May 7, 1940. F. A. JONES 2,200,025

GRINDING MACHINE

Filed Dec. 15, 1937 2 Sheets-Sheet 1

FIG. 1.

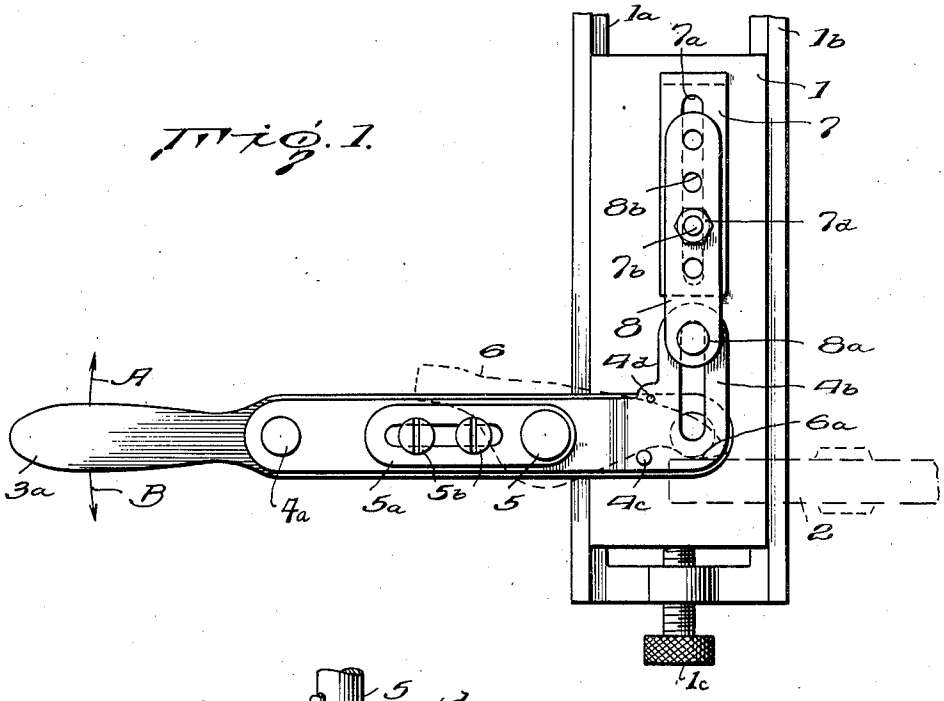


FIG. 2.

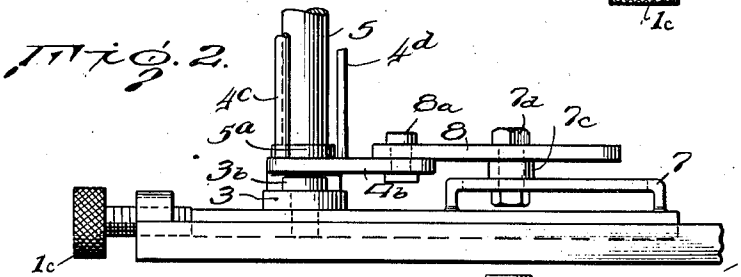
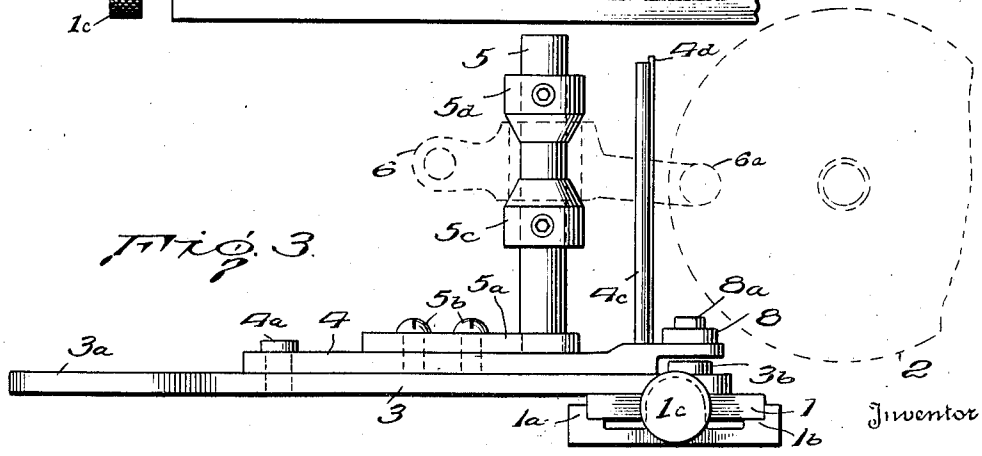


FIG. 3.



