

Sept. 18, 1962

J. C. EVANS

3,054,645

MECHANICAL SLIDE

Filed April 18, 1960

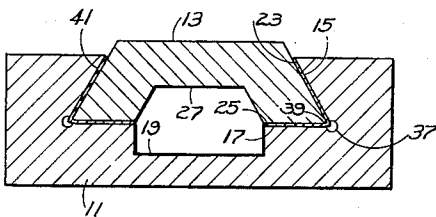
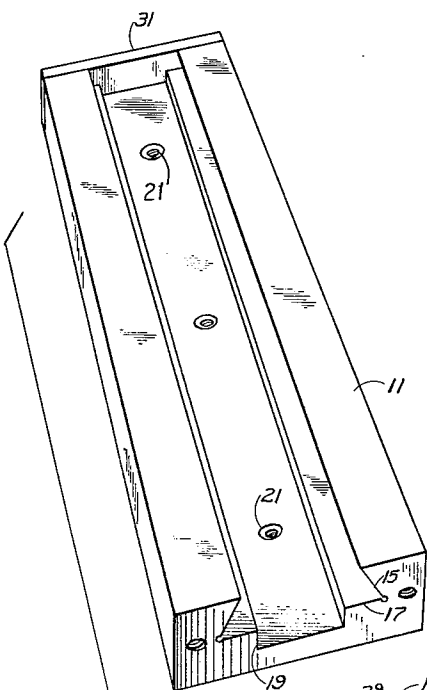


Fig. 2

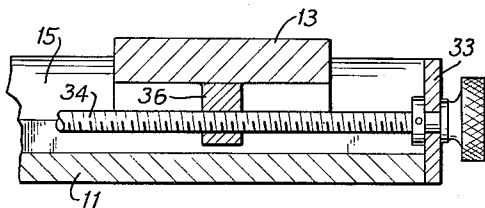


Fig. 3

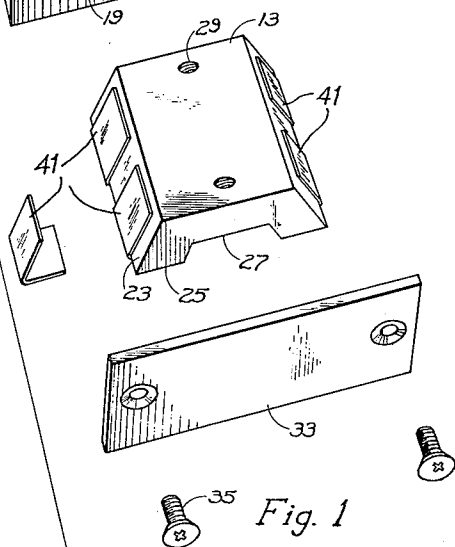


Fig. 4

1

3,054,645

MECHANICAL SLIDE

John C. Evans, Rochester, N.Y., assignor to Tropel, Inc.,
Fairport, N.Y., a corporation of New York
Filed Apr. 18, 1960, Ser. No. 22,776
4 Claims. (Cl. 308—3)

The present invention relates to a mechanical slide and slider unit.

An object of the invention is to provide a new and improved slide of the type wherein a slider has a dovetail engagement with a slide.

Another object is the provision of a compact and lightweight slide designed to be produced at low cost while yet retaining accurately aligned guides.

Yet another object is to provide a new and improved slide and slider of such cross section as to be readily adapted for screw drive and rack and pinion drive.

A further object is to provide a new and improved low cost slide capable of being manufactured in a variety of sizes and having great versatility of application.

A still further object is the provision of a new and improved method for constructing and assembling a low cost slide and slider unit.

These and other desirable objects may be attained in the manner disclosed as an illustrative embodiment of the invention in the following description and in the accompanying drawings forming a part hereof, in which:

FIG. 1 is an exploded perspective view of the slide and slider unit according to the invention;

FIG. 2 is a transverse cross section of the assembled unit taken through the slider; and

FIG. 3 is a fragmentary longitudinal section illustrating an embodiment of the present invention with a screw drive.

The same reference numerals throughout the several views indicate the same parts.

