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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B65H	A2	(11) International Publication Number: WO 97/48631
		(43) International Publication Date: 24 December 1997 (24.12.97)

(21) International Application Number: PCT/US97/12597

(22) International Filing Date: 18 June 1997 (18.06.97)

(30) Priority Data:
08/666,854 19 June 1996 (19.06.96) US

(71) Applicant: QUANTUM CORPORATION [US/US]; 500 McCarthy Boulevard, Milpitas, CA 95035 (US).

(72) Inventor: DALY, Keith; 10 Park Street, Shrewsbury, MA 01545 (US).

(74) Agents: CHEN, John, C. et al.; Quantum Corporation, 500 McCarthy Boulevard, Milpitas, CA 95035 (US).

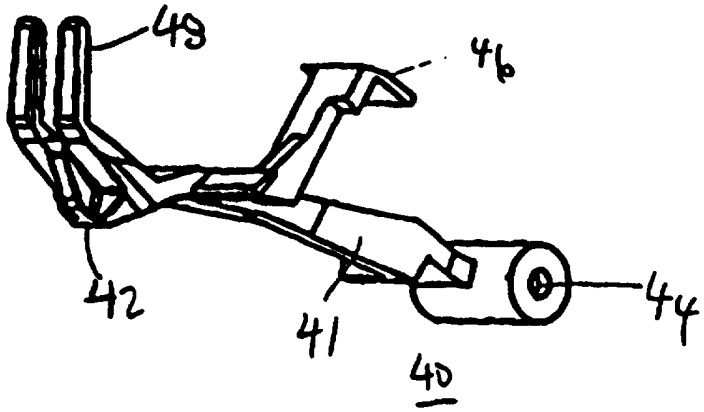
(81) Designated States: AU, CA, CN, JP, KR, NO, SG, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: TAPE BUCKLING MECHANISM FOR SINGLE REEL CARTRIDGE TAPE RECORDING

(57) Abstract

A buckling mechanism for improving buckling reliability between a take-up leader and a cartridge leader is disclosed. The mechanism includes a buckling link, buckling arm and a link driver. The buckling link is biased about one end and includes a protruding portion having a T-shape face at the other end. The combination of the dimensions of the protruding portion and the constant biasing force ensures that the leaders are positioned and remain in position for successful buckling as the tape cartridge is inserted into the tape drive. The buckling link is mounted such that it functions independently of the other components, enabling the buckling link to maintain the biasing force against the take-up leader even after the buckling arm releases the take-up leader.



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TAPE BUCKLING MECHANISM FOR SINGLE REEL CARTRIDGE TAPE RECORDING

Field of the Invention

The present invention relates to tape recording. More particularly, the present invention relates to a mechanism for buckling a take-up leader with a cartridge leader in a single reel cartridge tape drive.

Background of the Invention

A typical magnetic tape includes a plastic film, e.g. a Mylar substrate, having a costing of magnetic recording material on one side and a non-stick "back coating" on the other side of the Mylar. The tape runs between a rotatable supply tape reel, typically housed within a tape cartridge 10 such as that shown in Fig. 1a, and a rotatable take-up tape reel in the tape drive assembly 15, such as that shown in Fig. 1b. The take-up reel includes a take-up leader 50 secured therein, shown in Fig. 1b, while the supply reel includes a cartridge leader 30 at one end of the tape, shown in Fig. 1a. As the tape cartridge 10 is inserted into a tape drive, the take-up leader 50 locks with cartridge leader 30 and pulls and transfers the tape from the supply reel to the take-up reel. The procedure of locking the take-up leader 50 with the cartridge leader 30 is known as "buckling". Typically, the buckling process is automatic is response to the tape cartridge being inserted into the tape drive.

Fig. 2a shows the cartridge leader 30 including a cartridge leader hoop 39. The hoop 39 includes a notch area 32. The hoop 39 is dimensioned to enable a take-up leader nose 51 and a take-up leader neck 55, both shown in Fig. 2b, to pass therethrough. The notch 32 is dimensioned to enable the neck 55 to pass therethrough, but prevent the nose 51 from passing therethrough. Thus, in a buckled position, the nose 51 is locked against the notch 32 about take-up leader ears 56 and 57. Fig. 2b also shows a take-up leader window 52 enabling a buckling mechanism to engage the take-up leader 50. Commonly assigned U.S. Patent Nos. 4,662,049 and 4,720,913 provide examples of prior tape buckling arrangements and structures.

