

July 28, 1959

W. E. DICKINSON

2,897,254

SELF GUIDING ARCUATE SET ELECTRIC CABLE

Filed June 21, 1956

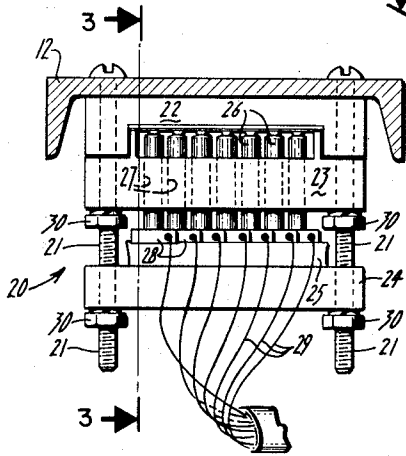


FIG. 2

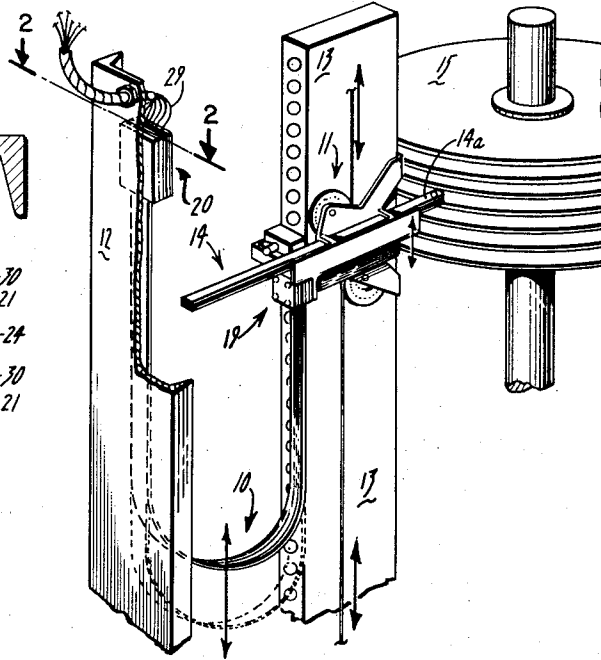


FIG. 1

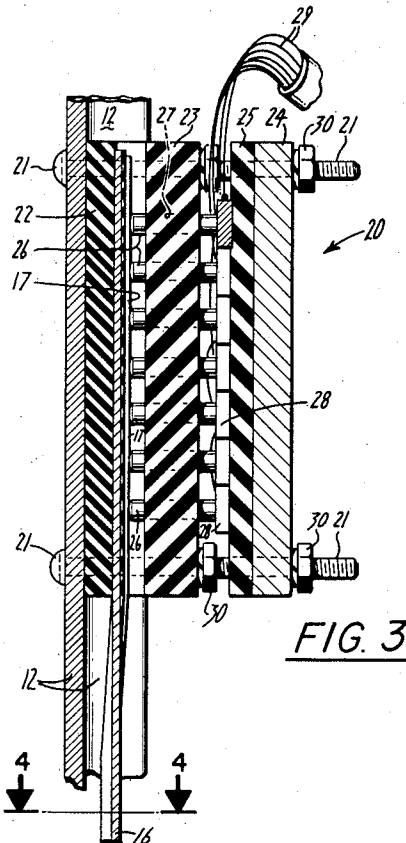


FIG. 3

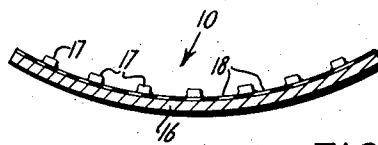


FIG. 4

INVENTOR.
WESLEY E. DICKINSON

BY *John R. Clark*

ATTORNEY

1

2,897,254

SELF GUIDING ARCUATE SET ELECTRIC CABLE

Wesley E. Dickinson, Santa Clara County, Calif., assignor to International Business Machines Corporation, New York, N.Y., a corporation of New York

Application June 21, 1956, Serial No. 592,787

9 Claims. (Cl. 174—117)

The present invention pertains generally to flexible electrical cables and relates more particularly to a cable arrangement for making electrical connections between objects movable relative to each other.

In mechanisms wherein electrical connections are made between parts movable with respect to each other, such connections in the past have been made by ordinary wires or the like. In some applications this has proved satisfactory; however, in others wire fatigue or breakage due to continual bending of the wire is a problem. Such a problem arises in an arrangement such as that disclosed in the copending application Serial No. 477,468, filed December 24, 1954, wherein electrical connections are made to a translatable access mechanism which is repeatedly repositioned at new locations.

Thus, it is one of object of the present invention to provide an improved electrical cable.

Another object is to provide a novel cable arrangement for connecting between mechanisms movable relative to each other.

According to the invention, the individual conductors are made very thin, thereby reducing stresses set up therein due to bending, and the physical characteristics necessary for supporting the thin conductors are provided by a flexible steel tape to which the conductors are affixed.

