Feb. 21, 1928. 1,660,291

M. BIRKIGT

GRINDING MACHINE

Filed June 26, 1925 3 Sheets-Sheet 1

Fig. 1.

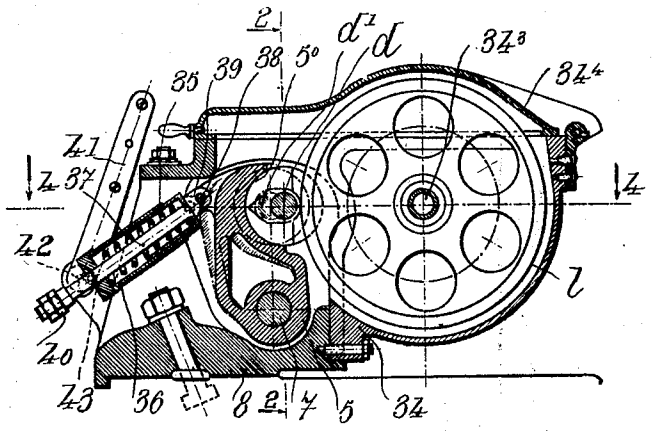


Fig. 3.

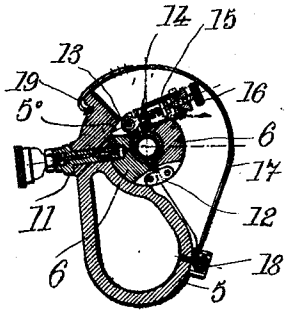
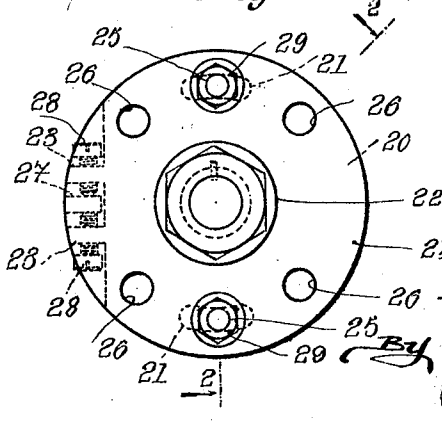


Fig. 5.



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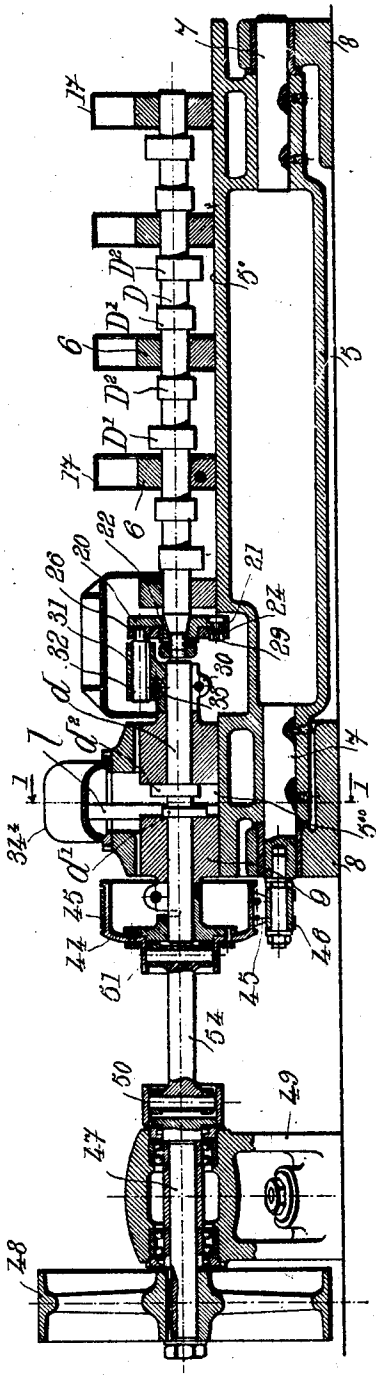


Fig. 2.