During the buckling process, various factors may cause unsuccessful buckling, some leading to complete failure of the tape drive. For example, over an extended period of usage, the take-up leader may develop a condition called "curl in". In this state, the take-up leader tends to "curl" away from the cartridge leader hoop, making a successful buckling operation less likely. In addition, if the tape cartridge is not loaded into the drive, the cartridge leader may be buckled in a misaligned manner.

Prior buckling mechanisms of the type generally described in the referenced patents have not been designed to compensate for leader curl or misaligned cartridges. Two common buckling failure modes are "leader runaway" and "half-buckling". Leader runaway occurs when the leaders are not completely locked, and the take-up leader unbuckles before the cartridge leader has been pulled into the take-up reel. Half-buckling occurs when only one ear of the take-up leader nose engages and locks to the cartridge leader hoop often resulting in leader runaway. Leader runaway if a failure which cannot be fixed by the end user and requires the tape drive to be returned to the manufacturers for repair. Thus it is imperative for tape drive manufacturers to ensure that a possibility of leader runaway, as well as any unsuccessful buckling, be minimized.

The present invention provides a buckling mechanism which improves the reliability of the buckling process by minimizing the failure modes mentioned herein above.

Summary of the Invention with Objects

The present invention provides a buckling mechanism disposed within a tape drive assembly which provides enhanced buckling reliability between a take-up leader and a cartridge leader. The buckling mechanism includes a buckling link, a buckling arm, and a link driver. The buckling link includes a protruding portion at one end and is pivotably biased about the other end. The protruding portion is dimensioned to contact and guide the take-up leader into a locking relationship with the cartridge leader, as the cartridge leader is loaded into the drive. The combination of the biasing force and the size dimension of the protruding portion enables the buckling link to maintain constant contact with the take-up leader throughout the buckling process ensuring that the leaders do not lose locking relationship. The buckling arm releasably engages with the take-up leader, pulling the take-up leader into the locking position with the cartridge leader. The link driver includes a cam portion for contacting the cartridge. The link driver is also coupled to the buckling arm thereby providing cammed movement for the buckling arm. In addition, the buckling link is mounted such that it functions independently of the other components, enabling it to maintain the biasing force against the take-up leader even after the buckling arm releases the take-up leader.

Brief Description of the Drawings

In the Drawings:

Fig. 1a is an isometric view in elevation of a prior art single-reel tape cartridge including a cartridge leader therein.

Fig. 1b is a front view in elevation of a front panel of a prior art tape drive, showing a take-up leader inside the tape drive, located at a nominal position to engage a cartridge leader upon cartridge insertion.

Fig. 2a is an enlarged plan view of a prior art cartridge leader.

Fig. 2b is an enlarged plan view of a prior art take-up leader, having the same dimensional scale as the Fig. 2a cartridge leader.

Fig. 3a is an enlarged isometric view of the buckling mechanism in accordance with principles of the present invention.

Fig. 3b is an enlarged isometric view of the buckling link shown in Fig. 3a.

Fig. 3c is a plan view of the protruding portion of the Fig. 3b buckling link shown cut away from the other portion of the buckling link of Fig. 3b.

Fig. 3d is a side view in elevation of the protruding portion of Fig. 3c, shown cut away from the other portion of the buckling link of Fig. 3b.

Figs. 4a, 4b and 4c are isometric views showing the functional relationships between the buckling mechanism and the take-up leader and cartridge leader in successive stages of the tape buckling operation employing the Fig. 3a improved buckling mechanism.

