Aug. 8, 1933. E. J. WHALEN 1,921,714

GRINDING MACHINE

Filed Dec. 9, 1929 3 Sheets-Sheet 1

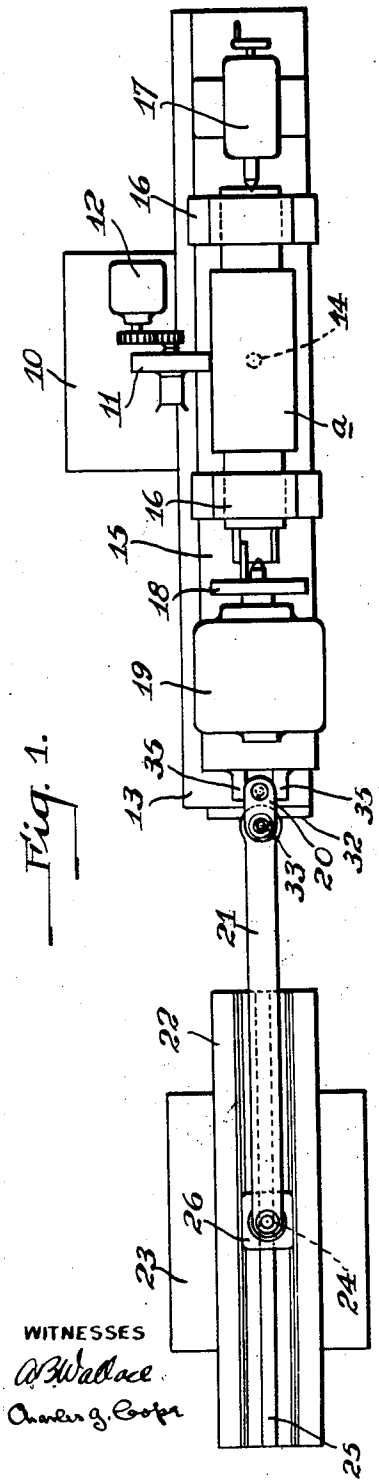


Fig. 1.

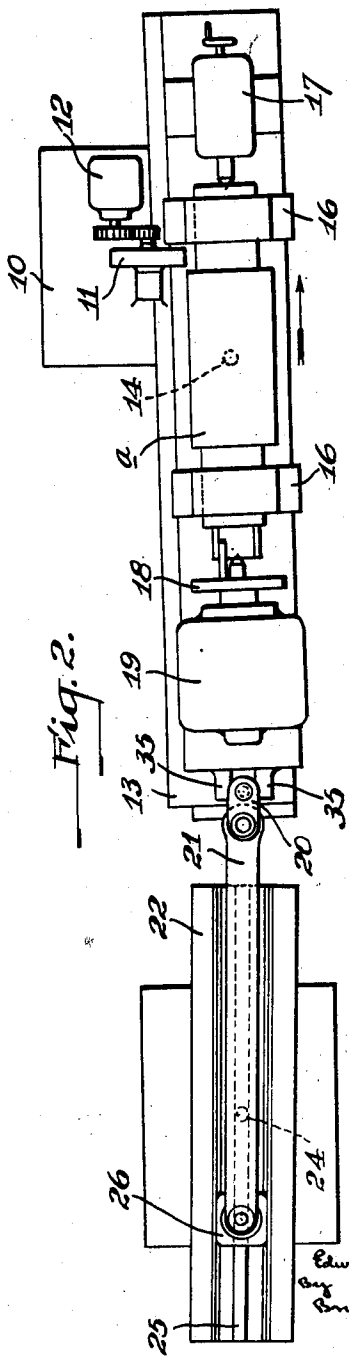


Fig. 2.

