April 25, 1933. A. ALSAKER ET AL 1,905,784

ADJUSTABLE LEVER

Filed July 15, 1929

Fig. 1.

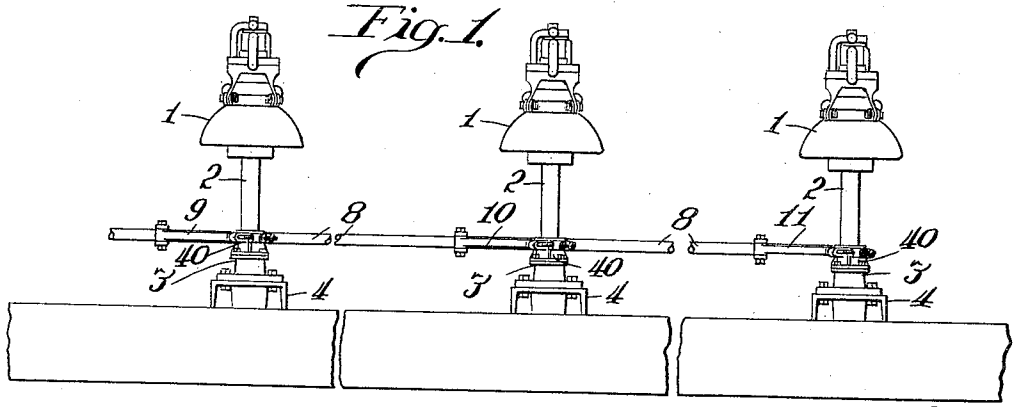


Fig. 2.

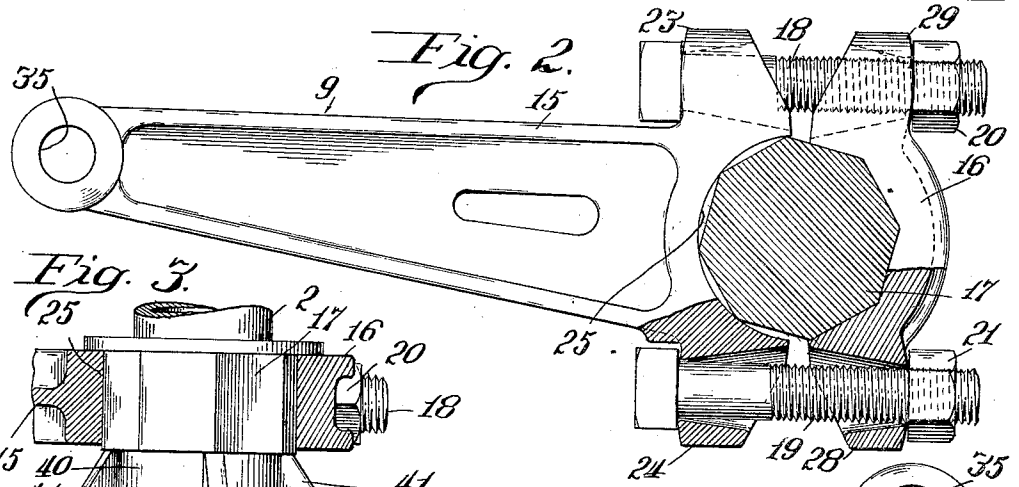


Fig. 3.

Fig. 4.

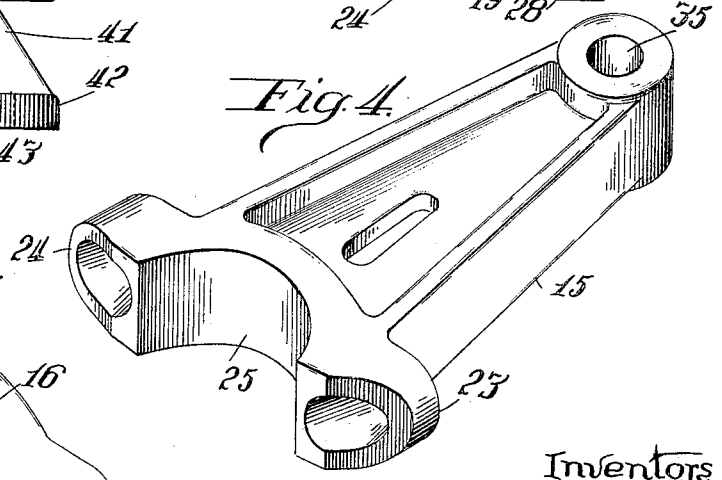
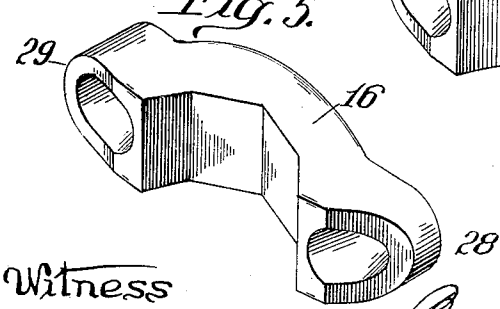


