Feb. 12, 1935. H. W. H. BETH 1,990,927

MULTIPLE UNIT GRINDING WHEEL

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FIG. 1

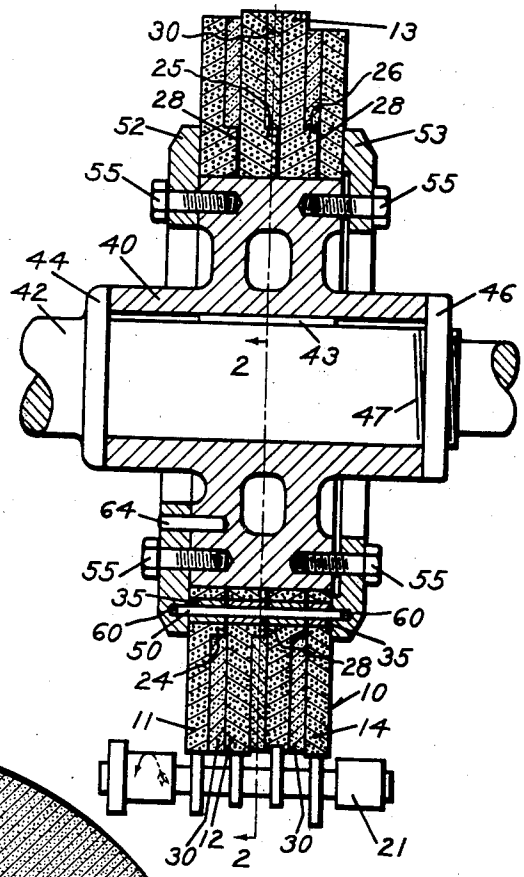
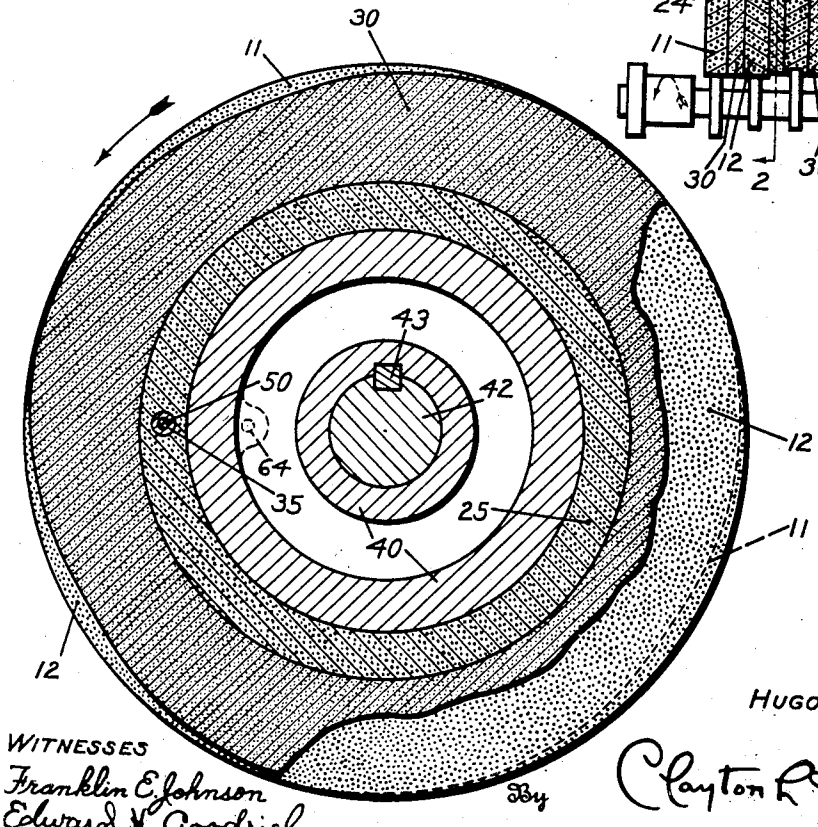


FIG. 2



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MULTIPLE UNIT GRINDING WHEEL

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5 Claims. (Cl. 51—207)

This invention relates to a multiple unit grinding wheel wherein several separately manufactured grinding wheel units are secured together to form an integral grinding wheel adapted to grind a plurality of spaced surfaces.

