

United States Patent

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[56]

References Cited

UNITED STATES PATENTS

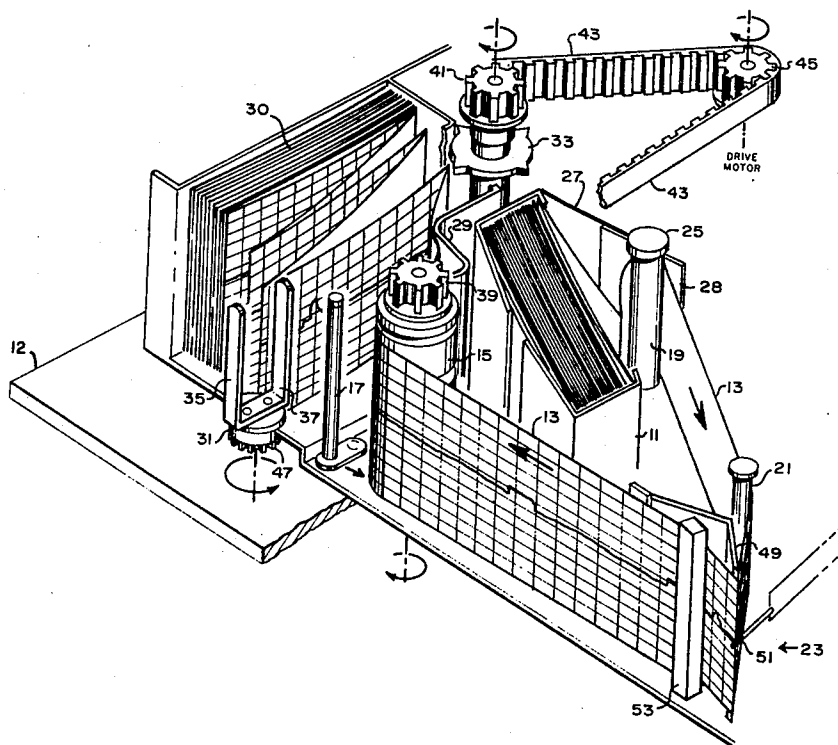
2,446,400	8/1948	Woolley	346/136X
3,082,970	3/1963	Rasmussen	346/136X
3,427,635	2/1969	Siegelman et al.	346/76X
3,438,049	4/1969	Polster	346/136X

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[54] **HORIZONTAL Z-FOLD RECORDER**
 12 Claims, 3 Drawing Figs.

[52] U.S. Cl. 346/76,
 346/136, 270/61, 197/133
 [51] Int. Cl. G01d 15/30
 [50] Field of Search 346/136,
 76, 22; 270/61 (F), 52.5, 79; 197/133 (F);
 226/(Inquired)

ABSTRACT: A strip chart recording mechanism unfolds Z-folded paper from a supply stack and guides the paper past a recording station. The paper is then refolded and stacked in a Z manner. The mechanism operates to feed the paper horizontally with respect to a ground plane. The recording station includes two knife edges for engaging opposite surfaces of the paper. One knife edge serves as a recording platen in conjunction with a writing stylus, and the other knife edge counteracts the effect of the first knife edge on the Z-fold creases in the paper.