Fig. 5.



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UNITED STATES PATENT OFFICE

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ADJUSTABLE LEVER

Application filed July 15, 1929. Serial No. 378,337.

This invention appertains to levers such as are used on rotary switch bearings for rotating an insulator or stack of insulators of high tension switches, although such levers are capable of general use in other connections.

In modern high tension gang operated switches close synchronism is desired between three or as many as six poles of a switch. These switches are mouunted on individually rotated insulators that are connected by means of individual levers to an interconnecting operating pipe.

To obtain close synchronism between the poles of the switches two adjustments are necessary on each single pole unit, that is, at the connection between the insulator stack and the operating lever, and at the connection between the operating lever and the interconnecting operating pipe. Suppose one unit of a three pole switch is operating slower than the other two; say, for instance, that all three line up in the open position but not in the closed position. If the angle that the operating lever makes with the insulator stack with reference to a blade driving lever on the insulator cap is varied, the speed of operation of the insulator stack may be increased or decreased within certain limits. A change in the lever angle speeds or slows up the individual units, but does not correct its terminal positions. To get the unit in alignment in the open position again it is necessary to shift the connection on the interconnecting operating pipe without disturbing the other two units.

It is an object of the present invention to provide a lever that may be readily adjusted through any angle up to 360° with reference to the insulator that it rotates. As a result of the adjustability, the lever constitutes means for synchronizing the poles of the switches. In the ordinary case the adjustment necessary at the lever in order to bring the switch poles into synchronism is only a small fractional part of 360°.

However, by providing a lever that is fully adjustable throughout the entire 360° it is possible to use the same lever for different types of switches which may require many different lever settings depending upon the amount of angular rotation desired in the particular form of switch.

Offset control bearings also require many special lever positions to suit structural layouts. The present form of lever takes care of all such cases as it can be adjusted by extremely small steps throughout the entire 360°.

The lever of the present invention comprises a lever arm the end of which is circular to embrace a portion of an octagon shaped shank on the rotatable element of an insulator support that is mounted in a suitable bearing. A separate heel piece having faces cooperating with the sides of the shank is provided. The lever arm and the heel piece are clamped together about the shank by means of two bolts passing through holes in ears on the arm portion and the heel piece, respectively. When the bolts are loosened, the lever arm may be turned through a limited angle, with respect to the heel piece, of about 16°, and by tightening the bolts, the lever is locked in any desired position throughout its range of adjustment.

The center of the lever arm is not symmaterial with the ears on the lever but is offset 6°, and by reversing the arm an angular change of approximately 12° is obtained. The heel piece is offset 11° and may also be reversed to obtain an independent change of 22° in the position of the lever arm.

Three means of adjustment are, therefore, provided.

First, large changes in angle in intervals of only 22° are obtained by shifting and flopping the heel clamp about the octagon in sixteen different positions. The center line of the heel clamp will always be 11° to either side of an octagon corner.

Second, smaller changes of angle in intervals of only 12° are obtained by flopping the lever arm. Now the center line of the lever, when in normal equalized position (i. e. when the clearance between the ears of the heel clamp and lever is the same on both sides) will always lie 6° to either side of the center line of the heel clamp. There are two positions of the lever arm, therefore, for each of the sixteen different settings of the clamp.

