Dec. 23, 1947. C. W. HARROLD 2,433,120

SHEET DETECTOR

Filed Dec. 11, 1944 2 Sheets-Sheet 1

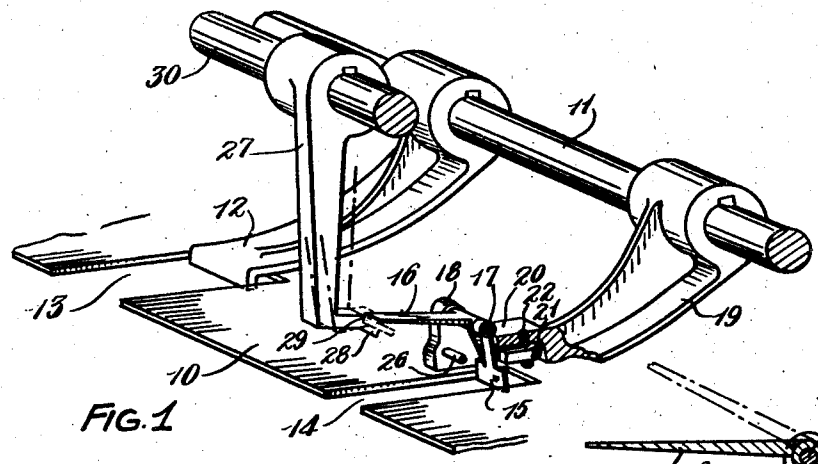

FIG. 1

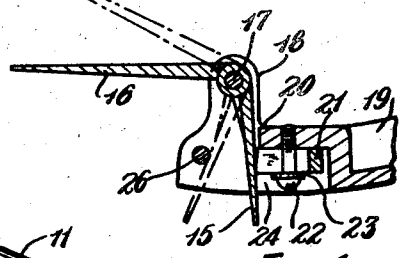

FIG. 4

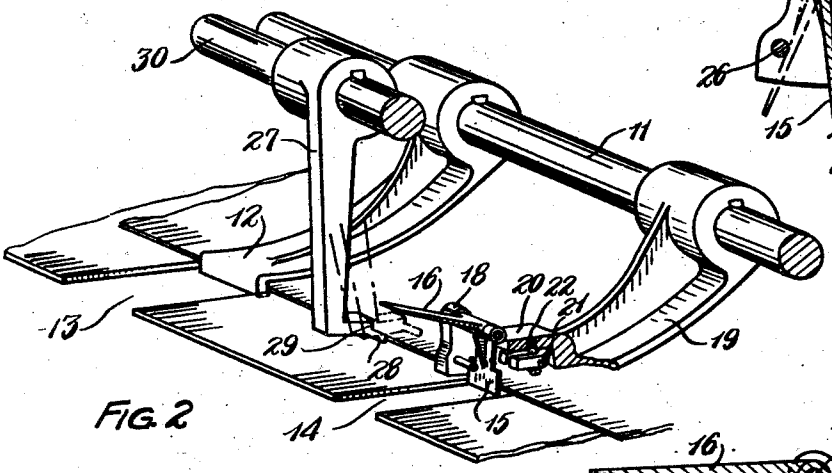

FIG. 2

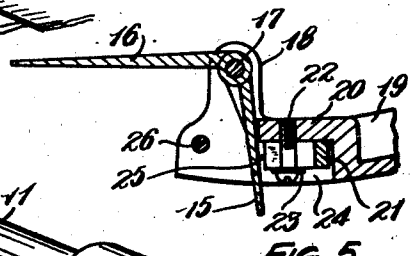

FIG. 5

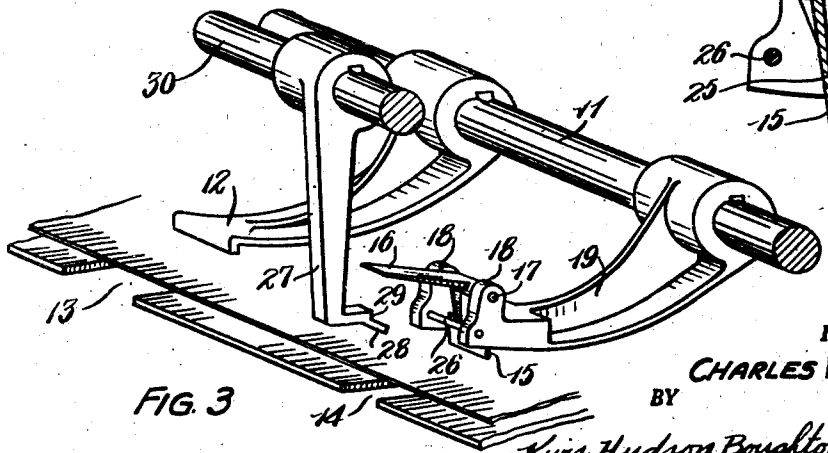

FIG. 3