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2 Sheets-Sheet 1

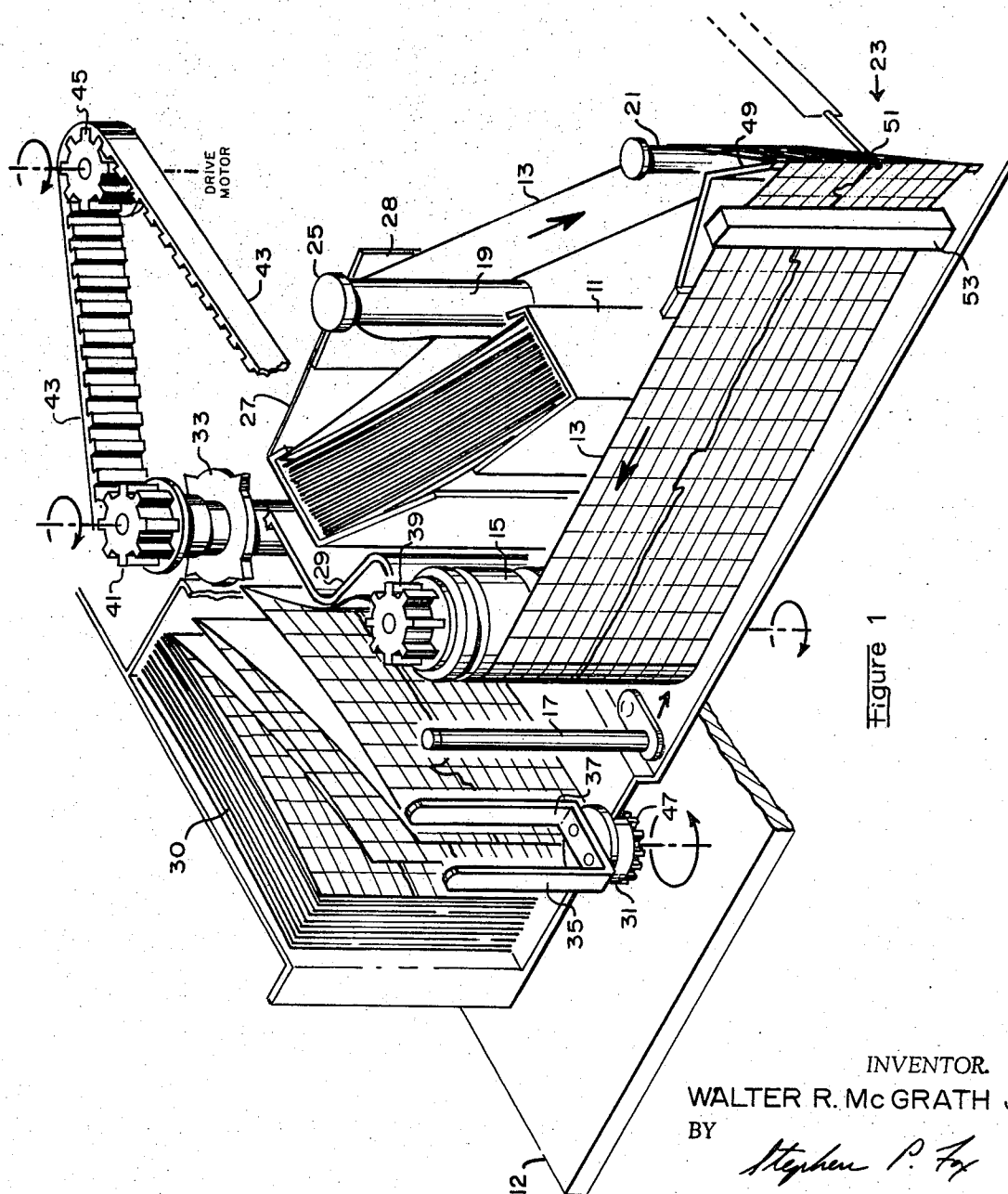
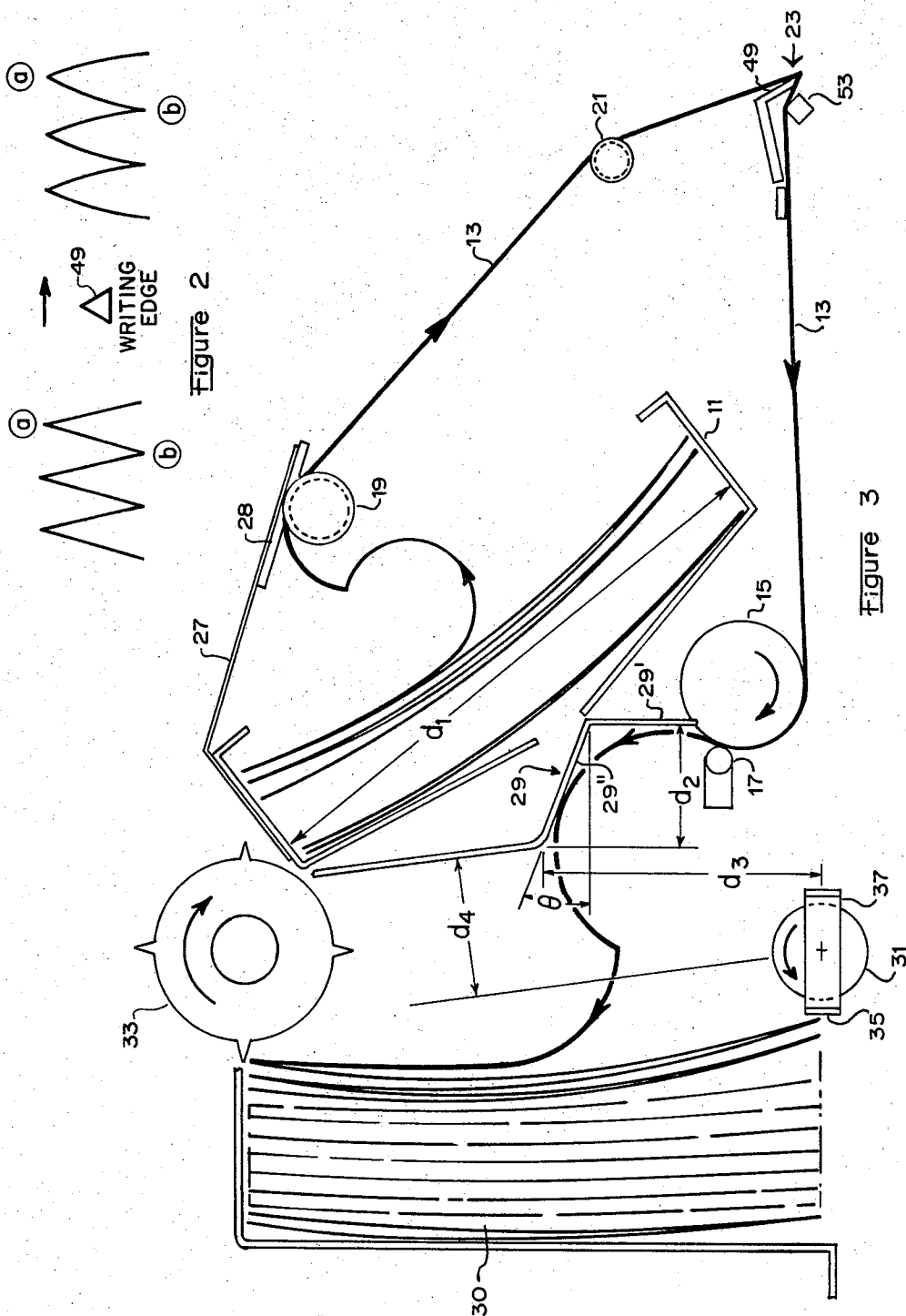


