March 18, 1947. J. B. ARMITAGE 2,417,672

WAY GUARD STRUCTURE

Filed July 27, 1944 4 Sheets-Sheet 1

FIG. 1

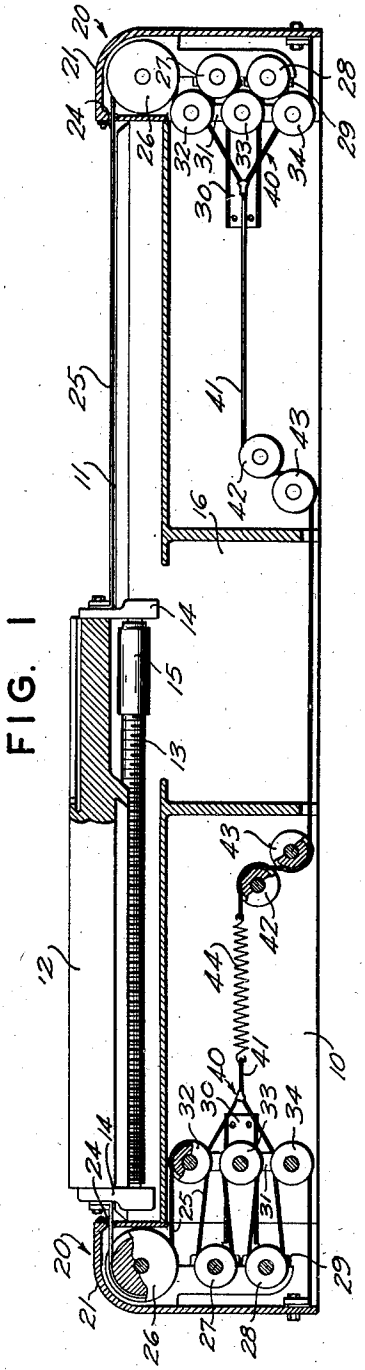
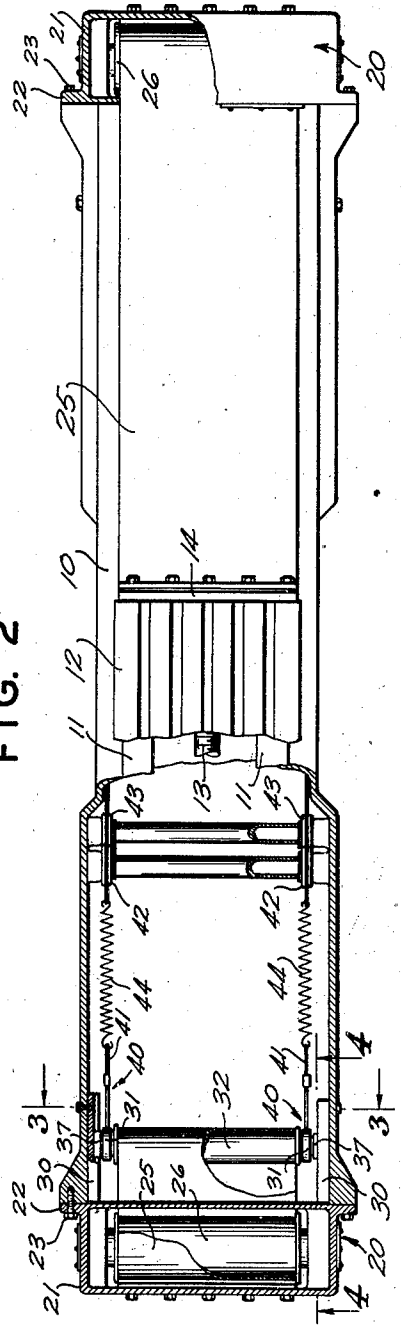


FIG. 2



INVENTOR
JOSEPH B. ARMITAGE
BY W. D. O'Connor
ATTORNEY

March 18, 1947. J. B. ARMITAGE 2,417,672

WAY GUARD STRUCTURE

Filed July 27, 1944 4 Sheets-Sheet 2

FIG. 3

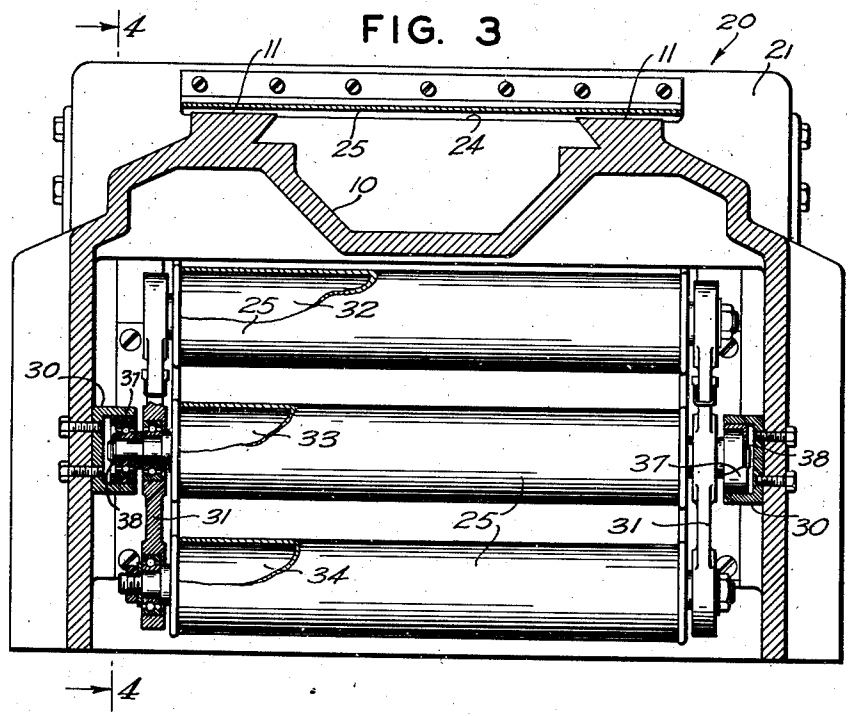
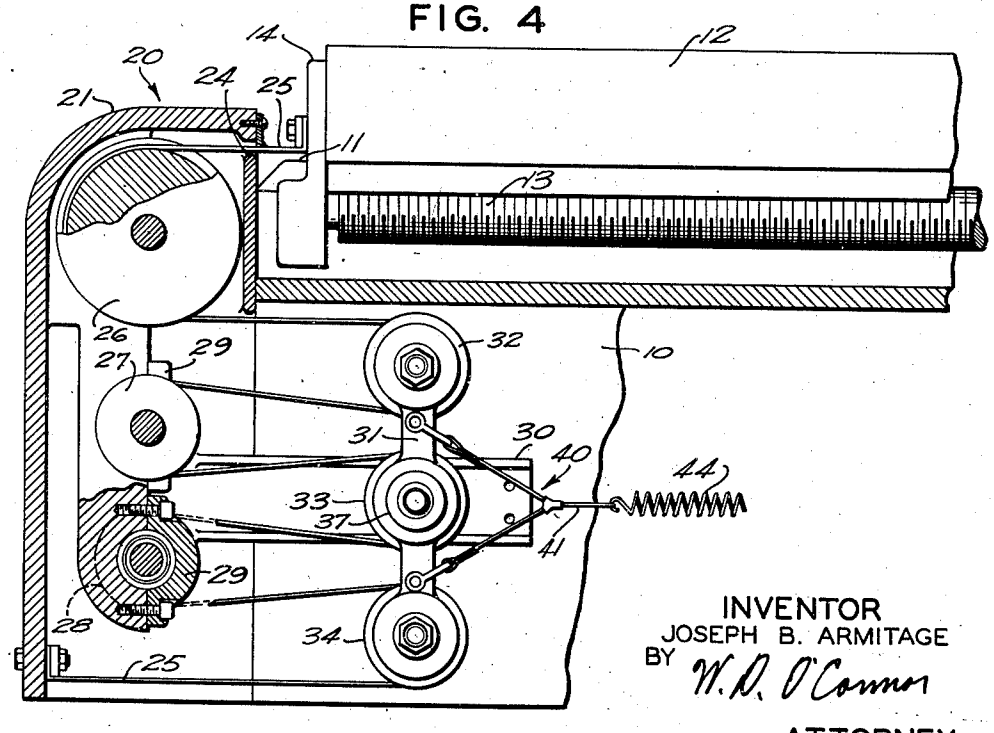


