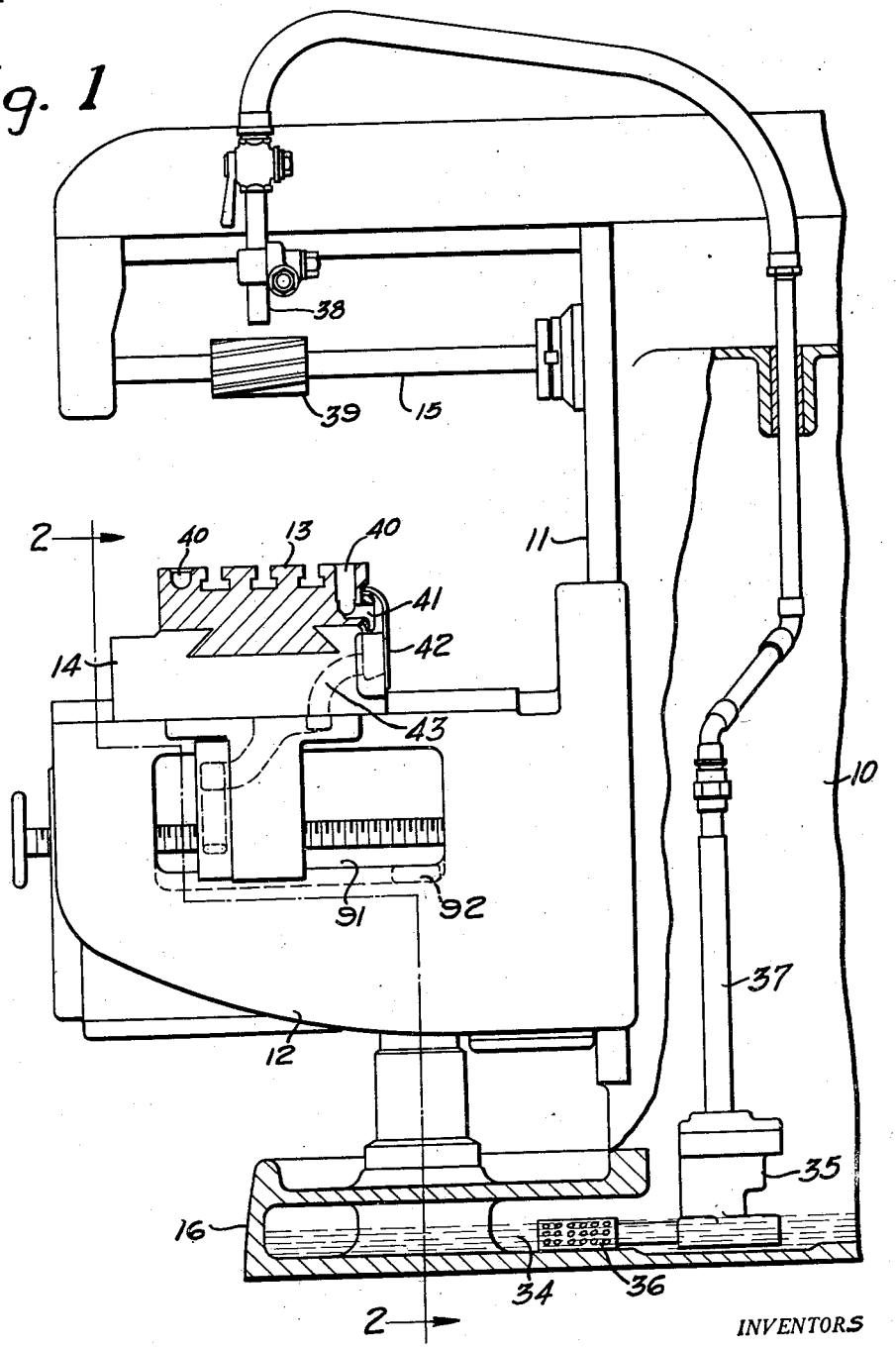
Nov. 2, 1948. L. F. NENNINGER ET AL 2,452,674