The mechanical slide according to the invention, referring to FIGS. 1 and 2, comprises an elongated generally rectangular slide 11 in which a slider 13 is received for longitudinal movement, the slide 11 and slider 13 being coupled by a suitable dovetail guide arrangement. The dovetail guide of the slide 11 is provided by a recess having oppositely slanting upwardly and inwardly inclined guide surfaces 15 at an angle of 60 degrees, for instance, the base 17 of the recess being approximately parallel to the upper and lower surfaces of the slide 11. The guide base 17 preferably has, in turn, a central recess 19 extending downwardly toward the base of the slide 11. The recess 19 preferably extends along the full length of the slide 11 and has a plurality of longitudinally spaced apertures 21 to receive fasteners, not here shown, for securing the slide unit to a base or mounting member. The recess 19 serves to lighten the weight of the slide 11, and in addition provides a space for a driving screw or rack for moving the slider 13, this cross section being readily adaptable to a screw drive or a rack and pinion drive.

The slider 13 has side guide surfaces 23 slanting oppositely inwardly and upwardly at an inclination corresponding to that of the guide surfaces 15 on the slide 11, the length of the slider 13 being considerably less than that of the slide 11. The base 25 of the slider 13 has an upwardly extending central recess 27 in alignment with the recess 19 when the slider is assembled on the slide 11. The recess 27, in similar fashion to the recess 19, serves to lighten the weight of the slider 13, and to provide a space for receiving the driving screw or rack. A plurality of longitudinally spaced apertures 29 are provided in the recess 27 to receive appropriate fasteners, not here shown, for attaching the slider 13 to any machine part or instrument part which is to be mounted thereon and moved thereby. The slider 13 is freely slid-

2

able on the slide 11 between a pair of end stop plates 31 and 33 secured to the ends of the slide 11 in a convenient manner, as by screw fasteners 35.

It can be readily seen that the driving screw of a screw drive may be journaled for rotation in one end plate, such as 33, and may extend through the recesses 19 and 27 into a tapped bore in a block secured to the slider 13 in the recess 27, so that rotation of the screw outside the end plate causes translation of the slide 13. FIG. 3 illustrates such a screw drive, the drive screw 34 being journaled in the end plate 33 and being threaded through the block 36 secured to the slider 13. In similar fashion, the rack of a rack drive may be fixed to the under side of the slider 13 in the space 27, and may be engaged by a pinion located at any convenient place, the pinion rotating, for example, in a slot formed through the recessed portion 19 of the base member 11.

The slide 11 and slider 13 are preferably made of a lightweight hard aluminum alloy to provide maximum strength for the weight involved. In order to reduce manufacturing costs, the slide 11 and slider 13 are desirably extruded, and the aluminum alloy to be used is one of the hardest alloys which can be commercially extruded. A satisfactory material is the aluminum alloy known in the trade as No. 2024, which is a Duraluminum alloy having copper as its chief alloy element to give the alloy precipitation hardening properties. The heat treatment for this readily available alloy is desirably a water quench as it is extruded and an age hardening at room temperature. Such a heat treatment is known in the trade as temper treatment No. T-4. For aluminum, this metal is hard and has good machining and wearing properties.

Since the slide 11 is to be extruded, it may be noted that the junctions between the slanting dovetail guide surfaces 15 and the base 17 are not sharp acute angles, but rather are looped outwardly as indicated at 37 to eliminate sharp corners. In similar fashion, sharp corners on the guide surfaces of the slider 13 between the slanting guide surfaces 23 and the base 25 are avoided by rounding off these corners as shown at 39. With this construction, the production of expensive sharp corners is eliminated and stress concentration is materially reduced, in addition to facilitating the machining of the dovetail guide surfaces.

In accordance with the invention there are a plurality of pads or laminations 41 of nylon material between the mating dovetail guide surfaces of the slide 11 and slider 13. The pads 41 are applied to the guide surfaces 23 and 25 of the slider 13 at either side, and slide on the guide surfaces 15 and 17 of the slide 11. In the preferred arrangement, there are two pads 41 at either side of the slider 13 spaced longitudinally from one another to provide bearing surfaces at either end. It is contemplated that the slide 11 and slider 13 may be made in a variety of lengths to suit the requirements at hand, and the pair of pads 41 on either dovetail guide surface of the slider 13 is sufficient to provide a bearing regardless as to the length of the slider 13. Each pad 41 preferably extends, for its width, over the entire length of the engageable portions of the mating dovetail guide surfaces. The upper surface of the slider 13 preferably extends above the upper surface of the slide 11, so that each pad 41 begins at the slanting dovetail guide surface 23 below the upper surface of the slider 13, at a level corresponding to the upper surface of the slide 11, and continues downwardly as a single piece to be applied around the corner 39 and over the full width of the lower dovetail guide surface 25 to the edge of the recess 27.