FIG. 4



INVENTOR
JOSEPH B. ARMITAGE
BY W. D. O'Connor
ATTORNEY

March 18, 1947. J. B. ARMITAGE 2,417,672

WAY GUARD STRUCTURE

Filed July 27, 1944 4 Sheets-Sheet 3

FIG. 5

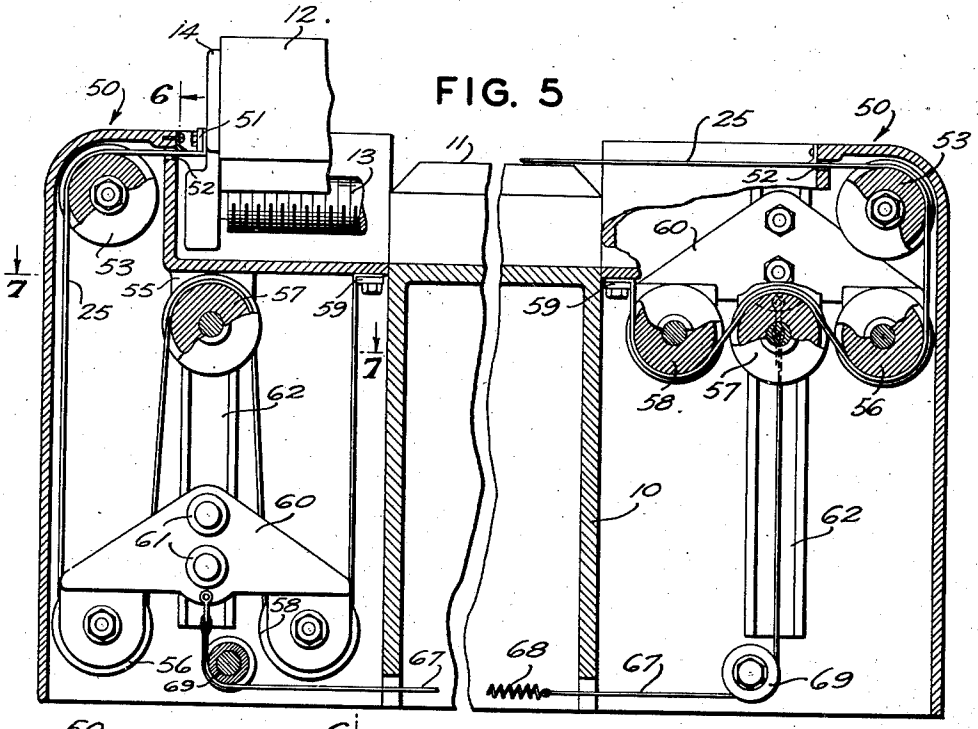


FIG. 6

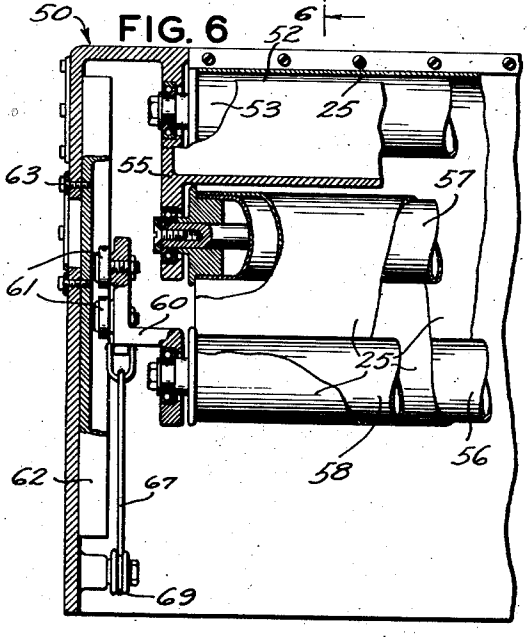
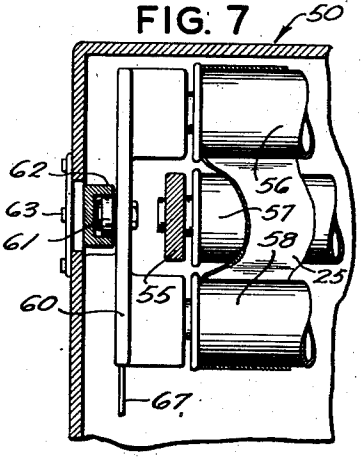