Detailed Description of a Preferred Embodiment

In accordance with principles of the present invention, a buckling mechanism 70 is shown in Fig. 3a and includes three members: a buckling link 40, a buckling arm 60 and a link driver 20. Link driver 20 is pivotably biased about one end 24 and pivotably coupled to buckling arm 60 about the other end. Link driver 20 also includes a cam portion (not shown) for contacting the tape cartridge 10 as the cartridge is inserted into the tape drive 15. As shown in Fig. 3a, buckling arm 60 includes an elongated slot 64 at one end and a hook member 62 extending from the other end. The slot 64 fits over a pin (not shown), enabling the buckling arm 60 to

move rotationally as well as linearly, relative to the drive 15. This translational movement, in turn, enables the hook member 62 of the buckling arm 60 to releasably engage the take-up leader 50 without interfering with tape travel.

The buckling link 40 is presented in detail in Fig. 3b and includes a protruding portion 42 extending from one end of an elongated body 41. Finger-like members 48 also extend from the same end, away from the protruding portion 42. The buckling link 40 is pivotably biased about an opposite end 44, and a spring (not shown) provides a constant rotational biasing force to the protruding portion 42 towards the leaders. An arm 46 extends away from the body 41 at a location intermediate the two ends. During a buckling mechanism assembly process, the arm 46 functions to maintain the link 40 in concert with other members of the buckling mechanism 70.

In the preferred embodiment, the protruding portion 42 includes an improved tapered plateau region defining a T-shaped face 43, shown in Fig. 3c, for contacting and guiding the take-up leader 50 into a locking position with the cartridge leader 37. Specifically, the T-shaped face 43 includes a wide portion W1 and a narrower portion W2. Wide portion W1 is dimensioned sufficiently wider than the width of the neck 55 for guiding the nose 51 and the neck 55 into a penetrating relationship with the hoop 39 as well as for preventing the neck from "slipping" off the T-shaped face 43. The narrow portion W2 is also wide enough to prevent the neck 55 from slipping and possibly half-buckling. In the present embodiment, the wide portion W1 exhibits a nominal width of approximately 0.26 inches, while the neck 55 exhibits a nominal width of approximately 0.10 inches. As shown in Fig. 3d, a depth, d, of protruding portion 42 is dimensioned to ensure that the take-up leader nose 51 penetrates through the cartridge leader hoop 39 as the cartridge 10 is inserted into the drive 15.

As shown in Fig. 3a, the buckling link 40 functions independently of the buckling arm 60 and the link driver 20. This enables the protruding portion 42 to maintain biased contact against the take-up leader 50, keeping the take-up leader nose 51 protruding through the cartridge leader hoop 39 after the buckling arm 60 has disengaged from the take-up leader 50. As will be explained herein below, these features cooperate to improve buckling reliability.

Figs. 4a - 4c show successive stages of a buckling process. At the stage depicted in Fig. 4a, the tape cartridge 10 has been inserted into the tape drive 15, but not fully installed, i.e. the cartridge 10 has not contacted the link driver 20. As shown, take-up leader 50 is engaged by the buckling arm hook member 62 through the take-up leader window 52. As the cartridge leader 37 approaches the take-up leader 50,

the protruding portion 42 forces the neck 55 and the nose 51 of the take-up leader 50 to penetrate through the hoop 39. In this preferred position, the take-up leader 50 is in position to successfully buckle with the cartridge leader 37 once tension is applied to the take-up leader 50. On the other hand, if the take-up leader is not sufficiently pushed through the hoop 39, take-up leader nose 51 may not lock into the notch 32 of hoop 39 when tension is applied. In addition, if the protruding portion 42 releases contact with the take-up leader 50 before tension is applied, the nose 51 may half-buckle with the hoop 39. Leader curl would further increase this possibility.

As the cartridge 10 is further inserted and fully installed, depicted in Fig. 4b, the cartridge 10 contacts the link driver 20, rotating the link driver 20 and the buckling arm 60. As buckling arm 60 is being rotated, it is also moving linearly about slot 64, enabling the hook member 62 to disengage with the take-up leader window 52 without contacting the leader 50. At this stage, only the protruding portion 42 remains in contact with the take-up leader 50 and the take-up leader nose 51 continues to penetrate through the cartridge leader hoop 39. At the same time, the take-up leader neck 55 is securely supported on the T-shaped face 43 of the protruding portion 42. As previously mentioned, the T-shaped face 43 is advantageously dimensioned to prevent the neck 55 from "slipping off" of the protruding portion 42, thereby minimizing half buckling failures. Again, without the protruding portion 42 remaining in contact with the take-up leader 50, the nose 51 may not sufficiently protrude into the hoop 39 to successfully buckle therewith.