KNEE ACTUATING MECHANISM FOR MILLING MACHINES

Filed April 22, 1946 2 Sheets-Sheet 1

Fig. 1



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Filed April 22, 1946 2 Sheets-Sheet 2

Fig. 2

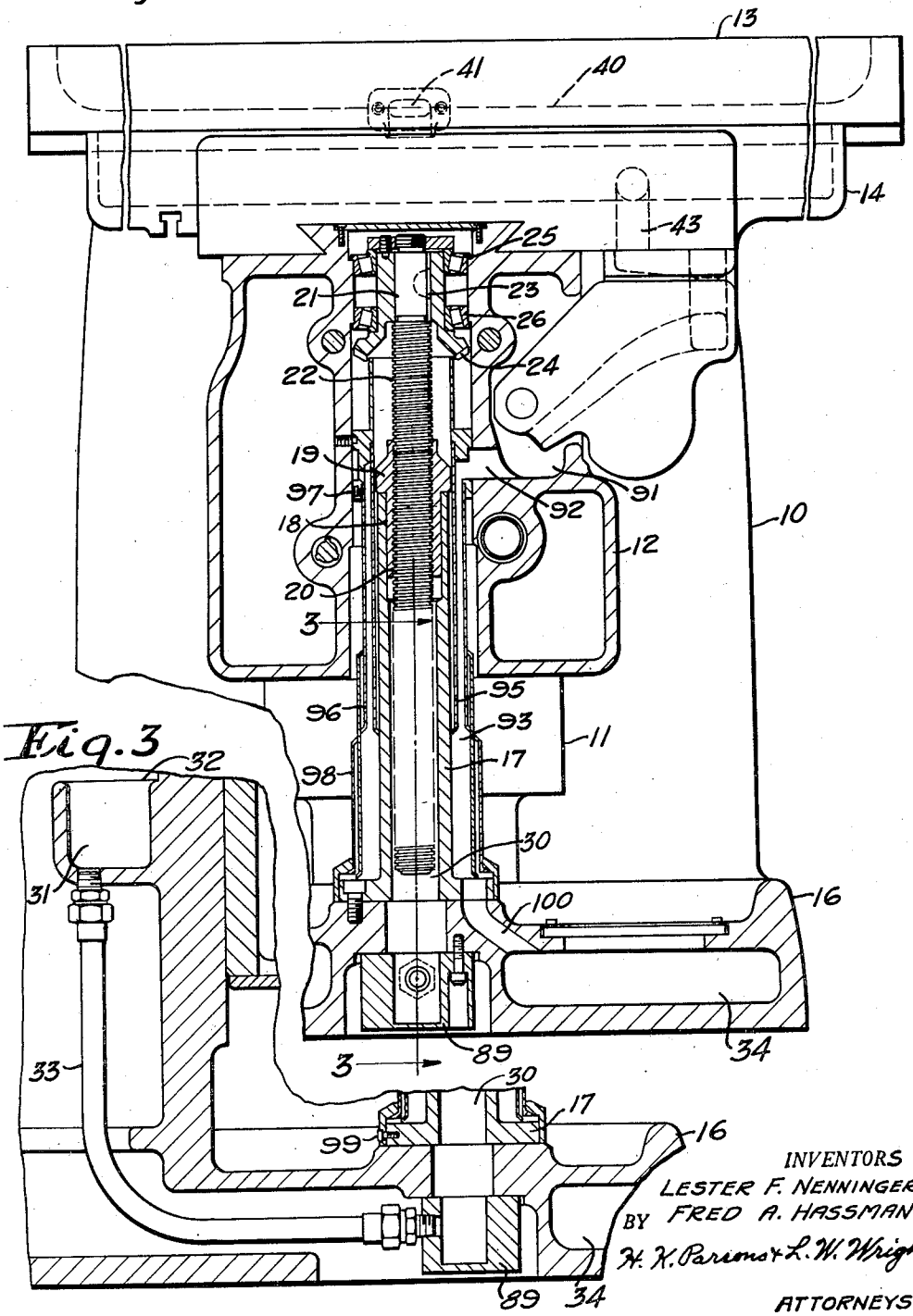


Fig. 3

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KNEE ACTUATING MECHANISM FOR MILLING MACHINES

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6 Claims. (Cl. 90—11)

1

This invention relates to improvements in milling machines or like machine tools and has particular reference to improvements in the adjusting mechanism therefor.