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Filed Dec. 15, 1937 2 Sheets-Sheet 2

Fig. 4.

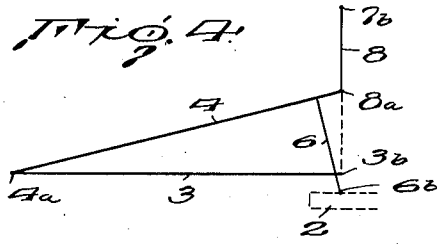


Fig. 5.

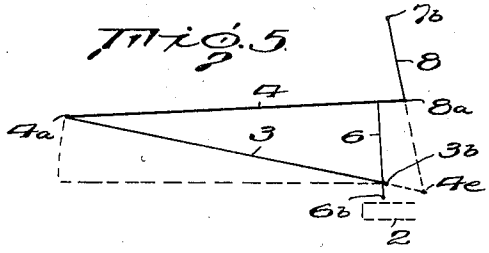


Fig. 6.

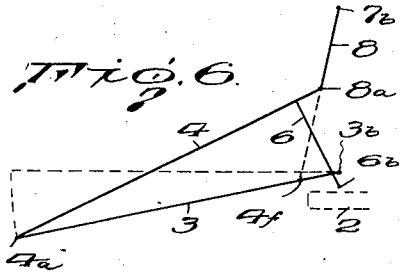
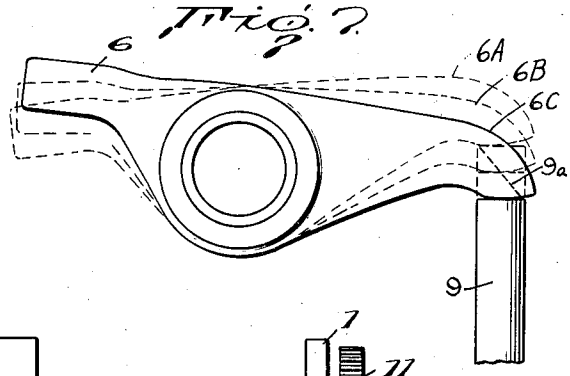


Fig. 7.



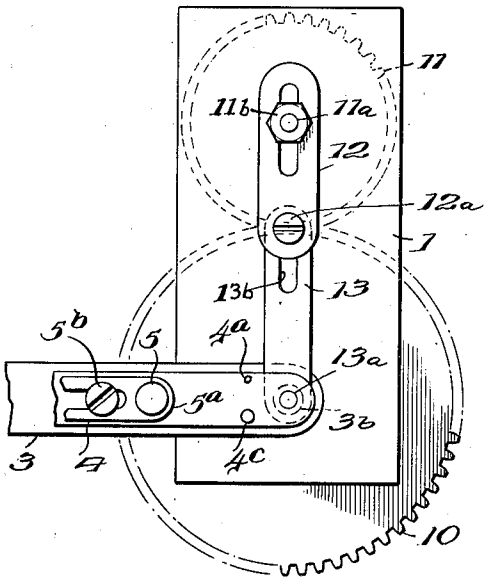


Fig. 8.

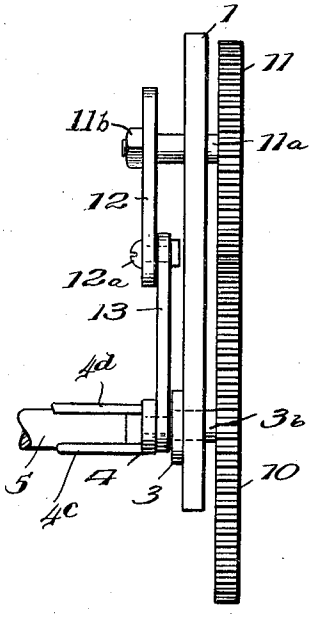


Fig. 9.

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UNITED STATES PATENT OFFICE

2,200,025

GRINDING MACHINE

Frank A. Jones, Greer, S. C., assignor of one-half to R. G. Hodgson, Greer, S. C.