During the final stage of buckling represented in Fig. 4c, the take up reel of the drive 15 applies tension to the take-up leader 50, pulling the take-up leader neck 55 through the notch 32 of the hoop 39 and the take-up leader nose 51 into a locked relationship with the notch 32.

Test data have shown that the present buckling mechanism provides improved reliability over an existing buckling mechanism, particularly with curled leaders. Over 1,000,000 load/unload cycles have been executed with the present buckling mechanism without a detected occurrence of leader runaway. Of the successful cycles, 400,000 were conducted with curled leaders. Each cycle consisted of loading a tape cartridge into a tape drive, transferring the tape from the cartridge to the take-up reel, then rewinding the tape back onto the supply reel and unloading the cartridge. In marked contrast, the prior art buckling mechanism has not on average been able to execute in excess of 13 load/unload cycles with curled leaders without exhibiting leader runaway failure. Failure of the prior buckling mechanism has been undesirably

very repeatable when leader curl is present. The new invention overcomes this drawback of the prior mechanism.

To those skilled in the art, many changes and modifications will be readily apparent from consideration of the foregoing description of a preferred embodiment without departure from the spirit of the present invention, the scope thereof being more particularly pointed out by the following claims. The descriptions herein and the disclosures hereof are by way of illustration only and should not be construed as limiting the scope of the present invention which is more particularly pointed out by the following claims.

What is claimed is:

1. A mechanism for guiding a take-up leader secured at one end to a take-up reel of a tape drive to a cartridge leader connected at a first end to a supply tape reel rotatably disposed about a tape cartridge, the take-up leader including a nose disposed about a second end supported by a neck that is narrower than the nose, the cartridge leader including a second end with a hoop for permitting the nose and the neck of the take-up leader to pass therethrough, the hoop including a notch for permitting the neck to pass therethrough while preventing the nose from passing therethrough, the mechanism comprising:

an elongated member pivotably biased about a first end to provide a biasing force about a second end;

a protruding portion formed about the second end, the protruding portion being contoured to contact and guide the nose and neck into a locking relationship with the hoop wherein the nose and neck penetrate into the hoop; and

the protruding portion being sized to push maintain constant biased contact against the nose and neck after the nose and neck have penetrated the hoop such that rotation of the take-up reel draws the nose against the notch of the hoop, thereby buckling the take-up leader and the cartridge leader together.

2. The mechanism of claim 1 further comprising means for releasably engaging the take-up leader.

3. The mechanism of claim 2 wherein the means for releasably engaging the take-up leader releases the take-up leader after the take-up leader has penetrated the hoop during cartridge loading.

4. The mechanism of claim 3 wherein the means for releasably engaging the take-up leader engages the take-up leader after the take-up leader has unlocked from the cartridge leader during cartridge unloading.

5. The mechanism of claim 4 wherein the means for releasably engaging the take-up leader comprises a hook like member dimensioned to extend through and engage a window in the take-up leader.

6. The mechanism of claim 5 wherein the means for releasably engaging the take-up leader further comprises a first arm pivotably biased about a first end and rotationally coupled to a second arm at the second end, the hook like member extends from a first end of the second arm while a second end of the first arm is mounted to provide both rotational and linear movement of the second arm for facilitating releasable engagement with the take-up leader.

7. The mechanism of claim 6 wherein the elongated member functions independently of the first arm and the second arm.

8. The mechanism of claim 1 wherein the protruding portion includes a T-shaped face for contacting the take-up leader.

9. The mechanism of claim 3 wherein the protruding portion remains in biased contact with the take-up leader after the means for releasably engaging releases the take-up leader.

10. The mechanism of claim 8 wherein the T-shaped face includes a portion having a width greater than a width of the neck.

