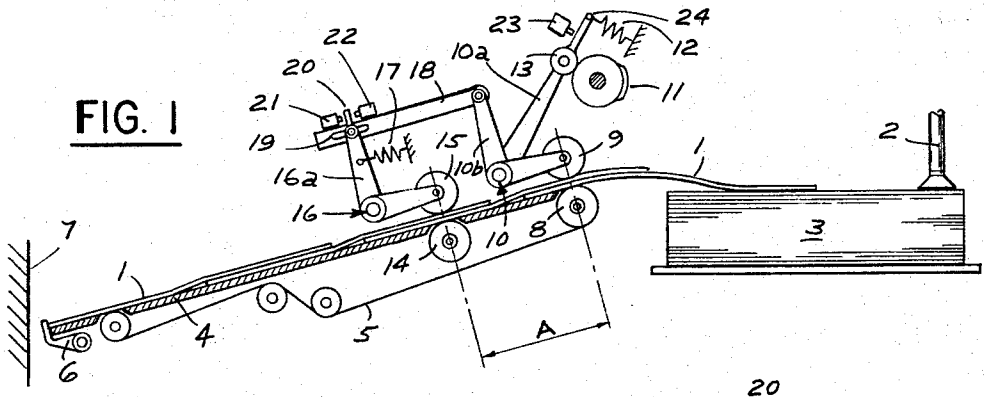
Nov. 22, 1966 F. PREUSS ET AL 3,287,015

DETECTING DEVICE FOR THE SHEET FEEDER OF A PRINTING PRESS

Filed Jan. 21, 1965 2 Sheets-Sheet 1

FIG. 1



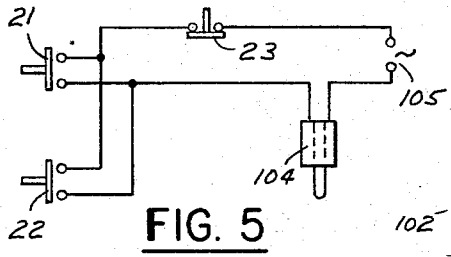


FIG. 5

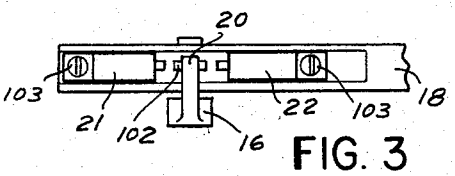


FIG. 3

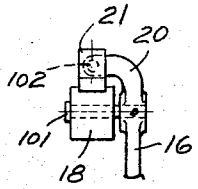


FIG. 4

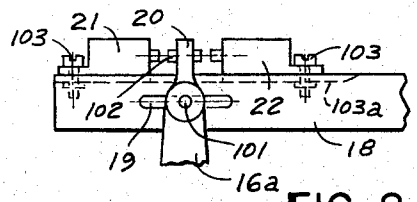


FIG. 2

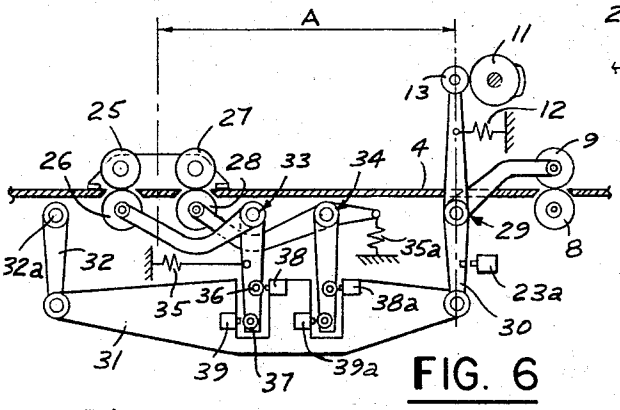


FIG. 6

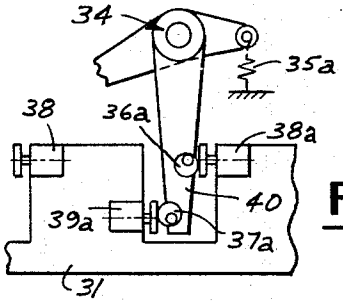


FIG. 7

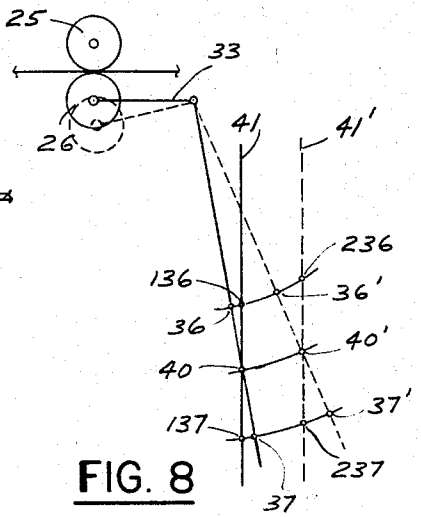


FIG. 8

INVENTORS
FRIEDRICH PREUSS
WALTER RÜCKERT

BY Hane and Nydick

ATTORNEYS

Nov. 22, 1966 F. PREUSS ET AL 3,287,015

DETECTING DEVICE FOR THE SHEET FEEDER OF A PRINTING PRESS

Filed Jan. 21. 1965 2 Sheets-Sheet 2