Third, small changes in angle in any steps desired up to 16° are obtained by unequally varying the clearance between the ears of the heel clamp and lever arm, by means of the clamping bolts. That is, the lever arm may be set to any angle up to and including 8° to either side of the "normal" lever arm center. The "normal" lever arm centers are the positions 6° to either side of the heel clamp center. The heel clamp center in turn may be any one of the sixteen positions the heel clamp may assume, which are 11° to either side of the center lines passing through diametrically opposite octagon corners.

By combining the three adjustments, therefore, it is apparent that the lever may be adjusted to any desired angular position throughout the entire 360° range.

The attainment of the above and other objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is an end view of three poles of a gang switch embodying my invention;

Figure 2 is a plan view in partial section of our improved lever;

Figure 3 is a fragmentary side view in partial section showing the manner in which the clamp fits about the rotary member;

Figure 4 is a perspective view of the lever arm; and

Figure 5 is a perspective view of the heel piece used with this lever.

Referring now more particularly to Figure 1, the three poles of the switches shown comprise each an insulator which may comprise one or more sections, one section only being shown at 1. On the top insulator the usual form of switch mechanism is mounted, and an insulator pin, indicated at 2, is secured to the bottom insulator and constitutes the means for mounting the insulator. The insulator pin 2 is bolted or otherwise secured to the rotatable element of a bearing member 3 which is itself supported by a channel 4. The bearing 3 may be of any preferred construction, a suitable bearing being shown in the pending application of Alfred Alsaker, Serial No. 137,926, filed September 27, 1926. The three poles of the switch shown are operated in unison by means of an operating rod 8 to which rod all of the poles of the switch are connected by suitable levers 9, 10 and 11. The insulators supporting the switches are rotated upon the longitudinal movement of the operating shaft 8. This much of the switch structure is standard construction well known in the art and a further explanation thereof is not necessary at this time.

The novel features of the switch shown reside in the particular construction of the levers 9, 10, and 11, which are shown more particularly in Figures 2, 3, 4 and 5. The lever 9 comprises a lever arm 15 and a separate heel piece 16 which are adapted to be clamped about the octagonal shank 17 of the insulator pin 2, by means of bolts 18—19 and nuts 20—21. The lever arm 15 is provided with two ears 23 and 24 through which the bolts 18 and 19 are passed, the bolt holes in the ears being divergent, as may be clearly seen in Figure 2, with their greatest diameter along the surfaces of the heel piece and clamp that face one another. The side of the lever arm that bears against the octagonal shank 17 is circular or of cylindrical shape, as indicated at 25. The portion of the inner face of the heel piece 16 that bears against the octagonal shank 17 is provided with flat surfaces that fit around a number of sides of the shank, as may be seen in Figure 2. With the heel piece in position about the shank, as shown, the lever arm 15 may be turned eight degrees (8°) to either side of the position shown by loosening one or the other of the two nuts 20—21 and tightening the other nut. When the nuts and bolts 18—20 and 19—21 are tightened, the lever arm 15 is rigidly keyed to the shank 17. It is thus apparent that the bolts 18—19 and the nuts 20—21 constitute micro-adjusting means for adjusting the angular position of the lever arm 9 with reference to the shank 17 while the lever arm is clamped to the shank.

It is to be noted that the center line of the lever arm 15 does not pass midway between the two ears 23 and 24. This center line is approximately six degrees (6°) off of a true center passing midway between the two ears. It is thus apparent that with the heel 16 in a given position the lever arm 15 may be flopped over so that the ear 23 is opposite the ear 28 of the heel piece and the ear 24 is opposite the ear 29 on the heel piece. Two large adjustments of the lever arm are therefore possible. It is to be noted also that the two ears 28 and 29 are not symmetrically disposed with respect to the flat sides on the inner side of the heel piece 16, that is, the flat surfaces that bear against the octagonal shank. As a result of this arrangement, it is possible to reverse the heel piece so that the ear 28 is opposite the ear 23, as shown in Figure 2, and the ear 29 is opposite the ear 24. When this is done, the center of the lever 15 is shifted upwardly by 22° and from this position there is a

possible adjustment in small steps up to 8° in either direction, assuming the ears of the lever arm to be in equalized position with respect to ears of the heel clamp.

