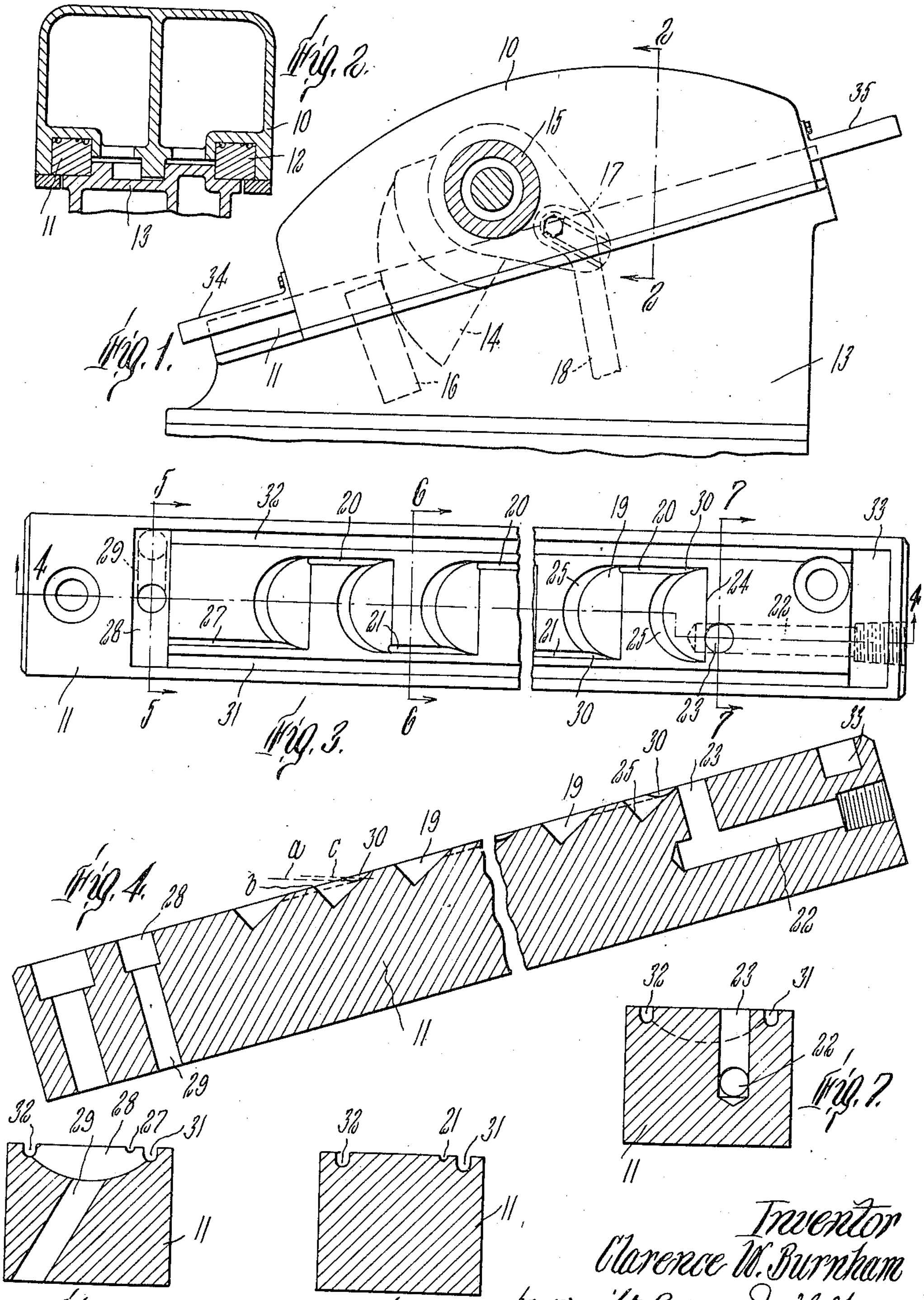
March 7, 1944. C. W. BURNHAM 2,343,533

SLIDEWAY LUBRICATION

Filed March 16, 1942



Inventor
Clarence W. Burnham
by Wright, Brown, Quinby & May
Attys.