WITNESSES

A. B. Wallace

Charles J. Cooper

INVENTOR

Edward J. Whalen

by Brown & Critchlow

Attys

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GRINDING MACHINE

Filed Dec. 9, 1929 3 Sheets-Sheet 2

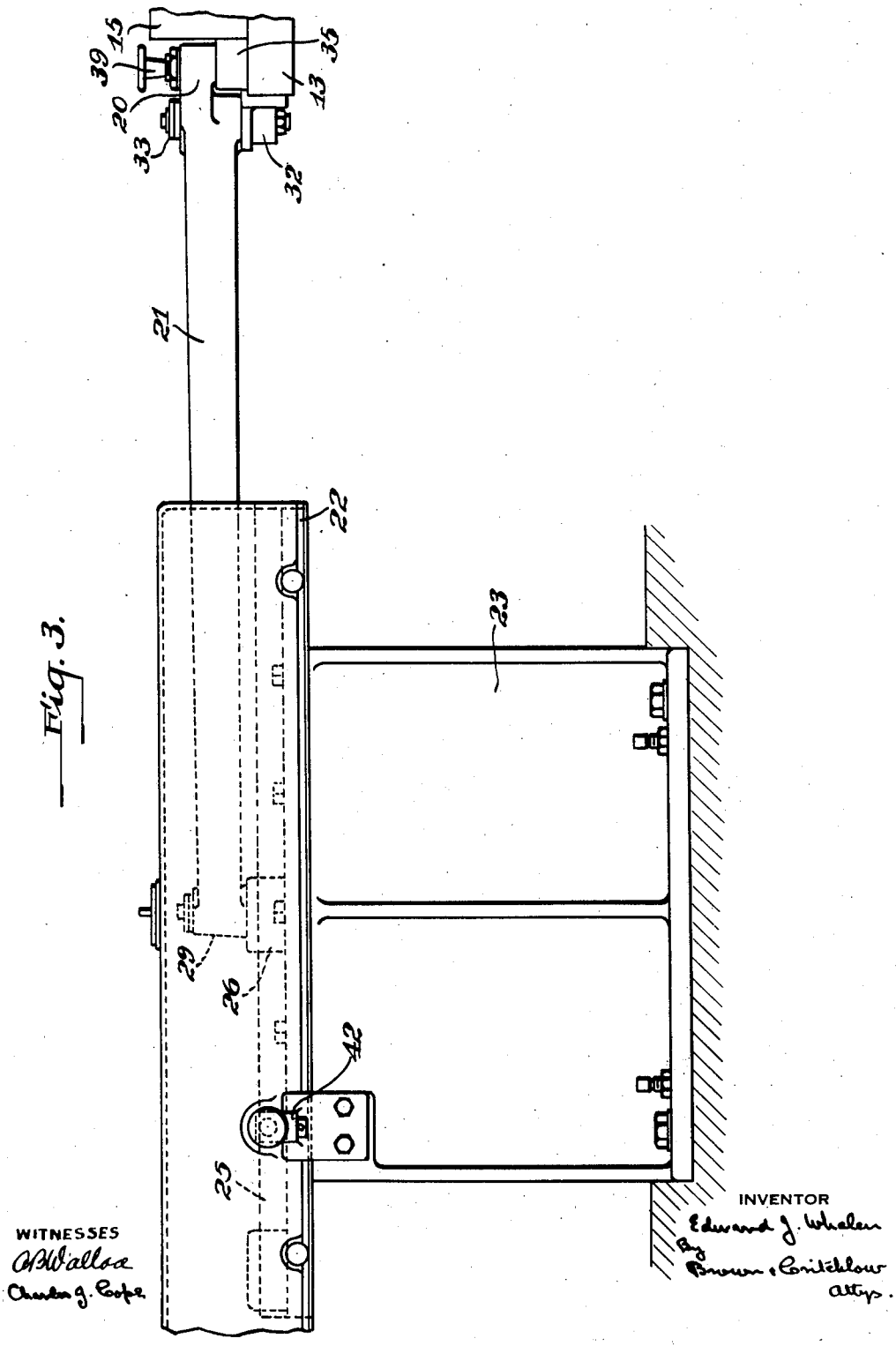


Fig. 3.

WITNESSES

A. Wallace

Charles J. Pope

INVENTOR

Edward J. Whalen

By Brown & Critchlow

attys.