The sequence for complete rotary adjustment of the lever arm 15 from the starting position, which may be assumed to be the position shown in Figure 2, is, therefore, as follows:

First position

1. Adjust by means of bolts to extreme of 8° say, counterclockwise, counting from normal starting point.

2. Flop lever—adjust between limits of 4° and 20° from starting point.

3. Flop clamp and lever—adjust between limits 14° and 30°.

4. Flop lever—adjust between limits of 26° and 42°.

Second position

5. Shift clamp to next octagon corner in counterclockwise direction — and reverse both lever and clamp—adjust between limits of 37° and 53°.

6. Flop lever and adjust between limits of 49° and 65°.

7. Flop clamp and lever—adjust between limits of 59° and 75°.

8. Flop lever—adjust between limits of 71° and 87°.

Third position

9. Shift clamp to next octagon corner and reverse both lever and clamp and adjust between limits of 82° and 98°, and so on, until arriving again at the starting point.

It will be noted from the above that there is 4° of overlap in the range of adjustment between successive stages such as between 3 and 4 or 5 and 6, etc. The overlap is 5° between transition stages, i. e., from adjacent octagon positions, such as 4 and 5 or 8 and 9.

The end of the lever arm that is opposite the shank 17 is provided with a hole 35 for receiving a clevis pin whereby the lever arm may be secured to the operating rod 8. The manner in which the lever arm is secured to the operating rod is shown in the pending application of Alfred Alsaker, Serial No. 325,751, filed December 14, 1928, the portion of the control rod indicated at 3 in the above referred to application corresponding to the lever arm 15.

Figure 3 shows the construction of the lower portion of the spindle 2 and the manner in which the lever fits around the shank of the insulator pin. The pedestal 40 which is integral with and immediately below the shank portion 17 of the insulator pin has a number of reinforcing flanges 41 and a circular flange 42 provided with a number of bolt holes 43 whereby the insulator pin 2 may be bolted to the rotary element of the bearing 3.

An explanation will now be given of the manner in which the lever is adjusted to bring the individual poles of the gang operated switch into synchronism. Assume that the operating rod 8 of Figure 1 is moved at a uniform linear velocity to rotate the insulator stacks 1. It is apparent that the insulator pins 2 will not be rotated at a uniform angular velocity but that the angular velocity of the pins will vary as the angle that the lever 15 makes with the operating rod 8 carries throughout the range of operation. Suppose that all three switch units line up in the open position but that the switch unit at the left operates slightly faster than the other wo and, therefore, does not line up with them in the closed position. To speed up this slow unit the bolts 20 and 21 are loosened to permit a movement of the lever 15 with respect to the insulator stack, and the lever angle with respect to the operating rod 8 is then adjusted so that the speed of operation of this switch unit is the same as the speed of the other units.

This change in lever angle speeds up or slows down the individual unit independent of the other units but does not correct its terminal positions. To get the unit which is under adjustment in alignment in the open position again it is necessary to shift the pipe clevis that connects with the operating rod 8 through the hole 35 in the lever. The clevis may be easily shifted along the operating rod 8, as is apparent from a consideration of the clevises used, said clevises being shown in the pending application of Alfred Alsaker, Serial No. 325,751, previously referred to.

In compliance with the requirements of the patent statutes we have herein shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise embodiment herein described, the same being merely illustrative of the invention.

What we consider new and desire to secure by Letters Patent is:

1. An adjustable lever comprising a heel clamp having two ears in which bolt holes are formed to carry bolts in substantial parallelism, a lever arm having similar ears provided with similar bolt holes, said heel clamp and lever arm being adapted to embrace a polygonal shaft between them, the side of the heel clamp engaging the shaft being polygonal shaped to prevent slippage thereof around the shaft, and the side of the lever that engages the shaft being circular to permit slippage of the lever about the shaft, and bolts passing through the ears in the two members for locking the lever and the heel clamp in position, the polygonal sides of the heel clamp being non-symmetrical with the bolt holes in the heel clamp, whereby upon reversing the heel clamp the angular position of the lever with respect to the shaft is changed.