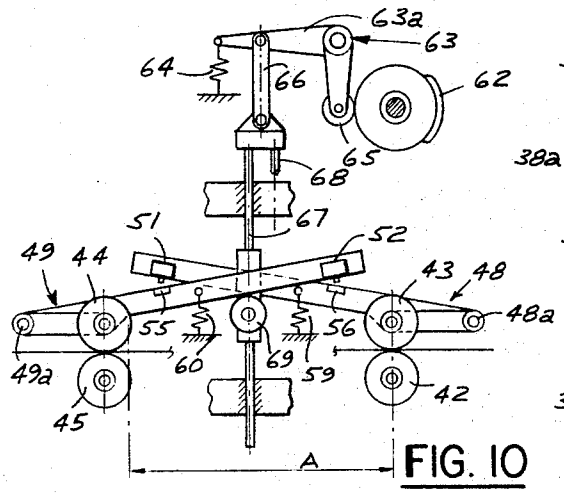


FIG. 10

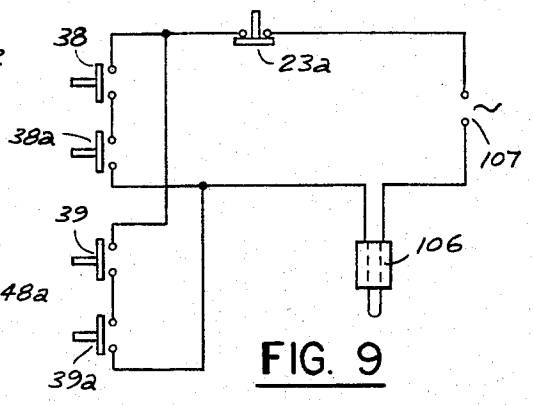


FIG. 9

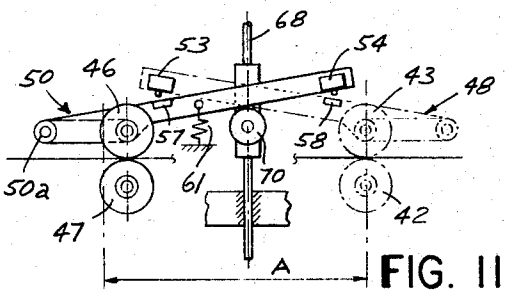


FIG. 11

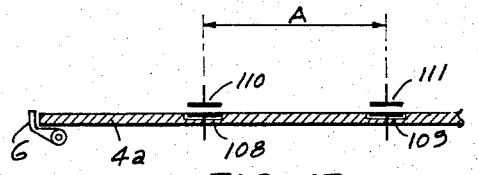


FIG. 13

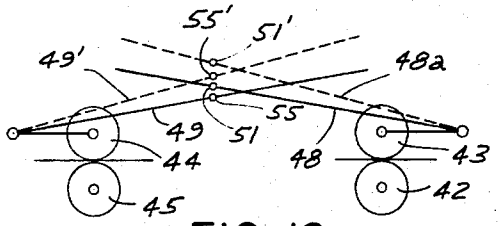


FIG. 12

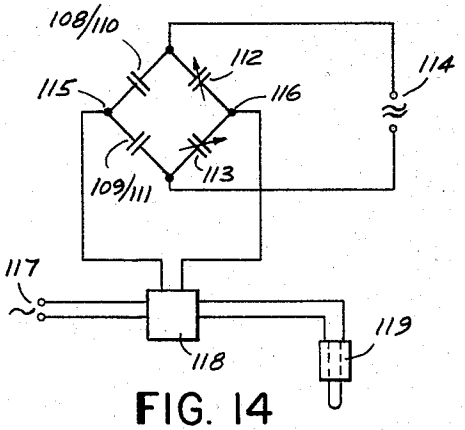


FIG. 14

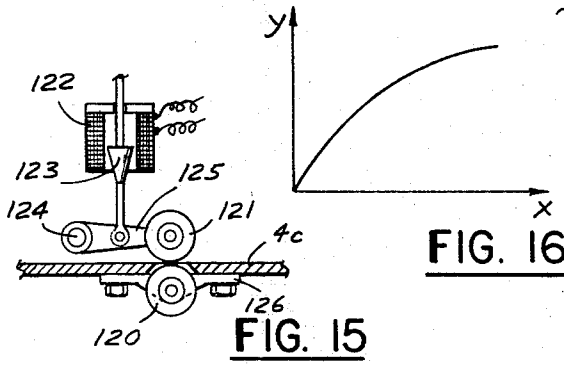


FIG. 15

FIG. 16

INVENTORS
FRIEDRICH PREUSS
WALTER RÜCKERT

BY Haven and Nydick

ATTORNEYS

United States Patent Office 3,287,015
Patented Nov. 22, 1966

3,287,015

DETECTING DEVICE FOR THE SHEET FEEDER OF A PRINTING PRESS

Friedrich Preuss, Neu-Isenburg, and Walter Rückert, Offenbach (Main), Germany, assignors to Roland Offsetmaschinenfabrik Faber & Schleicher AG, Offenbach (Main), Germany, a firm of Germany