As disclosed in the prior application of Stubbs, Serial No. 612,232, it has been proposed to employ several specially shaped grinding wheels individually mounted in spaced relation on the same shaft to simultaneously determine the shapes of several work pieces or surfaces such as the cams on an automotive camshaft. In such a machine, the preshaped grinding wheels and work are rotated in angular synchronism or in a definite cyclic timed relation so that while each wheel contacts with its corresponding work surface, certain portions of each wheel periphery will always engage certain portions of the work, and the rotation of the wheels and work will always remain in a fixed angular phase relation causing each specially shaped grinding wheel to form a specially shaped work contour which is the conjugate thereof.

The term "conjugate" as applied to the shape of a grinding wheel relates to that curved wheel shape which will remain in rotative contact with the surface of a work piece which is of such shape or is so mounted that the line of grinding contact varies in its distance from the axis of grinding wheel rotation, while the wheel axis and work axis are maintained relatively stationary except for feeding the wheel into the work, and provided that the wheel and work are rotated with angular velocities equal or in a simple ratio, the grinding operation being caused by the unequal length of wheel and work surfaces which are moved relative to each other as they are rotated in angular synchronism.

Due to the fact that many types of work such as multi-cylinder automotive camshafts have their grinding surfaces in very close proximity to each other, it has been found extremely difficult to provide sufficient support for a plurality of large diameter, narrow, closely spaced grinding wheels. Grinding wheels of this type are very fragile and due to insufficient driving and lateral support therefor, breakage is frequent. Grinding wheels as used for such a multiple cam grinding operation may have an approximate diameter of 42 inches and a thickness of ¾ of an inch and the spacing between adjacent wheels may be as close as ⅛ of an inch or more. It will be appreciated that due to the fragile construction of such a wheel, even a slight side thrust of the work thereagainst might tend to break it, causing probable damage to the grinding machine, spoilage of the work and injury to the machine operator.

It is, therefore, the primary object of my invention to provide a multiple unit grinding wheel wherein several relatively narrow, large diameter grinding units may be secured together as a strong easily transportable integral wheel adapted for grinding a plurality of spaced surfaces wherein the opposed side faces of adjacent units are supported against side pressures by a wearable material which does not interfere with the grinding operation as the grinding wheel wears down in size.

It is a further object of this invention to provide a multiple unit grinding wheel having a plurality of spaced specially shaped grinding units which are held together and have their opposed side faces supported by a cementitious wearable material which will not interefere with grinding operations, thereby forming an integral wheel unit.

Since the special shape of each individual grinding annulus serves to determine the shape of its product work piece in a conjugate grinding operation, it will be appreciated that considerable difficulty might be encountered in angularly locating various wheels during the assembly of a multiple wheel as herein proposed.

It is, therefore, a still further object of this invention to provide an integral grinding wheel of multiple unit construction wherein the individual grinding units may be positively aligned in correct angular relation to each other when secured together as an integral wheel and wherein the assembled wheel can only be mounted with a predetermined fixed angular relation to its support.

With these and other objects in view, as will be apparent to one skilled in the art, this invention resides in the combination of parts set forth in the following description and appended claims.

In the drawing illustrating a wheel and wheel mount embodying this invention:

Fig. 1 is a sectional view taken through a multiple wheel unit showing one form of my invention, and

Fig. 2 is a view taken along the line 2—2 of Fig. 1.

In the embodiment of this invention as illustrated in the drawing, there is provided a multiple unit grinding wheel wherein a plurality of individual grinding discs or bonded abrasive annuli are positively secured together in fixed spaced relation in such manner as to provide an integral easily transportable grinding wheel which has a

plurality of spaced wheel peripheries adapted to grind spaced work surfaces. The grinding wheel may comprise a plurality of bonded abrasive annuli which are separated by portions projecting from the faces of the annuli such as hubs integral with certain of the annuli, or by spacing members between the individual wheels such as rings of metal, paper or other suitable materials employed to separate the abrasive annuli as required. The adjacent units of the wheel assembly may be secured together to form an integral wheel by cementing the spacing members or hubs firmly to the adjacent grinding units or annuli of the assembly, and the spaces between the adjacent grinding annuli may be filled with any medium which will easily wear away during the grinding operation and which will aid in supporting the side faces of the grinding annuli. The cement securing the wheels together and the filler between the adjacent grinding annuli may be of the same or different materials. It is essential, however, that the filler between the adjacent annuli be composed of an easily wearable or friable material which will substantially fill the intervening space, transmit the lateral thrusts and yet will not interfere with the grinding operation as the grinding wheel wears down in size.