FIG. 7



INVENTOR
JOSEPH B. ARMITAGE
BY W. D. O'Connor
ATTORNEY

March 18, 1947. J. B. ARMITAGE 2,417,672

WAY GUARD STRUCTURE

Filed July 27, 1944 4 Sheets-Sheet 4

FIG. 8

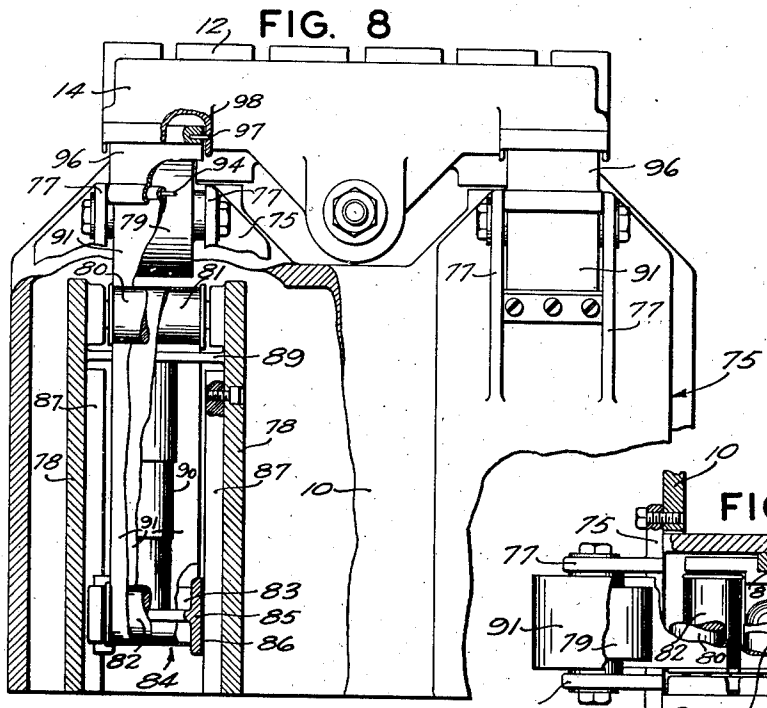


FIG. 10

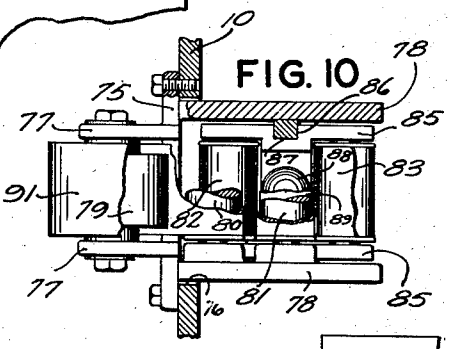
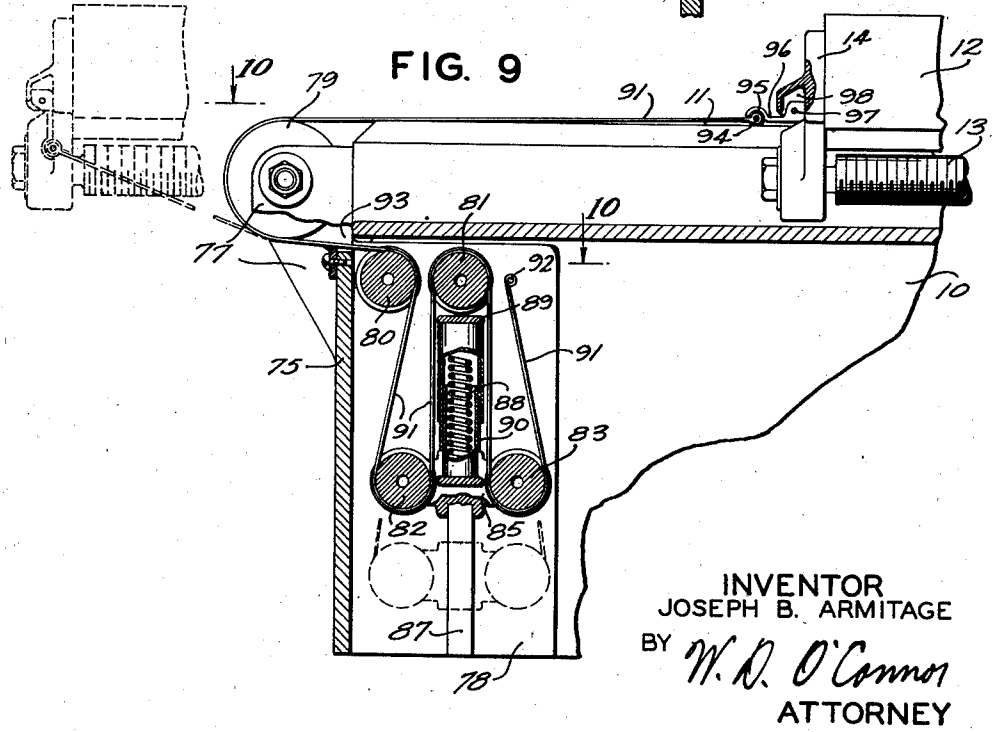


FIG. 9



INVENTOR
JOSEPH B. ARMITAGE
BY W. D. O'Connor
ATTORNEY

Patented Mar. 18, 1947

2,417,672

UNITED STATES PATENT OFFICE

2,417,672

WAY GUARD STRUCTURE

Joseph B. Armitage, Wauwatosa, Wis., assignor to Kearney & Trecker Corporation, West Allis, Wis., a corporation of Wisconsin

Application July 27, 1944, Serial No. 546,833

22 Claims. (Cl. 308—3.5)

1

This invention relates, generally, to improvements in way guards and more particularly to an improved way guard structure adapted to prevent the deposit of chips or other injurious foreign matter upon the accurately finished ways that form the bearing surfaces for the movable work supporting element of a machine.

A general object of the invention is to provide a way guard structure that comprises an improvement over applicant's copending application, Serial No. 497,034, filed August 2, 1943.

Another object of the invention is to provide an improved way guard structure arranged for unitary application to the base of a machine.

Another object of the invention is to provide improved way guard structures, each including a strip of flexible material adapted for attachment to one of the opposite ends of the movable work support and movable therewith in a manner to protect the portions of the ways not covered by the movable work support.

Another object of the invention is to provide an improved way guard structure including a flexible way guard strip trained about a plurality of fixed and movable support and guide members arranged in such a manner that the inactive portion of the strip follows a path of reversely directed spaced flights and is yieldably maintained extended at all times so that the contaminated surface of the strip is never permitted to contact the surface of the strip that forms the protective covering for the normally exposed portions of the ways of the machine.

