An apparatus for folding a length of cable interconnecting electrical components mounted to a chassis and to a drawer movably supported by the chassis. When the drawer is retracted the cables are arranged in closely adjacent loops with movable support cards carrying halves of the loops. Withdrawal of the drawer pulls the loops apart in the direction of movement of the drawer and pivots the cards towards their mutual alignment to thereby increase the effective length of the cable loop according to the spacing between the drawer and the chassis.

9 Claims, 4 Drawing Figures
SELF-FOLDING CABLE CARRIER

BACKGROUND OF THE INVENTION

This invention relates to extensible cable carriers and more particularly to a cable carrier which folds the cable or cables when retracted and which maintains them in mutual alignment and/or fixed relative positions to prevent entanglement of the cables during use.

Various solutions have been devised to extensibly store lengths of cables for selective extension of the cables as, for example, when a component connected to one end of the cable is moved towards and away from a component mounted to the other end of the cable. Such solutions included cable coils, as commonly found on telephones, spring-loaded carpentry reel in mechanisms or, in instances where appearance and neatness is not required, simply excess lengths of tape. Such devices are only adapted for use with relatively heavy gauge cables comprising no more than a few strands.

The storage of extensible cable becomes difficult when large number of wire strands interconnect relatively movable electrical components. Thus, in the computer art generally and on magnetic disk storage devices in particular great numbers of wire strands are employed to form the necessary electrical connections. For example, certain recently developed magnetic disk memories employ read-write heads mounted on a drawer than can be retracted into and withdrawn from a supporting chassis. Large numbers of wire strands are required to interconnect the electronic circuitry in the chassis with the read-write head. The read-write head travels a substantial distance and thus requires a substantial excess length of wire strands. It is undesirable to leave the wire strands loose since they become entangled and can be damaged. Moreover, it is frequently highly desirable to separate certain of the strands carrying various signals to provide for an electrical noise separation.

It has been suggested to secure the wire strands to interconnect, hinged frames which can be folded together to reduce the effective cable length or extended to increase it. Frequently encountered space limitations, however, make this approach undesirable for compact electronic equipment. Moreover, the hinged frames are relatively heavy and expensive to construct.

SUMMARY OF THE INVENTION

The present invention provides a cable carrier for cables connected to relatively movable structures to prevent the entanglement of the cables while enabling changes in the distance between the structures. Briefly, the carrier comprises a plurality of plate means, means attached to one of the structures for movement between the structures, and means permitting pivotal movements of the mounted plate means about axes disposed transversely to the direction of the relative movement of the structures. Means are further provided for connecting the cable at a plurality of locations intermittently spaced over the length of the cables to the plate means so that substantially equal, alternating lengths of the cables are connected to movably mounted plate means and are freely disposed between adjacent mounted plate means. An increase in the distance between the structures causes pivotal movements of the plate means to increase the effective length of the cables in accordance with the increase in the spacing between the structures.

In the embodiment of the invention particularly adapted for the above-described use on disk memories having a drawer mounting the read-write head which can be withdrawn from the chassis, and moved up and down the front of the chassis, the plates depend downwardly from a pair of spaced guide bars and maintain the cable in loops extending towards and away from the guide bars. One-half of each loop is attached to one of the plates. A forwardmost loop is free, that is, is not attached to the guide bars, and has one-half affixed to a loose card which assures the formation of the forwardmost cable loop when the drawer is retracted and allows the horizontal withdrawal of the drawer as well as the vertical adjustment of the withdrawn drawer. Similarly, an aftmost cable loop is attached to an aft loose cable guide card which assures the formation of the rearwardmost cable loop, without being attached to the guide bars, when the drawer is retracted.

The cable-folding carrier of the present invention is compact, that is, it permits the retraction of the cables into closely adjacent loops with only thin positioning cards therebetween which increase the overall size of the cable pack insignificantly. It is therefore ideally suited for use with compact electronic equipment such as computers, disk memories and the like. Moreover, the components of the cable carrier are simple and available at costs substantially below those of prior art devices. Lastly, and most importantly, the cables supported by the cable carrier of the present invention are firmly positioned, are prevented from becoming entangled when extended or retracted, and are adapted to physically separate certain of the cables for the reduction of electrical noise.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevational view of the upper section of a disk memory provided with an outwardly extensible drawer for the memory read-write head;

FIG. 2 is an enlarged, fragmentary side elevational view of the rearwardmost section of the memory illustrating the drawer in its retracted position and the excess cable length folded into tight loops in accordance with the present invention;