Application December 15, 1937, Serial No. 179,988

11 Claims. (Cl. 51—230)

My invention relates to a grinding machine for grinding the end of a rocker arm commonly employed for operating valves in internal combustion engines.

An object of my invention is to devise a machine for grinding the end of a rocker arm so that the arm will have rolling contact with the end of the valve stem, thereby avoiding sliding of the arm over the end of the valve stem and reducing the consequent wear and friction. By my invention, the end of the rocker arm is provided with a cam-like surface which maintains rolling contact with the end of the valve stem and causes substantially straight line movement of the valve stem, thereby greatly eliminating lateral thrust on the side of the valve stem and preventing excessive wear between the valve stem and the wall of the valve stem bushing.

While my invention is designed especially for grinding the end of a rocker arm, it will be obvious that it may be used for grinding other devices than rocker arms.

A further object is to devise a work support for a grinding machine for grinding a curved surface on the work of relatively large radius and wherein the work is rotated about a shifting instantaneous center of rotation which may be relatively close to the grinding surface.

Two modifications of my invention are illustrated in the accompanying drawings in which:

Figure 1 is a plan view of one arrangement of the work-supporting carriage forming my grinding machine;

Figure 2 is a side view of Figure 1;

Figure 3 is an end view of Figure 1 showing the work supporting carriage in elevation;

Figures 4, 5 and 6 are kinematic linkage diagrams illustrating the operation of the arrangement shown in Figures 1 to 3;

Figure 7 shows a rocker arm in operative relation to a valve stem;

Figure 8 is a fragmentary view showing a modified form of the invention; and

Figure 9 is a side view of Figure 8.

Referring to the drawings, the work supporting carriage for the grinding machine comprises a base 1 arranged to slide in a suitable way formed by rails 1a and 1b. The base 1 is arranged for sliding movement parallel with the axis of a grinding wheel 2 indicated in dotted lines, or at right angles to the radial grinding face of the wheel. A lever 3 having a handle portion 3a is pivotally secured by a pin 3b to the base 1 and normally extends substantially at right angles to the base 1, or parallel to the grinding face of wheel 2, as shown in Figure 1. A lever 4 is pivotally secured by a pin 4a to the lever 3 near the outer end thereof and is provided with a slotted extension 4b at the free end and arranged at right angles to its main axis and extending over the base 1. A stud or pin 5 has a base 5a secured thereto which in turn is adjustably mounted upon lever 4 as by means of a pair of screws 5b passing through a slot in the base 5a and having threaded engagement with the lever 4. A pair of collars 5c and 5d having opposed conical ends are mounted on pin 5 for supporting a rocker arm 6 (indicated in dotted lines). It will be understood that collars 5c and 5d are adjustably secured onto pin 5 by suitable means such as set screws. A pair of pins 4c and 4d are mounted upon lever 4 and arranged to embrace opposite sides of the front end of the rocker arm as shown in Figure 1 and hold the rocker arm in position against the radial face of wheel 2 during grinding operation. Pin 4d is a resilient pin to hold the rocker arm against pin 4c but permit the rocker arm to move back in case of too severe contact with the grinding wheel. A screw 1c forming an adjustable stop limits the movement of base 1 towards wheel 2.

Mounted upon the base 1 is a bracket 7 having a longitudinal slot 7a formed therein, the bracket 7 being arranged in line with the angle extension 4b on lever 4 or at right angles to the grinding surface. A link 8 is pivotally secured to extension 4b on lever 4 by means of a pin 8a adjustably secured in the slot of the extension 4b, and link 8 is also pivotally secured to the bracket 7 by means of a pin 7b adjustably secured in the slot 7a by means of a collar 7c and a nut 7d. Link 8 is provided with a series of holes 8b formed therein to vary the position of pivotal connection on the link.