Filed Jan. 21, 1965, Ser. No. 426,943
Claims priority, application Germany, Apr. 23, 1964, R 37,758
14 Claims. (Cl. 271—57)

The invention relates to a detecting device for use with a sheet printing press for detecting the absence of sheets consecutively fed by a sheet feeder from a stack of sheets to the forward stops of the press and also for detecting the occurrence of doubled-up sheets in the feed path. More particularly, the invention relates to a detecting device of the general kind above referred to which includes two detectors spaced apart from each other in the direction of the feed path. Each of the two detectors generates a signal which is indicative of the thickness of the sheet material detected by the respective detector and these signals are compared as to the differential between the two detected thickneses of the sheet material. In the event the differential between the two signals exceeds a predetermined value, a control signal is generated causing the press to be stopped or otherwise controlled in a conventional fashion. Sheet feeders for presses to be practical should be capable of handling all sheet sizes between a maximum and a minimum size and also sheets of widely different gauges.

The design of detecting devices using two detectors presents considerable difficulties wihch are particularly pronounced when the sheets are fed with overlap so that the sheets move along the feed path in the form of a continuous train of sheets. Depending upon the length of the individual sheets in the direction of the feed path, for one limit size of sheets only one sheet may be within the range of each detector during each cycle of the press and for the other limit size, up to three sheets. Consequently the signal produced by each detector changes each time the leading edge and the trailing edge passes a detector. The signals change additionally each time the size of the fed sheets is changed. As a result a very short detecting time may be available during each cycle of the press and such short detecting time may affect the reliability of the detecting device.

It is a broad object of the invention to provide, particularly for overlap feeding devices, a novel and improved detecting device including two detectors, which device at any moment during normal feed operation probes the same number of sheets within the range of each detector, independent of the dimensions of the sheets.

A more specific object of the invention is to provide a novel and improved detecting device including two detectors which does not need to be specifically adjusted for the gauge of the sheets to be supervised or the dimensions thereof, thereby greatly simplifying the operation of the detecting device.

Another more specific object of the invention is to provide a novel and improved detecting device which is operative during the full cycle of the printing press, thereby assuring that the feed of sheets is continuously supervised.

Still another more specific object of the invention is to provide a novel and improved detecting device which is capable of distinguishing between heavy gauges of sheet material and lighter gauges, in that the detecting

device generates a control signal at greater differentials between the signals produced by the detectors when heavy gauge sheets are fed than sheets of lighter gauge. This has the advantage that the detecting device always responds at approximately the same percentage of a departure from the correct thickness of the sheet material, for instance due to the presence of a doubled-up sheet, irrespective of the gauge of the sheet material to be supervised. If the detecting devices would be operated always with the same absolute sensitivity and such sensitivity would be adjusted according to the lightest gauge, the device, when used for carboard might produce a control signal in response to thickness variations that are within the tolerance range for such heavy material.

The aforementioned objects, features and advantages and other objects, features and advantages which will be pointed out more fully hereinafter are attained by arranging the two detectors of the device at a distance from each other which is equal to the spacing of the trailing edges of adjacent overlapping sheets forming the train of overlapping sheets moving along the feed path, or equal to an integral mulitple of said spacing.

The invention also contemplates providing in one of the detectors two probes, the distance of which in the direction of the sheet travel from the other detector is larger and smaller respectively by substantially the same amount as the aforesaid spacing of the sheets from each other in said train of sheets whereby the detector including the two probes transmits a signal for comparison with the signal of the other detector only when the signal produced by the two probes are approximately equal.

In the event the sheets to be supervised are not accurately cut or not cut at all, the detecting device tends to respond, since with such irregular sheets the same number of sheets is not necessarily present when the leading edge and the trailing edge respectively of the sheets passes the two detectors. Another result of inaccurately cut sheets or uncut sheets would be that the aforesaid overlap spacing between adjacent sheets would be changed. By providing the aforedescribed two probes in one of the detectors such fautly indications due to inaccurately or uncut sheets are avoided.

The invention further contemplates providing for each detector a stationarily mounted roller, which coacts with a yieldably supported roller whereby the axial distance between the two coacting rollers constitutes a measure of the thickness of the sheet material between the rollers. Such an arrangement is simple and rugged and hence reliable in operation.

The invention also provides coupling the yieldably supported rollers of the two detectors by a yieldable linkage which operates a switch in response to a displacement of either roller from a predetermined position. Such operation of the switch may be utilized to initiate suitable control operations. A switch control of this kind is reliable and can be conveniently serviced.

The invention further contemplates providing means for intermittently lifting the yieldable rollers of the two detectors to insure a free run-in of the leading edges of the sheets thereby assuring that the sheets reach the feed table of the press in a wrinkle-free condition.