One of the objects of the present invention is the provision of means for minimizing the rise in temperature occasioned by friction between relatively moving parts.

A further object of the invention is to contrive a knee elevating mechanism in such manner that the coolant normally utilized with such a machine may be led or conducted in a heat exchanging relationship with the operating parts and thereby equalize the temperature throughout the knee mechanism and preserve any precision setting of the machine.

A further object of the invention is the provision of a structure which will insure adequate lubrication of the relatively movable parts thereof during adjustment and facilitate dispersion of heat from said parts and said lubricant as created by the adjusting operation.

A further object of the invention is the provision of a construction which will eliminate separate elevating and coolant return mechanisms and permit their joint association in a manner to improve the efficiency of operation of the machine.

Other objects and advantages of the present invention should be readily apparent by reference to the following specification, considered in conjunction with the accompanying drawings forming a part thereof, and it is to be understood that any modifications may be made in the exact structural details there shown and decribed, within the scope of the appended claims, without departing from or exceeding the spirit of the invention.

Figure 1 represents a view partially in elevation and partially in section of a machine embodying our improvements.

Figure 2 represents an enlarged sectional view taken as on the line 2—2 of Figure 1, and

Figure 3 represents a correspondingly dimensioned sectional view taken as on the line 3—3 of Figure 2.

This invention relates to elevating mechanisms for vertically moving machine parts and will be described in connection with a movable part of a machine tool such as the knee of a milling machine. In Figure 1 of the drawings there is shown a typical milling machine having a column, which is indicated by the reference numeral 10, on which is formed guideways 11 for receiving a knee 12 for vertical movement or adjustment. This movement or adjustment is primarily for the purpose of changing the relationship between the top surface of the table 13, which is supported on the knee through the medium of an interposed saddle 14, relative to the axis of a cutter spindle 15, which is journaled for rotation in the column 10.

2

The table 13 is supported on the saddle 14 for translation in a horizontal plane, while the saddle 14 is supported for translation on the knee in a horizontal plane but in a direction at right angles to the direction of movement of the table. It will be obvious that any change in the position of the knee, which might be caused by uneven expansions thereof, may affect the accuracy of any machining operation.

It is common practice to raise or lower the knee through the medium of a screw and nut mechanism, but it will be noted that the combined knee, saddle and table are supported by the column in cantilever fashion, and since the total weight of these parts is very considerable a great amount of friction is developed in the screw and nut mechanism, which, due to the weight which has to be moved, requires a large amount of power to effect any change in position.

The machine is provided with a base 16 upon which is formed an upstanding pedestal 17. The upper end of this pedestal has a counterbore 18 in which is secured a nut member 19. The interior bore of the nut member has a spiral thread 20 turned therein, and the elevating screw 21 also has a spiral thread 22 formed thereon, interfitting with that of the nut. The screw 21 is keyed at 23 to a bevel gear 24 which is supported for rotation by two sets of anti-friction bearings 25 and 26 in the upper part of the knee 12. It will thus be seen that the screw supports the knee and is mounted for rotation in the knee. Conventional manual or power driving mechanism as shown in our Patent No. 2,402,290, of which this application is a continuation in part, may be supported by the knee for rotation of gear 24.

Referring to Figure 2 the pedestal 17 has an interior bore through which the elevating screw passes and the lower end of this bore is closed by a cup-shaped member 89. This entire bore may be filled with lubricating oil for lubricating the screw and nut mechanism.

In order that the bore 30 and the cup 89 may be kept continuously filled with oil for lubrication of the screw and nut at any vertically adjusted position of the screw, the column 10 may be provided with a reservoir 31 supported interiorly of the column as indicated in Figure 3.