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SHEET DETECTOR

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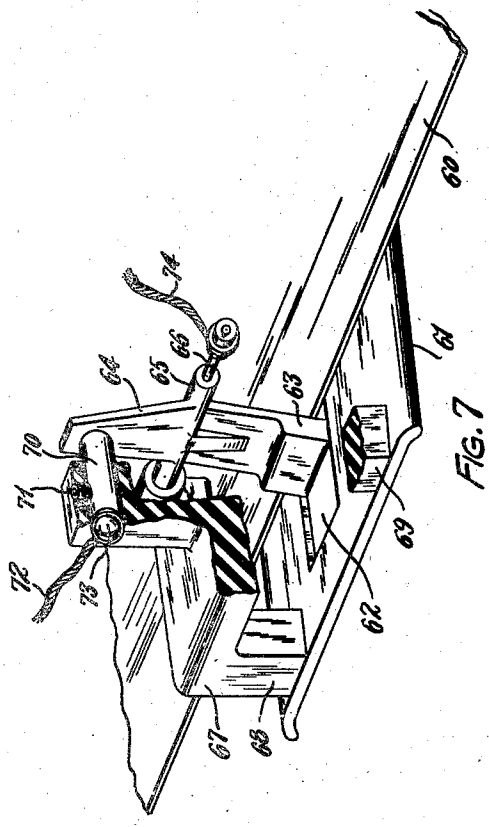

FIG. 7

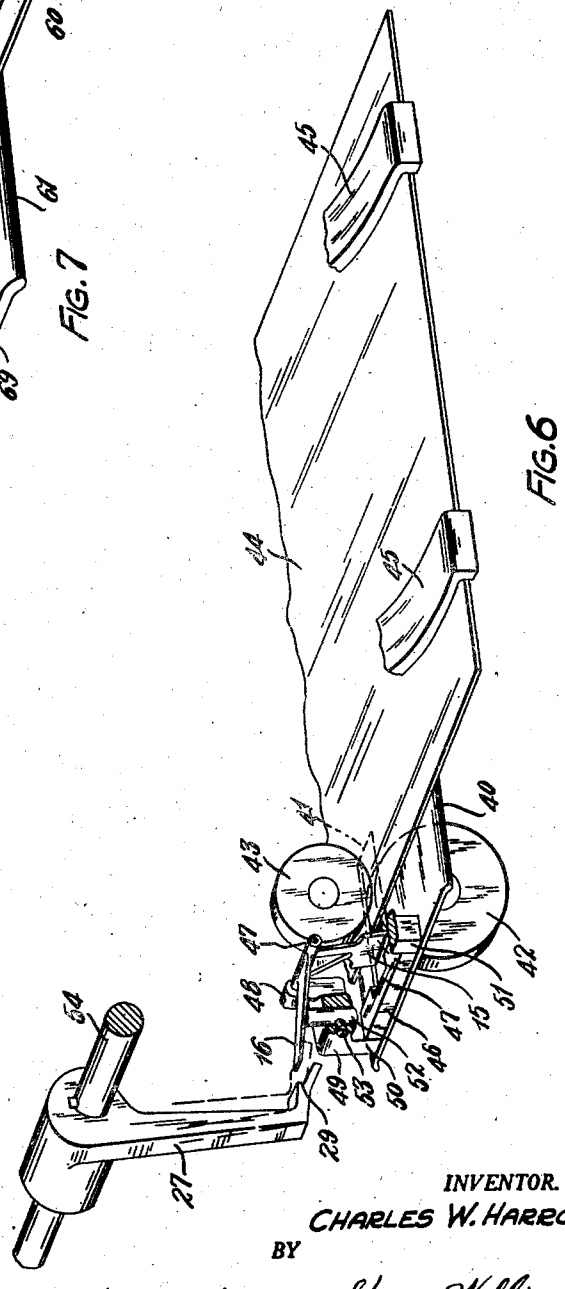

FIG. 6

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SHEET DETECTOR

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15 Claims. (Cl. 271—57)