When using specially shaped grinding wheels as required in a conjugate grinding operation, it is necessary to locate the adjacent grinding units of the wheel assembly in predetermined angular relations and to further mount the integral wheel assembly in a predetermined angular relation to its support so that the multiple unit wheel may be angularly positioned, with each of the grinding annuli in correct angular relation with the work. To accomplish this, each individual wheel is provided with an accurately positioned locating device which has the required angular relation to a given radius passing through a predetermined point on the wheel periphery. In assembling the various grinding units to make up my wheel, it is only necessary to assemble the proper units and align their locating devices. When the cement has set, with the individual wheels angularly aligned with their locating devices in correct relation to one another, it is simply necessary to mount the integral wheel assembly with the locating devices correctly positioned with reference to a given point on the wheel support whereupon the wheels may be secured in correct angular relation for a grinding operation.

The preferred embodiment of this invention, one form of which is illustrated in the drawing, may comprise a multiple unit grinding wheel 10 adapted to grind a plurality of spaced surfaces and composed of a plurality of spaced separate, bonded abrasive discs which are secured together to form the integral grinding member 10. In the present instance, the wheel 10 comprises four abrasive annular discs 11, 12, 13 and 14 secured together in spaced relation and arranged to grind four separate work surfaces such as the cams on a product camshaft 21 in the same manner as shown in the application of Stubbs, Serial No. 612,232.

The various abrasive discs are separated by spacing members, which, as illustrated, may be formed integral with the abrasive units. That is, the discs 11, 12 and 13 are provided with protruding portions or hubs 24, 25 and 26 respectively which are of such size and shape as to serve in separating the adjacent grinding discs and locating them in the desired spaced relation. It will also be appreciated that these portions 24, 25 and 26 need not be integral parts of the abrasive discs as shown but they may comprise separate pieces of metal, paper, fiber or any other suitable material adapted to serve the purpose of separating the adjacent grinding annuli as required.

To secure the separate abrasive discs into an integral grinding wheel structure which may be mounted on any suitable support for rotation as a unit, I preferably secure the protruding portions or hubs 24, 25, and 26 to the faces of the adjacent grinding discs with a suitable cement 28 while the abrasive discs are co-axially held together in any suitable manner. Cements composed of litharge and glycerin, sulphur, lavasul (which is a mixture of ground coke and sulphur), or other suitable materials may be employed to cause the adjacent abrasive discs to be firmly secured together into an integral grinding wheel structure. For example, the protruding portions 24, 25 and 26 of the discs 11, 12 and 13 may be coated with any cement adapted to hold the discs together and then the discs may be co-axially supported and firmly held together until the cement has set and of itself serves to hold the wheel units together into an integral grinding wheel structure. It will be appreciated that if the separating members are not integral parts of the driving discs they may be firmly cemented on both sides to adjacent opposed faces of the grinding discs. To provide the maximum grinding wear for a wheel of this type, the separators 24, 25 and 26 are preferably as close to the wheel axis as possible so that they may not interfere with the grinding operation and the individual grinding discs are preferably of a large diameter as compared to their thickness.

It will be appreciated that ceramic bonded abrasive discs of such size are very fragile and are subjected to frequent breakage unless properly supported against side pressures. I have, therefore, provided ample support for the opposed grinding disc faces to obviate this difficulty which has existed in prior narrow grinding wheel constructions. To accomplish this, the intervening space between the opposed faces of each pair of adjacent grinding discs is filled with suitable material 30 which may act as a support for the opposed wheel faces and yet is sufficiently wearable so that it will not interfere with the grinding operation as the peripheries of the grinding discs wear down in size. By providing a construction of this type it will be appreciated that any side shocks or pressures upon the end discs 11 or 14 will be transmitted through the entire wheel structure to be absorbed thereby and the entire wheel structure will be substantially as strong as a single abrasive wheel of comparable size.

