

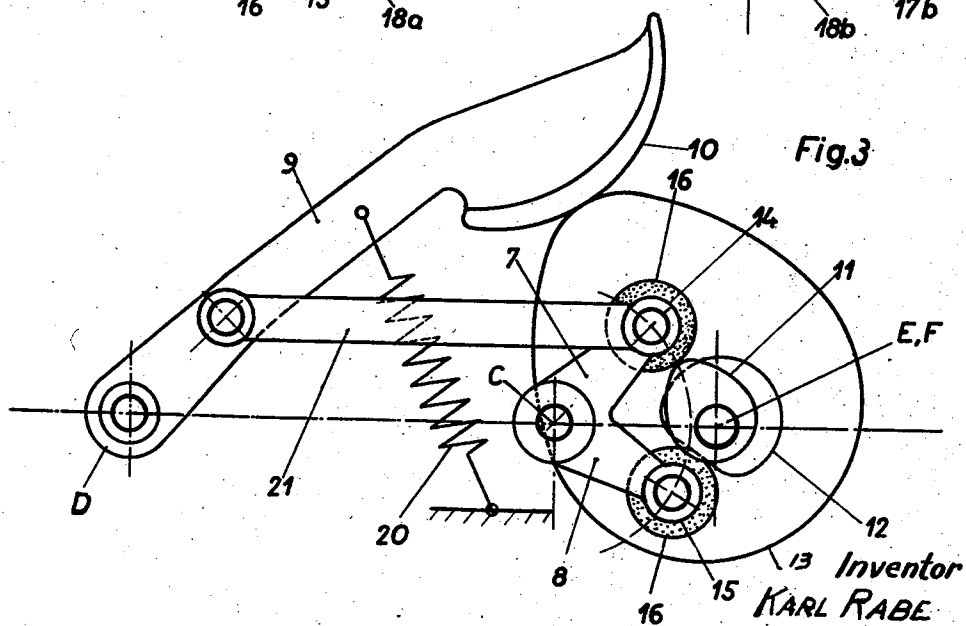
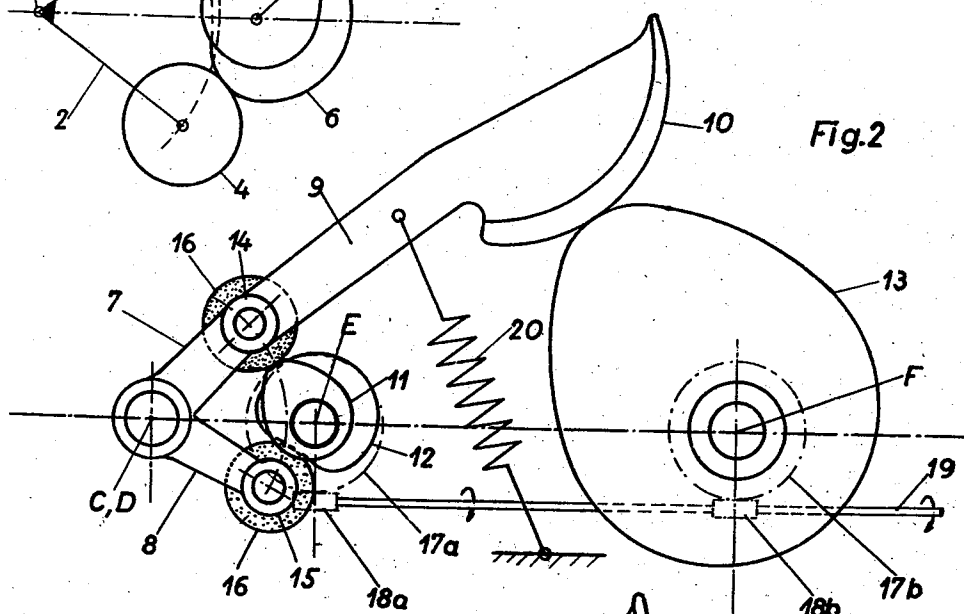
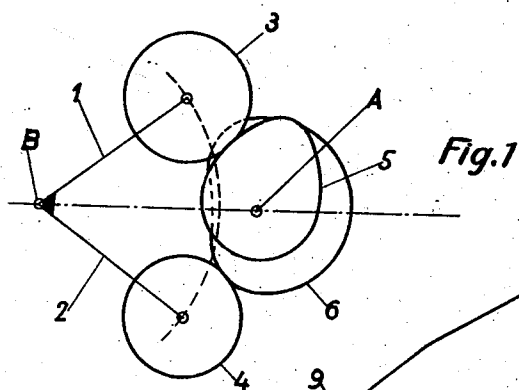
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MEANS AND METHOD FOR PRODUCING CAMS