To obtain the aforementioned automatic differentiation between different gauges of sheet material to be supervised, the invention provides that the yieldable roller of the detector including the two probes is supported on one arm of a bell crank lever, the other arm of which mounts two lugs which are disposed at different distances from the pivot axis of the lever. These lugs coact with switch

contacts which are displaced substantially parallel to each other by a displacement of the yieldably supported roller of the other detector. Such control assembly is simple and rugged and can be conveniently checked when in operation.

The invention also provides for the purpose of differentiating between different sheet gauges that each of the yieldably supported rollers of the two detectors is mounted on a pivotal lever. The two levers are oppositely directed and cross each other. Each lever carries at one end a switch which coacts with a preferably adjustable abutment part on the other lever to effect operation of switches initiating control functions in predetermined angular positions of the two levers in reference to each other.

The invention further contemplates utilizing the variable spacing between two coacting rollers, which as previously pointed out, is indicative of the thickness of the sheet material passing between the rollers, for operating a mechanical-electrical converter preferably with a non-linear characteristic. With such an arrangement a sensitivity of the detecting device variable as a function of the gauge of the sheet material to be supervised, is obtained by purely electrical means.

For detecting devices which detect the thickness of the sheet material capacitatively by comparing two obtained capacitance values in a suitable bridge, the invention contemplates providing across the bridge output terminals a circuit component which produces a control signal in response to a predetermined and preferably adjustable imbalance of the bridge. If the bridge is designed with a linear characteristic, the detecting device responds to the same differential between the signals of the detectors irrespective of the gauge of the sheet material to be supervised.

In the accompanying drawing several preferred embodiments of the invention are shown by way of illustration and not by way of limitation.

In the drawing:

FIG. 1 is a diagrammatic elevational side view of the detecting device according to the invention coacting with the feed table of a printing press,

FIG. 2 is a fragmentary detail view of FIG. 1 on an enlarged scale,

FIG. 3 is a plan view of FIG. 2,

FIG. 4 is a side view of FIG. 2,

FIG. 5 is a diagram of the control circuit controlled by the device of FIG. 1,

FIG. 6 is an elevational side view of a modified detecting device having two probes in one of the detectors of the device,

FIG. 7 is a fragmentary view of FIG. 6 on an enlarged scale,

FIG. 8 is a diagram of the operational movements of some of the components of the detecting device according to FIG. 6,

FIG. 9 is a diagram of the control circuit controlled by the device of FIG. 6,

FIG. 10 is a diagrammatic elevational view of another modification of the detecting device,

FIG. 11 is a detail view of part of FIG. 10 in a different operational position of the detecting device,

FIG. 12 is a diagram of the operational movements of some of the components of the device according to FIG. 10,

FIG. 13 is a fragmentary diagrammatic view of a detecting device using capacitative detectors,

FIG. 14 is a circuit diagram for a detecting device using capacitative detectors,

FIG. 15 is a fragmentary view showing a modification of the detectors for detecting devices as shown in FIGS. 1 to 12; and

FIG. 16 is a graph showing the characteristics of a detector according to FIG. 15.

Referring first to FIGS. 1 through 4 in detail, FIG. 1 shows a stack 3 of sheets from which sheets 1, such as paper sheets, are successively withdrawn by a suitable pick-up device shown as a suction cup 2. The individual sheets are placed with overlap upon a feed table 4 on which they are transported in the form of a continuous train of overlapping or shingled sheets to the front markers 6 of a diagrammatically indicated printing press 7. The lifting and the transport of the sheets are assumed to be conventional and do not constitute part of the invention. The conveyor 5 includes a roller 8 which coacts with a roller 9 mounted on an arm of a three-arm lever 10. Several rollers 9 may be provided, and roller 8 may extend across the width of table 4. A second arm 10*a* of the lever coacts by means of a cam follower 13 with a unidirectionally rotated cam disk 11 whereby the rollers 9 are intermittently lifted in reference to roller 8 to permit a free and smooth run-in the leading edge of successive sheets 1. A loaded spring 12 may be provided to urge follower 13 into engagement with cam disk 11. A further roller 14 which may extend across the width of table 4, coacts with one or several rollers 15. Each of the rollers 15 is mounted on one arm of a bell crank lever 16. A loaded spring 17 urges the roller or rollers 15 toward roller 14. The distance A between the rotational axes of rollers 14 and 8 is substantially equal to the spacing of the trailing edges of the individual sheets forming the aforementioned train of overlapping sheets, or equal to an integral multiple of the spacing, the so-called overlap spacing. A rod 18 links arm 10*b* of lever 10, which arm is substantially normal to the plane of table 4, to the arm 16*a* of lever 16, which arm is also substantially normal to the plane of table 4. As can best be seen in FIG. 2, an elongated slot 19 in rod 18 engaged by a bolt 101 permits a limited angular movement of lever arm 16*a* in reference to rod 18. An extension 20 of lever arm 16*a* mounts on each side a lug 102 coacting with switches 21 and 22 supported on rod 18. The positions of switches 21 and 22 in reference to rod 18 and thus in reference to extension 20 and the lugs thereon may be adjusted by set screws 103 engaging slots 102*a* in rod 18 or by other suitable means.