As indicated, the upper wall 32 of this reservoir is at a level above the lower end of the nut, and it has sufficient capacity so that there will be gravity pressure feeding the oil in any position of the screw from the reservoir through pipe 33 to the cap 89 and connected portion of the bore. As a result, during up and down movements of the screw the oil will be pumped to and from the reservoir and a constant lubricant supply maintained within the bore in heat transferring relationship between the screw 21 and the wall of the bore.

Alternatively, if desired, a constant circulation may be effected so that the oil in the upper portion of the bore will be replaced with fresh oil from the reservoir portion facilitating disposition of heat created by the friction between nut and screw while assisting in maintaining proper lubrication thereof. A suitable mechanism for effecting such circulation is shown, for example, in Patent 2,226,431.

As indicated in Figures 1 and 2, there is provided in the base 16 of the machine a reservoir 34 of appreciable capacity to contain adequate coolant supply for delivery to cutter and work during a milling operation. Contained in the reservoir is a circulating pump 35 provided at the intake with a strainer 36, and a suitable conduit system 37 extends upwardly within the column and has a discharge nozzle as at 38 overlying the cutter 39 for projecting the coolant onto the cutter and work as disposed on table.

It will be understood that during the tooling operation a continuous supply of this coolant in volume is delivered to the work for cooling the cutter and washing away the chips formed during the cutting operation. The table is provided with suitable drain grooves as at 40 terminating in a discharge outlet 41 from which the coolant is guided during any longitudinal movement of the table as by shield 42 through conduit 43 in the saddle to passageway 91 in the knee.

In order to maintain a more uniform temperature throughout the pedestal and in relation to the knee, passages have been formed in the pedestal and in the knee to conduct coolant applied to work on the table to a reservoir 34 formed in the base 16 in such a manner that it will pass in heat-exchanging relationship to the pedestal.

In this connection the knee is provided with a passageway 91 which normally receives coolant from the table and this passage is connected to an opening 92 in the inner wall of the knee which surrounds the pedestal. By providing this opening, the coolant may flow through an annular passage 93, the inner wall of which comprises telescoping tubes 95 attached to the knee and in telescoping engagement with the pedestal 17.

The outer wall of this annular passage is composed of a series of telescoping tubes 96, 98, the inner one of which is attached by screws 97 to the knee for movement therewith and the outer tube 98 is attached by screws 99 to the base 16. The coolant thus flows in close relationship to the telescoping tube 95 and the pedestal itself and thereby serves to conduct heat away from the pedestal 17 to maintain the temperature thereof substantially uniform and thereby prevent expansion which might tend to vary the height of the nut member in the upper extremity and cause a variation in the height of the table relative to the base of the machine and also prevent overheating of the associated screw and nut. The coolant flowing through the passage 93 may flow through an interconnecting passage 100 which is formed in the base 16 to the reservoir 34.

From the foregoing it will be noted that but a single pedestal structure or connection exterior to the column of the machine has been provided as respects the knee and elements carried thereby for lubrication, support and coolant return. This general pedestal structure provides a support for the nut and screw mechanism by which vertical movement for positioning or feeding operations of the knee and associate parts are effected. It provides conduit means insuring continuous adequate lubrication of the interfitting portions of the screw and nut with a continuous column of lubricating medium intervening the screw, and supporting pedestal of the machine placing these parts as a unit in heat transferring relationship one with the other for dispersion of localized heat. Additionally, it will be noted that by the arrangement of parts shown there has been provided in circumscribing relation to the elements just referred to a supplemental, extensible, annular chamber formed interiorly by the pedestal and the telescoping tube 95 and exteriorly formed by the series of telescoping interfitting tubes 96, 98. In this manner there is provided by the space a continuously changing water jacket circumscribing the pedestal and in heat absorbing relation therewith to maintain the parts and contained oil column at low operating temperature. It is further to be noted that by this arrangement both the elevating screw mechanism, the lubrication chamber therefor, and the coolant return are embodied in a single extensible and retractable unitary structure, eliminating the plurality of independent devices hitherto employed.

