. This problem had to be corrected by another detector or sensor, ordinarily located directly adjacent the sheet registering mechanism. This other detector would sense only "early" sheets, i.e., those which were advanced in their position of the stream of sheets. It will be seen that the present invention, in addition to sensing multiple sheets or scraps located in the lapped sheets, also enables accomplishment of "early" sheet direction. It also provides detection of "late" sheets by virtue of the fact that a sheet which is retarted at its lead edge will also have a tail edge which is likewise positioned rearwardly of its normal position and thus presented from the lap section into the stream section immediately to the rear thereof. The manner of accomplishing this detection will be discussed presently. "Absent" sheets are not detected by the shown apparatus, but such can be easily provided by actuating a switch closed by arm 16 when only a single sheet thickness is found in the stream section of the example in the drawing.

OPERATION

Sheets in correct time

The operation of the sheet detecting mechanism when the stream of sheets is of the correct thickness and properly formed and all sheets are in proper position as shown in the drawing is as follows: At the time that the roller **12** is riding on a lap section, an adjustable screw **19** threaded in the arm **16** is adapted to engage the button of a normally open limit switch **20** to close the switch. This switch is in series circuit with a limit switch **21** operated by an adjustable cam **22** driven in timed relation with the stream. It will be seen that the limit switch **21** is open when roller **12** is riding on a lap section, and consequently closing of the switch **20** has no immediate effect upon the solenoid **14** in series with the switches **20** and **21**. As the stream of sheets moves to the left in the drawing and the roller **12** drops off the tail edge of sheet S^1, the roller will engage the stream section immediately behind the sheet S^1. This stream section is shown as having but two sheet thicknesses, namely sheets S^2 and S^3. The adjustable screw **19** which closed the switch **20** while the roller **12** was riding on a proper thickness lap section is arranged to disengage the button of the limit switch **20** when but two sheets, i.e., a stream section, are presented to the roller **12**. Cam **22** will then enable limit switch **21** to be closed during the entire time a stream section is presented to the roller **12**, but the fact that switch **20** is no longer closed during this time prevents operation of the solenoid **14**. It will be seen therefore, that screw **19** operates switch **20** once for each cycle, the switch **20** being closed during the "lap" portion of a cycle and being open during the "stream" portion of the cycle. So long as the sheets remain properly positioned and so long as double sheets or scraps are not fed into the stream of sheets, the mechanism will continue to operate as just mentioned and the stream of sheets will continue to be fed unless stopped by the operator or certain other mechanisms in conventional fashion.

Double or multiple sheets

Let us assume that a sheet adhered to sheet S^3 when it was placed in the stream of sheets. The signal provided by this double thickness sheet causes roller **12** to detect not three sheet thicknesses in the lap section, but four. When the lead edge of sheet S^3 with its sheet thickness increased by the extra sheet arrives at the roller **12**, this will cause the lever **17** to pivot clockwise about pivot **18** through a greater angle than normal. This causes an adjustable screw **23** carried by arm **16** to engage the button of a normally open limit switch **24** to close the switch. The adjustable screw **23** is set to detect any thickness greater than the proper thickness of a lap section by the additional angular movement of arm **16**. When switch **24** is closed, it will immediately actuate solenoid **14**, by-passing the opened limit switch **21** to perform its customary control function, e.g., tripping of the press. The operator will thereafter correct the stream on the table or will remove the double sheet and all sheets to the left of it so that operation may be resumed.