Another object of the invention is to provide an improved way guard structure, including compensating mechanism arranged in a manner to yieldably retain the way guard in extended taut condition at all times, while permitting movement thereof in response to movement of the work support to provide the desired protective covering for the ways of the machine, regardless of the position of the work support along the ways.

Another object of the invention is to provide a unitary way guard structure adapted for attachment to the end of the bed of the machine and constructed in a manner to permit overtravel of the work supporting element beyond the ends of the ways.

Another object of the invention is to provide an improved way guard structure adapted for unitary application to each end of the machine and including coupling means operative in a manner to permit the unitary action of the compensating mechanism disposed at opposite ends of the machine to effect the retraction of the way guard

2

attached to the leading edge of the movable work support at the same rate at which the trailing way guard is being paid out under the action of the moving work support.

A further object of the present invention resides in the provision of a plurality of unitary way guard structures arranged for attachment to the opposite ends of the bed of the machine and each including a flexible way guard strip, a plurality of way guard guiding and supporting members carried by the frame of the way guard structure and adapted to direct the course of travel of the flexible way guard member along a plurality of spaced reversely directed paths; a movable unit mounted in the frame for supporting some of the way guard guide and supporting members; and means for yieldably urging the movable unit away from the fixedly mounted way guard support and guide members, whereby the flexible way guard member is constantly retained in extended taut condition.

According to this invention, an improved way guard structure of unitary form, including a flexible way guard strip, disposed to cover the normally exposed portions of the ways, is adapted for application to the bed of the machine to provide ample protection against the deposit of chips or other injurious foreign matter upon the relatively soft and accurately finished ways of a machine. In some instances, a single flexible way guard strip of sufficient width to cover both of the parallel machine ways may be employed. In other instances, it may be advantageous to utilize separate strips to afford protection for the individual ways. In any event, one end of each flexible way guard strip is anchored within the way guard structure and its remaining or free end is arranged for attachment to one end of the work support that is mounted for sliding movement along the ways of the machine. The intermediate portion of each flexible way guard strip is guided and supported by a plurality of fixed and movable members over which the way guard is trained in a manner to provide a plurality of spaced reversely directed flights arranged to retain the contaminated surface free from contact with the remaining surface of the guard. The movable way guard support and guide members are mounted to permit their unitary movement in response to movement of the work support and yieldable means serves to retain the way guard extended and taut at all times. As the movable work support is reciprocated under power through controlled cycles of movement, the way guard attached to its trailing edge is ad-

vanced and the way guard attached to its leading edge is retracted. The yieldable means, attached to the unit carrying the movable way guard support and guide elements, serves as a compensating mechanism, which functions in response to movement of the work support to permit the individual way guards to be paid out or retracted. As indicated in the forms of the invention illustrated in the accompanying drawing, the compensating mechanisms disposed at opposite ends of the bed in the unitary way guard structures may be harnessed together to work in unison, or they may function independently. The independent operation of the compensating mechanism is particularly advantageous in instances where the work support is permitted sufficient movement to overtravel the end brackets or housings containing the way guard structures.

The foregoing and other objects of the invention will become more fully apparent from the following detailed description and may be achieved by means of the exemplifying apparatus depicted in and set forth in the specification in connection with the accompanying drawing, in which:

Figure 1 is a vertical longitudinal sectional view through the base of a milling machine, showing a way guard structure constructed in accordance with the teachings of the present invention;

Figure 2 is a top plan view of the structure shown in Figure 1 and having parts broken away to more clearly illustrate certain structural features of the invention;

Figure 3 is an enlarged vertical transverse sectional view, taken substantially along the plane of the line 3—3 of Figure 2 and showing more particularly the unit that carries the movable way guard support and guide members, together with means for guiding the path of travel of the movable unit;

Figure 4 is an enlarged fragmentary vertical longitudinal sectional view, taken substantially along the plane of the line 4—4 of Figure 3 and having parts broken away to more clearly illustrate certain structural features of the invention;

Figure 5 is an enlarged fragmentary vertical longitudinal sectional view through the ends of a milling machine base provided with way guard structures embodying a modified form of the invention;

Figure 6 is an enlarged fragmentary vertical transverse sectional view, taken substantially along the plane of the line 6—6 of Figure 5 and having parts broken away to more clearly illustrate certain structural features of the form of invention there shown;

Figure 7 is an enlarged fragmentary horizontal sectional view, taken substantially along the plane of the line 7—7 of Figure 5 and showing the guide rail and mounting bracket for the movable way guard supporting members;

Figure 8 is a fragmentary end elevational view of the base of a milling machine provided with another modified form of way guard structure and having parts broken away to more clearly illustrate the use of individual guards for the separate ways;

Figure 9 is a fragmentary vertical longitudinal sectional view through the structure illustrated in Figure 8 and showing an arrangement of parts which permits overtravel of the movable work support beyond the end of the base of the machine; and

Figure 10 is a fragmentary top plan view of a portion of one end of the machine illustrated in Figure 8 and showing a unitary way guard structure with parts broken away to more clearly disclose the arrangement of its cooperating elements.

Accuracy of production on machines including a reciprocating work supporting element mounted for sliding movement along ways formed on the base is dependent upon the continuing accuracy of the finish of the ways. The invention herein set forth presents improved way guard structures constructed in a manner to provide ample protection for the ways of the machine, to insure against the deposit of chips or other foreign matter upon the normally unprotected portions of the ways. The maintenance of the ways in clean condition, without mars or scratches which normally result from the accumulation of chips or other foreign matter on the way surfaces over which the table is being constantly reciprocated, gives continued accuracy and added life to the machine.

Referring to the drawing, the several forms of the improved way guard structure embodying the teachings of the present invention are shown in conjunction with a milling machine. It will be noted that the machine comprises a base or bed 10 having a pair of horizontally disposed parallel guide ways 11 upon which a work support or table 12 is mounted for sliding movement. The table 12 is provided with a feed screw 13, rotatably mounted in a pair of end brackets 14, secured to the opposite ends of the table. A cooperating driving nut 15 is mounted in the base 10 in the usual manner so that relative rotation between the screw 13 and nut 15 effects longitudinal displacement of the table 12 along the ways 11. Operation of the screw and nut mechanism to move the table 12 along the ways 11 may be effected in the usual manner, either manually or by means of a power transmission mechanism (neither of which is shown) located in a central compartment 16 within the base 10.