When the feed of sheets operates normally there are always two sheets between rollers 8, 9 and rollers 14, 15 as it is shown. Lever arm 16*a* is adjusted so that lugs 102 thereon will not operate either one of switches 21 and 22. However, if a doubled-up sheet should be present between rollers 8 and 9, rod 18 is moved somewhat toward the left in reference to lever arm 16*a* and accordingly switch 22 will be operated. Similarly, the absence of a sheet between rollers 8 and 9 will cause a movement of rod 18 towards the right and thus an actuation of switch 21. Referring now to the circuit diagram of FIG. 5, this circuit diagram shows that the closing of either switch will connect a solenoid 104 to a source of current 105. Solenoid 104 should be visualized as constituting part of a conventional control circuit system which may stop the press, or initiate another appropriate control action.

As it is evident, the sensitivity of the detector may be adjusted by varying the spacing of switches 21 and 22 in reference to lugs 102 on the extension 20 of lever arm 16*a*.

As has been previously described, roller 9 is intermittently lifted by the action of cam disk 11. Such lifting of the roller causes a movement of rod 18 towards the left and thus an operation of switch 22 and also a lifting of roller 15. To prevent an energization of solenoid 104 and the initiation of control functions due to such energization when the roller 9 is lifted by disk 11, as part of the normal function of the detecting device, a normally closed switch 23 is provided in the connection between solenoid 104 and source of current 105. Switch 23 is controlled by an extension 24 of lever arm 10*a* and opened whenever cam disk 11 acts upon follower 13, thereby rendering ineffective the closing of switch 22.

Referring now to the embodiment of FIGS. 6, 7, 8 and 9, the detecting device according to these figures comprises two probes in one of the two detectors of the device. The roller pairs **25, 26** and **27, 28** of FIG. 6 correspond functionally to rollers **14** and **15** of FIG. 1. The distance A is again equal to the overlap spacing of the train of sheets. The spacing between roller **25, 26** and roller **8, 9** is greater than the distance A by a distance which is equal to the distance by which the spacing between rollers **27, 28** and rollers **8, 9** is smaller than the distance A. Rollers **8, 9, 25, 26, 27** and **28** may extend across the entire width of table **4**.

Roller **9** is supported on one arm of a pivotal three-arm lever **29**, an arm **30** of which pivotally supports one end of a rod **31**. The other end of rod **31** is linked to a lever **32**, the other end of which is pivotally mounted about a stationary pivot point **32***a*. Roller **26** is supported by a bell crank lever **33** and roller **28** by a bell crank lever **34**. Loaded tension springs **35** and **35***a* urge rollers **26** and **28** respectively toward rollers **25** and **27** respectively. The arms **33***a* and **34***a* of levers **33** and **34** respectively are approximately normal to the plane of table **4** and mount lugs **36, 36***a* and **37, 37***a* respectively. The positions of these lugs are adjustable, for instance by eccentrically mounting the lugs on rotatable supports as is shown in FIG. 7. The lugs coact with electric switches **38, 38***a* and **39, 39***a* respectively.

The distance of lugs **36, 36***a* from the pivot axes of levers **33** and **34** respectively is smaller by a predetermined distance than the length of lever arms **30** and **32** and the distance between lugs **37** and **37***a* from the pivot axes of lever **33** and **34** respectively is larger by the same amount. The point **40** in FIG. 7 signifies the point at which rod **31** is linked to lever **30**.

The aforedescribed ratios of distances result in the paths of movements diagrammatically indicated in FIG. 8. The eccentric lugs **36, 36***a* and **37, 37***a* are adjusted in accordance with the desired detecting sensitivity to wit: so that the switches **38, 38***a* and **39 39***a* are closed only after a predetermined movement of lever arms **33***a* and **34***a* in reference to rod **31**. More specifically, the lugs may be so adjusted that for thin paper the lugs **36** and **37** must move into the positions indicated at **136** and **137** respectively to effect operation of switches **38** and **39** respectively. Line **41** indicates the positions in which the lugs will operate the switches. The dotted lines in FIG. 8 indicate the required movements for a heavy gauge of paper or cardboard. The line **41** has moved into the dotted line position **41'** and the point **40** into the position **40'**. Accordingly, the switches **38** and **39** are operated when point **36'** has moved into the position **236** and point **37'** into the position **237**. As it is evident, the distance between point **36'** and point **236** and between point **37'** and point **237** are greater than the distances from point **36** to point **136** and from point **37** to point **137**. Accordingly, the absolute detecting sensitivity is correspondingly reduced for heavier gauges of sheet material. The aforedescribed geometric proportions can be conveniently so adjusted that the relative detecting sensitivity remains approximately the same for each gauge of the sheet material. Accordingly, the detecting device will respond only when a sheet is missing or sheets are doubled up but not to tolerances in gauge which are acceptable for heavier types of cardboard and are in the order of magnitude of the gauge of very thin paper.