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This invention relates to improvements in sheet detectors, that is to say detectors for sheet material generally, including separate sheets and sheet material in the form of a continuous web. More especially the invention relates to a detector to be incorporated in a sheet feeder for detecting the presence or absence of properly presented sheets at the forward end of a feed board or at the side guide thereof. The present application is a continuation-in-part of my co-pending application, Serial No. 517,147, filed January 5, 1944, since abandoned.

Apparatus of the kind above referred to usually embodies a detector finger which is periodically positioned in the sheet path for engagement with the advancing edge of each sheet in succession, this finger being resiliently held against accidental displacement by means of a spring. In the operation of the device the advancing edge of each sheet must engage and shift this finger against the action of the spring.

The conventional apparatus just described presents the disadvantage that the force which must be exerted by the edge of the advancing sheet in order to swing the detector finger increases as the finger is moved and the stress of the spring is correspondingly increased.

One of the objects of the present invention, therefore, is the provision of means for yieldably holding a detector finger against its stop, which shall not only avoid the objection of presenting an increasing load to the edge of the material being fed as the finger moves away from its stop, but shall in fact present a sharply decreasing load as the finger is thus shifted.

More specifically, an object of the invention is the provision of means for holding a detector finger against its stop by magnetic action.

Other objects and features of novelty will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Fig. 1 is a fragmentary perspective view of the forward end of the feed board of a sheet feeding machine, including front registering means, and sheet detector means embodying the invention, the parts being shown in operative position with no sheet present, in other words, in position to trip the feeder.

Fig. 2 is a similar view with a sheet present and the parts in non-tripping position.

Fig. 3 is a similar view but with the detector finger and front stops raised to clear an advancing sheet.

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Fig. 4 is a vertical, sectional, detail view showing the detector finger held against a magnet.

Fig. 5 is a similar view illustrating means for adjusting the effective pull of the magnet upon the detector finger.

Fig. 6 is a fragmentary perspective view illustrating the application of the invention to the detection of sheets as they are being side registered, and

Fig. 7 is a fragmentary perspective view illustrating the application of the invention to the control of the web in a web handling machine.

Referring first to mechanism for detecting sheets at the forward end of the feed board of a sheet feeding machine, as illustrated in Figs. 1 to 5 inclusive of the drawings, 10 represents a fragment of a feed board of a sheet feeding machine. 11 is an oscillating shaft to which are fixed at intervals along its length front stops 12, one only of which is illustrated. The front stops 12 in their lowered position shown in Figs. 1 and 2 extend into recesses 13 in the forward end of the feed board and are thus in position to front register the sheet, as indicated in Fig. 2, and to act as guides during its side registration, in a manner well known in the art.

At one or more points across the front of the feed board there are further cutouts or recesses 14 provided the cooperation with the detector finger or fingers. One detector finger only is illustrated at 15. It is made of magnetic material. Formed integrally with it there is a forwardly extending arm 16, the elements 15 and 16 in effect constituting a bell-crank lever which swings freely upon a pivot pin 17 that is carried on a pair of spaced upwardly extending ears 18 formed at the forward extremity of a non-magnetic arm 19 which is keyed to shaft 11 and swings with front stops 12 through the same angle. Gravity tends to hold the finger 15 and its arm 16 in the position illustrated in Figs. 4 and 5.

Below and somewhat behind the pivot pin 17 the arm 19 has a ledge 20 with a recess therebeneath in which I secure a magnet 21, herein illustrated as a permanent horseshoe magnet. Its two poles extend forwardly, and it is mounted preferably by means of a screw 22 and washer 23, the latter overlapping the two legs of the horseshoe and thereby holding the magnet against the ledge. Beneath the ledge 20 the arm 19 has a pair of side walls 24 which prevent angular movement of the magnet while permitting its adjustment forward and backward.