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GRINDING MACHINE

Filed Dec. 9, 1929 3 Sheets-Sheet 3

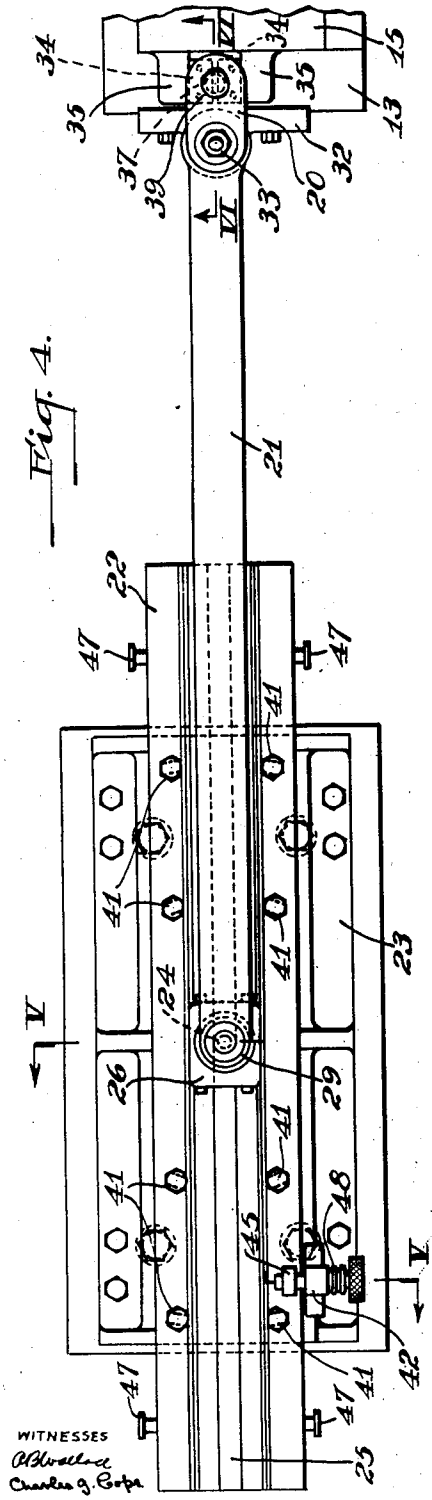


Fig. 4.

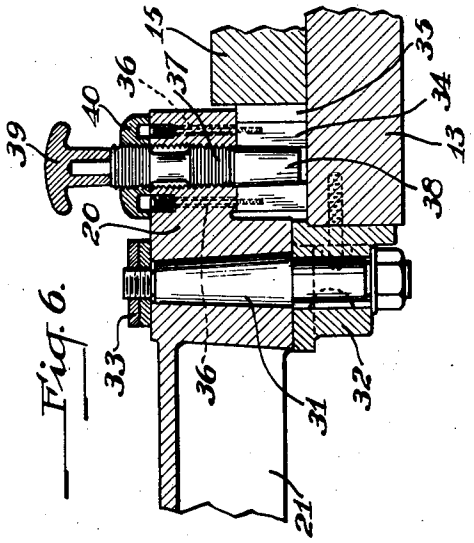


Fig. 6.

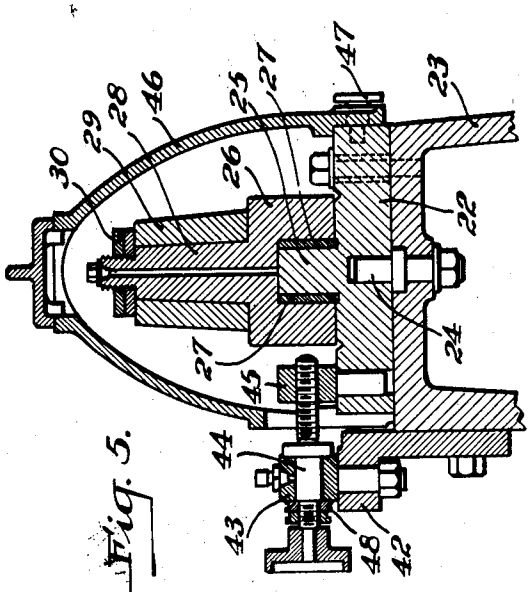


Fig. 5.