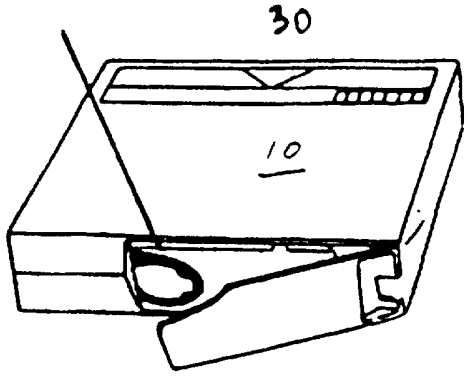

Fig 1a (prior art)

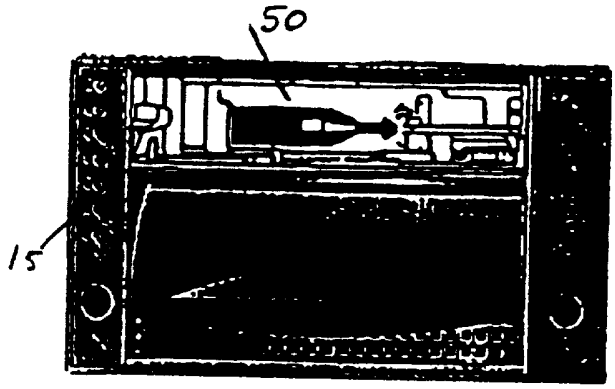

Fig 1b. (prior art)

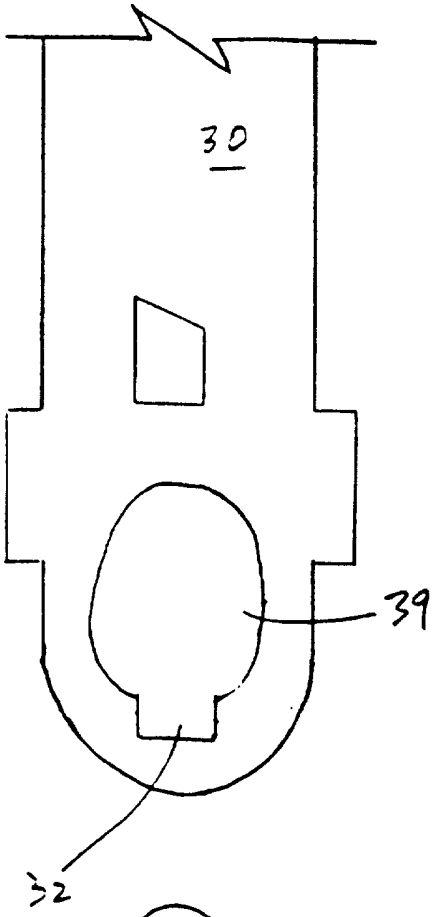

Fig 2a
(prior art)

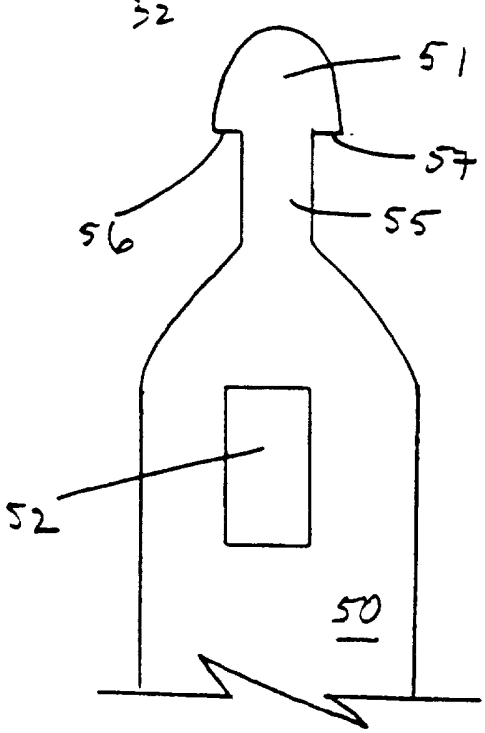

Fig 2b
(prior art)