It will be appreciated that the scope of this invention is intended to cover any suitable filler between the adjacent opposed wheel faces. This filler 30 preferably comprises a suitable cement and particularly the same cementitious medium which is utilized to secure the adjacent abrasive discs together into an integal structure, in which case the wheel will be strengthened by the cement adhering to the opposed disc faces. It is essential, however, since this invention is primarily intended to provide an integral multiple wheel unit structure adapted for grinding spaced surfaces, that the filler 30 be of sufficient strength to offer a rigid support to the side faces of the grinding discs and be sufficiently friable and

wearable so that it may not interfere in any way with the grinding operation as the wheel wears down in size. It is also preferable that the material be non-abrasive so as not to affect the work being ground if it should engage the same. Lavasul and litharge cement are particularly suitable for a wheel used for a cam grinding operation. If a non-cementitious filler is employed, it is preferable to cement it to the opposed disc faces and make the parts integral. It is to be understood that my invention is also intended to cover the use of a filler between the adjacent grinding annuli which does not completely fill the intervening spaces therebetween but which may be in the form of spaced ribs or supporting posts sufficiently close to one another to provide ample lateral wheel support.

When a multiple wheel unit of this type is to be employed for simultaneously grinding the cams on an automotive camshaft, it is essential that each grinding disc of the multiple unit grinding wheel be specially shaped as the conjugate of the desired finished work contour and mounted and maintained in correct phase relation with the work so that the shape of each grinding disc may form the desired work shape in the required angular relation. To accomplish this, each grinding disc has been provided with a locating device which has the required angular relationship to a given radius passing through a predetermined point on the specially shaped disc periphery. Such a locating device may comprise a shoulder, boss or recess on the wheel or a shoe or other suitable member may be secured to or made integral with the wheel, which has a definitely located surface, edge or other portion precisely positioned with a definite angular relationship to a radius passing through a given point of the wheel periphery, which may be aligned or engaged by an accurately shaped member on the wheel mount to precisely locate the grinding wheel therewith in a predetermined angular position. In the preferred embodiment of this invention, the locating devices may be composed of metal, hard rubber, a resinoid or other suitable material on the wheel and have pre-located surfaces, edges or holes which may be aligned with an accurately shaped member on the wheel mount to positively locate each grinding disc in a predetermined angular relation to the adjacent disc in the assembled unit and also to the wheel mount.

In my preferred construction as illustrated, each of the grinding discs during manufacture may be shaped to a master form and provided with a hole passing therethrough which is the required radial distance from the wheel axis and which is placed at the required angular relation to a given radius passing through a given point in the periphery of the disc. Each hole is bushed with babbitt or other suitable bushing material 35 which constitutes a shoe or aligning surface to aid in angularly locating each grinding disc in correct phase relation with the respective product cam.

To facilitate wheel assembly, each abrading disc may be marked with a number or other designating feature indicating which cam the disc is intended to grind. When assembling a multiple wheel unit as shown in Fig. 1, it is simply necessary to assemble the individual grinding discs and spacing members in the required order with the holes in bushings 35 aligned and the discs coaxially located relative to each other. After the cement 28 has set, the grinding discs will firmly adhere together into an integral wheel structure. If the filler 30 comprises a setable semi-fluid material, such as a cement, it may now be filled in between the adjacent grinding annuli.

The integral grinding wheel may be mounted for rotation in any suitable manner with the wheel held in fixed angular relation to its support. To accomplish this, a wheel support 40 adapted to peripherally support the wheel assembly 10 is mounted upon a driving shaft 42 and secured for positive rotation therewith by means of a key 43. To prevent axial movement of the wheel support relative to the driving shaft 42, the support may be positively secured in accurate longitudinal relation thereto in any convenient manner, which in the present case may comprise a flanged portion 44 on shaft 42 against which the wheel support may be securely clamped by a nut 46 screwed upon a threaded portion 47 on shaft 42 and acting to clamp against the opposite end of the wheel support 40.

To secure the wheel assembly 10 on its rotatable support 40 in fixed angular relation thereto and for positive rotation therewith, a locating member, which in the present instance may comprise a pin 50 is slidably engaged within the bushings 35. Clamping flanges 52 and 53 are secured to the opposite ends of the wheel support 40 by means of screws 55 which serve to force said flanges against the opposite sides of the integral wheel assembly 10. Each of the flanges 52 and 53 is provided with a recessed portion 60 adapted to slidably engage and receive one end of pin 50 and thereby serve in angularly locating the wheel assembly 10 in a predetermined angular relation with the driving shaft 42 which may be synchronized in its rotation with the camshaft as shown in the application of Stubbs, Serial No. 612,232. To prevent incorrect assembly of the flanges 52 and 53, a locating pin 64 is mounted in the end face of one end of the wheel support so that it may slidably engage a hole correctly aligned therewith in one of the wheel clamping flanges.