Referring more particularly to the form of the invention shown in Figures 1 to 4, inclusive, of the drawing, it will be noted that identical way guard receiving structures 20 are applied to each end of the base 10. Each way guard structure 20 comprises a frame 21 in the form of a housing provided with side marginal flange portions 22 adapted to receive anchor bolts 23 (see Figure 2) by which the frame members are secured to the ends of the base 10. The frame member 21 provides a housing adapted to contain and support the way guard structure of the present invention. The frame member 21 is provided with a transversely extended horizontal slot 24 adapted to provide an opening through which a strip 25 of flexible way guard material may be passed. A plurality of way guard guide and support members, preferably in the form of rollers 26, 27 and 28, are mounted in substantial vertical alignment in the frame 21 and are respectively journalled for rotation in suitable bearings positioned and retained by bearing caps 29, in the manner shown in Figure 4. The frame 21 also includes a pair of horizontally disposed track or guide rails 30, extending into the open end of the bed 10, and each disposed to lie adjacent to a side wall of the bed 10, to which it may be secured by suitable anchoring bolts. The guide rails 30 serve as spaced supports for a movable unit that includes

a pair of arms 31 in which a plurality of rollers 32, 33 and 34 are each rotatably mounted in spaced relationship in suitable trunnions or bearings. The shaft of the center roller 33 extends outwardly beyond the arms 31 and its ends each receive a roller bearing 37, releasably retained thereon by a snap ring 38. The bearings 37 ride within the guide rails 30 which are of channel form and serve to support the unit that includes the bank of way guard guide rollers 32, 33 and 34, in its movement toward and from the stationary rollers 26, 27 and 28.

A suitable harness 40 is attached to each of the connecting arms 31, above and below the intermediate roller 33. The harnesses 40 are arranged to be connected in pairs, one adjacent each side of the base 10, by means of cables 41 directed over separate sets of pulleys 42 and 43, positioned in a manner such that the cable is passed through the lower portion of the compartment 16, so as not to interfere with the usual power transmission mechanism contained therein. A coil spring 44 is incorporated in each of the cables 41 for the purpose of constantly maintaining tension upon the harnesses 40 to yieldably urge the movable units, including the way guard rollers 32, 33 and 34, away from the stationary rollers 26, 27 and 28, so as to maintain the way guard strips 25 in extended taut condition at all times. The coil springs 44 are so arranged that they exert a balanced tension on each of the movable units disposed at opposite ends of the machine, so that the units will move evenly along the guide rails 30.

With reference to Figure 1, it will be noted that the table 12 is shown in an extreme position at the lefthand end of the bed 10 wherein the movable unit carrying the support and guide mechanism for the way guard strip 25, associated with one end of the table, has been retracted to its inner extreme position to take up the unused portion of the way guard strip. The movable unit carrying the support and guide means for the way guard strip connected to the other end of the table is disposed in its outer extreme position, wherein it lies adjacent the stationary rollers 26, 27 and 28. As the table 12 is moved toward its other extreme position at the righthand end of the bed, the two way guard support and guide mechanisms will each be moved to positions which are the reverse of those illustrated in Figure 1 of the drawings. The coil springs 44 serve, at all times, to draw the movable units carrying the way guard support and guide mechanisms toward each other, so that the way guard strips 25, attached to each end of the table 12, are always retained in extended taut position, with their active portions disposed to form a protective covering for the portions of the ways 11 that are not covered by the table 12.

The form of invention shown in Figures 1–4, inclusive, is particularly well adapted for use in machines having a relatively long bed, the hollow end portions of which provide adequate space for the receipt of the movable way guard support and guide members.

A modified form of the invention is illustrated, in Figures 5, 6 and 7 of the accompanying drawing, wherein the way guard support and guide mechanism is completely contained within a housing 50 arranged for attachment to the end of the bed 10 in any suitable manner. While the modified form of invention shown in these figures partakes generally of the characteristics of the previously described form, it should be noted

that the movable way guard support and guide members are arranged for movement in a vertical plane and wholly within the confines of the housing 50. One purpose of this arrangement lies in the fact that the length of the bed is not a controlling factor in the organization of the way guard structure. Since the structure is self-contained, the size of the housing 50 may be modified in accordance with the required length of table travel so that the amount of movement of the unit carrying the movable way guard support and guide members multiplied by the number of reversely directed flights of the way guard is equal to or greater than the maximum distance of table travel. In this form of invention, one end of the way guard strip 25 is attached to the end bracket 14 on the table 12, by means of a clamping bar 51, arranged to be bolted against the outer surface of the end bracket 14, to secure the way guard strip in desired position, above the way to be protected. The housing 50 is provided with a horizontally disposed opening 52, through which the way guard strip 25 may be threaded. A suitable wiper element is positioned on the end bracket 50 in a manner to contact the top surface of the way guard strip as it passes through the opening 52 to effect the removal of loose material from the contaminated surface of the way guard strip. The way guard strip is then passed over a roller 53, journalled for rotation in suitable bearings mounted in a flange portion 55 of the housing 50. The way guard strip 25 is then directed over additional guide and support rollers 56, 57 and 58 and arranged to have its free end anchored to the housing 50 by the application of a clamping bar 59. The roller 57 (see Figure 6) is journalled for rotation in bearings mounted in the flange 55 in a manner similar to that described for the roller 53. The rollers 56 and 58 are journalled in laterally spaced relationship in suitable bearings mounted in ears formed on each of a pair of yokes 60, which form a movable unit for supporting the rollers 56 and 58. Each of the yokes 60 is provided with a pair of vertically spaced guide rollers 61 mounted to extend outwardly therefrom and arranged to be received and guided in channel members 62 secured in upright position on the side walls by means of anchor bolts 63. As in the previously described form of invention, the movable units, including the way guard support and guide rollers 56 and 58, disposed at opposite ends of the machine, are arranged to be connected by means of a pair of cables 67, each including a tension spring 68, which serves to maintain the way guard strips 25 in extended taut condition. The cables 67 are anchored in any suitable manner to each of the yokes 60 and are trained about guide pulleys 69 mounted on the side walls adjacent the bottom of the housing 50 so that the cables 67 and springs 68 will not interfere with the power driving mechanism contained in the central hollow portion of the bed 10.

The particular advantage of the modified form of the invention shown in Figures 5, 6 and 7 resides in the fact that the way guard structure is wholly contained within the housing 50 to provide a unitary structure arranged for attachment to the end of the bed of the machine. With the way guard structure self-contained within the housing 50, the length of the bed of the machine is relatively unimportant, since none of the way guard structure extends into that portion of the machine and, hence, the structure may readily be applied to machines wherein the overall length

of the base would normally be insufficient to properly accommodate the way guard structure shown in Figures 1 to 4, inclusive.