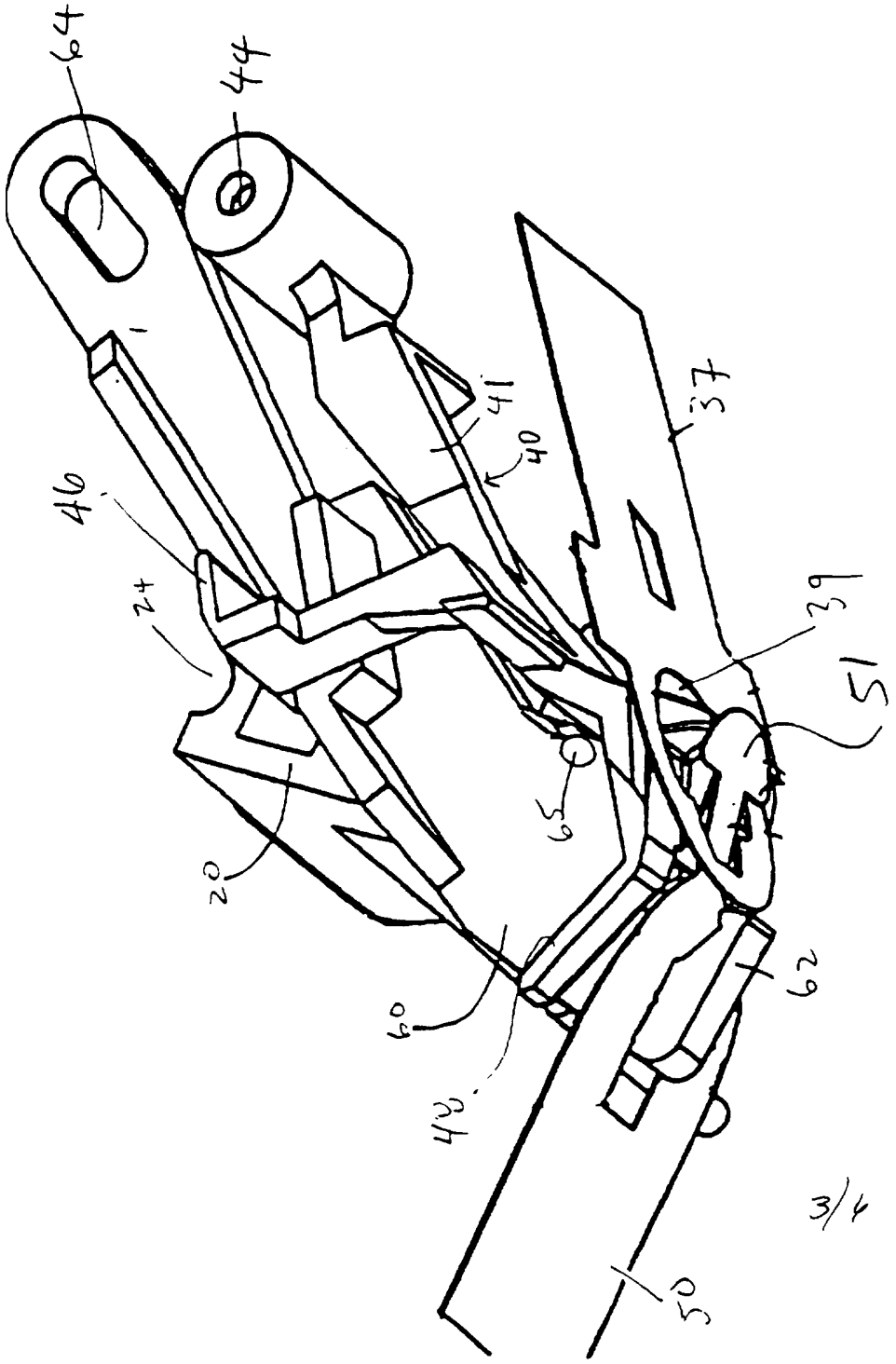

Fig 3a

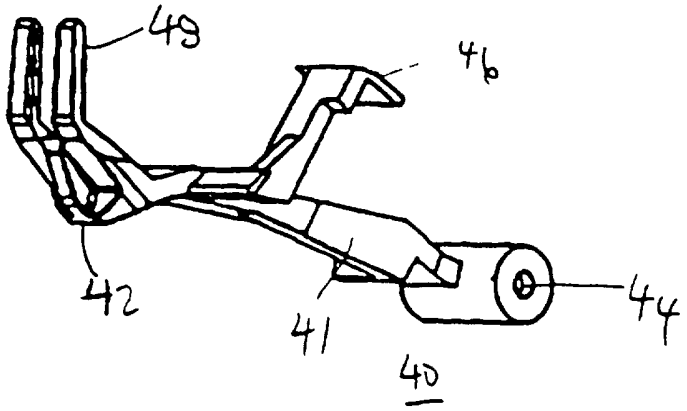

Fig 3b