2. An adjustable lever comprising a heel

clamp having two ears in which bolt holes are formed to carry bolts in substantial parallelism, a lever arm having similar ears provided with similar bolt holes, said heel clamp and lever arm being adapted to embrace a polygonal shaft between them, the side of the heel clamp engaging the shaft being polygonal shaped to prevent slippage thereof around the shaft, and the side of the lever that engages the shaft being circular to permit slippage of the lever about the shaft, and bolts passing through the ears in the two members for locking the lever and the heel clamp in position, the center line of the lever being non-symmetrical with respect to the ears on the lever whereby upon turning the lever over, the angular position of the lever with respect to the shaft is changed.

3. An adjustable lever comprising a heel clamp having two ears in which bolt holes are formed to carry bolts in substantial paralleism, a lever arm having similar ears provided with similar bolt holes, said heel clamp and lever arm being adapted to embrace a polygonal shaft between them, the side of the heel clamp engaging the shaft being polygonal shaped to prevent slippage thereof around the shaft, and the side of the lever that engages the shaft being circular to permit slippage of the lever about the shaft, and bolts passing through the ears in the two members for locking the lever and the heel clamp in position, the polygonal sides of the heel clamp being non-symmetrical with the bolt holes in the heel clamp, whereby upon turning the heel clamp over, the angular position of the lever with respect to the shaft is changed, and the center line of the lever being nonsymmetrical with respect to the ears on the lever whereby upon turning the lever over the angular position of the lever with respect to the shaft is still further changed.

4. The method of keying a lever at any angle desired on an octagon shaft by obtaining a limited adjustment of said lever to a total of 16° about any possible position of a heel clamp engaging one half of said octagon shaft, providing offsets in said heel clamp of 11° and similar offset in said lever arm of 6°, permitting thirty two different angular settings of said lever arm in intervals of approximately 12° when both heel clamp and lever are alternately and jointly reversed in assuming progressively all possible positions around said octagon shaft.

5. In combination, an octagonal shaft, a lever including an arm portion and a removable heel piece, means for clamping the two about the shaft, the inner surface of the heel piece having flat faces shaped to cooperate with the octagonal sides of the shaft, and the inner face of the arm portion being circular to permit positioning about the shaft in any desired angular position, there being enough clearance between the heel piece and the arm portion to permit an adjustment up to about 16° for any position of the heel piece, said arm and said heel piece being each individually reversible to permit an adjustment at intervals of about 12°.

6. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, bolt holes formed in said ears whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by a few degrees along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other.

7. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, bolt holes formed in said ears whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by a few degrees along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other, said shaft and said heel piece being non-circular to prevent the heel piece from sliding around the shaft.

8. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, bolt holes formed in said ears whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by a few degrees along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other, said shaft and said heel piece being non-circular to prevent the heel piece from sliding around the shaft, the ears on the heel piece being non-symmetrical with respect to the center of the heel piece, whereby upon

reversing the heel piece a different position of the arm portion is obtained for the same relative position of the heel piece and the shaft.

9. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, bolt holes formed in said ears whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by a few degrees along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other, said shaft and said heel piece being non-circular to prevent the heel piece from sliding around the shaft, the ears on the arm portion being non-symmetrical with respect to the center line of the arm, whereby upon reversing the arm a different angular position of the arm is obtained for a given position of the heel piece.

10. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, bolt holes formed in said ears whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by a few degrees along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other, said shaft and said heel piece being non-circular to prevent the heel piece from sliding around the shaft, the ears on the heel piece being non-symmetrical with respect to the center of the heel piece, whereby upon reversing the heel piece a different position of the arm portion is obtained for the same relative position of the heel piece and the shaft, the ears on the arm portion being likewise non-symmetrical with respect to the center line of the arm, whereby upon reversing the arm a still different angular position of the arm is obtained.