It will be appreciated that an integral grinding wheel structure of this type adapted to simultaneously grind a plurality of cams, may also be shaped after assembly. In such a case, the multiple unit wheel 10 could be built up from circular grinding discs and the individual grinding annuli could be trued to the desired contours by suitable devices to provide correctly shaped grinding peripheries each of which is in phase relation to the work and is shaped as the conjugate form of the desired work shape. It will further be appreciated that several of my multiple unit grinding wheels could be mounted upon an elongated wheel support in spaced relation to simultaneously finish any desired number of spaced work surfaces.

It is to be understood that the present invention is not limited to a grinding wheel having a plurality of specially shaped non-cylindrical abrading surfaces, but may apply to any type of multiple unit grinding wheel composed of a plurality of separate, spaced grinding annuli held together as an integral grinding member and whose opposed side faces are supported against side pressures by an easily wearable material which breaks down and does not interfere with a grinding or truing operation as the wheels are reduced in size.

In the use of such a multiple wheel, it is often desirable to cut away the filling material slightly below the peripheral surfaces of the grinding discs so that it cannot engage the work during

the grinding operation; and the claims herein presented are to be understood as covering a multiple wheel structure in which the filler does not completely fill the spaces between the abrasive discs. However, it will be appreciated that in such a case, the filler fills these spaces sufficiently to support the abrasive discs against lateral pressures.

Having thus described the inventions, what is claimed as new and desired to secure by Letters Patent is:

1. A grinding wheel adapted for grinding a plurality of spaced surfaces comprising a plurality of adjacent annular abrading members, spacing members located solely outside of the grinding zone which space the adjacent abrasive annuli at predetermined and material distances apart, and a cementitious, relatively soft, non-abrading material located in the spaces between the disks in the grinding zone, which will wear away during grinding without interfering with the grinding operation, said material serving to fill the intervening space between the individual grinding annuli and support them laterally and secure them together into an integral grinding wheel structure having spaced grinding elements.

2. A multiple unit grinding wheel adapted for grinding spaced surfaces comprising a plurality of adjacent coaxial abrasive discs, spacing members located solely outside of the grinding zone and arranged to axially space the discs at predetermined and material distances apart, a cementitious medium securing the spacing members to adjacent disc faces and forming an integral grinding wheel, and a wearable material between the opposed faces of adjacent discs and in the grinding zone which supports them individually against side pressures and which will be worn away during the grinding operation without interfering with the abrading action of the wheel as it is reduced in size.

3. A multiple unit grinding wheel adapted for grinding spaced surfaces comprising a plurality of adjacent coaxial grinding discs, spacing members integral with various discs to space them at predetermined distances apart, a cementitious medium securing the spacing members to the adjacent disc faces and forming an integral grinding wheel unit, and a non-abrading, relatively soft, wearable material between the opposed faces of adjacent wheels which supports the individual discs against side pressures and which will be worn away during the grinding operation without interfering with the abrading action of the wheel as it is reduced in size.

4. A multiple unit grinding wheel adapted for simultaneously grinding spaced surfaces comprising a plurality of adjacent coaxial grinding discs having central hubs projecting therefrom which serve to provide spaced grinding annuli located at predetermined distances apart, a cementitious, friable filler in the spaces between the opposed faces of the annuli which will easily wear away without interfering with the grinding operation and support the grinding wheels against lateral pressure, and a cement to secure the hubs to the adjacent discs and form an integral grinding structure.

5. A multiple unit grinding wheel for simultaneously grinding a plurality of curved surfaces whose lines of grinding contact lie at different distances from the grinding wheel axis comprising a plurality of spaced, coaxial grinding discs, each of which is shaped as the conjugate of the work piece ground thereby, each disc being provided with a portion accurately located in a predetermined angular relationship to a given point thereon, means to align said locating portions, means to fixedly secure the discs coaxially together in said spaced relation with said locating portions aligned and thereby form an integral grinding wheel with each disc properly located for grinding its work piece, and a filler of wearable material arranged to fill the intervening spaces between adjacent discs to support them laterally against side pressures, said filler being of such material that it will not interfere with the grinding operation as the wheel is reduced in size.

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