What is claimed is:

1. In a milling machine having a column, a cutter spindle journaled in the column, a knee slidably mounted on the column for movement toward and from the spindle, an upstanding pedestal integral with the column, a nut member mounted in the top of said pedestal, an elevating screw supported in the knee for operative engagement with said nut member, a drive gear for actuating said screw, inner and outer sets of telescoping tubes surrounding said pedestal to form an annular space therebetween, a coolant-conducting passage formed in the knee, means connecting said passage to said annular space whereby returning coolant may pass in heat-exchanging relationship with the pedestal, passageways connecting said space with a reservoir in the base of the machine, and means for supplying coolant from the reservoir to the knee by way of the cutter spindle.

2. A machine of the character described including a base, a column rising from the base, a unit mounted for vertical sliding movement on the column, a pedestal rising from the base at a point remote from the column and underlying the movable unit, interengaged adjusting screw and nut means intervening the pedestal and unit for effecting relative movement of said parts, means providing a column of lubricating fluid within the pedestal extending into engagement with the screw nut mechanism, means circumscribing the pedestal in spaced relation thereto providing a chamber surrounding the pedestal and its contained fluid column, and means for effecting circulation of a cooling medium within said chamber to maintain a low temperature in the contained fluid column and associated parts.

3. A machine of the character described including a base having a column rising therefrom,

a unit mounted on the column for vertical sliding movement relative thereto, a hollow pedestal rising from the base at a point remote from the column, an adjusting nut and screw mechanism intervening the movable unit and the pedestal and having a portion extending into the hollow interior of the column, said pedestal providing an interior chamber, a tubular member surrounding the pedestal in spaced relation thereto to provide a circumscribing chamber, and means for maintaining fluid in one of said chambers whereby to exert a cooling action minimizing temperature rises due to operation of the nut and screw mechanism.

4. A machine of the character described including a base having a column rising therefrom, a unit mounted on the column for vertical sliding movement relative thereto, a hollow pedestal rising from the base at a point remote from the column, an adjusting nut and screw mechanism intervening the movable unit and the pedestal and having a portion extending into the hollow interior of the column, said pedestal providing an interior chamber, a tubular member surrounding the pedestal in spaced relation thereto to provide a circumscribing chamber, means for maintaining fluid in one of said chambers whereby to exert a cooling action minimizing temperature rises due to operation of the nut and screw mechanism, and additional means for supplying a fluid medium to the other of said chambers to supplement the cooling action of the first liquid medium.

5. A machine of the character described including a base, a column rising therefrom, a knee vertically movable on the column, said base having a pair of independent reservoirs formed therein, a hollow pedestal rising from the base at a point remote from the column and subtending the knee, means providing communication between the interior of the pedestal and one of said reservoirs, adjusting nut and screw mechanism mounted on the pedestal and projecting into the upper portion of the hollow interior thereof, means connecting said mechanism with the knee for effecting adjustment thereof on relative rotation of said nut and screw elements, means

forming a chamber circumscribing the pedestal, conduit means connecting said chamber with the other of said reservoirs, means for effecting fluid flow from the first reservoir into the hollow pedestal, and means for effecting fluid flow from the second reservoir into the chamber circumscribing the pedestal whereby said fluids are mutually brought into heat transferring relationship to the pedestal and the associate parts for preventing rise in temperature thereof during operation of the machine.

6. A machine of the character described including a base having a pair of separate reservoirs formed therein, a column rising from the base, a knee unit vertically slidable on the column, a supporting pedestal rising from the base at a point remote from the column having a hollow interior communicating with one of said reservoirs, an adjusting mechanism carried by and projecting into the pedestal and having an outwardly projecting portion interengaged with the unit for effecting adjustment thereof on the column, telescoping members surrounding the pedestal in spaced relation thereto providing a circumscribing chamber, means for maintaining a lubricant column within the pedestal by way of the first reservoir and of height to engage the adjusting mechanism, and means for effecting a coolant circulation from the second reservoir by way of the circumscribing chamber whereby the fluid column and circulating fluid in the chamber cooperate to absorb and dissipate heat generated in the adjusting mechanism during operation of the machine.

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