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MEANS AND METHOD FOR PRODUCING CAMS

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This invention relates to a means and method for producing cams and more particularly is concerned with the production of a complementary cam pair.

5 An object of this invention is to provide an improved device and method for the production of cams.

10 Another object of this invention is to provide a device and method for the formation of a cam from a master cam form.

A further object of this invention is to provide an improved device and method for the production of a pair of complementary cams.

15 A still further object of this invention is to provide a device and method for the production of a pair of complementary cams from a single master cam form.

20 A comprehensive object of this invention is the provision of a single device which may be used for the cutting, milling, grinding and/or lapping of a pair of complementary cams from a single master cam having the shape of only one of the cams to be produced.

25 Other objects of this invention will be apparent from the following description of this invention with reference to the accompanying drawing wherein:

Fig. 1 is a partially diagrammatic illustration of the use of a complementary cam pair;

30 Fig. 2 shows one form of an arrangement according to this invention for the production of cams; and

Fig. 3 is a modified arrangement of the construction shown in Fig. 1.

35 The use of cams for transmitting variable motion is well known in the machine art. Likewise, the use of a pair of complementary cams for transmitting variable motion but at the same time positively constraining the movement of the moved object is known. Such a combination is 40 illustrated in Fig. 1 wherein a pair of arms 1, 2 rigidly interconnected with one another have rollers 3, 4 mounted upon their respective ends. This rigid assembly is connected for oscillation about an axis B. Cooperating with the rollers 3, 4, is a complementary cam pair 5, 6 mounted 45 for rotation about an axis A. The cams 5 and 6 are so formed that contact of the cam 5 with the roller 3 will give to the integral assembly comprising arms 1 and 2 and rollers 3 and 4 the 50 same movement as is imparted by the cam 6 to the roller 4. The advantage of this arrangement over, for example, the use of the single cam 5 acting upon the roller 3, is that movement of the 55 moved assembly is constrained due to the contact

of the roller 4 upon the cam 6 although the imparted motion is exactly the same.

Fig. 2 discloses an arrangement for the production of a device such as the cam pair 5, 6 of Fig. 1. As illustrated in Fig. 2 a single master form or cam 13 is mounted for rotation about an axis F. A follower 9 having a contacting face 10 is also 5 mounted for rotation about an axis C which is parallel to the axis F. A spring 20 is shown as holding the follower against the master cam. A work piece or pieces to which the complementary cam shapes are to be given is mounted for rotation about an axis E preferably parallel to the 10 axes C and F of the follower and master cam respectively. The complementary cams formed upon the work piece are designated in the drawing as 11 and 12. The cams 11 and 12 are cut or ground upon the work piece by the use of any suitable grinding or cutting device or devices designated as 16. These cutting devices, in the form 15 of the invention here illustrated, are mounted for rotation about an axis D coinciding with the axis C of the follower 9. They are supported upon a pair of arms 7, 8 which may be formed as an integral part of the follower. Suitable mounting means are illustrated as shafts 14 and 15 at 20 the respective ends of arms 7, 8. Means are provided for simultaneously and equally rotating the master cam and the work piece. Such means may be a common shaft 19 acting respectively through worm gears 18a and 18b upon the gear wheel 17a mounted co-axially with the work piece and gear wheel 17b mounted co-axially with the master cam. 25