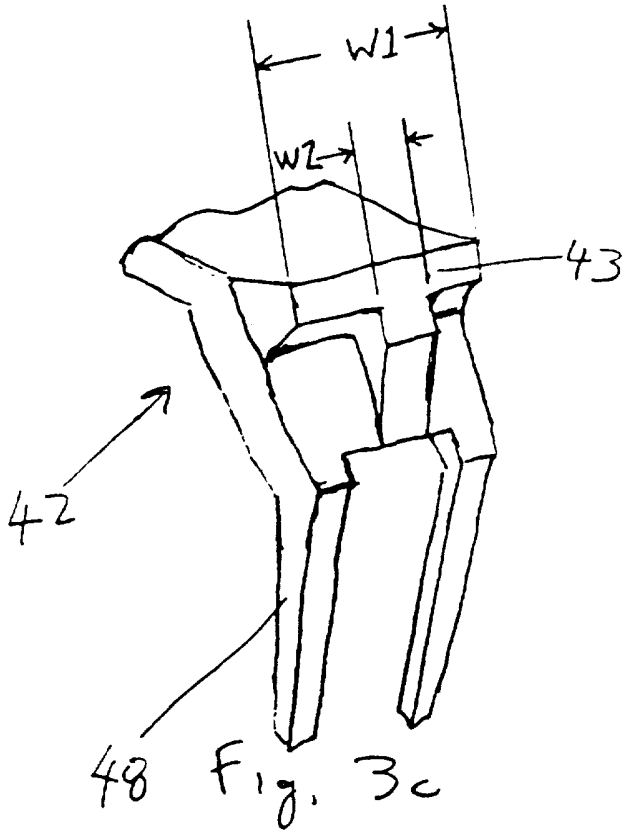

Fig. 3c

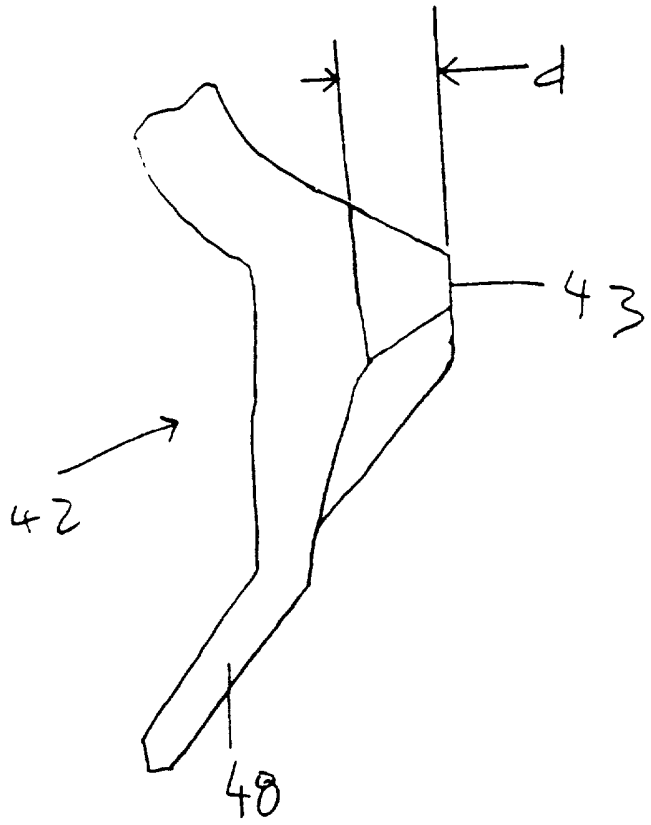

Fig 3d