A further object is to provide an electrical cable wherein wire fatigue brought about by repeated bending of the cable is substantially reduced.

Another feature of the invention concerns the use of a steel tape for supporting the conductors wherein the tape is provided with a "set." This yields a cable having very good dynamic characteristics. Such a tape has excellent ability to follow the moving portion with which it is associated and acts as its own guide, thereby rendering additional guiding structure unnecessary.

Still another feature of the invention is directed to an improved mechanism for connecting the cable described above, which mechanism permits ready assembly and disassembly of the cable therefrom, whereby the cable is easily replaced when necessary.

A further object of the invention, therefore, is to provide an improved cable connecting structure.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

Fig. 1 is a perspective view of a machine equipped with the cable assembly of the present invention.

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1.

2

Fig. 3 is a sectional view taken along line 3—3 of Fig. 2.

Fig. 4 is a transverse section of the novel cable.

Referring now to Fig. 1, the cable 10 of the invention connects between a movable carriage 11 and a stationary support member 12. The apparatus with which the cable 10 is associated is shown solely for the purpose of demonstrating a useful application of the cable, and it will be understood that the utility thereof is not limited to such structure. Returning to the drawing, the carriage 11 is slidably mounted for vertical movement along a way 13 and magnetic transducers (not shown) are mounted near one end 14a of an arm 14 supported by the carriage 11 for movement therewith. The carriage 11 is arranged to dispose the transducers adjacent selected magnetic discs 15 for cooperation therewith. It is necessary, therefore, to make certain electrical connections between the carriage 11 and other structure (not shown) provided for operating the transducers. When the carriage is continually repositioned, as it is in a device of this type where repeated access is to be had to various portions of the discs 15, failure in these connections due to repeated bending occurs if ordinary wire cable is utilized. (Stresses set up in the wire when the wire is bent cause breakage.) However, if these connections are made in the manner disclosed herein, fatigue problems are greatly lessened.

The cable 10 comprises a flexible steel tape 16 (Fig. 4) which serves as a guide and supporting structure for the actual conductors. The tape 16 is of a type which has a "set" put into it such as is used in steel tape rulers. By using this kind of tape the cable is provided with rigidity and yet is free to bend. The "set" in the tape gives it rigidity normal to the thin dimension whereby the tape bends only at its lowermost point. This yields good dynamic characteristics in that the tape is maintained clear of moving parts and is guided in the proper manner without provision of additional guiding structure.

Several conductors 17 are carried by the tape 16. The tape is provided with a thin coating of insulating material 18 affixed to the concave surface thereof and the various conductors 17 are arranged thereon in any convenient manner. In the present embodiment a strip of aluminum foil is bonded to the material 18, the material 18 being suitably bonded to the tape 16, and the foil is then etched by ordinary printed circuit techniques to form the necessary number of conductors 17 which extend longitudinally of the tape. In this way the tape carries the necessary conductors to form a cable which provides connections to the movable carriage. It should be noted that the conductors comprise very thin strips of foil and that for this reason the stresses set up therein due to bending are low. (This results in reduced fatigue.) It is possible to make the conductors very thin since mechanical strength required for support is furnished by the tape.

The cable is secured electrically and mechanically to the carriage 11 (Fig. 1) by a terminal connection member 19, a similar member 20 being provided for terminating the cable at the support 12. The members 19 and 20 are substantially identical to each other, and for this reason only the member 20 will be described.

Referring now to Figs. 2 and 3, the member 20 is secured to the support member 12 by four bolts 21 (only two being shown in each figure) and includes a bracket 22, a guide 23, a pressure plate 24 and a resilient pad 25. The bracket 22 as well as the guide 23 and pad 25 are

composed of a suitable insulating material. The cable 10 is disposed between the guide 23 and the bracket 22, and several contact pins 26, one for each conductor 17, extend between the pad 25 and the corresponding conductors 17 through holes 27 provided therefor in the guide 23. The pins 26 are formed integrally with corresponding base members 28 which abut the pad 25, and the pins are staggered diagonally of the tape to provide suitable spacing therefor, whereby each pin cooperates independently with its respective conductor 17. A wire 29 is connected to each base member 28 for use as is necessary.