Fast sheet

Let us assume now that a sheet has its lead edge presented a few inches in advance of its proper position in a stream of sheets. (This example applies also to double sheets in which the leading edges of the sheets are staggered.) For instance, sheet S^4 may have its lead edge somewhat to the left of its position shown in the drawing, and within the range of time during which switch **21** is permitted to be closed by the cam **22**, as designated by the space entitled "Cam Switch Closed" in the drawing. As the roller drops from the lap section as shown onto the following stream section, switch **20** will open, since screw **19** is adjusted to close switch **20** only when more than the thickness of a stream section is engaged by the roller **12**. When the lead edge of the out-of-time "fast" sheet S^4 now comes opposite the roller **12**, the roller will immediately reclose switch **20**. The timing of this reclosing occurs while the cam switch **21** is permitted to be closed by cam **22**, thus causing a circuit through both switches **20** and **21**, and an actuation of solenoid **14**. The solenoid performs its ordinary control function of tripping the machinery. The stream of sheets may again be fed only after the incorrectly timed sheets are corrected or removed.

Late sheet

If sheet S^1 is "late," i.e., retarded from its proper position in the stream of sheets, the trailing edge of that sheet will extend rearwardly of its normal position. Switch **20** is set to close as soon as a lap section comes under the roller **12**. Since the trailing edge of sheet S^1 extends rearwardly of its proper position, however, switch **20** will remain closed until roller **12** drops off the trailing edge of sheet S^1. When the cam **22** then permits the limit switch **21** to be closed while roller **12** is still riding on the lap section, a circuit will be established through switches **20** and **21**, thus energizing solenoid **14** as in the previous example. The "late" sheet will therefore appear as an added sheet thickness in the early portion of a "stream" section, during the period designated "Cam Switch Closed."

Scrap detection

If a scrap of paper or board comes beneath the roller **12**, either while the scrap is riding atop the stream of sheets or hidden between sheets, the roller **12** will operate switch **24** if such scrap is located in a lap section or will operate switch **20** while switch **21** is also closed if the scrap is located in a stream section. The control mechanism will therefore detect the difference between three and more sheets in a lap section, and between two and more sheets in a stream section.

When a stream of underlapped sheets is properly formed, the leading edges of sheets will be equidistantly spaced. This spacing is maintained in conventional sheet feeding mechanism even though the mechanism is later arranged to feed sheets of a different length. Assume that sheets 25" in length have been fed and the printing or other job has been completed. If sheets 23" in length are now to be fed to the press, the lead edges of each sheet will be spaced the same as they were for 25" sheets, but the trailing edge of each sheet will be 2" to the left of their positions shown in the drawing. This means that the lap section will be shortened and the stream section lengthened. To compensate for this, the cam **22** may be adjustable by providing a portion **25** which must be moved angularly to cause earlier closing of the limit switch **21** so that proper detection may be accomplished during the full length of time corresponding to the now-lengthened stream section. Obviously, the cam can be likewise adjusted in the opposite direction when longer sheets are fed.

Although I have shown the switch **21** as being operated by an adjustable cam, it is obvious that other mechanical or electrical means can be utilized to provide this adjustable feature. The type of mechanism to be used will depend somewhat upon the range of sheet lengths for which the mechanism is adapted. It is theoretically possible that the lap section of a stream may occupy anywhere from 5° to 355° of a cycle of the mechanism for operating the switch **21**.

While I have simply illustrated my invention as embodying a single roller **12**, I wish it to be understood that this roller may be of narrow width or of the full width of the stream of sheets. Full width is in fact preferable when scrap detection is a problem. When roller **12** is the full width, I may wish to supply levers **17** and the various parts operated thereby at each end of the roller so that if either lever **17** is operated, the solenoid **14** will be energized.

While I prefer that a single roller 12 be used to operate both switches 20 and 24, it should be understood that a separate roller may be used to operate each switch. One roller may perform only to close switch 24 when the thickness of the stream of sheets is greater than the proper thickness of a lap section, and the other to actuate switch 20 to close whenever the thickness of a stream section is greater than its proper thickness.

Although I have demonstrated the switches 20 and 24 as being normally open, I may also use normally closed switches which are positioned on the opposite side of arm 16 and held open during proper feeding conditions. Then, when a scrap, double, early or late sheet is detected, a clockwise movement of lever 17 will cause the normally closed switches to close, this being permitted by movement of the arm 16 away from its position of holding these switches in their open conditions.