Fig 4a

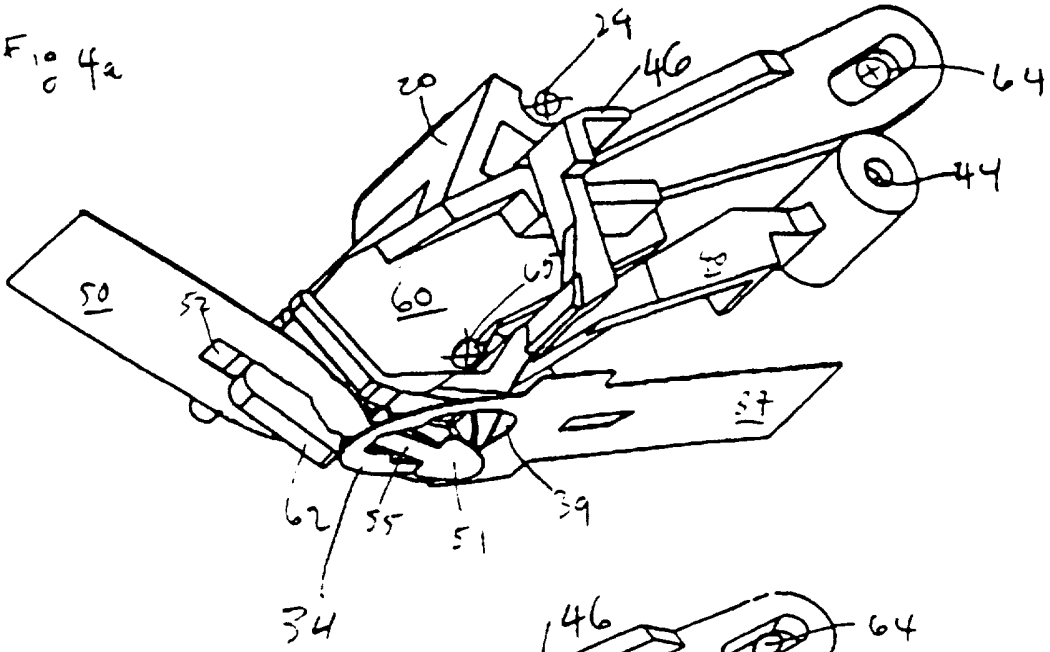

Fig 4b

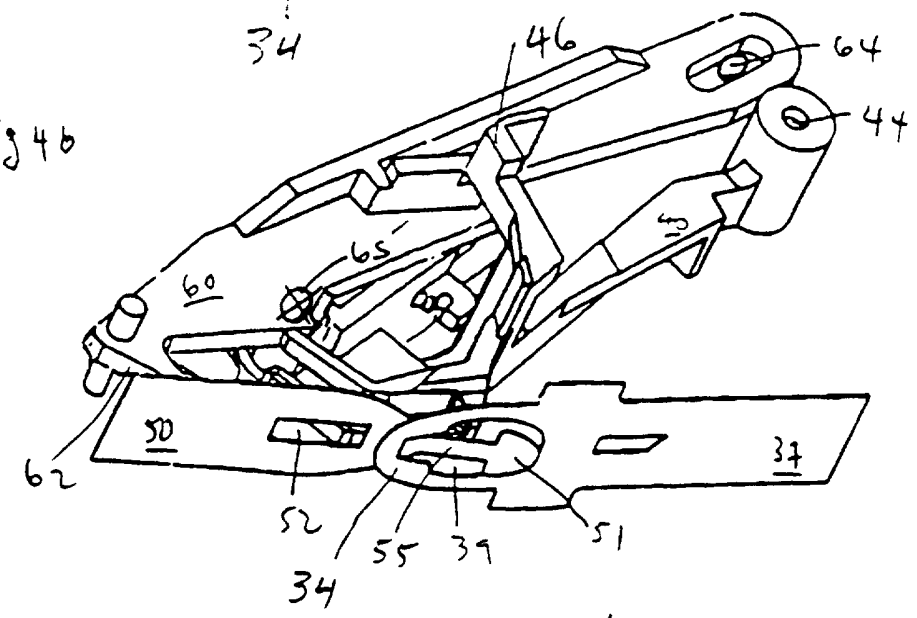

Fig 4c