April 11, 1961 A. R. GEISZLER ET AL 2,978,941

SHEET CLASSIFIER

Filed Feb. 9, 1955

2 Sheets-Sheet 1

Fig. 1.

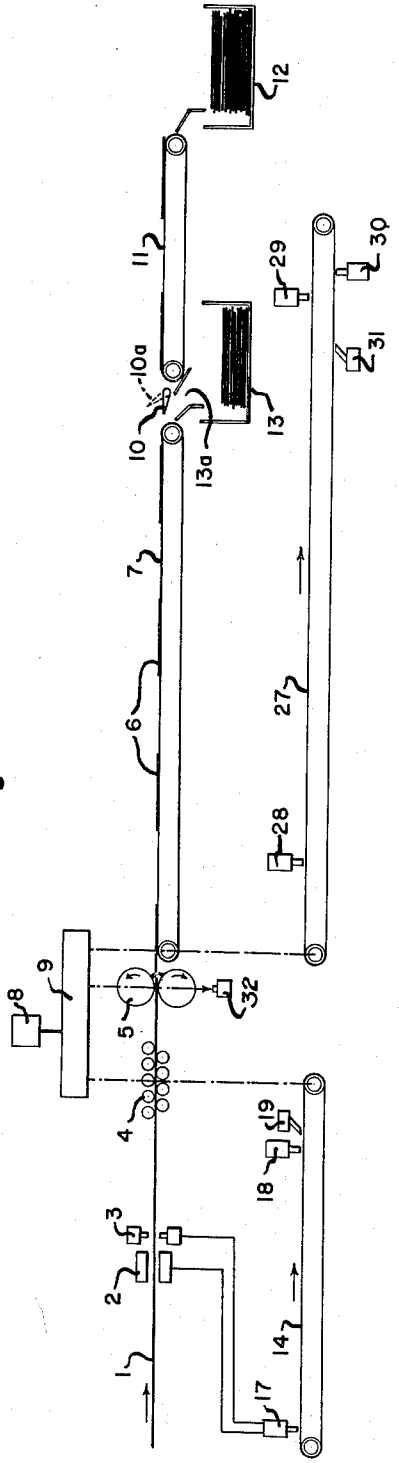
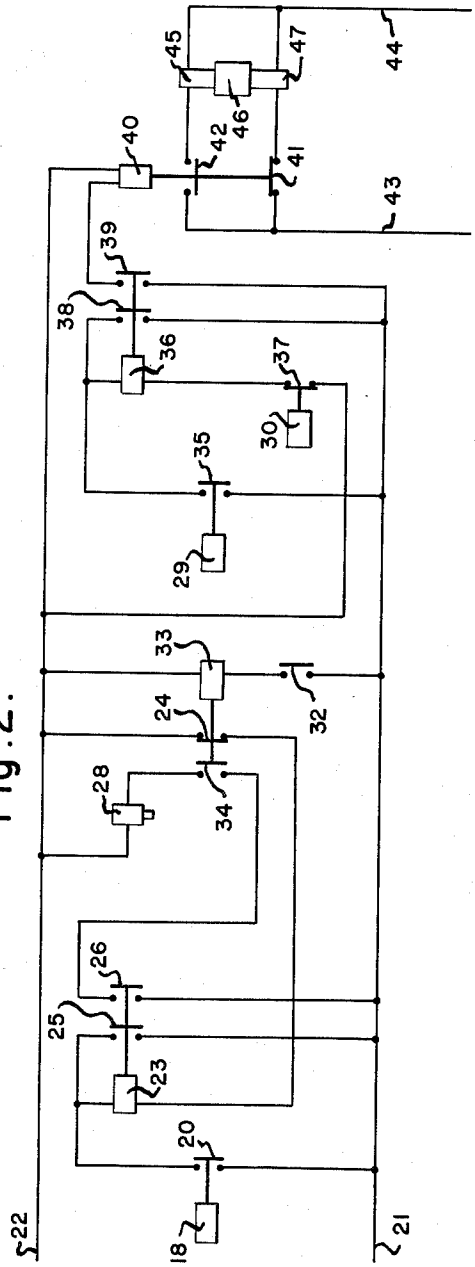


Fig. 2.