WITNESSES

INVENTOR

Edward J. Whalen

By Brown & Critchlow

Attys.

Patented Aug. 8, 1933 1,921,714

UNITED STATES PATENT OFFICE

1,921,714

GRINDING MACHINE

Edward J. Whalen, Pittsburgh, Pa., assignor to Aluminum Company of America, Pittsburgh, Pa., a Corporation of Pennsylvania

Application December 9, 1929. Serial No. 412,653

4 Claims. (Cl. 51—94)

My invention pertains to devices for grinding circular bodies to contours which are curved lengthwise of the body,—as, for example, in grinding a rolling mill roll to a camber or crown,—and relates especially to grinding devices in which the support which carries the body being ground is given a swivelling movement during the passage of the body past the grinding wheel, thereby to produce the desired convex or concave lengthwise curvature.

In grinding work of this character, extreme accuracy in the degree of lengthwise curvature imparted to the finished body is frequently a necessity, and has, in grinding devices for this purpose as heretofore employed, been exceedingly difficult to obtain. It has been common in such prior devices to pivot the support on which the body rotates while being ground, and to cause such support to swivel about its pivot during lengthwise movement of the body past a grinding wheel, thus obtaining a lengthwise curvature, which is convex or concave depending on the direction in which the support is swivelled. In some instances this swivelling has been obtained through the agency of a master pattern by means of which the swivelling movement of the support is controlled; but such constructions have not been satisfactory because of the difficulty in obtaining an accurate setting of the master pattern and of the errors resulting from wear and lost motion in the engaging parts. In other instances, it has been proposed to obtain the swivelling of the support by special, and more or less complicated, mechanical movements not dependent on any master pattern; but in these cases the number of relatively moving parts, with a corresponding cumulative error resulting from wear and lost motion, has stood materially in the way of the obtaining of the desired accuracy.

It is a major object of my invention to provide a grinding device of the character referred to which is not dependent for its operation on any master pattern or the like and which will perform its functions with exceptional accuracy. A further object is to provide such a device in which adjustments can be made, for grinding the bodies to different degrees of lengthwise curvature, readily and with little liability of error. It is another object to provide a grinding device for these purposes which will be relatively simple and economical of manufacture, and which can be applied to existing types of grinding machines without material changes in the latter. Other objects will appear from the following specification and claims.

I have described, by way of example, in the following specification, and shown in the accompanying drawings, one form of grinding device constructed in accordance with my invention. It is to be understood, however, that the same may be embodied in other forms, and that changes may be made in the form described and shown, without exceeding the scope thereof, as defined in the appended claims:

In the drawings:

Fig. 1 is a plan of a grinding machine having a grinding device of my invention applied thereto, the device being shown as adjusted for straight grinding;

Fig. 2 is a view similar to Fig. 1, but showing the device as adjusted for grinding a roll to a convex lengthwise curvature, or crown;

Fig. 3 is an enlarged side elevation of the guide stand, actuating lever and associated parts which constitute the left hand portion of Fig. 1;

Fig 4 is a plan of the parts seen in Fig. 3, the cover for the guide being removed;

Fig 5 is a section, on a scale enlarged further, taken on the broken line V—V of Fig. 4; and

Fig. 6 is a similar enlarged section taken on the line VI—VI of Fig. 4.

Referring now particularly to Figs. 1 and 2, the grinding machine comprises a base 10 carrying bearing supports for a grinding wheel 11, driven by a suitable motor 12. A reciprocating table 13 is associated with the base 10 and is caused, usually by a rack and pinion actuated from the motor 12, to travel first in one direction and then in the other past the operating face of the grinding wheel 11. The machine is equipped with automatic reversing means whereby the table moves in one direction a distance equal to the length of the body being ground, plus the width of the grinding wheel face, plus clearances at each end, and is then reversed to make the same movement in the opposite direction.