The V-shaped pads or laminations 41 may be made of plain nylon, or more suitably, of a molybdenum disulfide filled nylon. It is important in this application that the pads 41 have dimensional stability in order to assure a close sliding fit between the slider 13 and the slide 11.

The molybdenum disulfide filled nylon is preferred because plain nylon changes dimensionally with relative humidity to a greater extent. Molybdenum disulfide is furthermore usually considered to be a lubricant, or at least an anti-frictional material in about the same sense as graphite is a dry lubricant. Thus, nylon containing molybdenum disulfide presumably is also a better bearing material than nylon from the friction point of view. A convenient molybdenum disulfide filled nylon is manufactured by the Polymer Corporation of Pennsylvania under the trade designation Nylatron G.S.

The pads 41 are bonded to the dovetail guide surfaces 23 and 25 of the slider 13 in any suitable manner, as by cementing. The cement to be used desirably is a nitrile-rubber adhesive, a neoprene-phenolic adhesive, or a nitrile-phenolic adhesive. Convenient cements which have been used successfully are those of the Minnesota Mining & Manufacturing Company, bearing the trade designations EC10221, EC826, and EC776. The Goodyear Pliobond cement has also been used successfully. Although not as satisfactory as direct cementing, nylon tapes to which cement has already been applied may also be used. Furthermore, Mylar and paper tapes which are coated with adhesive on both sides may be used, although again this is not as satisfactory as direct cementing. Where a tape is used to provide a bond between the nylon pad 41 and the slider 13, it becomes, of course, an interlayer in the assembly.

The thin pads or laminations 41 providing the bearing surfaces between the slide 11 and slider 13 have the advantage of allowing a tight fit between the sliding parts while yet requiring a minimum of machining of the metallic guide surfaces. In other words, there may be broad tolerances on the mating dimensions of the slide 11 and slider 13, in the order of .003 inch. The parts are machined so that there is ordinarily, in the cold state, an interference fit between the slide 11 and the slider 13 to which the nylon pads 41 have been applied. The dovetail guide surfaces 15 and 17, and 23 and 25, are preferably smoothed by a lapping operation, which also assures parallelism of the ways. The guide surfaces are thus machined to a high degree of surface finish but have a relatively broad tolerance in absolute dimensions.

Assembly of the slider 13 on the slide 11 is accomplished in the following manner: The slide 11 is heated in an oven to expand it, to a temperature in the range of about 150 degrees to 300 degrees Fahrenheit. The slider 13 with the cemented nylon pads 41 is maintained at room temperature or below, in the range of zero degrees to 70 degrees Fahrenheit, so that although there would ordinarily be an interference fit between the parts 11 and 13, under the differential temperature condition imposed, slider 13 can be inserted into slide 11. After this assembly, the slide unit is kept at the elevated temperature of about 150 degrees to 300 degrees Fahrenheit for a sufficient period of time, usually from one to two hours although possibly less than one hour, for the adhesive cementing the nylon pads 41 primarily to yield thermoplastically under the pressure exerted when both parts 11 and 13 come to equilibrium temperature. Alternatively, the temperature may be raised to the range of about 400 degrees to 475 degrees Fahrenheit for less than twenty minutes or so, during which time the nylon yields primarily. In this higher temperature range oxygen attacks nylon readily, embrittling it so that a coating of oil is desirable over the nylon pads, and the holding time is made as short as possible, not longer than twenty minutes and preferably less. The degree of temperature and the length of time at which the assembled slide is kept at the elevated temperature determines the closeness or looseness of fit. The nylon pads 41 are kept relatively thin so that their mechanical strength properties do not have much effect upon the mechanical yield of the slide when loaded.

As has been mentioned previously, the length of the slide 11 may be varied. For example, it may be manufactured as a stock item in lengths from 6 inches to 18

inches, with different sizes varying by three inch increments. The length of the slider 13 may also be varied, either correspondingly or independently according to the requirements at hand. For the sample dimensions given, the width of the slide 11 may be 1½ inches, and the width of each of the nylon pads 41 may be one-half inch. The thickness of the nylon pads 41 for this example is only .010 inch.