The work piece is either fed into the space between the grinding wheels 16 or the wheels are 35 moved against the work piece until they have assumed a position determined by the position of the master form 13. The shaft 19 is then rotated and the grinding operation repeated until the entire circumference of the master form 13 has been followed at which time the work piece will assume the outlines of the cam pair 11, 12. It will be obvious to those skilled in the art that the arrangement described above is useful not 40 only for cutting out a cam pair 11, 12 in accordance with the master cam 13, but also for any type of shaping such as milling, grinding, polishing or lapping the cam pair. Furthermore, the cam pair may be formed even if only one grinding or cutting wheel is available. If the grinding wheel 16 is, for example, first placed upon the shaft 14, the cam 11 will be formed by following the above described process. If the wheel 16 is 55

then placed upon the shaft 15 the complementary form 12 can then be made.

In order that the cam pair 11, 12 be formed exactly in accordance with the master cam 13, it is preferable that the radius of the follower face 10 bear the same proportion to the size of the master cam 13 as the radius of the grinding wheel 16 bears to the size of the desired cam pair 11, 12.

The arrangement according to Fig. 3 is substantially the same as that of Fig. 2 with the exception that the work piece is mounted upon an axis E which coincides with the axis F of the master cam. The axis C of the double armed lever 7, 8 bearing the grinding or cutting wheel 16 is then preferably mounted parallel to the axis D of the follower arm 9. The double armed lever is however, given the same motion as the follower arm 9 by means of a link 21 pivotally interconnecting these two parts. It will be obvious that in this form of the invention no special connecting means between the master cam and the work piece is necessary, for these being both mounted upon the same shaft will of necessity move together. This arrangement is perhaps preferable to that illustrated in Fig. 2 since the axes of the work piece and the master cam being the same, a more exact cutting will result.

It will be obvious to those skilled in the art that variations in the size of the cam pair can be made either by a change in size of the master cam or by an appropriate change in size of the grinding or cutting wheels 16. The correctness of the produced cam pair will in such cases not be impaired so long as the geometry of the arrangement is maintained.

It will also be obvious to those skilled in the art that the arrangement described above is not limited to the formation of a cam pair but can be equally advantageously used for the formation of a single cam or its complement or for the formation of any desired shapes in accordance with the shape of a single master form.

Various changes of the above described arrangement may be made without departing from the scope of this invention. It is not necessary that the grinding or cutting means be mounted in the manner indicated so long as they will partake of the correct motion. The relative size and exact positioning of the various parts is not limited to those shown on the drawing but may be made within a wide range of dimensions necessitated by the size of the parts to be produced, the size of the master form, etc. The follower and grinding wheel support need not be rotatably mounted, but may be positioned upon slides, depending upon the type of motion which it is desirable to transmit to the moved element and the relationship of this element to the cam pair. The arrangements illustrated in Figs. 2 and 3 have been designed to produce a cam pair acting in the manner proscribed by Fig. 1. If the proscribed motion to be imparted is different, the grinding setup will vary accordingly, as will be obvious to those skilled in this art, it being only important that the geometry of the arrangement as herein taught for grinding a complementary cam pair be maintained.

Accordingly, I do not intend that the scope of this invention be limited to the two forms above described, but only by the scope of the claims which follow.

I claim:

1. In combination, a rotatably mounted master form, means adapted to rotatably support a pair of co-axially mounted work pieces, a rotatably

mounted follower, the axis of rotation of which is substantially parallel to the axes of rotation of the master form and the work piece support, a pair of shaping devices interconnected with said follower and partaking of its rotatable movement, one of said shaping devices being positioned to cooperate with one work piece and the other of said shaping devices being positioned to cooperate with the other work piece, said shaping devices being mounted at an angle to one another along an arc the plane of which is perpendicular to the axis of rotation of said follower, means urging said follower against said master form, and means for simultaneously rotating said master form and said work piece support.

2. The combination according to claim 1 in which the axis of rotation of said work piece support is parallel to the axis of rotation of said master form.