Upon the reciprocating table 13 is mounted, to swivel about a pivot 14, a swivel table 15 which carries steady rests 16, a tail stock 17 and a head stock 18 adapted to be rotated by a motor 19. The work, shown as a roll *a*, is mounted in the steady rests and held in place between the tail stock and the head stock 18, which latter rotates it during the grinding operation. If the swivel table 15 remains stationary upon, and in alignment with, the reciprocating table 13 during the movements of the latter past the grinding wheel 11, as indicated in Fig. 1, the work *a* will be

ground in a straight line. If, however, the swivel table is caused to swivel about its pivot 14 during the longitudinal movement of the reciprocating table 13, the work will be ground to a lengthwise curvature,—either convex or concave, depending on whether the leading end of the work is made to swing away from or towards the grinding wheel.

The grinding machine construction as described up to this point is well known in the art and does not require more than the general reference which has been made.

To obtain the swivelling movement of the swivel table 15, I pivot upon the tail end of the reciprocating table 13 an actuating lever having a short arm 20 which makes a pivoting and sliding connection with the end of the swivel table 15, and a long arm 21 which slidably cooperates with a fixed guide 22, which latter (when the work is to be ground to a lengthwise curvature) is inclined with respect to the line of movement of the reciprocating table 13. In this way the actuating lever is made to rock about its pivot on the reciprocating table 13 as the latter moves lengthwise, such rocking movement being communicated to the table 15, to swivel the latter about its pivot 14.

The guide 22 (Figs. 3–5) is mounted on a stand 23 so as to be capable of swivelling, under adjustment, about a pivot pin 24 secured to the stand and disposed in line with the line of movement of the pivot 14 of the swivel table 15. The guide 22 has extending upwardly therefrom a central longitudinal rail 25 on which, and on the guide, is adapted to slide a shoe 26 equipped with inside liners 27 adapted to embrace the rail. The shoe 26 is formed with an upwardly extending tapered pin 28 upon which fits a correspondingly tapered bearing 29 formed at the rear end of the long arm 21 of the actuating lever, nuts 30, threaded on the pin 28, being employed for retaining the actuating lever and shoe in their swivelling connection.

The actuating lever (Fig. 6) is pivotally connected with the reciprocating table 13 by a tapered stud 31 which is carried in a bracket 32 secured to the end of the said table, the parts being retained in position by nuts 33.

The short arm 20 of the actuating lever has secured to its lower side a rectangular split bushing 34 adapted to slidingly engage between lugs 35 formed at the tail end of the swivel table 15. The two halves of this split bushing are retained in position by spring seated cap screws 36 which pass through holes in the arm 20 which are sufficiently large to permit considerable movement of the cap screws therein. Thus, when otherwise free, the halves of the split bushing are permitted material lateral movement with respect to the arm 20.

The arm 20 has threaded therein a plug 37 having a tapered end 38 adapted to enter a correspondingly tapered seat with which the split bushing is formed. When the plug is screwed downwardly, by means of a knob 39 with which it is provided, its tapered portion 38 will move the halves of the split bushing 34 apart to cause them to engage neatly between the lugs 35 of the swivel table, and in this way an accurate pivotal and sliding connection, without lost motion, between the arm 20 and the swivel table is obtained. The plug 37 is held in its properly adjusted position by a lock nut 40.

The length of the arm 21 of the actuating lever and the position of the pivot 24 of the guide 22 are so chosen that when the pivot 14 of the swivel table comes opposite the center of the grinding wheel the pin 28 of the shoe 26 will have come to such a position that it is coaxial with the pivot 24 of the guide 22; so that regardless of the inclination at which the guide 22 may be set, the swivel table will always be centralized at the moment when its pivot 14 is opposite the center of the grinding wheel face.

In order that the guide 22 may be adjusted to various angles of inclination about its pivot 24, it is formed with a plurality of elongated slots for receiving cap screws 41 which pass through such slots and enter the base 23, so that upon loosening the screws the guide can be swung about its pivot. The base 23 has secured to it a bracket 42 in which is mounted a pivot bearing 43 for receiving an adjusting screw 44 which is threaded into a nut 45 pivoted upon the guide 22. A graduated disc 48 on the screw 44, working against a zero mark on the bearing 43, indicates the extent to which the inclination of the guide has been varied by screwing the screw 44 in or out with respect to the nut 45. This in turn, for a given length of article being ground, will indicate the lengthwise curvature given to such article. However, the effective leverage of the device will vary with different lengths of article being ground, and it will therefore generally be desirable to substitute different graduated discs (48) for one another where articles of different lengths are handled.