A further modified form of the invention is disclosed in Figures 8, 9 and 10 of the accompanying drawing. This modified form differs from the preceding forms in two ways. The single way guard strip 25, previously described, has been replaced with a pair of relatively narrow way guard strips adapted to provide individual protection for each of the pair of spaced ways 11 formed on the bed 10 of the machine. The other principal difference lies in the fact that the individual unitary way guard structures each function independently of the remaining structures and, more particularly, those disposed at one end of the machine are wholly independent of those mounted on the other end of the machine. The general arrangement of parts disclosed in the modified form shown in Figures 8, 9 and 10 is similar to the structure shown in Figures 5, 6 and 7, save for the fact that the utilization of the form shown in Figures 8, 9 and 10 will permit the table 12 to overtravel the way guard structure applied to the end of the base 10 of the machine.

Referring specifically to the structure of the last-mentioned form of the invention, it will be noted that the independent way guard structures are each unitary in form and include a frame member 75 adapted to be secured to the end wall of the base 10 to form a cover for a way guard structure receiving opening 76, positioned in vertical alignment with the ends of each of the ways 11. The frame members 75 each include pairs of parallelly disposed outwardly and inwardly directed ears and flanges 77 and 78, respectively. A way guard guide roller 79, disposed to lie adjacent the extremity of the way 11, is journalled in the ears 77. Additional way guard guide rollers 80 and 81 are journalled in spaced relationship for rotary movement in the flanges 78 formed on the frame member 75. A pair of guide rollers 82 and 83 are rotatably journalled in a movable unit 84 comprising a yoke element 85, which includes a vertically disposed groove 86 formed in each side thereof and arranged for cooperation with guide bars or rails 87, anchored on the flanges 78, which form a track for the movable unit 84, including the guide rollers 82 and 83. The yoke 85 includes a horizontally disposed rib portion, which serves as a support for one end of a coil spring 88 that forms a yieldable means for normally urging the yoke 85 and associated rollers 82 and 83 away from the fixed rollers 80 and 81. The upper end of the coil spring 88 is disposed to contact a bar 89, which extends across the channel formed by the flanges 78 of the frame member 75. A telescopic tube 90, having its ends secured respectively to the yoke 85 and bar 89, provides a housing within which the spring 88 is retained.

Each of the way guard structures includes a relatively narrow flexible way guard strip 91, which has one end attached to a tie rod 92, secured between the flanges 78 of the frame member 75 and disposed at a position above the guide roller 83. The free end of the way guard strip 91 is threaded around the rollers 83, 81, 82 and 80, through an opening 93 disposed between the ears 77 and thence around the roller 79. The free end of the way guard 91 is anchored on a pin 94 mounted in a recess 95 formed on one end of a hinge plate 96. The other end of the hinge plate 96 is rockably mounted on a pin 97, carried by flanges 98 formed on a housing cast integrally with the end bracket 14, secured to the table 12 in the usual manner.

The hinge plate 96, to which one end of the flexible way guard strip 91 is attached, provides a simple and expedient method of avoiding undue wear upon the way guard 91 when the table 12 is moved to a position beyond the extremity of the ways 11, which are co-extensive with the length of the bed 10. As the end bracket 14 moves beyond the position in which the way guard 91 is supported by the guide roller 79, the hinge plate 96 will ride over the surface of the roller 79 and move to a substantially vertical position (see dotted line showing in Figure 9), wherein its lower extremity will lie below the lower surface of the table way, so that the flexible way guard 91 will be maintained out of contact with the depending portion of the table way. Since the way guard 91 is maintained in taut condition at all times under the action of the coil spring 88, it is desirable to afford a positive stop for limiting the rocking movement of the plate 96. To accomplish this end, the bottom surface of the plate 96 is arranged to contact the surface of the end bracket 14, disposed between the flanges 98.

In each of the three forms of invention described, it will be noted that a suitable wiper element has been applied to the frame element of each way guard structure and disposed in such relationship with the way guard receiving opening formed therein that the wiper element will contact the contaminated surface of the way guard to effect the removal of foreign matter such as chips and the like which may have been deposited upon it.

It should also be noted that, in each form of the invention described in the foregoing specification, the flexible way guard strip is arranged in a manner to insure against contact between the upper or contaminated surface of the guard and the lower or protective surface of the guard that is brought into protective relationship with the normally exposed portions of the ways 11. The novel method for insuring against the contamination of the surface of the way guard disposed to contact the way of the machine comprises the threading of the way guard strip over a plurality of fixed and movable guide and supporting members, in a manner to constantly retain the adjacent runs of the guard in spaced relationship with respect to each other. The movable guide and supporting members are constantly urged away from the fixed guide and supporting members under the action of a yieldable means to take up all slack in the several runs of the way guard, to insure proper relationship between the way guard and way and also to insure the maintaining of the contaminated and clean surfaces of the way guards in spaced relationship.

From the foregoing description of the illustrative embodiments of a protective way guard structure, it will readily be seen that a new and improved unitary way guard structure has been provided for application to the bed of the machine and arranged in a manner to have the free end of the flexible way guard strip attached to one end of the movable work support to provide a protective covering, operative at all times, to prevent the deposit of chips or other injurious foreign matter upon the finished way surfaces of the machine, over which the table or work supporting element is reciprocated. Each of the forms of the invention illustrated in the accompanying drawing provides a way guard struc-

ture, which in no way impedes the normal operation of the machine and, furthermore, each is designed to compensate for the complete travel of the table or work supporting element whether the same be within the length of the machine base or whether it is extended to permit overtravel of the ends of the table beyond the base of the machine. A further advantage of the way guard structures disclosed in the present application lies in the fact that the guard and supporting elements are positioned in a manner to direct the path of travel of the way guard in a series of reversely directed spaced flights, wherein contact between the protective surface and the contaminated surface of the way guard is precluded, with result that the protective surface of the way guard is maintained in clean condition, at all times.

While the invention has been described in considerable detail in the foregoing specification, it is to be understood that various changes may be made in its embodiments, without departing from or sacrificing any of the advantages hereinafter claimed.

I claim:

1. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a unitary way guard structure arranged to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame element for attachment to the base of the machine, a flexible way guard carried by said frame, said way guard having one end attached to said frame and the other attached to the movable work support, a plurality of fixedly mounted way guard guide members in said frame, a unit slidable mounted in said frame, a plurality of way guard guide members mounted in said movable unit, and yieldable means attached at one end to said frame and at the other end to said movable unit and operative to retain said way guard taut and control the movement of said unit in accordance with the position of the movable work support along the ways on the base.