In Fig. 4 the two legs of the horseshoe are beveled off so that actual contact between the finger

15 and the magnet is along a transverse line only. Hence, in this case the lower edge of the magnet itself constitutes a stop to limit the rearward movement of the finger 15, and the effective pull of the magnet upon the finger is limited in comparison with what it would be if contact were possible over the entire pole faces.

In Fig. 5 the magnet is set back somewhat behind the forward end of the ledge 20, leaving an air gap 25 between the magnet and the finger, which may be varied in width by adjustment of the magnet, thereby controlling the effective maximum pull of the magnet upon the finger.

A transverse rod 26 is carried by the arm 19 in position to constitute a stop limiting the movements of the finger 15 in a direction away from the magnet. When heavy stock is being fed and the sheets are travelling rapidly a blow of some magnitude may be struck against the finger 15 by an advancing sheet, which might carry the finger around far enough to throw arm 16 over the pivot 17, whereupon gravity could not act to return the element 15, 16, to normal position. Rod 26 prevents such overthrow.

An arm 27 with an inclined foot 28 and abutment 29 constitutes part of a conventional throwoff mechanism. The arm 27 is secured to a shaft 30 which swings through a small angle once for each sheet fed. So long as the oscillation of this arm is permitted to occur freely, that is between the full line and the dotted line positions of Fig. 2, the throwoff does not operate. However, if its oscillation is interfered with, that is if it is cut down to the extent indicated by the full and dotted line positions of Fig. 1, the throwoff functions and stops the feeder. When the finger 15 is held against the magnet, as in Fig. 4, or against the ledge 20, as in Fig. 5 and the arm 19 is in its lowered position, arm 16 stands in the way of the abutment 29 and prevents the arm 27 from moving rearward through its full natural stroke, thereby setting the throwoff in operation. This condition is illustrated in Fig. 1, where there is no sheet against the finger 15 at a time in the cycle when a sheet should be present.

When a sheet comes down the feed board at the proper time and in its normal correct condition, as illustrated in Fig. 2, the finger 15 is swung clockwise by the sheet and the arm 16 is lifted far enough so that when the arm 27 swings rearwardly the abutment 29 will move beneath the arm 16, clearing the same. When the sheet comes down it strikes finger 15 first. It then continues a very short distance further before engaging stops 12, by which it is front registered. Immediately thereafter the sheet is side registered by means not shown. Then shaft 11 turns to lift stops 12 and the arm 19 to the positions indicated in Fig. 3, whereupon the sheet resumes its travel into a printing press or other machine served by the feeder.

The attraction of the magnet for the finger is strong if there is actual contact between the two. Adjustment may be made to reduce the maximum attraction in order to best suit the device to paper stocks of different weights. As soon as the swing of the finger begins in response to the impact of a sheet upon it the effective pull of the magnet drops to a small fraction of the maximum, so that practically no force other than the force of gravity acting upon the finger is encountered by the sheet after it first strikes the finger. This is in sharp contradistinction to the action of the spring formerly used for holding the finger against its stop.

The spring retracted finger of the prior art must be adjusted to light tension when thin stock is being fed, because otherwise the sheet would be buckled against the finger as it moved toward the front stops. In a modern sheet feeder operating at high speed the finger support, such as arm 19, must move rapidly. When it descends at high speed and stops suddenly there is a tendency to snap the finger element 15, 16 away from its regular position against the stop. This tendency is opposed by the spring plus gravity. If the spring is adjusted to light tension for feeding light stock it may yield momentarily, and then after being stretched it will pull the finger back. In that event the spring naturally tends to overthrow, that is, it will contract more than necessary and rebound, thereby causing the finger to bounce or vibrate. This action in a construction of the type of that illustrated herein may raise the arm 16 above the abutment 29 at the critical instant and fail to cause the throwoff to operate at a time when it should do so.

The magnetic action of the present invention overcomes this difficulty to a large extent, that is to say, even though the effective magnetic force be decreased materially for the feeding of light stock, there will still be very little tendency toward bouncing or vibration of the finger element, because magnetism will not produce any tendency toward overthrow, and the only tendency in that direction will be that due to gravity which is very weak in comparison to spring action.

It is to be understood that the term "detector finger" as herein used is intended to apply to any detector member, without regard to form or contour, having a function or operation generally equivalent to that of the finger herein shown.