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2 Sheets-Sheet 2

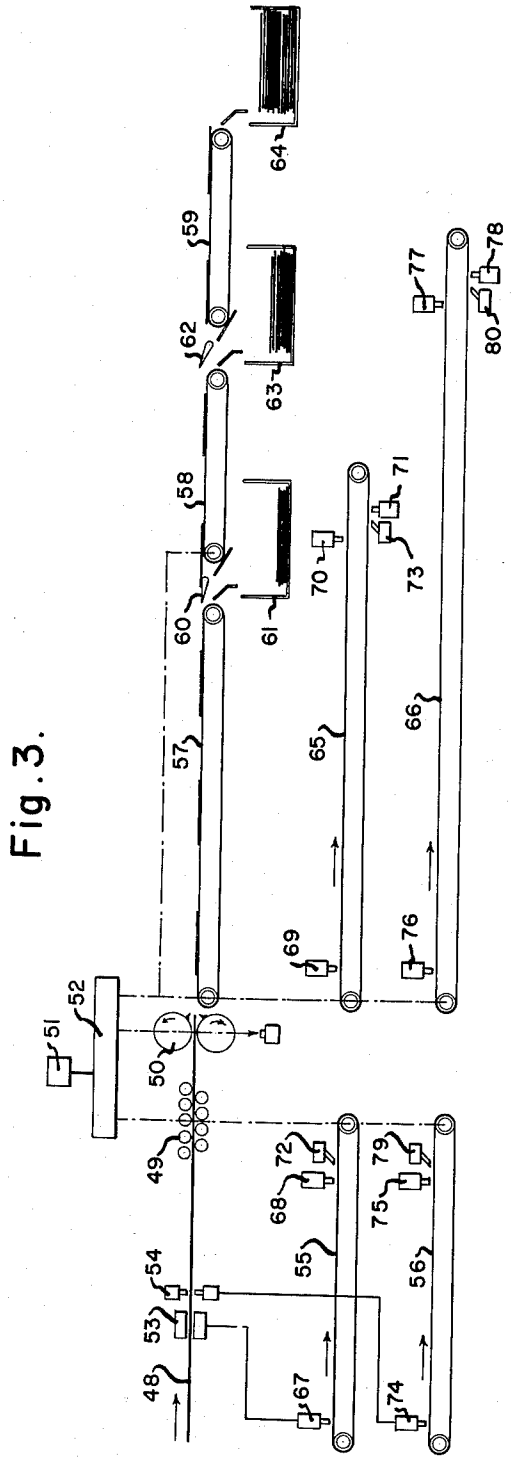


Fig. 3.

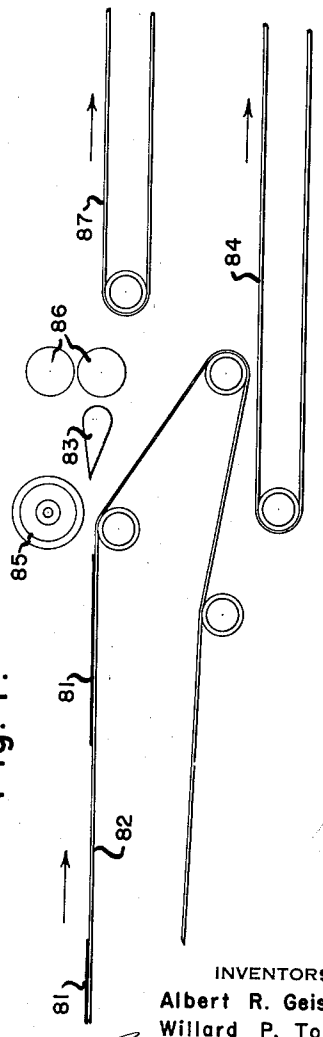


Fig. 4.

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SHEET CLASSIFIER

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5 Claims. (Cl. 83—106)

This invention relates to apparatus for classifying sheets according to an inspection of the material.

In the manufacture of sheets for further fabrication it has been customary to cut the sheets from a roll of thin flat material. In the manufacture of tin cans, for instance, a strip of steel coated with tin is customarily cut into conveniently-sized sheets. Formerly, the individual sheets were inspected by hand for imperfections and flaws. Due to the unwieldy size of the sheets this is an inconvenient and time-consuming procedure. More recently, attempts have been made to build mechanical sheet classifiers which will inspect a continuous strip of tin plate, for example, shear it into sheets and segregate those sheets which appear to be defective. It has been a difficult problem to properly associate a defect in the strip with the sheet which, when cut, contains the same defect. As the top speed of the strip becomes greater and as variations in the speed of the strip increase, the problem of proper identification and classification becomes more difficult. Various timing and marking devices have been used in an attempt to make an accurate and speedy classification, but these have all been subject to inaccuracies. It has also been well-known to inspect sheets after they have been cut and to classify them. Where the inspection of individual sheets is made as they pass an inspection point, the same difficulty has been encountered in making a proper classification.