3. The combination according to claim 1 in which the axis of rotation of said work piece support coincides with the axis of rotation of said master form.

4. The combination according to claim 1 in which said shaping devices are mounted on an integral portion of said follower.

5. The combination according to claim 1, in combination with a double-armed rotatably mounted lever, the axis of rotation of which is substantially parallel to the axis of rotation of said follower, and a link pivotally interconnecting said follower and said lever, said shaping devices being respectively mounted on opposite arms.

6. The combination according to claim 1 in which said shaping devices are mounted on an integral portion of said follower, and the axis of rotation of said work piece support is substantially parallel to the axis of rotation of said master form.

7. The combination according to claim 1, in combination with a double-armed rotatably mounted lever, the axis of rotation of which is substantially parallel to the axis of rotation of said follower, and a link pivotally interconnecting said follower and said lever, said shaping devices being respectively mounted on opposite arms, and the axis of rotation of said work piece support coinciding with the axis of rotation of said master form.

8. The combination according to claim 1 in which the master form has the shape of only one of the devices to be produced.

9. In an arrangement for the production of a complementary cam pair, in combination, a rotatably mounted master cam, means adapted to rotatably support a work piece, a follower, means for pressing said follower against said master cam, a pair of supports mounted for movement with said follower, each extending over opposite longitudinally displaced portions of a work piece carried by said work piece support, rotary grinding means mounted on at least one of said supports, and means for simultaneously rotating said master cam and said work piece support.

10. In an arrangement for the production of a complementary cam pair, in combination, a rotatably mounted master cam, means adapted to rotatably support a work piece, a follower, means for pressing said follower against said master cam, a pair of supports mounted for movement with said follower, each extending over opposite longitudinally displaced portions of a work piece carried by said work piece support, rotary grinding means mounted on each of said supports, and

means for simultaneously rotating said master cam and said work piece support.

11. The combination according to claim 10 in which the master cam has the shape of only one of the cams to be produced upon said work piece.

12. The method of grinding a complementary cam pair which comprises moving a pair of angularly displaced grinding wheels over axially displaced portions of a complementary cam blank in accordance with the outline of a single master cam, the position of one of said grinding means relative to its blank being the same as the position of the cam follower is to have to its finished cam.

13. A combination according to claim 1 in which the axis of rotation of said work piece support is spaced from and parallel to the axis of rotation of said master form, said master form being larger than each of the work pieces to be worked on.

14. In combination, a rotatably mounted master form, a lever pivoted at a distance from and on an axis parallel to the axis of rotation of said master form and formed with a cylindrical follower surface contacting said master form, means adapted to rotatably support a work piece, means for simultaneously rotating said master form and said work piece support, a rotating shaping device for forming the contour of said work piece mounted for oscillation about an axis parallel to the axis of the work piece, the axis of the master form and the axis of the follower surface, and means for so connecting said shaping device for movement with said lever that it is moved through the same angle but a shorter distance than the follower surface, the extent of movement of the shaping device bearing the same rela-

tion to the extent of movement of the follower surface as the radius of curvature of the shaping device bears to the radius of curvature of the follower surface, and as the desired dimensions of the finished work piece bears to corresponding dimensions of the master form, whereby a large master form may be employed to control the formation of a geometrically similar or complementary work piece of a smaller size.

15. The combination according to claim 14 in which the shaping device is carried by the lever which carries the follower surface.

16. In combination, a rotatably mounted master form, a pivoted lever formed with a follower surface contacting said master form, a support for a work piece connected for rotation in synchronism with said master form, a shaping device for operating upon a work piece to be carried for rotation by said work piece support, a support for said shaping device carried upon a pivot at a distance from said shaping device so connected with said follower lever that angular movement of the follower lever will impart corresponding angular movement to said shaping device support, the distance of said shaping device from its pivot being smaller than the distance of the follower surface from its pivot, and the follower surface being geometrically similar to the shaping device and bearing the same geometric proportion thereto as the master form bears to the work piece to be formed, whereby a large master form may be employed to control the formation of the geometrically similar contour of a small work piece.

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