Figure 1

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HORIZONTAL Z-FOLD RECORDER

BACKGROUND OF THE INVENTION

In a typical strip chart recorder, paper in continuous form is fed past a recording station where it is selectively marked. The continuous paper may be supplied from either a roll or a stack of paper, the latter of which is manifolded in a zigzag or Z manner. The Z-folded paper is creased in opposite directions at regular intervals to permit stacking of the paper in a compact manner. Also, the crease lines are often perforated so that the paper may be easily separated into individual sheets.

Prior art recording devices have used Z-folded paper as the recording medium; however, such devices generally feed the paper vertically with respect to a ground plane. In this type of system, there is reliance on the effects of gravity to properly unfold the paper from a supply stack, and refold the paper into a receiving stack after it has passed a recording station. A gravity feed system severely limits the possible applications of the recording device. For example, such a system will not operate where horizontal paper feeding is required, and numerous problems may arise when the paper feed is slightly off vertical.

The recording station should be operable to provide definitive, clear markings on the paper with a minimum of distortion. One method of achieving this capability is to pass thermally or electrically sensitive paper over a knife edge and mark the paper with a controllable writing stylus positioned for engagement with the paper along the knife edge. Several problems appear in a recording system of this type when Z-folded paper is used. One of these is that the knife edge over which the paper is passed has an adverse effect on the crease lines along which the paper is folded. In particular, after the crease lines are pulled across the knife edge, the folds in one direction become more sharply pronounced whereas the alternate folds in the opposite direction become less pronounced. As a result, the paper will not properly bend so as to be refolded into a stack.

SUMMARY OF THE INVENTION

In the illustrated embodiment of the transport mechanism and recording system of the present invention, a Z-folded web such as strip chart paper is unfolded from a supply stack and fed past a recording station and then refolded into a receiving stack. The entire paper unfolding, feeding, and refolding operation is achieved in a plane horizontal to the ground plane without reliance on gravity feed effects. The transport mechanism of the invention includes the combination of a paper supply bin and guide members configured to cause Z-folded sheets to pop out of the bin singly in succession. The unfolded paper is then pulled in a tensed condition past a recording station by drive roller means. Directing means and power driven stacker means operate to receive the paper from the drive roller means and refold the paper in a Z manner into a firmly packed stack.