We have invented new and useful apparatus whereby successive sheets may be readily and accurately classified at high or varying speeds.

We provide means to inspect a member for defects, means to retain a signal, means actuated by the inspecting means to impress a signal upon the retention means and means to classify the product according to the signal impressed upon the retention means.

We preferably provide means to inspect strip for defects, signal means actuated by the inspecting means to impress a signal upon first retention means, pickup means to pick up the signal from the retention means when the defective portion of the strip has passed through a shear, means to hold the picked up signal until the shear has cut a sheet from the strip, means to impress the held signal upon second retention means and pickup means to operate classifying means in accordance with the signal on the second retention means. We prefer to employ endless magnetic tapes as retention means and provide therewith an eraser to demagnetize signals on the tapes after they have actuated the pickup means.

Other details, objects and advantages of our invention will become apparent as the following detailed description of certain present preferred embodiments thereof proceed.

In the accompanying drawings we have illustrated certain present preferred embodiments of our invention in which:

Figure 1 is a schematic elevation of a sheet classifier embodying one form of our invention;

Figure 2 is a wiring diagram of the sheet classifier shown in Figure 1;

Figure 3 is a schematic elevation of a sheet classifier embodying a modified form of our invention; and

Figure 4 is a fragmentary schematic elevation of a sheet classifier showing a modified form of classifying means.

Referring now to Figure 1 in which we have shown a sheet classifier in schematic elevation, strip 1 is delivered to the classifier from a coil or processing line. It passes through a thickness gauge 2, a pinhole detector 3 and a roller leveler 4 to a rotary shear 5. Sheets 6 which are cut from the strip by shear 5 are carried away from the shear by conveyor 7. Conveyor 7 operates at a higher speed than the strip coming to the shear so that there is a gap between successive sheets on the conveyor. A motor 8 drives roller leveler 4, shear 5 and conveyor 7 through gearbox 9. At the delivery end of conveyor 7 is a movable gate 10. When gate 10 is in the position shown, sheets will pass over the gate to conveyor 11 and be delivered to a prime sheet piling station 12. Gate 10 may be pivoted about its axis by hydraulic or pneumatic means (not shown in the drawing) so that its leading edge will be above the pass line of sheets on conveyor 7. This position is shown in dotted outline 10*a*. When the gate is in this position, sheets coming to the gate on conveyor 7 will be diverted through chute 13*a* to a reject sheet piling station 13. Means for retaining a signal comprise an endless magnetic tape 14 driven from gearbox 9 at a speed synchronized to the speed of the roller leveler 4 and shear 5. Since strip 1 is firmly engaged by roller leveler 4 and shear 5, tape 14 is necessarily synchronized with the speed of the strip into the roller leveler and shear. Ordinary iron oxide sound recording tape, mounted on a backing belt for strength and longer life may be used. An operator 17 is mounted to place a magnetic signal on magnetic tape 14. Operator 17 is connected to thickness gauge 2 and pinhole detector 3. When either the thickness gauge or the pinhole detector finds a portion of the strip which is off-gauge or contains pinholes they will cause operator 17 to magnetize the iron oxide particles in magnetic tape 14. Pickup 18 is located to pick up a signal on magnetic tape 14. The distance from operator 17 to pickup 18 is adjusted to fit the synchronous speed of magnetic tape 14 with strip 1. During the time that a defect passes from thickness gauge 2 and pinhole detector 3 to a point just past the point of shear, a signal at operator 17 will have moved to the point of pickup of pickup 18. Beyond pickup 18 is an eraser 19 which will demagnetize the tape and erase any signal from it. When pickup 18 picks up a signal on magnetic tape 14 it will close switch 20 (Figure 2) and complete a circuit between power lines 21 and 22 through the coil of relay 23 and normally closed switch 24. Operation of relay 23 will close switches 25 and 26. A holding circuit will be set up through switch 25 which will hold relay 23 energized.