As shown in Figure 1, the parts are in their normal position and the rocker arm 6 is supported on the pin 5 so the face of the front end 6a of the arm is brought into contact with one radial face of the grinding wheel 2. By swinging the lever 3 by its handle 3a in the direction indicated by arrow A, the lever 3 pivots about the axis of pin 3b, while the left end of lever 4 is carried with lever 3 due to the pivotal connection of pin 4a. The right end of lever 4 is guided in its movement by link 8 which is pivotally connected by pin 7b to bracket 7 and also has pivotal connection at 8a to the extension 4b on lever 4. The arrangement is such that as the lever 3 is moved in the direction A, the

end 6a of the rocker arm is rotated about an axis somewhere near the axis of pin 3b and at the same time is drawn away from the face of the grinding wheel 2. It will be clear that upon rotating the handle 3 in the direction of the arrow B, a similar movement of the end of the rocker arm will take place. In other words, by moving the handle 3 in either direction from its normal position, the end 6a of the rocker arm 3a will be rotated about an axis somewhere near the axis of pin 3b and will at the same time be drawn away from the face of the grinding wheel 2.

In Figures 4, 5 and 6 I have shown the kinematic linkage diagrams for the grinding arrangement shown in Figures 1 to 3. In these diagrams the lines 3, 4 and 8 represent levers 3 and 4 and link 8 respectively. 3b indicates the fixed pivot point for lever 3, 4a indicates the pivot point for one end of lever 4 on lever 3, and 7b indicates the fixed pivot point for one end of link 8. The line 6 extending from line 4 represents the rocker arm which is secured to and carried by lever 4.

Figure 4 represents the linkage arrangement in its normal position, and the point 6b indicates the point of contact between the rocker arm and the grinding wheel 2. Since the right end of line 4 tends to rotate about fixed pivot 7b, and the left end of line 4 tends to rotate about fixed pivot 3b, the instantaneous center of rotation of the lever 4 is represented by the point 3b where the center line of link 8 intersects the center line of lever 3.

Figure 5 represents the arrangement where the lever 3 has been moved upward from its normal position. In this condition it will be seen that the original point of contact 6b has moved away from the face of the grinding wheel, and the instantaneous center of rotation of the lever 4 has shifted to the right and is located at the point 4e.

Figure 6 represents the arrangement where the lever 3 has been moved downwardly from its normal position, and under this condition it will be seen that the original point of contact 6b has also moved away from the face of grinding wheel 2, and the instantaneous center of rotation of the lever 4 has shifted to the left and is located at the point 4f.

Upon an inspection of Figures 4, 5 and 6, it will be seen that the instantaneous center of rotation of the rocker arm shifts substantially parallel to the face of the grinding wheel, and while the center of rotation of the rocker arm is located very close to the face of the grinding wheel 2, nevertheless, due to the shifting of the instantaneous center of rotation, the curvature which is ground on the face of the rocker arm has an effective radius very much greater than the distance from the instantaneous center of rotation to the face of the wheel. It will thus be seen that my invention provides an arrangement by which a curvature of relatively large effective radius may be ground upon a limited surface without interference between other parts of the work and the grinding wheel. The desired curvature cannot be ground by using a fixed center of rotation nor by using a great radius of rotation because the edge of the wheel would cut into the web of the rocker arm.

In Figure 7 I have shown a rocker arm in operative relation with the upper end of a valve stem 9. In position 6A, the rocker arm is shown in its uppermost position, while at 6B the arm is shown in its mid-position, and at 6C the arm is shown in its lowermost position. In order to produce rolling contact between the face of the rocker arm and the upper surface of the valve stem, it is desirable that the point of contact progress substantially uniformly from a point on the edge of the valve stem nearest the center of oscillation of the rocker arm to a point on the opposite side of the valve stem. The line 9a represents the path of travel of the point of contact between the rocker arm and the upper end of the valve stem, and it will be seen that the contact shifts from left to right as the rocker arm is moved from its upper position to its lowermost position. Stated another way, the point of contact shifts to the left when the valve is raised from its mid-position and shifts to the right when the valve is depressed from its mid-position. By referring to Figures 5 and 6, it will also be seen that the center of rotation of the rocker arm shifts to the right from its normal position when the lever 3 is moved in a direction corresponding to the direction of movement for depression of the valve from mid-position, while in Figure 6 it shifts to the left from its normal position when the lever 3 is moved in a direction corresponding to raising of the valve from neutral position.

Rocker arms of different lengths may be accommodated by adjusting the position of the supporting pin 5 along the length of lever 4. The position of the fixed pivot 7b for the link 8 may be adjusted by shifting the pivot in the slot 7a formed in bracket 7, and the length of the link 8 may be adjusted by shifting the connection to different holes 8b formed in the link, and also by shifting the pivot 8a in the slot formed in extension 4b. It will be understood that instead of using a series of separate holes 8b in link 8, an elongated slot may be formed in this link.