11. In combination, a shaft, a lever having an arm portion and a separate heel piece, said arm portion and heel piece being adapted to embrace and be clamped to the shaft, two ears on the arm portion and two ears on the heel piece, said ears having bolt holes formed therein whereby bolts may be passed through the ears to rigidly clamp the parts to the shaft, said bolt holes being divergent with their greatest diameter along the surfaces of the heel piece and arm portion that face one another, and the faces of the heel piece and the arm portion clearing one another by 8° along the periphery of the shaft, whereby the lever arm may be angularly adjusted with respect to the heel piece by loosening one of the bolts and tightening the other, said shaft and said heel piece being octagonal to prevent the heel piece from sliding around the shaft, the ears on the heel piece being non-symmetrical with respect to the center of the heel piece so that center line of heel piece falls 11° offset with respect to center line passing through opposite corners of the octagon shaft, whereby upon reversing the heel piece a different position of the arm portion is obtained for the same relative position of the heel piece and the shaft, the ears on the arm portion being likewise non-symmetrical with respect to the center line of the arm, so that the center line of lever arm falls 6° offset with respect to center line passing between said ears of lever arm or 6° to either side of heel clamp center line giving in all thirty two possible positions the lever arm may take around said shaft in intervals of approximately 12° so that said lever arm may be set to any angle desired with respect to shaft when said clearance of 8° between heel clamp and lever arm ears is utilized to obtain any setting desired up to 8° on either side of the 12° interval positions.

12. In combination, a polygonally shaped rotatable shaft, an arm having a semi-cylindrical end surface adapted to embrace said shaft, opposed ears at said arm extending outwardly in angular relation with respect to each other, a heel piece adapted to non-rotatably cooperate with said shaft, opposed ears extending outwardly from said heel piece, and adjustable means for drawing one set of correspondingly disposed ears of said arm and heel piece together and simultaneously drawing apart the other set of correspondingly disposed ears of the arm and heel piece whereby the angularity of said arm may be varied with respect to said heel piece.

13. In combination, a polygonally shaped rotatable shaft, an arm having a semi-cylindrical end surface adapted to embrace said shaft, opposed ears at said arm extending outwardly in angular relation with respect to each other, a heel piece adapted to non-rotatably cooperate with said shaft, opposed ears extending outwardly from said heel piece in angular relation with respect to each other, the correspondingly opposed ears of said arm and heel piece being divergent relative to each other in assembled disposition on said shaft providing clearance therebetween, and adjustable means for drawing one set of correspondingly opposed ears together and separating the other set of correspond-

ingly related ears whereby the angularity of said arm with respect to said heel piece may be varied.

14. In combination, a polygonally shaped rotatable shaft, an arm having a semi-cylindrical end surface adapted to embrace said shaft, opposed ears at said arm extending outwardly therefrom, a heel piece adapted to non-rotatably cooperate with said shaft, opposed ears extending outwardly from said heel piece, the correspondingly opposed ears of said arm and heel piece being divergent relative to each other in assembled disposition on said shaft providing clearance therebetween, and adjustable means for drawing one set of correspondingly opposed ears together and separating the other set of correspondingly related ears whereby the angularity of said arm with respect to said heel piece may be varied within certain predetermined limits of adjustment, said arm being reversible for varying the angularity thereof within other predetermined limits of adjustment.

15. In combination, a polygonally shaped rotatable shaft, an arm having a semi-cylindrical end surface adapted to embrace said shaft, opposed ears at said arm extending outwardly therefrom, a heel piece adapted to non-rotatably cooperate with said shaft, opposed ears extending outwardly from said heel piece, the correspondingly opposed ears of said arm and heel piece being divergent relative to each other in assembled disposition on said shaft providing clearance therebetween, and adjustable means for drawing one set of correspondingly opposed ears together and separating the other set of correspondingly related ears whereby the angularity of said arm with respect to said heel piece may be varied within certain predetermined limits of adjustment, said heel piece being reversible for varying the angularity of said arm within other predetermined limits of adjustment.

16. In combination, a polygonally shaped rotatable shaft, an arm having a semi-cylindrical end surface adapted to embrace said shaft, opposed ears at said arm extending outwardly therefrom, a heel piece adapted to non-rotatably cooperate with said shaft, opposed ears extending outwardly from said heel piece, the correspondingly opposed ears of said arm and heel piece being divergent relative to each other in assembled disposition on said shaft providing clearance therebetween, and adjustable means for drawing one set of correspondingly opposed ears together and separating the other set of correspondingly related ears whereby the angularity of said arm with respect to said heel piece may be varied within certain predetermined limits of adjustment, said arm and heel piece being relatively reversible with respect to each other for varying the angularity of said arm within other predetermined limits of adjustment.

In witness whereof, we hereunto subscribe our names this 11th day of July, A. D. 1929.

ALFRED ALSAKER.
ELIAS S. CORNELIUSSEN.