As it is shown in FIG. 9, switches **38** and **38***a* are connected in series so that the energizing circuit for solenoid **106** through source of current **107** is closed only when both switches are closed at the same time. Solenoid **106** should again be visualized as being connected to or constituting part of a suitable control circuit for the press. Similarily, switches **39** and **39***a* are connected in series so that both of these switches must also be simultaneously closed to establish the energizing circuit for solenoid **106**.

To neutralize the closing of switches **39** and **39***a* when rollers **9, 26** and **28** are intermittently lifted by the action of cam disk **11** to provide for a free run-in of the sheets, a normally closed switch **23***a* is opened by lever **30** whenever lever **29** is pivoted by the coaction between cam disk **11** and follower **13**.

Referring now to the detecting device according to FIGS. 10, 11 and 12, these figures shows a device in which rollers **42, 43** correspond to rollers **8, 9** of FIG. 2; rollers **44, 45** correspond to rollers **25, 26** and rollers **46, 47** correspond to rollers **27, 28**. Roller **43** is supported on a lever **48**; roller **44** on a lever **49** and roller **46** on a lever **50**. As it is shown in the figures, levers **48, 49** and **50** are two-arm levers pivotal about pivot axes **48***a*, **49***a* and **50***a*. The levers extend in opposite directions and cross each other. The free ends of the levers support switches **51, 52, 53** and **54** respectively. These switches are operable by engagement with preferably adjustable abutment members **55, 56, 57** and **58** on levers **49, 48, 50** and **48**. Rollers **44, 45** and **46, 47** are disposed side by side adjacent to each other. Tension springs **55, 60** and **61** urge rollers **43, 44** and **46** toward the respective counter rollers **42, 45** and **47**.

If, as desired, the same number of sheets is present between rollers **42, 43**; **44, 45**; and **46, 47**, switches **51** through **54** are spaced apart from the respective abutments **55** through **58**. However, if sheets are doubled up between rollers **42** and **53**, the angular position of lever **48** in reference to lever **49** changes accordingly thereby causing operation of switches **52** and **54** by engagement with abutment portions **56** and **58**. As a result the control circuit means are activated in the manner described in connection with FIG. 9. Similarly, switches **51** and **53** are operated when a sheet is missing between rollers **42** and **43**.

Adjustment of abutment members **55** through **58** may be effected in any suitable and conventional manner, for instance by providing set screws or eccentric lugs of the kind shown in FIG. 7 and described in connection therewith.

A unidirectionally rotating cam disk **62** acts upon a pivotally mounted bell crank lever **63** by means of a cam follower **65**. A tension spring **64** acting upon lever **63** urges follower **65** toward the cam disk. A rod **66** linked to arm **63***a* of lever **63** couples the lever arm with two bars **67** and **68** which, in turn, coact with levers **48, 49** and **50** by means of rollers **69** and **70** respectively. As it is evident, rotation of cam disk **62** will cause an intermittent lifting of levers **48, 49** and **50** to provide for a free run-in of the leading edges of the sheets between the respective rollers to assure a substantially wrinkle-free transport of the sheets. A special switch to prevent generation of a control signal when the levers are lifted, such as switches **23** and **23***a*, is not necessary in this arrangement since the intermittent lifting of levers **48, 49** and **50** separates switches **51** through **54** from the respective abutment members **55** through **58**.

The automatic variation of the sensitivity of the detecting device in accordance with the specific gauge of the sheet material to be supervised is apparent from the diagram of FIG. 12 in which are shown the movement performed by switch **51** and its abutment member **55**. The full lines represent the positions for thin sheets and the dotted lines for heavy gauge sheet material, such as heavy cardboard. As it is apparent, the requirement movement of the point representing abutment member **55** to the point representing switch **51** is considerably shorter than the distance between point **55'** and point **51'**. As is also apparent, the sensitivity of the device is the higher the closer levers **48** approach parallel positions.

FIG. 13 shows diagrammatically an arrangement in which the previously described coacting pairs of rollers are replaced by capacitative detecting means. According to the figure, electrodes **108** in the form of metal plates are inserted in a feed table **4***a*. Each of the plates coacts with a second plate electrode **110** and **111** respectively.

The electrodes **108**, **110** and **109**, **111** are so spaced from each other that the sheets to be fed can freely pass between the electrodes. The two pairs of electrodes each constitute a capacitor, the capacitance value of which is controlled by the total thickness of the sheet material passing therebetween. The distance between the two capacitors is again equal to the distance A representing the spacing between adjacent sheets. As it is evident, the sheet material constitutes a dielectric for the capacitors and hence the capacitance values will accurately reflect the number of superimposed sheets or the absence of sheets.