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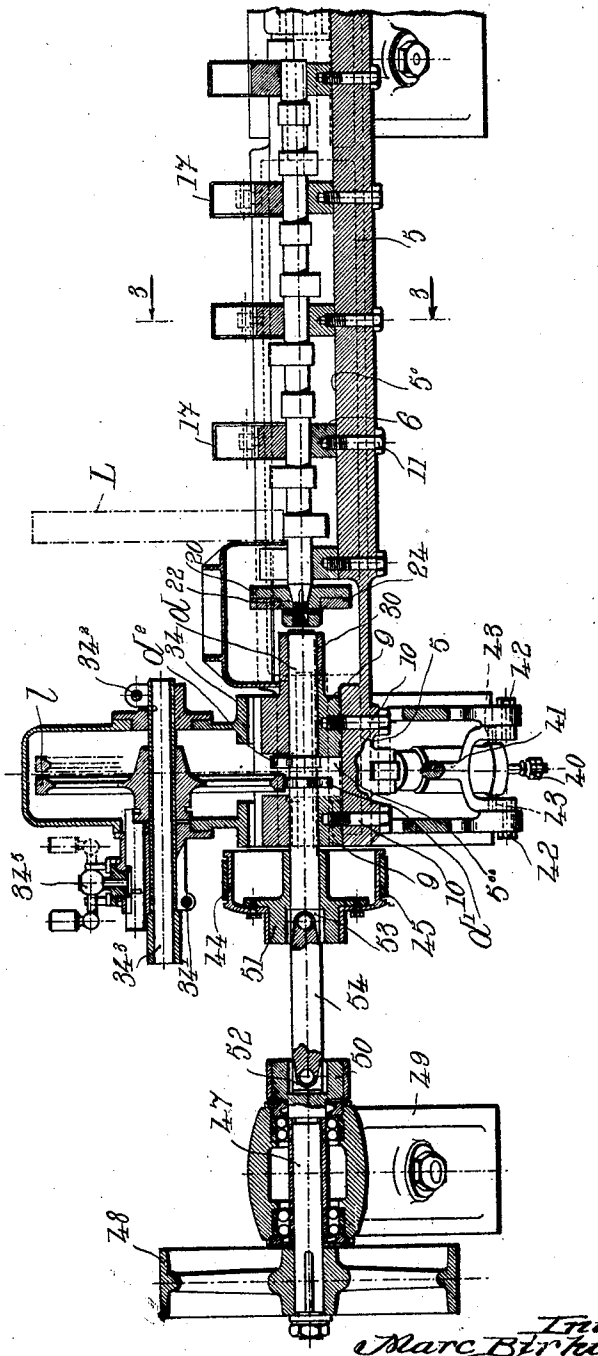
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Fig. 4.



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UNITED STATES PATENT OFFICE.

MARC BIRKIGT, OF BOIS-COLOMBES, FRANCE.

GRINDING MACHINE.

Application filed June 26, 1925, Serial No. 39,803, and in Belgium July 14, 1924.

This invention relates to articles which are machined by means of a grinding machine; and it relates more particularly (since it is in their case that its application seems to offer the greatest importance) but not exclusively, to cam shafts for explosion engines.

It has for its chief object to enable the said articles to be manufactured in an accurate manner.

It consists, chiefly, in using, for the grinding of the articles of the kind in question, on the one hand, and as the template to be used on the grinding machine to be itself used for the said grinding, a template of a cross-section identical, as regards the dimensions as well as the shape, with that which the articles must have after they have been machined, and on the other hand, in using, as the grinding machine, a grinding machine itself built in such a manner as regards its roller and its grinding wheel, that the said roller and the said grinding wheel should be of the same diameter.

Apart from this chief arrangement, it comprises certain other arrangements which are used preferably at the same time and are more explicitly referred to in the following, namely:

A first additional arrangement—exclusively relating to articles which, like the cam shafts of explosion engines with several cylinders in line, have to be supported in a series of bearings—consisting, in its turn, in using:

As the part intended to receive the said bearings, a part bored out cylindrically,

As the parts which constitute the said bearings, similar parts which, at least as regards their portion to be utilized for their own mounting, are turned exactly to the diameter of the said cylindrically bored part and in such a manner that, whatever be the point of the latter at which they are mounted, they will be automatically concentric.

A second additional arrangement consisting in its turn in using for the purpose of constituting the bearings which are to be provided in machines such as more particularly the grinding machines, bearings, the cap of which is pivoted to their body (so as to enable it to be turned down relatively to the latter) and comprising, as means for securing the said cap to the said foot, a quick locking device (a pivoted rod with a spring locking system, etc.).

It relates more particularly to a certain method of application (that in which the application is made to the machining, or, more accurately, to the finishing, of the cam shafts for explosion engines), as well as to certain methods of carrying out (those which will be referred to in the following) the said arrangements; and it relates more particularly still, by way of new industrial products, to grinding machines or other machines comprising the application of the same arrangements, to special elements suitable for building them, to articles obtained by means of such grinding machines or machines, to apparatus (engines, etc.) comprising such articles, as well as to installations, stationary or moving (namely aeroplanes), comprising such apparatus.