In Figures 8 and 9 I have shown a modified arrangement for guiding the right-hand end of the lever 4. In this arrangement the lever 3 is pivoted to the base 1 on pin 3b as in Figure 1, and the lever 4 is likewise pivoted to the lever 3 in the same manner as in Figure 1, but not shown in Figure 8 due to the fragmentary showing of these two levers. A gear wheel 10 is securely mounted upon the pin 3b which is journaled in base 1 and turns with the lever 3, whereby the gear wheel 10 rotates with the lever 3. A second gear wheel 11 is mounted upon a shaft 11a which is journaled in base plate 1 and extends through to the opposite side of the plate, gear 11 is arranged to mesh with gear 10 and is driven by gear 10. The opposite end of the gear shaft 11a has a key-like connection with the slot in a lever 12 which is adjustably secured to the end of shaft 11a by a nut 11b and rotates with gear 11. A link 13 joints the lever 12 to the free end of lever 4 by means of pivot 12a carried by the arm 12 and the pivot 13a joining the other end of link 13 to lever 4. The pivot 12a is adjustable in the slot 13b in link 13. It will be understood that lever 4 carries pins like 5, 4c and 4d of Figure 1 for supporting a rocker arm.

The arrangement shown in Figures 8 and 9 will operate generally in the same manner as the arrangement shown in Figures 1 to 3, in that movement of the arm 3 from its normal position in either direction will cause a rotation of the arm 12 from its normal position, and, through the action of link 13 will move the free end of the lever 4 away from the face of the grinding wheel. In other words, the arrangement is such that the rocker arm carried by the lever 4 will

rotate about an instantaneous center which shifts along a path substantially parallel with the grinding face of the grinding wheel.

While my invention has been shown and described as particularly suited for grinding the working surface on a rocker arm, it will be understood that it may be used for grinding other articles, if desired. Various modifications will be obvious to those skilled in the art, and my invention is restricted only in accordance with the terms of the appended claims.

What I claim is:

1. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base arranged for sliding movement in a direction substantially at right angles to said grinding surface, a lever pivoted to said sliding base and normally extending substantially parallel to said grinding surface, but being swingable to either side of said normal position, a link pivoted to said sliding base and normally arranged at right angles to said lever and extending towards the pivotal axis of said lever, a second lever pivotally supported at one end upon the first lever at a point removed from its pivotal axis, means for guiding the free end of said second lever in a curved path comprising a connection between the free end of said second lever and said link at a point thereon removed from its pivotal axis, and means carried by said second lever for supporting a work-piece in contact with said grinding surface.

2. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base arranged for sliding movement in a direction substantially at right angles to said grinding surface, a lever pivoted to said sliding base and normally extending substantially parallel to said grinding surface but being swingable to either side of said normal position, a link pivoted to said sliding base and normally arranged at right angles to said lever and extending towards the pivotal axis of the first lever, a second lever pivotally supported at one end upon the first lever at a point removed from its pivotal axis, said second lever being normally arranged so the free end thereof lies adjacent the pivot point of the first lever, a lateral extension on the free end of said second lever arranged in line with said link and having a longitudinal slot formed therein, adjustable pivot means mounted in said slot for pivotally connecting the free end of the second lever to the free end of said link, and means carried by said second lever for supporting a work-piece in contact with said grinding surface.

3. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base arranged for sliding movement in a direction substantially at right angles to said grinding surface, a lever pivoted to said sliding base, a gear secured to said lever and arranged to rotate about the pivotal axis thereof, a second lever pivoted to said sliding base, a gear secured to said second lever and arranged to rotate about the pivotal axis thereof, said second gear having meshing engagement with the first gear whereby the second lever is driven by the first lever, a third lever pivotally secured at one end to said first lever, a link element pivotally secured at one end to said second lever and having its free end pivotally connected to the free end of the third lever, and means carried by said third lever for supporting a work-piece in contact with said grinding surface.

4. A work support for a grinding machine comprising in combination, a work carriage comprising a supporting base, a lever pivoted to said base, a gear secured to said lever and arranged to rotate about the pivotal axis thereof, a second lever pivoted to said base, a gear secured to said second lever and arranged to rotate about the pivotal axis thereof, said second gear having meshing engagement with the first gear whereby the second lever is driven by the first lever, a third lever pivotally secured at one end to said first lever, a link element pivotally secured at one end to said second lever and having its free end pivotally connected to the free end of the third lever, and means carried by said third lever for supporting a work-piece.