As was previously mentioned, the cross section of the slide unit is designed for adaptability to a screw driven slider 13, and to a rack and pinion driven slider. Graduated scales may be placed upon the slide unit to indicate the position of the slider 13. Two or more slide units may be conveniently compounded into two and three way motion systems. In a two-way motion system, for instance, the slide 11 of the second unit is fastened to the slider 13 of the first unit, usually at right angles thereto.

The basic slide or slider assembly, or controlled motion units, may be incorporated into instruments, laboratory equipment, and light machinery, for example. The slide units are compact, lightweight, and may be produced at low cost while yet having versatility in action. They may be incorporated into instruments and equipment at a saving in production costs. The machining of the slide unit is reduced to a minimum, as the slide and slider are initially extruded aluminum stock. The dovetail guide surfaces 15 and 17 of the slide 11, and the guide surfaces 23 and 25 of the slider 13 require machining to a high degree of surface finish but only to relatively broad tolerances. A tight sliding fit of the slider 13 in the slide 11 is achieved by the aforementioned inexpensive method of assembly.

It is seen from the foregoing disclosure that the above mentioned objects of the invention are well fulfilled. It is to be understood that the foregoing disclosure is given by way of illustrative example only, rather than by way of limitation, and that without departing from the invention, the details may be varied within the scope of the appended claims.

What is claimed is:

1. A slide unit comprising a longitudinally elongated slide member having a longitudinal recess with integral rigid side walls immovable with respect to each other, said side walls having inwardly sloped inner faces providing between them a longitudinal guideway of dovetailed cross section, a slider movable longitudinally along said guideway, said slider being shorter than said guideway and having inclined side edges mating approximately with the sloped inner faces of said guideway, and a plurality of pads of nylon material affixed to each inclined edge of said slider and spaced from each other in a direction longitudinally along said guideway, each of said pads being firmly cemented to said slider throughout the entire area of the pad and being of sufficient thickness so that the pads tightly engage the adjacent faces of said slide member under substantial compressive force in the direction of the thickness of the pad.

2. A slide unit comprising a longitudinally elongated slide member having a longitudinal recess with integral rigid side walls immovable with respect to each other, said side walls having inwardly sloped inner faces providing between them a longitudinal guideway of dovetailed cross section, a slider movable longitudinally along said guideway, said slider being shorter than said guideway and having inclined side edges mating approximately with the sloped inner faces of said guideway, and a plurality of pads of nylon material filled with molybdenum disulfide affixed to each inclined edge of said slider and spaced from each other in a direction longitudinally along said guideway, each of said pads being firmly cemented to said slider throughout the entire area of the pad and being of sufficient thickness so that the pads tightly engage the adjacent faces of said slide member under substantial compressive force in the direction of the thickness of the pad.

5

3. A slide unit comprising a longitudinally elongated body member having a bottom wall and upstanding side walls integral with each other and immovable with respect to each other, said side walls being undercut so as to provide, in combination with the bottom wall, a dovetailed guideway extending longitudinally of said body, a slider element mounted for sliding movement longitudinally along said guideway, said slider element comprising a single rigid piece spanning the width of said dovetailed guideway and extending into the undercut portions at both sides thereof with relatively slight clearance from said undercut side walls and adjacent portions of said bottom wall, and a plurality of pads of non-metallic low friction material fixed to said slider element to travel therewith, said pads tightly filling part of the clearance space between said slider element and said undercut side walls and adjacent portions of said bottom wall, to make said slider element laterally and vertically tight in said dovetailed guideway during its longitudinal travel therein.

4. A construction as defined in claim 3, in which the bottom wall of said guideway has a longitudinally extending central depression and the bottom surface of said

6

slider element is centrally elevated to provide between said bottom wall of the guideway and bottom surface of said slider element a clearance space for receiving longitudinal feed means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,449,327	Schlitters	Sept. 14, 1948
2,675,276	Daugherty	Apr. 13, 1954
2,732,613	Renholts	Jan. 31, 1956
2,743,967	Lappe	May 1, 1956
2,937,765	Shank	Apr. 18, 1958
2,835,539	Conrad	May 20, 1958
2,881,509	Gadebusch	Apr. 14, 1959

OTHER REFERENCES

Frictional Behaviour of Plastics Impregnated With Molybdenum Disulphide, reprinted from Research, vol. 3, No. 8, August 1950, published by Butterworths Scientific Publications Ltd., London, W.C. 2.