The invention will be clearly understood from the following description and the accompanying drawings which, of course, are given chiefly by way of example.

Figures 1, 2, 3 and 4 of the said drawings show, respectively, in vertical cross-section on line 1—1 of Figure 2; in vertical longitudinal section on line 2—2 of Figures 1 and 5; in partial vertical cross section on line 3—3 of Figure 4; and in horizontal section on line 4—4 of Figure 2, the oscillating cradle of a machine for grinding cam shafts for explosion engines, built according to the invention, as well as certain of the accessories of the said cradle.

Figure 5 finally shows in front elevation, on an enlarged scale, the driving discs provided on the said cradle.

According to the invention, when it is intended to obtain for instance cam shafts, such as those of the explosion engines of the Hispano-Suiza type, or more accurately, to grind blanks of such shafts, the proceeding is as follows or in a similar manner.

As to the template to be used for the grinding in question, it is made—preferably, by proceeding to that end as indicated in my copending patent application filed of even date with the present one, Serial No. 39,802—in such a manner that the two master cams d^1 and d^2 with which the spindle d is

to be provided, should have the cross section, both as regards the dimensions and shape, identical with those of the corresponding cams D^1 and D^2 with which the shaft D to be machine, is to be provided.

As to the roller *l* and the grinding wheel L with which the grinding machine to be used, they are built in such a manner that their diameters should be as nearly the same as possible, use being made, for the purpose of constituting the said roller *l*, preferably not of a single roller, but a series of very easily interchangeable rollers, one of which has a diameter exactly equal to that of the grinding wheel before it has been used, whilst the others have respectively very slightly smaller diameters gradually decreasing, so as to make it possible to substitute them, one after another, for the preceding ones, as the grinding wheel wears out and that it should be therefore possible to maintain the equality of diameter just mentioned, so to say forever.

And to the other parts with which the grinding machine is to be provided, they are themselves built in any desired suitable manner.

Owing to which, and as will be readily understood without any further explanation, there will be obtained by the machining in question, cam shafts, the corresponding cams of which are all as nearly identical as possible with each other.

And either the proceeding for the manufacture of the grinding machine is as has been just described, or, and still better, the following arrangements are moreover used, namely separately.

The oscillating cradle 5, in vertical line with which has to be mounted the cam shaft to be ground, is constituted by a part 5^0 which is either simply bored or still better, also ground cylindrically in such a manner that the angle enclosed by the arc of circle which this part is thus made to have as its section, should be at the outside equal to 180°.

For mounting the cam shaft to be ground on the said cradle 5, instead of a simple pair of points, a series of bearings 6 which, at least as regards their portion to be used for their own mounting, are turned or ground so as each to have as the bearing surface, a cylindrical surface of exactly the same diameter as that of the said part 5^0.

The number of these bearings is preferably equal to that of the bearings to be utilized for mounting the said cam shaft on the engine for which it is intended, and moreover they are arranged on the part 5^0 exactly in the same way as are arranged in the said engine the bearings mentioned in the last instance.

Each of the bearings may be fixed in any suitable manner, for instance by means of a bolt 11 which passes through a hole—either round or elongated for the purpose of allowing of a regulation along the axis of the cradle—in the cradle 5, and said bolt may be either by an ordinary bolt, as assumed in Figure 4, or a lubrication bolt, as assumed in Figure 3, the bearing 6 being, in the latter case, provided with a conduit for the passage of the lubricant supplied by the lubricator bolt.

And the utilization, for the purpose of constituting the said oscillating cradle and bearings as well as the other parts with which the grinding machine is to be provided, of parts either simply more or less similar to those shown in the drawings, or exactly identical with the latter, that is to say: of an oscillating cradle 5 which is of a length slightly greater than the sum of the length of the cam shafts D to be machined, and of the length of the spindles *d* of the templates to be used.

The cradle 5 has at each of its two ends a spindle 7 so as to enable it to pivot on brackets 8.

The cradle 5 has, moreover, at one of its said ends (that which is shown on the left in Figures 2 and 4) a part 5^{00} adapted to receive the bearings 9 to be used for supporting the spindle *d* of the template to be used. The remainder of the length of the cradle 5 constitutes the above mentioned part 5^0 intended to receive the bearings 6 for mounting the shaft to be machined.

The said part 5^{00} is preferably made in an identical manner with the part 5, and at the same time as the latter, in which case the said bearings 9 are, of course, themselves made in a corresponding manner.

Two brackets 8 are anchored to the general bed of the grinding machine, and in which are supported effectively the spindle 7.