Patented Mar. 7, 1944 2,343,533

UNITED STATES PATENT OFFICE

2,343,533

SLIDEWAY LUBRICATION

Clarence W. Burnham, Springfield, Vt., assignor to The Fellows Gear Shaper Company, Springfield, Vt., a corporation of Vermont

Application March 16, 1942, Serial No. 434,815

12 Claims. (Cl. 308—5)

The present invention relates to means and provisions for lubricating the ways on which slides or carriages, or other moving parts of machines are supported for reciprocating motion. Its object is to provide a more adequate and copious lubrication of such slideways than is accomplished by the means heretofore used and, in particular, to insure effective and adequate lubrication at the end of the slideway remote from that to which the lubricant is supplied.

The common practice in connection with machines having elongated slideways on which reciprocating slides are supported is to admit oil to one end of the slideway and to provide a series of grooves in the surface of the slideway forming a continuous channel from the admission point to the opposite end of the slideway. These grooves have heretofore been made of equal depth and width in all parts and frequently have failed to accomplish adequate lubrication at, and for some distance back from, the outlet point. Lubrication in this manner has been more or less uncertain and variable, depending on the clearance, the pressure, and the width and depth of the grooves. It was not possible to determine just how much of the slideway would be lubricated and how much oil would be supplied to any given portion of its length. The present invention avoids the defects and uncertainties of the prior practice and insures an adequate and copious supply of oil to all parts of the slideway.

One embodiment of the invention and one of its possible modes of application are shown in the accompanying drawing, in which—

Fig. 1 is a fragmentary side elevation of the supporting portion of a machine having two parallel inclined guides or slideways, with a carriage or slide supported for reciprocating motion thereon;

Fig. 2 is a cross section taken on line 2—2 of Fig. 1;

Fig. 3 is a plan view of one of the slideways with which the machine of Fig. 1 is equipped and in which the lubricating provisions of this invention are embodied;

Fig. 4 is a longitudinal section of the slideway taken on line 4—4 of Fig. 3;

Figs. 5, 6 and 7 are cross sections of the slideway taken on lines 5—5, 6—6 and 7—7 respectively of Fig. 3.

Like reference characters designate the same parts wherever they occur in all the figures.

The machine partially shown in Figs. 1 and 2 illustrates one of the many situations in which the invention may be usefully applied. This machine includes a slide or carriage 10, which rests and reciprocates on two slideways or bars 11 and 12 mounted on a supporting structure 13 parallel to one another at an inclination to the horizontal. The broken line structure in Fig. 1 represents a mechanism for moving the slide in the uphill direction, consisting of a cam 14 secured to a quill 15, which is mounted rotatably on the slide, and reacting against a fixed abutment 16 on the supporting structure. The quill is oscillated by an arm 17 and a connecting rod 18 receiving motion from a crank not shown. Gravity moves the slide in the opposite direction and maintains pressure contact between the cam and the abutment. However, the character of the slide and the means for reciprocating it are immaterial to the present invention, which is concerned wholly with the problem of providing adequate lubrication between the supporting surfaces of the slideways and the bearing surfaces of the slide.

Figs. 3–7 inclusive show the slideway 11 with all the details of form and structure by which effective supply and distribution of lubricant is accomplished in accordance with the present invention. Both slideways are alike and the following description of one will suffice for both.

In the upper surface of the slideway are a series of pockets or recesses 19 and grooves 20 and 21 passing from each pocket to the next. Oil is delivered to the pocket at one end of the series through a channel 22 extending inward from the adjacent end of the slideway and terminating in a port 23 which is located in the upper surface of the slideway and intersects the nearer boundary 24 of the endmost pocket. A pipe for conducting the oil to the slideway may be screwed into the threaded entrance to the passage 22 shown in the drawing.