Referring now to Fig. 6 of the drawings, 40 represents a metal plate constituting a part of the feed board of a sheet feeder. Through this plate there is a transversely elongated opening 41 into which extends the upper part of a constantly driven roller 42. An idler roller 43 disposed directly above roller 42 moves up and down at the proper time in each cycle to insure traction between roller 42 and the sheets to be side registered. In the drawing there is illustrated at 44 a sheet which has been front registered against stops 45 which move up and down in properly timed relation to the movements of the other parts of the feeder.

On the plate 40 there is a side guide block 46 notched out on its inner side at 47 to accommodate the lower arm 15 of a detector finger 15, 16, which may be identical in form with the detector finger of the previously described form of the invention, this arm 15 extending down into the slot 41 so as to be contacted by the side edge of sheet 44 as the latter approaches the side guide block 46. Finger 15, 16 is supported to swing freely on a rod or shaft 47 mounted at its ends in upstanding projections 48 on a bracket 49 of inverted U-shape, which is broken away in the drawing in order to more clearly illustrate the invention. The bracket comprises legs 50 and 51 which are secured on plate 40 adjacent the ends of the side guide block 46. This bracket also carries a permanent bar magnet 52 disposed in a drilled hole in the bracket and held in any desired position of adjustment by means of a set-screw 53.

A longitudinally extending shaft 54 oscillates back and forth once for each sheet fed by the machine in the same manner as shaft 30 of the first described form of the invention. It carries

a depending arm 27 which may be identical with the similarly numbered element in the first form of the invention, and has the same function.

In the operation of the device, after a sheet 44 is front registered against the stops 45, roller 43 descends into engagement with the sheet and thereby imparts traction to the roller 42 which then draws the sheet over against the side guide block 46. Just before the edge of the sheet strikes the side guide block however, it engages the arm 15 of the sheet detector and swings the latter arm against the action of magnet 52 far enough to enable the arm 16 to clear the abutment 29 on the oscillating arm 27. Hence no obstacle is presented to interfere with the movements of arm 27. In the event however that no sheet is present or that a sheet is so disarranged on the feed board as not to engage the finger arm 15, then the arm 16, being held down positively by the magnet 52, will lie in the path of the abutment 29 and will interrupt the oscillation of arm 27, which will cause the throwoff to function and stop the feeder.

Fig. 7 illustrates an application of the invention to controls for maintaining a traveling web of sheet material in its intended path. The web is indicated at 60 as travelling over a transverse plate or board 61 in which there is a transverse slot 62 of a width sufficient to accommodate the lower arm 63 of a detector finger of a form somewhat different from that previously described. The other arm 64 extends upwardly from the hub 65 of the finger, which is oscillatably mounted upon a pin 66 that is supported at its ends in a bracket 67 having legs 68 and 69 that are secured to the plate 61, to one side of the path of the web. Bracket 67 is constructed of plastic or other insulation material. It carries a permanent bar magnet 70 disposed horizontally and transversely in a position to normally engage arm 64 of the detector finger. The magnet is adjustable endwise and may be held in any desired position of adjustment by means of a setscrew 71. An electric conductor 72 is joined to the outer end of magnet 70 by a screw 73, and to pin 66 another conductor 74 is electrically connected by any suitable means. Arm 63 is weighted at its lower end in order to enable gravity to assist the magnetic action for maintaining the detector finger normally in the desired position.

Detector mechanism of the kind described is mounted at each side of the web path, and these mechanisms are so disposed that the arms 63 just clear the edges of the web when moving in its intended path. When in the operation of the machine the web gets out of proper position, it engages the arm 63 on one side or the other of the machine and breaks the electrical contact between the arm 64 of that finger and the magnet 70. An electric circuit including the conductors 72 and 74 is thereby broken and a suitable control for moving the travelling web back into its proper path is put into operation. For example, the circuit may include the holding coil of a magnetic contactor controlling the current to a motor arranged to shift sidewise the reel of paper from which the web is drawn.

While as herein described the invention is applied to the detection of sheets as they approach the front stops or side guide of a sheet feeder and to the detection of the lateral position of a web of sheet material, it is to be understood that it may have other applications, that is, it may be employed to detect the position or presence or absence of sheet material under other conditions wherever relative movement between the material and the finger support may take place. Furthermore, the magnetic action need not necessarily result from a magnet on the supporting arm, since the magnet could be incorporated in the finger itself without any difference in the principle or mode of operation of the device.