Second retention means comprise an endless magnetic tape 27 which is driven from gearbox 9 at a speed synchronized to the speed of conveyor 7. An operator 28 similar to operator 17 is provided at one end of the tape. Two pickups 29 and 30 similar to pickup 18 are adjustably mounted to pick up signals from magnetic tape 27. An eraser 31 is provided to demagnetize the tape after it has passed beyond pickup 30. As shear 5 cuts a sheet from the strip it will momentarily close switch 32. This will energize the coil of relay 33 causing switch 24 to open and switch 34 to close. Switches 24 and 34 have overlapping contacts. In other words, switch 34 will close before switch 24 opens. When switch 34 closes, a circuit

will be completed through switch 26 (now held in closed position by relay 23) and through operator 28. When operator 28 is energized it will magnetize magnetic tape 27 putting a signal on the tape. When switch 24 opens (after switch 34 closes) the holding circuit through relay 23 will be broken and switches 25 and 26 will return to their normally open position.

When a signal or magnetic impulse on magnetic tape 27 reaches pickup 29, pickup 29 will close switch 35. This will complete a circuit through the coil of relay 36 and normally closed switch 37. When the coil of relay 36 is energized it will close switches 38 and 39 completing a holding circuit through switch 38. When switch 39 is closed it will energize the coil of relay 40 causing normally closed switch 41 to open and normally open switch 42 to close. This will complete a circuit between power lines 43 and 44 through coil 45 of solenoid valve 46 and will open a corresponding circuit through coil 47. Valve 46 controls the hydraulic or pneumatic means operating gate 10. Operation of relay 40 when it is energized will cause valve 46 to actuate gate 10 to open position 10*a*, deflecting the next sheet coming to the gate to reject sheet piling station 13. When a signal on magnetic tape 27 passes the point of pickup of pickup 30, pickup 30 will momentarily open switch 37. This will break the holding circuit of relay 36, cause the coil of relay 40 to be de-energized, switch 41 to be closed and switch 42 to be opened. This will reverse solenoid valve 46 which will lower gate 10, allowing subsequent sheets to pass over the gate to the prime sheet piling station. The positions of pickups 29 and 30 are adjustable along the axis of magnetic tape 27.

Alternatively, to the operation described above, we may employ an operator 17 which will normally impose a variable magnetic field of fixed frequency on tape 14. Conveniently, an audio frequency may be used. When either thickness gauge 2 detects an off-gauge portion of strip 1 or pinhole detector 3 detects a pinhole in the strip, it will cause operator 17 to impose a magnetic signal of a second and different frequency upon tape 14. Pickup 18 is sensitive to the second frequency and will pick up a signal only when this frequency has been imposed on the tape.

Referring now to Figure 3 of the drawings in which we have shown a modification of our invention, strip 48 is fed to the roller leveler 49 and rotary shear 50. The roller leveler and shear are driven by motor 51 through gearbox 52. As the strip passes to the roller leveler it passes through a thickness gauge 53 and a pinhole detector 54. Driven from gearbox 52 at a speed synchronized to the speed of roller leveler 49 and shear 50 are two magnetic tapes 55 and 56. In position to receive sheets from shear 50 is a conveyor 57 which may conveniently be driven from gearbox 52. Arranged beyond conveyor 57 are two additional conveyors 58 and 59. Conveyor 58, and, conveniently, conveyor 59, are driven at the same speed as conveyor 57. Located between conveyors 57 and 58 is gate 60 which, when it is raised, will deflect sheets delivered by conveyor 57 to off-gauge sheet piling station 61. Located between conveyors 58 and 59 is gate 62 which, when it is raised, will deflect sheets delivered by conveyor 58 to pinhole sheet piling station 63. When gate 62 is in a lowered position sheets delivered by conveyor 58 will pass onto conveyor 59 to prime sheet piling station 64. Synchronized to the speed of conveyors 57 and 58 are two magnetic tapes 65 and 66.

Operator 67 is actuated by thickness gauge 53 and will impose a magnetic signal on tape 55 when an off-gauge piece of strip passes through thickness gauge 53. Pickup 68 will pick up a signal in the same manner as pickup 18 when the off-gauge portion has just passed the point of shear. The signal which is picked up will be retained by means similar to those shown in Figure 2 and when the shear cuts a sheet from the end of strip 48 operator 69 will impress a signal upon magnetic tape 65. Pickup 70 is adjustable along the axis of magnetic tape 65 and is adjustable to pick up the signal just before the leading end of the off-gauge sheet reaches gate 60. Pickup 70 and pickup 71 (also adjustable) will cause gate 60 to open, deflect the off-gauge sheet to off-gauge sheet piling station 61 and cause gate 60 to close again. Erasers 72 and 73 will remove the signals from magnetic tapes 55 and 65 after the signals have passed pickups 68 and 71. In like manner, operator 74 is actuated by pinhole detector 54. It will place a signal upon magnetic tape 56 which will be picked up by pickup 75. By means similar to those shown in Figure 2, the signal will be held until the sheet containing the pinhole has been cut, at which time operator 76 will impress a signal upon magnetic tape 66. This signal will be picked up by pickups 77 and 78 which will cause gate 62 to open long enough to deflect the sheet with the pinhole to pinhole sheet piling station 63. Erasers 79 and 80 will demagnetize the tapes and remove the signals from them.