Where the slideway is mounted in an inclined position, as in the present illustration, the oil is supplied to its upper end. Each pocket is of progressively increasing depth in the direction from the upper toward the lower end of the slideway, and is bounded at the sides and lower portion by a curved wall 25 of progressive and continuous curvature. Preferably this curvature is circular and the wall 25 is cylindrical; although these latter particulars are not of the essence of the invention and may be varied within limits hereinafter indicated. The grooves 20 and 21 permit flow of oil from each pocket to the next, and are in staggered relation to one another. That is, the grooves 20, which lead from the first to the second pocket, from the third to the fourth, from the fifth to the sixth, and so on, are located approximately on the tangents to those pockets adjacent to one side of the slideway, while the grooves 21, which lead from the second to the third pocket, from the fourth to the fifth, from the sixth to the seventh, and so on, are located substantially on the tangents to those pockets adjacent to the opposite side of the slideway. And the port 23 opens into the first pocket near the side opposite to that into which the pasage 20 opens. Thus the oil enters each pocket at or near one side thereof and flows out of the pocket from a point near the opposite side thereof. A groove 27 leads from the last pocket of the series to a sump 28 from which a passage 29 leads to connection with an eduction pipe.

When the slide is supported on the guideways, it covers all the pockets and confines the oil mainly to the pockets and intercommunicating grooves. Oil fed from the port 23 fills the first pocket and flows thence to the second pocket through the groove 20, from the second to the third pocket through the groove 21, and so on through the entire series, entering each pocket at one side thereof and issuing from the opposite side. In passing from the entrance to the outlet point of each pocket, the oil flows along the curved wall 25 and is given a swirling motion thereby, so that it washes the overlying surface of the slide. In the construction here illustrated the grooves 20, 21 and 27 are much less deep than the deepest parts of the pockets and their depth is so related to the inclination of the slideway, when set up for use, that the lowest points of their entrance ends are at higher levels than the lowest points of the bounding edges of the pockets from which they respectively lead. That is, owing to the tangential relation of each groove to the pocket from which it receives oil, its intersection with the pocket, in the supporting plane of the slideway, is at a level higher than the upper edge of the curved wall 25 and the depth is shallow enough to bring the lowest point of its intersection with the pocket wall at a level higher than the level of the lowest point of the bounding edge of the pocket. This relation is illustrated by the broken line *a* in Fig. 4, which is the horizontal plane of the lowest point of the intersection 30 between one of the pockets and the groove leading therefrom. This is higher than the lowest point, *b*, of the bounding wall of the pocket, and is the lowest point to which the oil level can fall when the pocket is covered by the overlying slide. However, as oil is constantly being supplied to the pocket, the actual level is higher than the plane of the line *a*, and may be in the neighborhood of the plane indicated by the broken line *c*. Hence each pocket will always contain a body of oil in contact with the overlying surface of the slide throughout a considerable proportion of the width of the pocket. This is equally the case with the pockets nearest the lower end of the slideway as with those near the upper end. The oil above the level *a* creates a pressure head causing a copious gush of oil from the pocket at higher level to the one next below. The pools of oil thus maintained and constantly replenished, at numerous points throughout the length of the slideway, furnish a copious and adequate lubrication to all parts of the slide; as well near the end from which the oil is discharged as at the end to which oil is admitted.

The pockets are located near together throughout the length of the slideway, except as to locations where space is needed to pass fastening means for securing the slideways to the supporting structure, and to provide for the oil flow connections. The ratios of dimensions and spacing of the pockets and communicating grooves of one embodiment of the invention are accurately shown in Figs. 3 and 4 of the drawing, with the exception that a large section, amounting to a major proportion of its length, has been broken from the middle part of the slideway as shown, in order that its end portions may be represented on a large enough scale within the limitations of the drawing space.

Longitudinal grooves 31 and 32 are provided in the supporting surface of the slideway between the side edges of the slideway and the pockets to receive whatever oil may overflow or be forced out laterally between the sliding surfaces. These grooves open at their opposite ends into the sump 28 and a cross channel 33 in the upper end of the slideway.