Having thus described my invention, I claim:

1. In a sheet material handling machine, a detector finger adapted to engage and be moved by sheet material, and means functioning by magnetic action to yieldably hold said finger against said movement.

2. In a sheet material handling machine, a detector finger of magnetic material mounted to swing about an axis, a magnet arranged to hold said finger yieldably in a given position from which it may be moved by travelling sheet material, and control means the operation of which is dependent upon the angular position of said finger.

3. In a sheet material handling machine, a detector finger mounted to extend into the plane of sheet material being handled for engagement with an edge of said material, said finger having a position which it occupies except when shifted by the material and being held yieldably in said position by magnetic action.

4. In a sheet material handling machine, a detector finger mounted to extend into the plane of sheet material being handled and adapted to be shifted in one direction by relative movement between the sheet material and said finger, a stop for limiting the movement of said finger in the opposite direction, and magnetic means tending to hold said finger against said stop.

5. In a sheet material handling machine, an arm member, a finger member mounted on said arm member to extend into the plane of a sheet being handled and adapted to be shifted in one direction by relative movement between the sheet and said finger, one of said members possessing magnetic attraction for the other member tending to hold said finger member against movement in the opposite direction.

6. In a sheet material handling machine, a detector finger having two positions, said finger being adapted to move from the first position to the second position by engagement with sheet material, and means functioning by magnetic action to yieldably hold said finger in said first position.

7. In a sheet material handling machine, a detector finger mounted to extend into the path of sheets being handled for engagement with an edge of each sheet in succession, and means for attracting said finger and yieldably holding it in attracted position by magnetic action, whereby the pulling effect of said means decreases rapidly as said finger moves away from its attracted position.

8. In a sheet material handling machine, a detector finger mounted to extend into the path of sheets being fed for engagement with the forward edge of each sheet in succession, means for attracting said finger and yieldably holding it in rearward attracted position by magnetic action, and means for limiting the rearward movement of said finger.

9. In mechanism of the character described, a detector finger of magnetic material mounted to extend into the path of sheets being fed for engagement with the forward edge of each sheet in succession, means for attracting said finger and yieldably holding it in operative position comprising a magnet, a stop for limiting the movement of said finger toward said magnet and

means for adjusting said magnet and said stop relatively to each other.

10. In a sheet material handling machine, an arm of non-magnetic material mounted for movement toward and away from the sheet path, a detector finger of magnetic material mounted in said arm to extend into the sheet path when the arm is close to said path, and means for holding said finger in operative position in said arm comprising a magnet.

11. In mechanism of the character described, an arm of non-magnetic material mounted for movement toward and away from the sheet path, a detector finger of magnetic material mounted in said arm to extend into the sheet path when the arm is close to said path, means for holding said finger in operative position in said arm comprising a magnet, and adjustable means for varying the effective pull of said magnet.

12. In mechanism of the character described, an arm of non-magnetic material having a ledge, a magnet adjustably secured to said ledge to cause a pole of the magnet to occupy different positions relative to the forward end of the ledge, and a detector finger mounted in said arm in front of said ledge to swing toward and away from said magnet pole, said detector finger being arranged to extend into the sheet path when the arms is close to said path.

13. In combination, a feeder for sheet material comprising a feed board, a detector finger carried thereby adapted to be moved transversely of the feed board by traveling sheet material, a magnet for holding said finger yieldably in a given position from which it may be shifted by the traveling sheet material, and control means the operation of which is dependent upon the position of said finger transversely of the feed board.

14. In combination, a sheet feeder comprising a feed board, a side guide thereon, side registering mechanism carried by the feed board, a detector finger adapted to be moved transversely of the feed board by a sheet as the latter is moved sidewise by said side registering mechanism, a magnet for holding said finger yieldably in a given position spaced inwardly from the side guide, and control means dependent upon the position of said finger at a given point in the cycle of operation.

15. In a machine for feeding a web of sheet material, a detector finger mounted to swing transversely of the web path and normally occupying a position out of contact with the edge of the travelling web, magnetic means for yieldably holding said finger in said normal position, and means adapted to operate a control for shifting the web transversely in response to movement of said finger by the edge of the web in opposition to said magnetic means.

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