FIG. 3 is a fragmentary, enlarged side elevational view of the front section of the disk memory shown in FIG. 1, illustrates the drawer in its extended position and, in phantom lines, in its vertically raised extended position, with the cable carrier of the invention providing the needed cable length; and

FIG. 4 is a front elevational view of a cable carrying card depending from a pair of spaced apart guide bars constructed in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, a disk memory 6 is schematically illustrated to comprise an upright chassis 8 and, mounted thereto, a drawer 10 for horizontal movement into and out of the chassis. When in its outermost, extended position the drawer is also vertically movable (as schematically illustrated in FIG. 3) along the front side of chassis. The mechanism for such movement forms no part of this invention and is therefore not disclosed herein. Mounted to the drawer is a read-write head 12 that is connected to electronic circuitry 14 by cables 16 having a sufficient length to enable the withdrawal of the drawer. To prevent the bending, twisting, misaligning and entangling of the cables when the drawer is closed and opened a folding cable carrier 18 constructed in accordance with the invention is provided.

Referring now to FIGS. 2 through 4, cables 16 usually comprise two or more cable bundles, such as flat ribbon cables 20 and 22, having a plurality of wire strands 24 which are suitably connected to electronic circuitry 14 and to the read-write head 12 on drawer 10. Preferably, the ribbon cables are secured to an upright paddle card 26 mounted to an aft end 28 of the drawer and having the necessary breakthroughs (not separately shown) to guide the wire strands to their respective connections. The cable carrier itself comprises a plurality of suspension cards 30 which have a generally rectangular configuration and, adjacent their upper ends 32, include outwardly protruding arms 34. The underside of the arms define grooves or semicircular cutouts 36 which extend over and thus support the cards from a pair of laterally spaced guide bars 38 connected to the top of chassis 8. The guide bars extend parallel to the direction of horizontal movement of drawer 10 from adjacent chassis rear wall 40 towards but short of the front end of the chassis and permit slideable movement of the suspension cards along the guide bars between the ends thereof. Additionally, the arcuate cutout 36 in suspension card arms 34 per-
mits pivotal movements of the cards about axes perpendicular to the guide bars and, thus, to the direction of horizontal movements of drawer 10.

Cable ribbons 20 and 22 are arranged so that they extend into the space between each adjacent pair of suspension cards 30 and there form loops 42 which go back and forth towards and away from guide bars 38. One-half of each loop, say the aft half 44, is secured to the adjacent suspension card, preferably with a bonding agent 46 applied to the card and/or the cable. The card mounted cable sections are vertically oriented and physically spaced from each other for the aforementioned electrical noise suppression. Thus, the connection of the cables to the cards causes the cables to form loops 42 with the card 50 in its retracted position.

In addition, cables 20 and 22 are arranged to define a forwardmost loop 48 by securing a section of the cables spaced longitudinally about one-half loop length from the forwardmost suspension card to a free cable mounting card 50. The free card also has a generally rectangular cross section and folds into a substantially vertical position as illustrated in FIG. 2. When the drawer is closed, the free card 50, however, is not connected to or guided by guide bars 38.

Similarly to the formation of the forwardmost loop 48 an aftmost loop 52 between the connections of the cable to electronic circuitry 14 and the rearwardmost suspension card 50 is formed by securing a section of the cable spaced from the rearwardmost suspension card about one-half loop length to a second card 54. When the drawer is in its closed position the aft free cable mounting card 54 is also vertically oriented to form the aftmost cable loop 52. The card, however, is not connected to or guided by guide bars 38.

Turning now to the operation of the cable carrier 18 of the present invention, after its installation and the connection of the cables to circuitry 14 and read-write mechanism 12 the cables from the closed or adjacent, compact upright loops 42, 48 and 52 as illustrated in FIG. 2. It is to be noted that the cable support cards 30, 50 and 54 maintain the cables aligned, that is prevent a looping of the cables in horizontal or inclined loops, for example, to thereby prevent entanglement of the cables, their twisting, bending and the like. Moreover, wire strands 24 and the ribbon cables are maintained separate to suppress electrical noise.

Upon the withdrawal of the drawer, paddle board 26 secured to drawer end 28 moves the forwardmost cable end with the drawer and thus moves the cable loops 42, 48 and 52 to the right, as viewed in FIG. 2, to thereby form open loops 56 defined by angularly inclined, forwardly extending sloping cable sections 58. The formation of the open loops pivots the suspension cards 30 towards the drawer end, in an essentially horizontal plane. Thus, the overall effective length of the cables is extended in accordance with the increase in the spacing between drawer end 28 and electrical circuitry connection 14.