The pad 25 is made resilient to permit substantially equal pressure to be applied to each pin when nuts 30 are tightened on their corresponding bolts 21 to press the pins into engagement with the conductors. Thus, each conductor 17 associated with the tape 16 is connected electrically through a corresponding pin 26 to the wire 29 associated therewith, the wires extending from the member 20 being connected to suitable electronic circuitry for operating the transducers mounted on the carriage and the wires 29 extending from the member 19 being connected to these transducers. Thus, it will now be clear that suitable electric paths are provided from the wires 29 through the pins associated with the member 20, through the conductors 17 of the tape 16, through pins 26 associated with the member 19 to the wires 29 which are connected to the transducers.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to the preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. An electrical cable comprising a flexible steel tape having a transverse arcuate "set" therein extending longitudinally thereof for providing rigidity thereto normal to the thin dimension thereof, a thin insulating layer affixed to said tape, and a plurality of spaced flexible strips of conducting material attached to said insulating layer, said strips extending longitudinally of said tape and being thin in the dimension corresponding to the thin dimension of the tape, whereby stresses set up in said strips when bending said tape are minimized.
2. An electrical cable arrangement comprising a flexible tape having a transverse arcuate "set" therein for providing self-guidance thereof in a direction longitudinally of said tape, said "set" extending longitudinally along said tape, a plurality of thin flexible conductors, means including an insulating material bonding said conductors to said tape, said conductors being thereby insulated from each other, said conductors being thin in the dimension corresponding to the thin dimension of said tape, a plurality of connectors releasably engaged with said conductors, resilient means for urging each of said connectors independently against said conductors, means for connecting to said connectors, and means for releasing said connectors from engagement with said conductors, whereby said tape may be removed from said connectors.
3. A self-guiding electrical cable assembly for connecting between objects longitudinally movable relative to each other comprising a flexible steel tape having a transverse arcuate "set" extending longitudinally thereof, a thin layer of insulating material bonded to the inner concave side of said tape, and thin flexible conductive members printed on said layer and extending longitudinally thereof, whereby bending stresses in said conductive members are minimized.
4. A self-guiding electrical cable assembly for connecting between objects longitudinally movable relative to each other comprising a flexible steel tape having a

transverse residual curvature extending longitudinally thereof to confine bending of said cable substantially to the direction of the center of curvature of said curve, a thin layer of insulating material bonded to the inner concave side of said tape, and thin flexible conductive members printed on said layer and extending longitudinally thereof, whereby bending stresses in said conductive members are minimized.

5. A self-guiding electrical cable assembly for connecting between objects longitudinally movable relative to each other comprising a flexible steel tape having a transverse arcuate "set" extending longitudinally thereof to confine bending of said cable substantially to the direction of the center of curvature of said arc, a thin layer of insulating material bonded to one side of said tape, and thin flexible conductive members printed on said layer and extending longitudinally thereof, whereby bending stresses in said conductive members are minimized.

6. A self-guiding electrical cable assembly for connecting between objects longitudinally movable relative to each other comprising a flexible steel tape having a transverse arcuate "set" extending longitudinally thereof to confine bending of said cable substantially to the direction of the center of curvature of said arc, a thin layer of insulating material bonded to one side of said tape, and thin flexible conductive members bonded to said layer and extending longitudinally thereof, whereby bending stresses in said conductive members are minimized.

7. An electrical cable comprising a flexible steel tape having a transverse arcuate "set" therein extending longitudinally thereof for providing rigidity thereto normal to the thin dimension thereof, a thin insulating layer affixed to said tape, a plurality of spaced flexible strips of conducting material attached to said insulating layer, said strips extending longitudinally of said tape and being thin in the dimension corresponding to the thin dimension of the tape to minimize stresses set up in said strips upon bending of said strips, and means for connecting to said conductors including a plurality of discrete independently pressure loaded connector pins for releasably engaging said conductors, said pins being movable with respect to each other, each of said pins being in electrical contact with a corresponding one of said conductors, means for urging said pins against their associated conductors, and a resilient pad interposed between said urging means and said pins to individually compensate for variations in said urging among said pins whereby uniformly firm electrical connections are made between all said pins and their associated conductors.

8. A self-guiding electrical cable assembly for connecting between objects longitudinally movable relative to each other comprising a flexible steel tape having a transverse arcuate "set" extending longitudinally thereof, a thin layer of insulating material bonded to the inner concave side of said tape, thin flexible conductive members printed on said layer and extending longitudinally thereof to minimize stresses in said conductive members upon bending of said cable, and means for connecting to said conductors including a plurality of discrete independently pressure loaded connector pins for releasably engaging said conductors, said pins being movable with respect to each other, each of said pins being in electrical contact with a corresponding one of said conductors, means for urging said pins against their associated conductors, and a resilient pad interposed between said urging means and said pins to individually compensate for variations in said urging among said pins whereby uniformly firm electrical connections are made between all said pins and their associated conductors.

9. An electrical cable comprising a flexible steel tape having a transverse arcuate "set" therein extending longitudinally thereof for providing rigidity thereto normal to the thin dimension thereof, a thin insulating layer affixed to said tape, and a plurality of spaced flexible conductive members attached to said insulating layer,

said conductive members extending longitudinally of said tape and being thin in the dimension corresponding to the thin dimension of the tape, whereby stresses set up in said conductive members when bending said tape are minimized.

5

References Cited in the file of this patent

UNITED STATES PATENTS

243,180 Ware ----- June 21, 1881

1,142,282
2,701,818
2,703,854
2,721,312

725,032

Stewart ----- June 8, 1915
Tims ----- Feb. 8, 1955
Eisler ----- Mar. 8, 1955
Grieg et al. ----- Oct. 18, 1955

FOREIGN PATENTS

Great Britain ----- Mar. 2, 1955

OTHER REFERENCES

Electronics (publication) December 1955, page 313.