Two bearings 9 are provided to play the part of the bearings mentioned, each of which is fixed in position by means of a suitable part, for instance by means of a bolt 10.

The bearings 6 are preferably made entirely cylindrical and moreover are each divided into two equal halves adapted to constitute, one, the body and the other, the cap of the same, this body and this cap being preferably pivoted or hinged to each other by a kind of a shackle 12.

The body of each bearing 6 has pivoted to it by means of a pin 13, a rod 14 the free end of which is introduced into a spring cage 15 having a bottom in the form of a spherical cap and with means such as a screw 16 suitable for regulating the action exercised by the spring of the said cap.

In this manner it is possible, not only to place the said bearings in an exceedingly easy manner, into the desired position for

the mounting and dismantling of a cam shaft D as well as into the position in which, when a spindle has been thus mounted, it can be locked in position, whilst still free to rotate, which freedom to rotate can be regulated by acting on the regulating system 16.

Sheet metal gear cases 17 are provided for protecting each one of the said bearings 6.

These gear cases are each preferably hinged by means of a pin 18 to the bottom front part of the cradle 5 and terminate each in a part 19 which can be elastically hooked over a corresponding portion of the upper rear part of the said cradle;

Means are provided which, when the spindle d of a template and a cam shaft D have been mounted in their respective bearings, allow them to be interlocked as regards their angular movements, and this in such respective angular positions as may be advisable.

These means are preferably constituted by a driving composite disc, in its turn constituted by a first disc 20 which, when a template spindle and a cam shaft are in place, can be keyed on that end of the said cam shaft, which adjoins the spindle d, and comprises elongated circular openings 21, a hub 22 and a radial fork 23 with two teeth.

Said means also comprises a second disc 24 which can be pivoted to the said hub 22 and is provided with holes 25 which can be brought in vertical line under the elongated openings of the disc 20. The disc 24 also has seats 26 to the number equal to that of the groups of cams with which the cam shafts to be machined are to be provided, and a radial projection 27 adapted to be placed between the two prongs or teeth of the said radial fork 23 and play then to a certain extent between them.

Two screws 28 are adapted to be screwed, the first one into one, and the other into the other, of the two teeth of the fork 23, in such a manner as to act on the radial projection 27 to regulate at will the said respective angular positions.

Bolts 29 are introduced into the said elongated openings 21 and holes 25, and used concurrently with nuts, for assembling the said discs together in these same respective angular positions.

A clamping collar 30 is secured, during the mounting of a spindle d, on that of the ends of the latter, which is at the side, where when it is desired to put in place a cam shaft D, it is necessary to arrange the latter, the said collar comprising, along one of its generatrices, a boss 31 bored out in such a manner that a driver 32 could be moved in it parallel to the common axis of the bearings of the spindle d and cam shaft D.

The driver 32 is constructed in such a manner that it can be moved, for instance by means of a rack cut on the same, and of a corresponding pinion 33 whilst the collar 30 and the discs 20 and 24 are in place, to engage, without play, with any of the said seats 26.

An additional frame 34 can be secured at the back of that of the two brackets 8, level with which is situated, as soon as the cradle 5 is in place, the part 5^{00} of the latter.

This frame 34 is of generally cylindrical shape and of the desired dimensions in order to receive the roller l to be used on the grinding machine, and is constructed, on the one hand, in such a manner that when a roller l has to be replaced by another, such operation may be effected very quickly, for which reason the means for mounting the said rollers can comprise two clamping collars 34^1 and 34^2 secured at either side of the frame 34, and by a relatively long spindle 34^3 which makes it possible to put on it easily the rollers l; one of the parts of the frame in question, for instance the upper part 34^4, being concurrently made hinged and of such dimensions that, when turned down, the roller l can be introduced from the top downward into the remainder of the said frame, or withdrawn from the same in the upward direction, after the spindle 34^3 has been released from the action of the clamping collars 34^1 and 34^2, and after a sufficient pull has been exerted on the projecting portion of the same spindle in order to bring its other end sufficiently back.

A device 34^5, for instance with rack and pinion which, owing to a finger forming part of the same, and to a groove provided in the rollers l so that it can receive the said finger, can move the said roller as is necessary for bringing it level either with the master cam d^1 or with the master cam d^2 of the template utilized.

Means are provided which, and when a roller l is in place and a template has been mounted on the cradle 5, can push back the latter elastically in such a manner that the said template bears elastically against the said roller, and on the other hand, enables the said roller to be moved back to a sufficient extent, in order to move the template away from the roller.