It will be noted that the forwardmost cable loop 48 is partially supported by both the forwardmost suspension card 30 and paddle card 26 secured to drawer end 28. If the drawer is moved in a vertical direction up and down the face of disk memory 6, for example into the raised position illustrated in FIG. 3 in phantom lines, the forwardmost loop permits such raising while free cable support card 50 maintains the cables aligned and in their correct relative positions while the drawer is raised, in its open position or in its closed position without crossover, entanglements and the like.

While one embodiment of the invention has been shown and described, it will be obvious that other adaptations and modifications can be made without departing from the true spirit and scope of the invention.

Claim 1

Apparatus for holding flexible members having their respective ends attached to a relatively stationary and a relatively movable structure to prevent entanglement of the members while enabling changes in the distance between the structures comprising: a plurality of independent plate means, means attached to one of the structures mounting the plate means for independent movement of each plate means between the structures, means permitting pivotal movement of the mounted plate means about axes disposed transversely to the direction of relative movement of the structures, and means connecting the flexible member at a plurality of locations intermittently spaced over its length to the plate means with substantially equal, alternating lengths of the member being connected to the movably mounted plate means and being freely disposed between adjacent mounted plate means whereby an increase in the spacing between the structures causes pivotal movements of the plate means to increase the effective length of the members in accordance with the increase of the spacing between the structures.

2. Apparatus according to claim 1 wherein the means for mounting the plate means comprises elongate bar means secured to and spaced from one of the structures, and wherein the means permitting pivotal movement comprises means extending over the bar means and projecting from an upper end of the plate means for slidably and pivotally suspending the plate means from the bar means.

3. Apparatus according to claim 1 wherein the plate means comprise first cards pivotally engaging the mounting means, and second cards secured to free end portions of the member maintaining the end portions aligned and preventing their entanglement.

4. Apparatus for folding and unfolding a length of cable connected to relatively movable components comprising: substantially horizontally disposed guide means carried by a support structure for the components and extending in the direction of relative movement between the components, at least one first means movably along the guide means, depending therefrom, pivotable about an axis transverse to said direction and connected to an intermittent first section of the cable fixing the position of the cable with respect to the first means, second means independently movably with respect to the first means, the second means being connected to second sections of the cable spaced from the first section for guidance of the cable from the first means to its connection to the components, whereby the cable is folded and unfolded when the components are moved towards and away from each other.

5. Apparatus according to claim 4 wherein the cable comprises a plurality of substantially flat, flexible multistrand cables, wherein the suspension first and second means comprise flat cards having a greater width than the combined width of the cables, and including means securing intermittent cable sections to the cards in spaced apart positions to provide for electrical noise suppression between the cards.

6. Apparatus according to claim 5 wherein the securing means comprises an adhesive bonding the cables to the cards.

7. In a memory disk apparatus having a chassis, electronic circuitry mounted to the chassis, a drawer movable in and out of the chassis mounting a read-write mechanism electrically coupled to the electronic circuitry, the improvement comprising: a pair of spaced apart guide bars depending from the chassis and extending in the direction of movement of the drawer from a rear end of the drawer towards a front end thereof, a plurality of substantially flat cards slideably and pivotally connected to the guide bars, a flat ribbon cable connected to the circuitry and the read-write mechanism looped back and forth towards and away from the guide bars between the cards, means attaching portions of the cable defining first sides of the loops to the cards while portions of the cable defining second sides of the loops remain unsupported, whereby withdrawal of the drawer from the chassis slideably moves the cards along the guide bars and pivots the cards towards their mutual alignment to lengthen the cable and the cable position is controlled when the drawer is retracted to prevent entanglement of the cable.

8. Apparatus according to claim 7 wherein a connection point between the cable and the read-write mechanism is moveable past an end of the guide bars and, in that position, is further moveable in a transverse direction substantially parallel
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5 to the loops, and wherein the apparatus further includes an additional forward loop between the end of the guide bars and the cable connection at the drawer, and an unsupported positioning card secured to one side of the cable length defining the forward loop to assure the formation of the forward loop when the drawer is retracted.

9. Apparatus according to claim 8 including an additional aft cable loop between the cable connection to the circuitry and the rearwardmost card, and including an additional unsupported card secured to a portion of the aft cable loop to assure the formation of the aft cable loop when the drawer is retracted.

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