2. In a machine having a base including guide ways and a work support mounted for sliding movement on said ways, the combination of a unitary way guard structure comprising, a frame element for attachment to the base of the machine, a way guard and way guard support and guide members mounted in said frame element, said way guard being formed of flexible material and trained about said guard support and guide members in a manner to direct the path of said way guard in reversely directed spaced flights, a plurality of said guide members being mounted in fixed relationship in said frame element, a movable unit mounted in said frame element, a plurality of said guide members mounted in said movable unit, and yieldable means interposed between said frame element and said movable unit and operable to urge said unit and way guard guide means carried thereby away from said fixedly mounted support and guide members whereby said way guard is retained in extended taut condition and wherein a portion of said way guard is maintained in protective relationship with the ways throughout the movement of the work support on the ways.

3. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure comprising, a way guard formed of flexible material adapted to provide a protective covering for the ways, attaching means for anchoring one end of said way guard to the work support, guide means for positioning said way guard in protective relationship with the ways, additional guide means within said structure arranged to direct the path of travel of said way guard in a plurality of spaced paths, some of said additional guide means being movable in response to movement of the work support, and resilient compensating mechanism interposed between said base and said movable guide means and operable on said movable guide means to yieldably retain said way guard in extended taut condition.

4. In a machine having a base including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure adapted to provide protection for the normally exposed portions of the ways, said way guard structure comprising, a strip of flexible material disposed to form a protective covering for the ways, means for attaching one end of said way guard to the movable work support, guide and support means mounted in said structure in such a manner that the intermediate portion of said way guard is directed in a path of travel having reversely directed spaced flights, said guide and support means including a plurality of rollers arranged in a manner to provide a combination of fixed and movable elements, connecting means between said movable elements, and resilient means interposed in said connecting means in a manner to yieldably urge said movable elements away from said fixed elements whereby said way guard is retained in extended taut condition at all times while permitting movement of the work support on the ways.

5. In a machine having a base including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure comprising, a way guard formed of flexible material disposed to form a protective covering for the ways and having one end attached to the movable work support and having its other end anchored within said way guard structure, guide means including a plurality of fixed and movable rollers for engaging said way guard and directing its path of travel in reversely directed spaced flights, a unit slidably mounted in said structure for supporting said movable rollers, and resilient means operative between said slidably mounted unit and said base to normally urge said unit carrying said movable rollers away from said fixed rollers whereby said way guard is maintained in extended taut condition throughout the movement of said work support upon the ways.

6. In a machine having a base including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure comprising, a way guard formed of flexible material disposed to form a protective covering for the ways and having one end attached to the movable work support and having its other end anchored within said way guard structure, guide means including a plurality of fixed rollers and a plurality of movable rollers for contacting said way guard and directing its path of travel in reversely directed spaced flights, a movable unit carrying said movable rollers, guide means for said movable unit, and resilient means operative between

said movable unit and said base to normally urge said unit and movable rollers away from said fixed rollers whereby movement of the work support results in displacement of said movable unit in a manner to maintain said way guard extended and taut at all times.

7. In a machine having a base including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure comprising, a way guard formed of a strip of flexible material disposed to form a protective covering for the ways, guide means mounted in said structure and disposed adjacent the ends of the ways for directing said way guard into the base, a movable unit in said structure, additional way guard guide means in said unit, and yieldable means interposed between said base and said movable unit and operative upon said unit to maintain said way guard in extended taut condition and to compensate for movement of the work support upon the ways.

8. In a machine having a base including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure comprising, a separate housing attached to each end of the base, a pair of flexible way guards arranged for attachment respectively to the ends of the work support and disposed to overlie the ways, support and guide members disposed adjacent the ends of the ways in each of said housings for positioning said guards over the ways and directing them into the base, a movable unit in each of said housings, additional way guard guide members carried by each of said units, and yieldable means connecting said movable units and operable to retain both of said way guards in extended taut condition and to compensate for movement of said work support on the ways.

9. The combination with a machine tool including a base having ways and a work support mounted for sliding movement of the ways, of a way guard structure comprising, a flexible way guard strip attached at one end to the work support and disposed to form a protective covering for the ways, guide means mounted in said structure and disposed adjacent to the end of the ways for directing said way guard strip into the base of the machine tool, a movable unit in said structure, additional guide means for said way guard strip carried by said movable unit, and force exerting mechanism attached to said movable unit and to said structure and operative upon said way guard strip to retain the same in extended taut condition regardless of the position of the work supporting element on the ways of the machine tool.

10. In a machine including normally exposed guide ways and a work support mounted for sliding movement on the ways, the combination of a unitary way guard structure comprising a frame element for attachment to the base of the machine, a plurality of fixed and movable way guard guide members mounted in said frame, a flexible way guard trained in extended condition over said guide members to form a plurality of reversely directed spaced flights, said way guard having its ends anchored respectively to said frame and to said movable work support, and resilient means interposed between said fixed and said movable guide members and operating to urge them apart, the number of flights of said guard multiplied by the amount of movement of said guide members being not less than the amount of movement of the work support, whereby said guard is retained in extended taut condition regardless of the position of the work support along the ways.

11. In a machine having a work support slidably mounted on normally exposed guide ways, the combination of a way guard structure comprising, a way guard formed of a piece of flexible material having one end attached to the work support and being disposed in protective relationship with the guide ways and having its other end attached to said structure, a plurality of guide and support members for the intermediate portion of said way guard, some of said members being mounted in fixed trunnions and others being mounted in movable trunnions, a movable unit in said structure for supporting said movably mounted trunnions, a guide for controlling the path of travel of said movable unit, and resilient means interposed between said structure and said movable unit and operative to respond to movement of the work support in a manner to retain said way guard in extended taut condition and to compensate for movement of the work support upon the guide ways.

12. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a way guard structure including a pair of frame elements for application to the base respectively adjacent the opposite ends of the ways, a flexible way guard strip associated with each of said frame elements, one end of each of said way guard strips being anchored to one of said frame elements and the other end of each adapted for attachment to one of the opposite ends of the movable work support adjacent the way to be protected, guide means for said way guard mounted in each of said frame elements, said guide means including fixed and movably mounted members about which said strips are trained, a movable unit in each of said frame elements for supporting said movable members, and yieldable means connecting said units in a manner to retain the way guard strips in extended condition and under tension while the active length of each strip is varied in response to movement of the work support along the ways.

13. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a unitary way guard structure for application to the base to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame element for attachment to the base, a flexible way guard disposed to overlie the ways and having its ends attached respectively to said frame element and to said movable work support, a plurality of fixed and movable guide members carried by said frame element over which said way guard is trained in extended condition, and yieldable means interposed between said movable guide members and said frame element to yieldably retain said way guard in extended taut condition at all times regardless of the position of the movable work support along the ways.

14. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a unitary way guard structure for application to the base of the machine to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame element for attachment to the

base, a flexible way guard mounted in said frame element and having its ends attached respectively to said frame element and the movable work support, a plurality of fixedly mounted way guard guide members carried by said frame element, a movable unit mounted in said frame element, a plurality of way guard guide members mounted in said movable unit, and yieldable means operating between said frame element and said movable unit and operative on said unit to retain said way guard in extended condition and under tension while the active length of said way guard is varied in response to movement of the work support along the ways.

15. In a machine having a base including guide ways and a work support mounted for sliding movement along the ways, the combination of a unitary way guard structure arranged to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame for attachment to the base, a plurality of way guard guide members including fixed and movable members mounted in said frame, a flexible way guard strip trained about said fixed and movable way guard guides in a manner to retain said guard in extended condition within said frame, said way guard strip having one end anchored in said frame and the other end attached to the movable work support in a position to form a protective covering for the ways, and force exerting mechanism operative upon said movable guide members to urge them away from said fixed guide members in manner to retain said flexible way guard taut and to compensate for movement of the work support along the ways of the machine.

16. In a machine having a base including guide ways and a work support mounted for sliding movement along the ways, the combination of a unitary way guard structure arranged to provide a protective covering for the exposed portions of the ways, said unitary way guard structure comprising, a frame element for attachment to the base of the machine, a plurality of way guard guide members mounted in spaced relationship in said frame element, some of said members being fixedly mounted and others being movably mounted, a flexible way guard strip trained about said members to follow a tortuous path including reversely directed spaced flights, means for anchoring the ends of said flexible way guard strip respectively to said frame element and to said movable work support in a position to form a protective covering for the ways, and force exerting mechanism operative upon said movable way guard guide members at all times in manner to retain said way guard in extended taut condition regardless of the position of said work support along the ways.

17. In a machine having a base including guide ways and a work support mounted for sliding movement along the ways, the combination of a unitary way guard structure adapted to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame for attachment to the base of the machine, a plurality of way guard guide members including a bank of fixed and a bank of movable members mounted in said frame, said fixed and movable members being positioned respectively in spaced relationship, a flexible way guard strip trained about said guide members in extended condition, and a force exerting mechanism operative upon said movable guide members in manner to retain said way guard taut and permit movement of the work support along the ways of the machine.

18. In a machine having a base including guide ways and a work support mounted for sliding movement on the ways, the combination of a unitary way guard structure arranged to provide a protective covering for the normally exposed portions of the ways, said unitary way guard structure comprising, a frame adapted for attachment to the end of the base to form a component part thereof, a plurality of fixedly mounted way guard guide members positioned in spaced relationship in said frame, a plurality of movable way guard guide members positioned in spaced relationship in said frame, a flexible way guard strip trained about said fixed and movable guide members in a manner to effect the housing of its extended length within a relatively small space, and force exerting mechanism attached to said movable way guard guide members and operative thereon to force them away from said fixed guide members, said force exerting mechanism serving to retain said way guard in extended taut condition and to permit movement of said guide members to compensate for movement of the work support along the ways.

19. In a machine having a base including guide ways and a work support mounted for sliding movement along the ways, the combination of a way guard structure arranged to provide a protective covering for the normally exposed portions of the ways, said way guard structure comprising, a frame adapted for attachment to the end of the base to form a component part thereof, a plurality of way guard guide members mounted in said frame, a flexible way guard strip having its ends attached respectively to said frame and the movable work support and having its intermediate portion trained about said guide members, a movable unit supporting a plurality of said guide members, and a yielding force exerting mechanism operatively attached to said movable unit and acting in direction to provide a means for yieldably retaining said way guard in taut extended condition and permitting motion of said movable element to effect the advance or retraction of said way guard in response to movement of the work support along the ways.

20. In a machine having a base including guide ways and a work support mounted for sliding movement along the ways, the combination of a way guard structure arranged to provide a protective covering for the normally exposed portions of the ways, said way guard structure comprising, a way guard housing adapted for attachment to the end of said base to form a component part thereof, a plurality of fixed and movable way guard guide members mounted in said housing, said fixed and movable guide members being respectively mounted in spaced relationship, a flexible way guard strip having one end attached to the work support in a position to form a protective covering for the ways and its other end anchored in said guard housing with the intermediate portion thereof trained in extended condition about said guide members, and a resilient force exerting compensating mechanism attached to said guard housing and to said movable guide members and operative to control their movement in response to movement of the work support in a manner to retain said way guard in extended taut condition at all times.

21. In a machine tool having a bed presenting bearing ways and a carriage slidably mounted on said ways, guards for said ways comprising

flexible guard strips extending from each end of said carriage along said ways and over the ends of said bed, a plurality of guide rollers rotatably mounted in fixed positions at each end of said bed, a roller supporting unit slidably mounted at each end of said bed for movement toward or from said fixed position rollers, a plurality of guide rollers rotatably mounted in said bodily movable unit, said guard strips being threaded over said fixed rollers and said movable rollers alternately, and resilient force exerting means operatively connected to urge said movable rollers away from said fixed rollers for maintaining said strips taut while permitting them to be paid out or retracted in conformity with movement of said carriage along said ways.

22. In a machine tool having a bed presenting bearing ways and a carriage slidably mounted on said ways, a hinge plate pivotally connected to said carriage over each of said ways at each end of said carriage, flexible guard strips each pivotally connected at one end to one of said hinge plates and disposed to extend over and protect said ways, and means to take in and pay out said guard strips in accordance with movements of said carriage along said ways, the arrangements being such that when said carriage overruns said ways said hinge plates on the overrunning end pivot downward to support said guard strips out of contact with the lower surface of said carriage.

JOSEPH B. ARMITAGE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
848,578	Thelin	Mar. 26, 1907
1,679,912	Mondloch	Aug. 7, 1928
1,895,122	Benedict	Jan. 24, 1933
1,937,985	Schnuck	Dec. 5, 1933
2,190,213	Meyer	Feb. 13, 1940
2,246,199	Caldwell	June 17, 1941