Such means may comprise:

A telescopic cage consisting of two elements 35 and 36, and a spring tending to move the respective bottoms of the said two elements away from each other.

A rod 37 has one of its ends pivoted by means of a pin 38, to the cradle 5 and having at said end a head 39 threaded through the said cage and provided at its free end, which is screw-threaded, with a nut 40 and with a lock nut.

An operating lever 41 has its forked end

pivoted, by means of a pin 42, to arms provided for the purpose on the bracket 8.

The lower element 36 of the telescopic cage is pivoted by pins 43 in such a manner to the said prongs of the fork of the lever 41, eccentrically to the said pins 42, so that, as soon as the lever 41 is pushed towards the back of the grinding machine or pulled towards oneself, the desired movement of the cradle 5 is effected.

A brake is provided to resist the sudden movements to which the spindle of the template and the cam shaft which is being machined are liable to be exposed owing to the thrust exercised at certain moments of the operation, by the roller *l* or the grinding wheel L. Such brake could be advantageously constituted by a brake drum 44 which, as soon as the template is in place, can be secured by means of a clamping collar forming an integral part of the same, to the end of the spindle *d* of the said template, opposite that at which is mounted the collar 30, and by a corresponding band 45, and means 46 by means of which the action exercised by the said band on the said drum may be regulated.

Means are also provided which, when a template and a cam shaft to be machined are in place, can rotate then, whilst at the same time allowing of a longitudinal movement of the cradle 6.

Such means may comprise a spindle 47 connected in such a manner—directly or through a speed reducing gear (not shown)—to a driving pulley 48 as to be driven by the latter, the said spindle being mounted loosely on a bracket 49 arranged in such a manner that it should be at a fairly great distance from the outer bearing 9 and that, when the cradle 5 occupies its mean working position, the geometrical axis of the said spindle 47 should be in line with the axis which is common to the said bearing 9, to the other bearing 9 and to the bearings 6.

Such means may also comprise two parts 50 and 51 which can form seats respectively for a first Cardan block 52 and for a second Cardan block 53, these parts being secured, one to the free end of the spindle 47, and the other, to the opposing face of the drum 45 (this of course assuming that the latter is utilized and constructed as hereinbefore described).

The Cardan blocks 52 and 53, are connected by a spindle 54.

Means (not shown) are provided for driving the spindle of the grinding wheel at the desired speed, the roller *l* rotating only under the action of the friction exercised on it by the master cam brought to bear on it, and the spindle *d* of which is driven, concurrently with the cam shaft D, only at an exceedingly low speed.

A grinding machine constructed as just described has, among other advantages, of being particularly practical, because it reproduces directly, that is to say without any transformation either of their cross section or even their dimensions, the templates mounted on it; and of enabling parts of a very remarkable precision to be obtained, this precision being extreme if the said templates themselves have been prepared as described in the above mentioned patent application.

It goes without saying, and it appears besides from the preceding, that the invention is by no means limited to that of its methods of application or to those of the method of building its various parts, which have been more particularly indicated, but comprises on the contrary any modification.

Claims:

1. In apparatus for grinding articles and particularly cam shafts for explosion engines with several cylinders in line, a bearing support for the cam shaft to be machined, said bearing support having a cylindrical bored-out part to receive a plurality of bearings for the cam shaft, said bearings being, at least on a portion of their outer surface, cylindrically turned whereby they may rotate in the bored-out portion of the bearing support after they are set up therein and have brought the cam shaft into position.

2. In apparatus for grinding articles and particularly cam shafts for explosion engines with several cylinders in line, bearings to cooperate with the bearing journals on the cam shaft and thereby support said shaft during grinding of the cams thereon, each bearing comprising a supporting section and a cap section, a shackle forming a hinged connection between said bearing sections, a bar pivotally connected to one of the bearing sections diametrically opposite to said shackle, a spring cage arranged to receive the free end of said pivoted bar and having a spring therein which acts to close the bearing sections upon the respective journal of the cam shaft, and means for regulating the action of said spring.

3. In grinding apparatus provided with a pattern shaft adapted to be coupled to a cam shaft to be ground, coupling means comprising a bolt supported on the pattern shaft and movable in a direction substantially parallel to the longitudinal axis of said pattern shaft, a pair of coupling discs, one of said discs having a recess therein adapted to receive said bolt, means operable to clamp said discs together in any one of a plurality of relative angular positions, and means operable to attach said discs to a cam shaft to be ground.

In testimony whereof I have hereunto set my hand.

MARC BIRKIGT.