The particular wedge shaped or ungular formation of the pockets 19 here shown has been chosen partly as a measure of convenience, because such pockets can be simply and economically made by the operation of an end milling cutter fed into the surface of the slideway at an inclination to that surface. This manner of cutting the pockets makes the bounding wall 25 perpendicular to the bottom of the pocket. It also causes the wall 25 to be inclined at an obtuse angle to the supporting surface of the slideway throughout most of its extent. The angle is greatest at the longitudinal median plane, as shown by Fig. 4, and it is considerably more than 90° through a substantial distance to each side of the median plane. This slope of the wall 25 supplements the effect of centrifugal force in causing the swirling current of oil to exert upward force against the overlying surface of the sliding member 10 and to wash and scour that surface.

However, these details are not of the utmost importance and may be varied or modified within the scope of the broader aspects of the invention. A curved wall between the inlet and outlet points of the pocket is important because of the swirling and washing action given to the oil thereby. But the curvature of such wall may be other than circular, and it may be disposed otherwise than as the curved surface of an ungula. So great a depth in the deepest part of the pocket, as here shown, is also not essential.

With the slideway arranged in an inclined position, adequate flow of oil may be accomplished by gravity alone; although of course the force of gravity may be supplemented by hydrostatic pressure. However, the utility of the invention is not limited to inclined slideways, but may be applied to those which are horizontal as well, provided that the oil is supplied with sufficient pressure to cause it to flow through the pockets and grooves, to keep the pockets full of oil, and to obtain the desired swirling motion of the oil in its passage through the successive pockets. Then to confine the oil, the slide must cover all the open pockets and grooves at all points in its reciprocating travel. This may be accomplished either by making the slide longer than the slideways, or by providing extensions 34 and 35 on opposite ends of the slide of sufficient length to cover the exposed end portions of the slideways when the slide is at either end of its stroke.

What I claim and desire to secure by Letters Patent is:

1. In a machine having a sliding part, a guide or slideway having a supporting upper surface on which an under surface of said sliding part bears and by which the sliding part is supported, said slideway having pockets in its said supporting surface arranged in linear series, and having a channel for fluid lubricant leading to the first pocket of the series and other channels in its supporting surface leading in series from pocket to pocket; said pockets being adapted to contain pools of the lubricant in contact with the overlying surface of the sliding member and to be continuously replenished by lubricant flowthrough said channels.

2. In a machine having a reciprocable sliding member, and an elongated guide or slideway extending in the direction of reciprocation of said sliding member having an upper supporting surface on which an under surface of the sliding member rests, provisions for introducing lubricant between said surfaces of the slideway and sliding member consisting of pockets sunk into the upper surface of the slideway extending across a substantial proportion of the width thereof and arranged in linear series extending in the direction of reciprocation of the sliding member, channels leading from each pocket to the next in series, and a channel for delivering oil to the first pocket of the series; the channels between the pockets being of less width than the pockets and located alternately at opposite sides of the pockets so that the port at which oil enters each pocket is at the opposite side from the port through which oil leaves the same pocket, whereby the pockets contain pools of oil in contact with the overlying surface of the sliding member and oil flowing progressively through the series of pockets is given a cross current flow in passing between the respective inlet and outlet ports of the several pockets.

3. In a machine having an elongated guide or slideway arranged with its length dimension at an inclination to the horizontal and its transverse dimension horizontal, and a slide supported on said slideway for reciprocation up and down the slope thereof, provisions for lubricating the bearing surfaces of said slideway and slide comprising a series of pockets sunk into the supporting surface of the slideway spaced apart along the length dimension thereof and each occupying a substantial proportion of the width dimension of said surface, a flow passage leading into the uppermost pocket of the series for delivering oil thereto, and transmission channels sunk into said supporting surface of less width than the pockets leading from each upper pocket to the next lower pocket of the series, the eduction connection between each pocket and a channel being of less depth than the depth of the pocket at its lower boundary.