The recording station of the invention includes a platen having a sharp edge slidably engaging one surface of the paper and a movable writing stylus biased against the opposite surface of the paper adjacent to the sharp edge. The recording station also features a second sharp-edged member which slidably engages the paper on the same surface as the writing stylus. The second sharp-edged member operates to counteract the effect of the sharp-edged platen on the crease lines of the paper so that the crease lines do not become more or less pronounced compared to the direction of the original folds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view of the preferred embodiment of the transport and recording mechanism of the present invention.

FIG. 2 is a diagrammatic illustration of the effects of a sharp-edged recording platen on the crease lines of one type of Z-folded paper.

FIG. 3 is a plan view of a portion of the preferred embodiment of the invention shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, a paper transport mechanism includes a supply bin 11 for holding a compacted stack of strip chart paper which is manifolded in a zigzag manner. The stack of paper is supported on one lateral edge thereof, so that the folded edges are substantially vertical with respect to a ground plane 12. The bin 11 is shaped so that the sheet sections defined by the folds in the paper are fed out of the bin singly in succession, as hereinafter described.

The paper in the supply stack is unfolded and directed along a path of travel 13 in the direction of the arrows. The paper is pulled along its path of travel 13 by a drive roller 15 having a rubber surface which frictionally engages the paper. Another roller 17 is adapted for movement into contact with the drive roller 15 during operation of the transport mechanism to thereby pinch the paper between rollers 15, 17 and thus insure a good frictional drive free of slippage.

As the paper is pulled out of the bin 11, it is directed around first and second guideposts 19, 21 and then to a transducing station 23, described in detail hereinafter. A hub 25 on guidepost 19 serves to hold down the paper as it travels along its path; and the two guideposts 19, 21 are positioned so that the paper is aligned and properly fed to the transducing station 23. A spring plate 27 resiliently urges an attached Teflon sheet 28 toward the guidepost 19 and into frictional engagement with the paper to thereby create a drag on the paper against the pull produced by the drive roller 15. This drag produces a slight tension in the paper which is required for it to be properly marked at the transducing station 23.

On the downstream side of the drive roller 15, the paper is stripped from engagement with this roller and directed toward a receiving stack by a shaped plate member 29. A portion of the plate member 29 serves to receive the paper from the drive roller 15 and urge it in a direction such that the paper is refolded in a zigzag manner along its original crease lines, as hereinafter described. The loosely refolded paper is then pushed into a receiving stack 30 by front and rear power driven paper stacker wheels 31, 33. The front paper stacker wheel 31 has two spindles 35, 37 which catch the front fold edges of the refolded paper and propel them toward the receiving stack 30. The rear paper stacker includes an upper wheel 33, and a similarly configured lower wheel (not shown), each of which has four points on its periphery for engaging the rear folds of the paper and propelling them toward the stack 30.

The paper drive roller 15 and the rear paper stacker member 33 are driven through their respective gears 39, 41 in the directions shown by the arrows. The gears 39, 41 are linked by a continuous drive belt 43 which is driven by a gear 45 connected to the shaft of a motor (not shown). The front stacker member 31 is also power driven through a gear 47 on the lower portion thereof by a similar drive belt which is coupled to the motor.

The transducing station 23 includes a sharp-edged platen 49 which is longitudinally aligned transversely to the direction of travel of the paper, and over which the paper is pulled in its tensed condition. A writing stylus 51 is positioned for engaging the surface of the paper opposite to that in contact with the sharp-edged platen 49. The writing stylus may be an electrically heated element which is resiliently biased against the paper and movable in sliding contact therewith so as to mark the paper in accordance with a driving signal by selectively melting a thermally sensitive coating on the paper as it passes over the platen 49.