In Figure 4 we have shown a modified form of classifying means. Sheets 81 are carried by conveyor 82 toward fixed deflector 83. The line of the sheets carried by conveyor 82 will normally pass under deflector 83 and will be deflected down onto conveyor 84 which may lead, for example, to a reject sheet piling station. A magnetic roll 85 is placed ahead of and above deflector 83. When its coil is magnetized it will produce a magnetic field causing sheets 81 (if they are of a magnetic material) to be lifted above deflector 83. They will then pass between pinch rolls 86 to conveyor 87 which may, for example, deliver them to a prime sheet piling station.

In the operation of the embodiment of our invention shown in Figures 1 and 2 continuous strip from a coil or a treatment line is fed through the roller leveler 4 to shear 5. As the strip approaches the roller leveler it will be scanned by gauge 2 and pinhole detector 3. Should these detect a portion of the strip which is off-gauge or contains pinholes or both, they will cause a signal to be impressed upon magnetic tape 14. While the defect in the strip passes from gauge 2 and pinhole detector 3 to the point of shear the signal on magnetic tape 14 will pass from operator 17 to pickup 18. In other words, pickup 18 will pick up a signal on the tape just as the defect passes beyond the point of shearing. Pickup 18 will operate relay 23. When shear 5 cuts a sheet from the strip, switch 32 will be closed causing the held signal to be impressed upon magnetic tape 27 by operator 28. As the signal is being impressed upon magnetic tape 27, switch 24 will be opened destroying the holding circuit for relay 23. As the shear completes its cut, switch 32 will open, switch 24 will return to closed position and relay 23 is ready for pickup 18 to pick up another signal. The signal on magnetic tape 27 represents the trailing end of a sheet on conveyor 7 which is off-gauge or contains a pinhole. Pickup 29 is adjustable along the axis of conveyor 27 so that it will be actuated when the front end of a defective sheet is about to reach gate 10. In other words, while a signal on magnetic tape 27 moves from operator 28 to pickup 29, a point on conveyor 7 will move from shear 5 to slightly more than one sheet length from gate 10. The position of pickup 29 is adjustable to allow for different lengths of sheets which may be cut. The position of pickup 30 is likewise adjustable so that while a signal on magnetic tape 27 passes from pickup 29 to pickup 30 a point on conveyor 7 will travel slightly more than one sheet length. Eraser 31 will remove the signal from magnetic tape 27. In this manner sheets which have pinholes or are off-gauge may be segregated from prime sheets. Any other type of gauge or detector might equally well be substituted for a thickness gauge and pinhole detector.

In Figure 3 we have shown a similar apparatus which will segregate off-gauge sheets from sheets containing pin-

holes. We provide separate belts and circuits for the thickness gauge and separate belts and circuits for the pinhole detector. In this way we are able to classify the sheets as off-gauge, pinhole and prime sheets. Rather than using two sets of magnetic tapes we might equally well impose separate signals side by side on different tracks of the same tape. It will be apparent to those skilled in the art that we can easily place other inspecting means in the sheet classifier to make any number of desired classifications and that we might use other means than magnetic tapes to retain our signals.

While we have shown and described certain present preferred embodiments of our invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied within the scope of the following claims.

We claim:

1. Sheet classifying apparatus in which strip approaches shear means and sheets are cut from the strip and carried away from the shear means, said apparatus comprising shear means, conveyor means moving away from said shear and carrying sheets away from said shear at a higher speed than the strip approaches the shear to a point of classifying, magnetic signal retention means synchronized to the strip speed, strip defect detecting means positioned to scan said moving strip and detect flaws therein, signal means actuated by said defect detecting means and impressing a signal on said magnetic means when a defect is detected, signal pick-up means in spaced relation from the signal means whereby said signal is picked up when the defect passes the point of shearing, holding means actuated by said signal, second magnetic signal retention means synchronized to the speed of the sheet conveyor, second signal means actuated by the cutting means and holding means to impress a signal on said second magnetic means when a defective section is cut, and second pick-up means in spaced relation from the second signal means to pick-up signals on said second magnetic means when a defective sheet approaches the point of classifying, said second signal means and second pick-up means being adjustably positioned relative to said second magnetic means.