5. In a machine for grinding rocker arms, the combination of a grinding element having a flat grinding surface, a work carriage comprising a supporting base, a lever pivoted to said base on an axis parallel with said grinding surface, said lever normally extending substantially parallel to said grinding surface but being swingable to either side of said normal position, a link pivoted to said base and normally arranged at right angles to said lever and extending towards the pivotal axis of the lever, the pivotal axes of said lever and said link being located in a plane substantially at right angles to said grinding surface, a second lever pivotally supported at one end upon the first lever at a point removed from its pivotal axis, a connection between the free end of said second lever and said link at a point thereon removed from its pivotal axis, a pin supported upon said second lever at a point removed from the pivotal points thereof, and means for supporting a rocker arm on said pin with the face of the rocker arm in position to engage said grinding surface.

6. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base, a lever pivoted to said base and normally extending substantially parallel to said grinding surface, a link pivoted to said base and normally arranged at right angles to said lever and extending towards the pivotal axis of said lever, a second lever pivotally supported at one end upon the first lever at a point removed from its pivotal axis, said second lever being normally arranged so the free end thereof lies adjacent the pivot point of the first lever, a lateral extension on the free end of said second lever arranged in line with said link and having a longitudinal slot formed therein, adjustable pivot means mounted in said slot for pivotally connecting the free end of the second lever to the free end of said link, and means carried by said second lever for supporting a work-piece in contact with said grinding surface.

7. In combination, a grinding element having a flat grinding surface, a work supporting base, a lever pivoted to said base on an axis parallel to said grinding surface and located near the plane of said grinding surface, a second lever pivoted to said base on an axis parallel to the pivotal axis of the first lever and arranged at right angles to said grinding surface with respect to the pivotal axis of the first lever, means connecting said levers whereby one lever is rotated about its pivotal axis when the other lever is moved about its pivotal axis, a third lever pivoted at one end to said first lever at a point removed from its pivotal axis, a connection between the free end of said third lever and said second lever, and means for supporting a work piece on said third lever at a point removed from

the pivotal points thereof and in a position to engage said grinding surface.

8. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base arranged for sliding movement in a direction at substantially right angles to said grinding surface, a lever pivoted to said sliding base on an axis parallel to said grinding surface, said lever being normally arranged substantially parallel to said grinding surface but being swingable to either side of said normal position, a second lever pivoted at one end to said first lever at a point removed from its pivotal axis, means carried by the second lever for supporting a work-piece in contact with the grinding surface, and means for guiding the free end of said second lever whereby the work-piece is drawn away from the grinding surface when said first lever is moved in either direction from said normal position.

9. A work support for a grinding machine comprising in combination, a base, a lever pivoted to said base, said lever having a normal position but being swingable to either side of said position, a second lever pivotally supported at one end to said first lever at a point removed from the pivotal axis of the first lever, the free end of said second lever normally extending back towards the pivotal axis of the first lever, a link element pivotally secured to said base at a point substantially at right angles to the first lever from its pivotal axis, and a pivotal connection between the free end of said link and the free end of said second lever, and means carried by said second lever for supporting a work-piece.

10. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base, a lever pivoted to said base and normally extending substantially parallel to said grinding surface, but being swingable to either side of said normal position, a link pivoted to said base and normally arranged at right angles to said lever and extending towards the pivotal axis of said lever, a second lever pivotally supported at one end upon the first lever at a point removed from its pivotal axis, means for guiding the free end of said second lever in a curved path comprising a connection between the free end of said second lever and said link at a point thereon removed from its pivotal axis, and means carried by said second lever for supporting a work-piece in contact with said grinding surface.

11. In combination, a grinding element having a flat grinding surface, a work carriage comprising a supporting base, a lever pivoted to said base on an axis parallel to said grinding surface, said lever being normally arranged substantially parallel to said grinding surface but being swingable to either side of said normal position, a second lever pivoted at one end to said first lever at a point removed from its pivotal axis, means carried by the second lever for supporting a work-piece in contact with the grinding surface, and means for guiding the free end of said second lever whereby the work-piece is drawn away from the grinding surface when said first lever is moved in either direction from said normal position.

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