4. In a machine having an elongated guide or slideway arranged with its length dimension at an inclination to the horizontal and its transverse dimension horizontal, and a slide supported on said slideway for reciprocation up and down the slope thereof, provisions for lubricating the bearing surfaces of said slideway and slide comprising a series of pockets sunk into the supporting surface of the slideway spaced apart along the length dimension thereof and occupying a substantial proportion of the width dimension of said surface, a flow passage leading into the uppermost pocket of the series for delivering oil thereto, and transmission channels sunk into said supporting surface of less width than the pockets leading from each upper pocket to the next lower pocket of the series, the eduction connection between each pocket and a channel being mainly at a level above the level of the lowest part of the lower boundary of the pocket.

5. In a machine having a reciprocable sliding member and a guide or slideway supporting said member, provisions for lubricating the bearing surfaces of said sliding member and slideway comprising a series of pockets sunk into the supporting surface of the slideway and spaced apart in the direction of reciprocation of the sliding member, a channel for delivering oil to the pocket at one end of the series and channels in the supporting surface leading from each pocket to the next in series, said last named channels being of less width than the pockets and being located with their respective points of delivery connection to the several pockets at the opposite side of the respective pockets from the points of eduction therefrom, and the bounding wall at the side of the pocket toward which the inlet connection is directed being curved with a concave curvature progressively to the eduction connection, whereby the oil in flowing through the pockets from inlet to outlet is given a swirling motion in contact with the overlying surface of the sliding member.

6. In a machine having a sliding member and a guide or slideway on which said member is supported and along which it may reciprocate, provisions for lubricating the bearing surfaces of said member and slideway comprising pockets sunk into the supporting surface of the slideway and spaced apart from one another along the line of movement of the sliding member, conducting means for conveying oil to the pocket at one end of the series, a channel of less width than the pocket leading from an eduction port at one side of the first pocket to an inlet port at the corresponding side of the second pocket, a second channel similar to the first named channel leading from an eduction port at the opposite side from the inlet port of the second pocket to an inlet port at the corresponding side of the third pocket, and other channels between successive pockets of the series in alternating arrangement like the first and second channels precedently set forth, the several pockets each having a bounding wall of concave curvature between the inlet and outlet ports, which wall, in a portion of its extent, makes an obtuse angle with said supporting surface.

7. A guide or slideway for a machine having a sliding member, said slideway being provided with an upper supporting surface having pockets arranged to contain pools of oil and interconnecting channels for conducting oil to the endmost pocket and thence to the other pockets in series.

8. A guide or slideway as set forth in claim 7, in which the channels are of substantially less width than the pockets and respectively open into and lead from the several pockets at opposite sides of the pockets, whereby a cross

flow of oil in the pocket is produced in flowing from the inlet to the outlet port.

9. A guide or slideway as set forth in claim 7, in which one bounding wall of each pocket is curved and the channels leading into and out of the pockets are substantially narrower than the pocket and located at respectively opposite sides thereof, with the inwardly conducting channel arranged to discharge oil tangentially of said curved wall, whereby the oil is given a swirling movement in flowing to the eduction port.

10. A guide or slideway having a plane supporting surface with a row of pockets spaced apart in said surface and channels leading from each pocket to the next in series; each pocket having a concave curved wall at the side thereof toward the next pocket in series, and the channel leading into the pocket being of less width than the pocket and located at one side thereof substantially tangential to said wall, while the channel leading from the pocket opens through said wall at the side of the pocket opposite to the leading in channel.

11. A guide or slideway as set forth in claim 10, in which the curved wall makes an obtuse angle with the said plane surface in at least a portion of its extent between the leading in and eduction channels.

12. A guide or slideway for the purposes set forth having a plane supporting surface with a row of pockets sunk in said surface and channels leading from pocket to pocket in series; each pocket being of progressively increasing depth in the direction toward the next pocket in series, and the deeper parts of the pockets being bounded by a concave curved wall, the channels leading into and out of each pocket being substantially narrower than the pockets and being disposed at relatively opposite sides thereof substantially tangential to said curved wall.

CLARENCE W. BURNHAM.