To protect the guide 22 and shoe 26 from dirt and the like, a removable cover 46 is provided which encloses these parts, resting, for instance, on pins 47 extending from the guide 22.

It will be seen that the swivelling movement of the swivel table 15 is obtained with a small number of relatively moving parts, so that the chances of error resulting from wear and lost motion are reduced to a minimum. Furthermore, largely in consequence of my fixed guide and the resulting amplitude of movement of the shoe 26, the leverage exerted by the device is high, so that the effect of wear or lost motion in the shoe 26, guide 22, or pivot 24, or of misadjustment of the screw 44, is correspondingly reduced. For example, in practice a length of 68 inches for the long arm 21 of the actuating lever, and 4 inches for the short arm 20, and a distance of 55 inches between the pivot 14 of the swivel table and the center of the plug 37, has been found satisfactory. Supposing now the body to be ground to be 22 inches in length,—i. e. 11 inches on each side of the pivot 14 of the swivel table,—and that the degree of curvature between the center and the end of the body is to be one thousandth of an inch. The reciprocating table would be moved to one end limit position (Fig. 2), and the adjusting screw would then be manipulated so as to swing the guide 22 to a sufficient extent to swing the end of the work, from a position of alignment, one thousandth of an inch towards the grinding wheel. The leverage would be

$$\frac{68}{4}\times\frac{55}{11},$$

or 85, to one; so that the movement of the guide 22, from its aligned position, would have to be .085 inch. An error of one thousandth of an inch, either in adjustment or resulting from wear or lost motion between the guide 22

and the shoe 26 or the pivot 24, would only result in an error of about .000012 inch at the article being ground.

When it is desired to do straight grinding, the plug 37 is loosened, which leaves the split bushing 34 loose between the lugs 35 of the swivel table. The latter is then clamped by any suitable means in alignment with the reciprocating table 13. The guide 22 is preferably set in its central position (Fig. 1) in alignment with the reciprocating table 13.

I claim:

1. A device for use in grinding circular bodies to curved contours, comprising a base adapted to reciprocate in association with a grinding wheel, a work support pivotally connected with said base, a stationary guide member of a length not less than that of the body to be ground, said member being inclined with respect to the line of movement of said base, and an actuating lever pivotally connected with said base and having one arm operatively associated with said support and the other arm slidingly connected with said guide member.

2. A device for use in grinding circular bodies to curved contours, comprising a base adapted to reciprocate in association with a grinding wheel, a work support pivotally connected with said base, a stationary pivot member, a guide member of a length not less than that of the body to be ground, said member being mounted for adjustment about said pivot member to various inclinations, and an actuating lever pivotally connected with said base and having one arm operatively associated with said support and the other arm slidingly connected with said guide member.

3. A device for use in grinding circular bodies to curved contours, comprising a base adapted to reciprocate in association with a grinding wheel, a work support pivotally connected with said base, a stationary stand disposed in line with said base, a longitudinal guide member pivoted on said stand, said guide member being of a length not less than that of the body to be ground, a shoe slidingly associated with said guide, and an actuating lever pivotally connected with said base and having a long arm pivoted to said shoe and a short arm operatively associated with said work support, the parts being so constructed and disposed that the axes of the pivots of said guide member and the long arm of said actuating lever substantially coincide when the pivot of said work support is opposite the grinding wheel.

4. A device for use in grinding circular bodies to curved contours, comprising a base adapted to reciprocate in association with a grinding wheel, a work support pivotally connected with said base, a stationary pivot member, a guide member of a length not less than that of the body to be ground, said member being mounted for adjustment about said pivot member to various inclinations, and an actuating lever pivotally connected with said base and having a relatively short arm operatively associated with said support and a relatively long arm slidingly connected with said guide member, whereby a fine adjustment of the pivoting movement of said support can be obtained by a relatively coarse adjustment of said guide member.

EDWARD J. WHALEN.