The two capacitance values obtained with the arrangement according to FIG. 13 are compared in suitable comparing means such as the four-arm bridge shown in FIG. 14. The two capacitors are included in two arms of the bridge and each of the two other arms includes an adjustable capacitor **112** and **113** respectively. The bridge is connected to a high frequency source of current **114**, or any other suitable source of current and is adjusted by means of capacitors **112** and **113** so that the bridge is in balance when, as desired, the same number of sheets passes capacitors **108**, **110** and **109**, **111**. However, if one of the capacitors detects a different number of sheets, the bridge is in imbalance and a voltage is now present at points **115**, **116**. This voltage is fed to an amplifier **118** connected to a source of current **117** and controlling a solenoid **119** which constitutes part of the control circuit as described in connection with FIGS. 5 and 9.

The arrangement of FIG. 15 uses a mechanical-electrical converter for obtaining control signals corresponding to the spacing between rollers **120** and **121** which, as previously described, is controlled by the thickness of the sheet material passing between the rollers.

The converter comprises a suitably connected exciter coil **122** in which a core of varying cross sectional outline, such as a conical core **123**, is lengthwise displaceable. As it is evident, the conical shape of the core gives a non-linear characteristic to the converter. The core is coupled to an arm **125** pivotal at one end about a stationary pivot **124** and supporting at the other end a roller **121**. The counter roller **120** is suitably secured to a feed table *4c* for instance by means of a bracket **126**. The general function of the device according to FIG. 15 is evident from FIGS. 1, 6, 10 and 11. As it is also evident, a converter such as shown in FIG. 15 should be provided as previously described for two pairs of rollers spaced at the distance A representing the overlap spacing between adjacent sheets.

The signals obtained from the two converters may be compared in a bridge circuit of the kind shown in FIG. 14, though of course designed for signals of the kind delivered by an inductive converter.

FIG. 16 shows a graph in which the abscissa X indicates the gauge of the sheet material, such as paper, and the ordinate Y the induction of coil **120**. As it is evident, roller **21** is lifted higher by a heavy gauge than by a light gauge whereby the peripherally smaller portion of core **123** enters more deeply into coil **122**. FIG. 16 shows that the change in the induction of coil **122** is less for a heavy gauge in response to a given change in the total thickness of the sheet material than for a light gauge. Accordingly, the bridge comparing the signals obtained from the two converters will operate a control solenoid, such as solenoid **119**, when heavy gauge sheets are used, at larger departures from a reference value than when light gauge sheets are used.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention it will be understood by those skilled in the art after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same and to generate a signal corresponding to the detected thickness, the spacing between the two detectors being equal to the overlap spacing of the sheets within said train of sheets, comparing means comparing said signals and producing an electric control signal in response to a differential above a predetermined value between said compared signals, and control circuit means activated by said electric control signal.

2. A detecting device according to claim **1** wherein each of said detectors comprises a pair of coacting rollers for feeding said sheets therebetween, one of said rollers of each pair being yieldably supported, the spacings between the rotational axes of each of said pairs of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair.

3. A detecting device according to claim **1** wherein each of said detectors comprises a pair of coacting rollers for feeding said sheets therebetween, one of said rollers being yieldably supported, the spacings between the rotational axes of each of said pairs of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair, and comprising lifting means coacting with one of said yieldable rollers to lift the same intermittently for opening the respective detector to provide a free run-in for the leading edges of the sheets.

4. A detecting device according to claim **1** and comprising adjustment means responsive to the gauge of the fed sheets and controlling said comparing means to produce a control signal in response to a differential which is greater for sheet gauges above a predetermined value than for sheet gauges below said predetermined value.

5. A detecting device according to claim **1** wherein one of said detectors comprises two probes for detecting the thickness of sheet material at two points spaced apart in the direction of the sheet travel, the spacing of one of said probes from the other detector being larger than the overlap spacing of the sheets in said train of sheets by a predetermined amount and the spacing of the other of said probes from said other detector being smaller than said overlap spacing by approximately the same amount, the two probes producing a signal for comparison with the signal produced by said other detector when both probes detect substantially the same thickness of sheet material passing the probes.

6. A detecting device according to claim **1** wherein each of said detectors comprises a pair of coacting rollers for feeding said sheets therebetween, one of the rollers being yieldably supported, the spacings between the rotational axes of each pair of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair, and comprising two mechanical-electrical converts having a non-linear characteristic, each of said converters being coupled with the yieldable roller of one pair for generating an output signal corresponding to the spacing of the rollers of the respective pair, said output signals being fed to said comparing means.

7. A detecting device according to claim **6** wherein each of said converters is an inductive converter including an exciter coil and a tapered cone lengthwise slidable in said coil.

8. A detecting device according to claim **1**, wherein each of said detectors comprises a capacitance means having two spaced apart electrodes for passing the sheets therebetween, the thickness of the passing sheet material controlling the capacitance value of the respective capaci-

tance means, and wherein said comparing means comprise a bridge circuit including said capacitance means for generating a control signal in response to a predetermined imbalance of said bridge circuit.

9. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same and to generate a signal corresponding to the detected thickness, the spacing between the two detectors being equal to an integral multiple of the overlap spacing of the sheets within said train of sheets, comparing means comparing said signals and producing an electric control signal in response to a differential above a predetermined value between said compared signals and control circuit means activated by said control signal.

10. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same, the spacing between the two detectors being equal to the overlap spacing of the sheets within said train of sheets, each of said detectors including a pair of coacting rollers for feeding sheets therebetween, one of said rollers of each pair being yieldably supported, the spacings between the rotational axes of each of said pairs of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair and a linkage coupling the two yieldable rollers of said detectors, said linkage being displaceable in response to a differential in the positions of the two yieldable rollers in reference to the respective other roller of each pair, a control circuit means, and switch means operated in response to a positional differential above a predetermined value, said switch means when operated activating said control circuit means.

11. A detecting device according to claim **10** wherein said linkage comprises a pivotal arm coupled to one of said yieldable rollers, the angular position of said arm being controlled by the position of said yieldable roller in reference to the other roller of the pair, and a rod coupled to the other yieldable roller and crossing said arm at an angle, said rod being lengthwise displaceable in reference to said arm according to the position of said other yieldable roller in reference to the respective other roller, and wherein said switch means comprise two switches disposed on said rod on opposite sides of said arm, displacement of the arm and the rod in reference to each other above a predetermined value operating either one of said switches depending upon the direction of displacement of the arm and the rod in reference to each other.

12. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same, the spacing between the two detectors being equal to the overlap spacing of the sheets within said train of sheets, each of said detectors including a pair of coacting rollers for feeding said sheets therebetween, one of said rollers of each pair being yieldably supported, the spacings between the rotational axes of each of said pairs of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair, a bell crank lever pivotal about a rotational axis, one arm of said lever mounting the yieldable roller of one of said detectors and the other arm mounting two lugs disposed at different distances from the rotational axis of said lever, the angular position of said lever being controlled by the spacing between the two rollers of said one detector, a lengthwise displaceable rod coupled with the yieldable roller of the other detector for displacement of said rod in response to a variation of the spacing between the two rollers of the other detector, a control circuit means, and a pair of switches supported on said rod each disposed adjacent to one of said lugs, either one of said switches being operated by the respective lug in response to a change in the position of the lever and the rod in reference to each other above a predetermined value, operation of one of said switches activating said control circuit means.

13. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same, the spacing between the two detectors being equal to the overlap spacing of the sheets within said train of sheets, one of said detectors including two probes for detecting the thickness of the sheet material at two points spaced apart in the direction of the sheet travel, the spacing of one of said probes from the other detector being larger than the overlap spacing of the sheets in said train of sheets by a predetermined amount and the spacing of the other of said probes from said other detector being smaller than said overlap spacing by approximately the same amount, the two probes producing a signal for comparison with a signal produced by said other detector when both probes detect substantially the same thickness of sheet material passing the probes, each of said probes including a pair of coacting rollers for feeding sheets therebetween, one of said rollers of each pair being yieldably supported, the spacings between rotational axis of each pair of rollers being indicative of the total thickness of the sheet material passing between the rollers of the respective pair, a pair of bell crank levers, each of said levers being pivotal about a rotational axis, one arm of each of said levers mounting the yieldable roller of one of said probes and the other arm of each lever mounting two lugs disposed at different distances from the rotational axis of the respective lever, the angular position of each of said levers being controlled by the spacing between the two rollers of the respective probes, a lengthwise displaceable rod coupled with the yieldable roller of the other detector for displacement of said rod in response to a variation of the spacing between the two rollers of said other detector, a control circuit means, and two pairs of switches supported on said rod, the two switches of each pair being disposed adjacent to the lugs on the other arm of the respective lever, either one of said switches of both pairs being operated in response to a change in the positions of the respective lever and the rod in reference to each other above a predetermined variation, operation of one of the switches of either pair activating said control circuit means.

14. In a detecting device for detecting the absence of sheets and the presence of doubled-up sheets fed in the form of a train of overlapping sheets to a printing press, said detecting device comprising two detectors disposed spaced apart in the direction of the sheet travel, each of said detectors being arranged to detect the thickness of the sheet material passing the same, the spacing between the two detectors being equal to the overlap spacing of the sheets within said train of sheets, each of said detectors including a pair of coacting rollers for feeding said sheets therebetween, one of said rollers of each pair being yieldably supported, the spacings between the rotational axis of each pair of rollers being indicative of the total thickness of the sheet material passing between rollers of the respective pair, a pair of pivotally mounted levers, one end of each of said levers mounting one of the yieldable rollers, the angular positions of said levers

being controlled by the spacings between the yieldable rollers and the respective other rollers, said levers crossing each other, a switch mounted at the other end of each lever, the switch on each one of said levers being operable by engagement with the respective other lever in predetermined angular positions of the levers in reference to each other, and a control circuit means, operation of either one of said switches activating said control circuit means.

References Cited by the Examiner

UNITED STATES PATENTS

2,274,738	3/1942	Potts	261—57 X
2,680,614	6/1954	Gibson	271—57
2,940,754	6/1960	Stoothoff	271—57 X

M. HENSON WOOD, JR., *Primary Examiner.*

J. N. ERLICH, *Assistant Examiner.*