2. Sheet classifying apparatus in which strip approaches shear means and sheets are cut from the strip and carried away from the shear means, said apparatus comprising shear means, conveyor means moving away from said shear and carrying sheets away from said shear to a point of classifying at a higher speed than the strip approaches the shear, strip fault detection means, magnetic signal retention means synchronized to the strip speed, signal means in operative relationship with said detection means and operable to impress a signal on said magnetic means corresponding to faults in the strip, signal pick-up means positioned to pick-up signals when a fault passes the point of shearing, signal holding means in operative relation with said pick-up means, second magnetic signal retention means synchronized to the speed of the conveyor means, second signal means associated therewith and said shear means whereby a held signal is impressed upon said second magnetic means when a sheet having a fault is cut from the strip, second pick-up means in operative relation with classifying means and positioned to pick-up signals from said second magnetic means and operate said classifying means, said second pick-up means being in adjustably spaced relation from said second signal means whereby said classifying means is operated as a defective sheet closely approaches said classifying means.

3. Sheet classifying apparatus in which strip approaches shear means and sheets are cut from the strip and carried away from the shear means, said apparatus comprising shear means, conveyor means moving away from said shear and carrying sheets away from said shear to a point of classifying at a higher speed than the strip approaches the shear, strip fault detection means, magnetic signal retention means synchronized to the strip speed, signal means in operative relationship with said detection means and operable to impress a signal on said magnetic means corresponding to faults in the strip, signal pick-up means positioned to pick-up signals when a fault passes the point of shearing, signal holding means in operative relation with said pick-up means, second magnetic signal retention means synchronized to the speed of the conveyor means, second signal means associated therewith and said shear means whereby a held signal is impressed upon said second magnetic means when a sheet having a fault is cut from the strip, second pick-up means in operative relation with classifying means and positioned to pick-up signals from said second magnetic means and operate said classifying means, said second pick-up means being in adjustably spaced relation from said second signal means whereby said classifying means is operated as a defective sheet closely approaches said classifying means, and third pick-up means in adjustable spaced relation to said second pick-up means to return said classifying means to position closely following passage of a defective sheet.

4. Sheet classifying apparatus in which strip approaches shear means and sheets are cut from the strip and are carried away from the shear means, said apparatus comprising shear means, conveyor means moving away from said shear and carrying sheets away from said shear to a point of classifying at a higher speed than the strip approaches the shear, magnetic signal retention means synchronized to the speed of the strip, means inspecting said strip for faults, signal means in operative relation with said inspecting means and said magnetic means whereby signals are impressed on said magnetic means responsive to said inspection, signal pick-up means whereby said signals are picked up from said magnetic means when the corresponding strip passes beyond the point of cutting, signal holding means actuated by said pick-up means, second magnetic signal retention means synchronized to the speed of said conveyor, second signal means associated therewith and in operative relationship with said signal holding means and said shear means whereby held signals are placed upon said second magnetic means at the time of cutting, second pick-up means in adjustable spaced relation to said signal means whereby said signals are picked up shortly before sheets corresponding to said signals reach the classifying apparatus, said second pick-up means being in controlling relation to said classifying apparatus whereby defective sheets are separated from prime sheets.

5. Sheet classifying apparatus in which strip approaches shear means and sheets are cut from the strip and are carried away from the shear means, said apparatus comprising shear means, conveyor means moving away from said shear and carrying sheets away from said shear to a point of classifying at a higher speed than the strip approaches the shear, magnetic signal retention means synchronized to the speed of the strip fault inspecting means, signal means adjacent said magnetic means and in operative connection with said inspecting means whereby signals are impressed upon said magnetic means corresponding to faults in the strip, pick-up means positioned adjacent said magnetic means whereby said signals are picked up when the corresponding faults pass the shear, signal holding means receiving signals from said pick-up means, an endless magnetic tape synchronized to the speed of the sheet conveyor, second signal means adjacent thereto and actuated by the shear means and said holding means to impress held signals on said tape when a fault containing sheet is cut, and second signal pick-up means adjacent said tape and in adjustable spaced relation from said second signal means whereby classifying means in operative connection with said second pick-up means are actuated thereby shortly before a fault containing sheet arrives at the point of classifying.

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