The effect of the sharp-edged platen 49 on the crease lines of the paper is illustrated in FIG. 2. As shown in the left-hand portion of this FIG., the paper is creased at points *a* and *b* in opposite senses, so that if the paper is unfolded, it has a tendency to refold in its original condition, with the folds in op-

posite senses being equally pronounced. However, after the paper has been unfolded and passed over a sharp-edged writing platen, the crease lines may be affected such that when the paper is refolded, the folds in one direction, i.e., at point *a*, are less pronounced, whereas the folds in the opposite direction, i.e., point *b*, are more pronounced. This effect is particularly evident in the case where the paper is perforated along the crease lines and all of the perforations are cut from the same side of the paper. As a result, the paper is more difficult to refold into a tightly packed stack.

The adverse effect of the sharp-edged platen 49 shown in FIG. 2 is counteracted by a second sharp-edged member 53 which is positioned parallel to the platen 49 and which engages the other paper surface with respect to that engaged by the platen 49. The sharp-edged member 53 serves to reverse the unequal pronunciations of the folds in opposite directions and return these folds to their original conditions. As shown in FIG. 1, the sharp-edged member 53 is positioned downstream of the writing platen 49; however, alternatively member 53 may be positioned for engagement with the surface of the paper at a point upstream of the platen 49 to accomplish the same results on the folds of the paper.

The path of travel of the paper is shown in more detail in FIG. 3, which is a plan view of a portion of the horizontal Z folding transport mechanism of FIG. 1. With reference to FIG. 3, it can be seen that the bin 11 is configured such that its end plates contiguous with the paper folds are separated by a distance d_1 which is slightly less than the linear distance between successive folds of the manifolded paper. For example, if the distance between successive folds is 6 inches, then the dimension d_1 is preferably about 5.9 inches. With this end plate configuration, the manifold stack of paper is caused to bulge slightly. Guidepost 19 is spaced apart from the bin and positioned slightly closer to one end plate of the bin than the other end plate. The effect of the configuration of bin 11 and the location of guidepost 19 is to cause successive connected sheets of paper to pop out of the bin singly in succession as the paper is unfolded from the supply stack.

As stated hereinabove, the paper travels from the guidepost 19 to the drive roller 15 in a tensed condition due to the pull on the paper by the roller 15 against the drag produced by the frictional surface of the Teflon sheet 28 attached to the spring plate 27. The path of travel 13 followed by the paper past the transducing station 23 is clearly shown in FIG. 3. The paper is directed through an acute angle path around the knife edge recording platen 49, and then into engagement with the knife edge reversing member 53. Preferably the reversing member 53 is rotatable on its longitudinal axis to permit adjustment of its degree of engagement with the moving paper. In the case where the folds of the paper are weak, because the fold lines are perforated for separation of the paper into individual sheets, for example, the tension in the paper and/or the path of travel of the paper past the transducing station 23 may be changed to avoid undesirable tearing of the paper along the fold lines as it passes the knife-edged platen 49.

In FIG. 3, the idling roller 17 is shown moved into a position so as to pinch the paper against the drive roller 15 and thus to insure good frictional contact over about one-third of the periphery of roller 15. The roller has a rubber surface with axially spaced peripheral grooves therein (see FIG. 1). The guide plate 29 includes a portion 29' having teeth (not shown) which project into the grooves of the drive roller 15. The toothed portion 29' insures that as the paper leaves the roller 15, it is properly stripped therefrom.

After the paper leaves the roller 15, it strikes the angled surface portion 29'' and is directed toward the receiving stack. The angular position and dimensions of the guide plate 29 are selected so that the paper is refolded with the outside fold shown in FIG. 3 being directed toward the front stacker wheel 31, and the other fold in the opposite sense being directed toward the rear stacker wheel 33. Of the two folds in opposite senses, the outside fold shown in FIG. 3 is the more difficult one to refold and propel into the receiving stack. The refold-

ing of this outside fold is largely dependent on the configuration of the guide plate 29. By way of example, if the linear distance between successive folds in the paper is 6 inches, it has been found that the folds are directed alternately to the front and rear paper stackers when the guide plate 29 is configured with the following approximate dimensions: $d_2=1.2$ inches, $d_3=2.9$ inches, $d_4=1.4$ inches and the angle $\theta=20^\circ$.

Finally, after the paper leaves the directing surface 29'' and becomes loosely folded in a Z manner, the fold edges are caught by the stacking members 31, 33 and propelled toward the receiving bin 30 where the paper is tightly compacted in a stack.