Various other changes may be made in the details of the invention without departing from the spirit and scope of the claims.

Having thus described my invention, I claim:

1. In a sheet detecting mechanism,
a feed table,
means for transporting sheets in lapped stream fashion along said feed table to provide said stream with alternate thick lap and thinner stream sections in the direction of travel of said sheets,
a member riding in contact with the top of said stream of sheets and adapted to alternately move up and down on the lap sections and stream sections respectively,
means performing a control function upon detection of an excess thickness of sheets being presented to said member when riding on either of said sections of said stream of sheets,
a first switch in circuit with said control means and adapted to be closed in response to movement of said member upon detection of an excess sheet thickness in a lap section of said stream,
a second switch adapted to be closed in response to movement of said member upon detection of an excess sheet thickness in a stream section,
means cyclically timed with the travel of sheets along said table,
and a third switch adapted to be opened by said timed means during a period of time in which the member is normally riding upon a lap section of the stream of sheets and adapted to be closed by said timed means during a period of time in which the member is normally riding upon a stream section of said stream of sheets,
said second and said third switches being in series circuit with said control means, whereby said second switch can function to operate said control means only during that portion of a cycle when the member is riding upon a section which is normally a stream section.

2. The invention set forth in claim 1 wherein said timed means is adjustable to enable varying of the periods of time of each cycle during which said third switch is closed and opened.

3. In a sheet detecting mechanism,
a sheet support,
means for transporting sheets in lapped stream fashion along said support to provide said stream with alternate thick lap and thinner stream sections in the direction of travel of said sheets,
means sensing the thickness of said stream of sheets in both said lap and said stream sections,
means performing a control function upon detection of an excess thickness of sheets presented to said sensing means in either of said sections,

a first switch in circuit with said control means and adapted to be closed by said sensing means upon detection of an excess sheet thickness in a lap section of said stream,
a second switch adapted to be closed by said sensing means upon detection of an excess sheet thickness in a stream section of said stream,
means cyclically timed with the travel of sheets along said support,
and a third switch adapted to be opened by said timed means during a period in which the sensing means is normally sensing a lap section and adapted to be closed by said timed means during a period of time in which the sensing means is normally sensing a stream section,
said second and third switches being in series circuit with said control means, whereby said second switch can function to operate said control means only during that portion of a cycle when the sensing means is sensing a section which is normally a stream section.

4. The invention set forth in claim 3 wherein said timed means is adjustable to enable varying of the periods of time of each cycle during which said third switch is closed and opened.

5. In a sheet detecting mechanism,
a sheet support,
means for transporting sheets in lapped stream fashion along said support to provide said stream with alternate thick lap and thinner stream sections in the direction of travel of said sheets,
means sensing the thickness of said stream in said thinner stream sections,
means for performing a control function upon detection of an excess thickness of sheets presented to said sensing means,
switch operating means timed with the travel of sheets along said support,
a first switch independent of said switch operating means, said first switch being adapted to be closed by said sensing means upon detection of an excess sheet thickness in a stream section of said stream,
and a second switch operated by said switch operating means to open each time said sensing means is normally sensing a lap section and to close each time said sensing means is normally sensing a stream section,
said switches being in series circuit with said control means, whereby said first switch can function to operate said control means only during that portion of a cycle when the sensing means is sensing a section which is normally a stream section.

6. The invention set forth in claim 5 wherein said timed switch operating means is adjustable to enable varying of the periods of time of each cycle during which said second switch is closed and opened.

7. The invention set forth in claim 5 wherein said sensing means comprises a member normally riding in contact with the top of said stream of sheets.

8. The invention set forth in claim 5 including a third switch in circuit with said control means and adapted to be closed by said sensing means upon detection of an excess thickness in a lap section of said stream.

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ROBERT B. REEVES, *Acting Primary Examiner.*

RAPHAEL M. LUPO, SAMUEL F. COLEMAN,
Examiners.