I claim:

1. A transport mechanism for feeding a continuous manifolded web along a horizontal path of travel from a supply stack to a receiving stack comprising:

a bin for containing said supply stack, said bin being configured for holding said supply stack so that the folded edges of said manifolded web are disposed substantially vertically with respect to a ground plane;

means for guiding said manifolded web out of said bin horizontally with respect to said ground plane as said web is unfolded from said supply stack;

a transducing station disposed along the path of travel of said web and downstream of said guiding means for operating on said web in a selected manner;

drive means disposed in engagement with said web along said path of travel for pulling said web past said transducing station;

directing means disposed adjacent to and downstream from said drive means for engaging said web and urging said web toward said receiving stack and for causing successive fold edges of said web to be refolded in opposite senses; and

power driven stacker means disposed for engagement with the refolded edges of said web for urging said web into said receiving stack.

2. The transport mechanism of claim 1, wherein said bin includes two end plates contiguous with the folded edges of said manifolded web forming said supply stack, said end plate being spaced apart a distance less than the distance between successive folds of said web to produce a slight curve in said supply stack, thereby causing the folds of said web to pop out of said bin singly in succession.

3. The transport mechanism of claim 1, wherein said guiding means includes a guide post engaging said web and having a longitudinal axis transverse to the path of travel of said web, said guide post being positioned adjacent to said bin and intermediate the end plates of said bin.

4. The transport mechanism of claim 3, further including spring means for resiliently biasing said web against said guide post to provide a drag against the pull on said web produced by said drive means to thereby produce tension in said web.

5. The transport mechanism of claim 1, wherein said transducing station includes:

a first sharp-edged platen engaging one surface of said web and having a longitudinal axis transverse to the path of travel of said web;

a controllable writing stylus positioned for contacting the other surface of said web opposite to said platen; and

a second sharp-edged member engaging said other surface of said web and having a longitudinal axis transverse to the path of travel of said web, said second sharp-edged member being operable to insure that the folds of said web are restored to their original condition.

6. The transport mechanism of claim 5, said web having a thermally sensitive coating on the surface thereof; and

said writing stylus including an electrically heated member resiliently biased against said web for melting said coating on selected surface portions of said web.

7. The transport mechanism of claim 1, wherein said drive means includes a pair of pinch rollers disposed adjacent to one

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another on opposite surface portions of said web and in frictional engagement with said web, and wherein at least one of said rollers is power driven to move said web along its path of travel.

8. The transport mechanism of claim 1, wherein said power driven stacker means includes first and second rotatable stacker wheels positioned respectively adjacent to opposite web fold edges of said receiving stack, each of said stacker wheels having a plurality of projections for propelling said fold edges into said receiving stack.

9. The transport mechanism of claim 8, wherein said directing means includes a guide member positioned in the path of said web for deflecting the web edges folded in one sense toward said first stacker wheel and web edges folded in the opposite sense toward said second stacker wheel.

10. A strip chart recording mechanism comprising:

means for transporting a web in a tensed condition along a path of travel, said web being creased on lines transverse to the direction of travel of said web at intervals in a manner permitting said web to be manifolded in a stack;

a recording station interposed in the the path of travel of said web, said recording station including:

a platen having a sharp edge positioned transversely to the direction of travel of said web, said platen being positioned with the sharp edge thereof in sliding contact with one surface of the tensed web;

controllable writing stylus means for selectively marking the other surface of said web opposite to said platen; and

reversing means disposed in the path of said tensed web following said sharp-edged platen for counteracting the

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effect of said sharp-edged platen on the transverse crease lines in said web;

said transporting means including:

a first bin for containing a stacked Z-folded web so that the lateral edges of said web are substantially horizontal to a ground plane;

guiding and driving means for unfolding said web from said first bin and for moving said web horizontally to said ground plane along said path of travel past said recording station;

means providing a drag on said web against the direction of motion of said web for producing tension in said web in at least a portion of said path of travel;

means for refolding said web after it has passed said recording station; and

a second bin for receiving and stacking the refolded web.

11. The mechanism of claim 10 wherein said reversing means includes a member having a sharp edge positioned transversely to the direction of movement of said web and in sliding contact with said other surface of said web.

12. The mechanism of claim 11,

said web having a thermally sensitive coating on said other surface thereof;

said controllable writing stylus means including:

an electrically heated resistance element; and

means for resiliently biasing said resistance element against said other surface of said web opposite to said sharp-edged platen in sliding contact with said other surface.

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