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[11] **3,858,368**

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[54] **DISPOSABLE QUICK COUPLING ROTARY GRINDING DISC FOR COMPOUNDLY CURVED SURFACES**

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[52] **U.S. Cl.** ..... **51/358,** 32/59, 64/11 R

[51] **Int. Cl.** **B24d 17/00,** A61c 3/06

[58] **Field of Search** ..... 32/59, 170 T; 51/358, 380, 51/782, 376; 64/11 R, 4, 3

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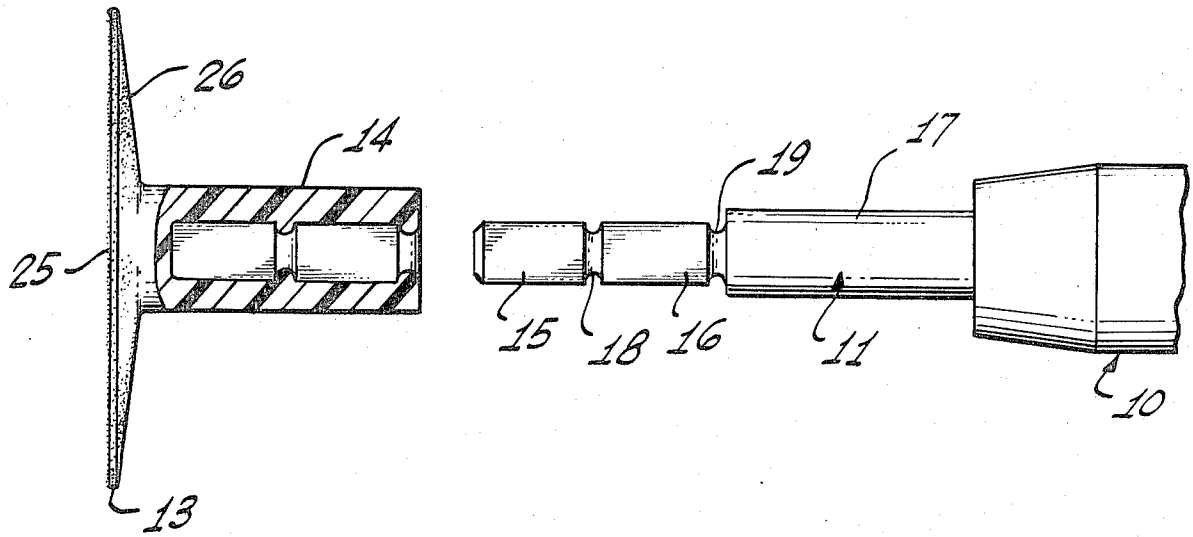
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[57] **ABSTRACT**

Either or both of the opposite surfaces of a disc are coated with an abrasive material that is held in place by an adhesive. The disc is thin in radial cross section and of a somewhat elastic material so as to be flexibly and transiently deformable, when axially loaded, into conformity with compound curvatures on surfaces to be ground by the abrasive. The rear or inner surface of the disc is centrally integrally formed with a coaxially rearwardly projecting coupling sleeve of relatively small outer diameter, e.g., preferably no more than one-fourth to one-fifth of the disc diameter. The sleeve is matingly engageable by one end of a male driving arbor, the two parts being press-fitted together and held against axial displacement in either direction by a detent means comprising complementarily shaped portions of the two pieces. The sleeve interior and the arbor are of non-circular cross sectional configuration to be keyed together for co-rotation.

8 Claims, 4 Drawing Figures



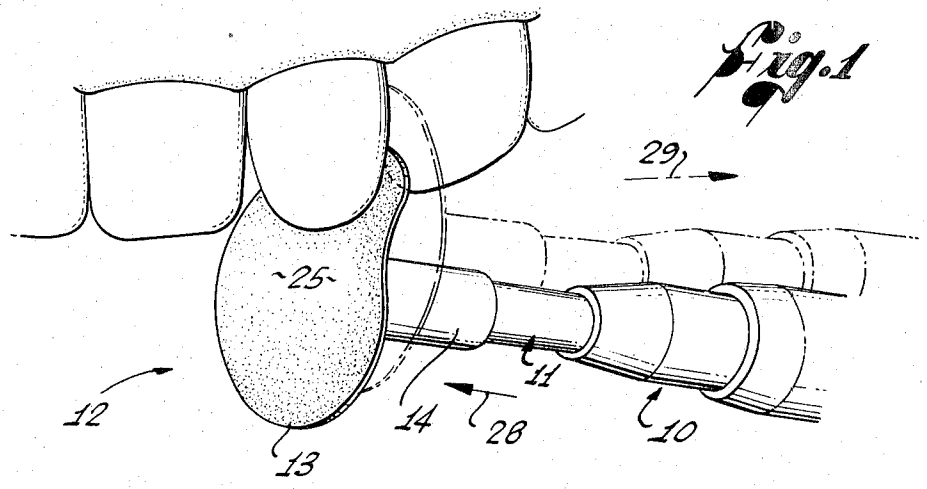


Fig. 1

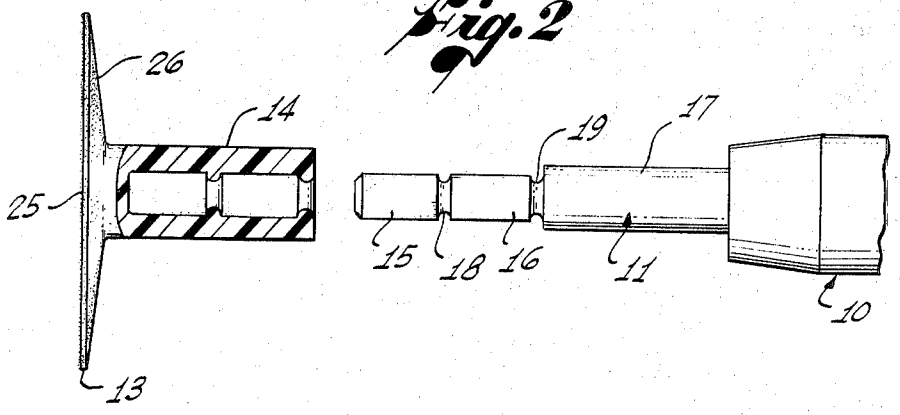


Fig. 2

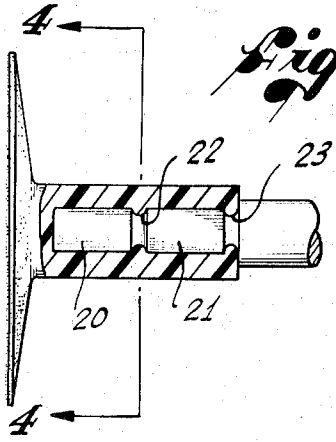


Fig. 3

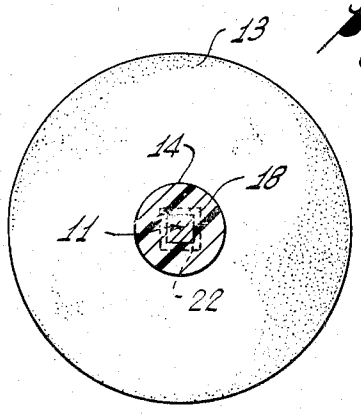


Fig. 4

DISPOSABLE QUICK COUPLING ROTARY GRINDING DISC FOR COMPOUNDLY CURVED SURFACES

BACKGROUND OF THE INVENTION

The present invention relates to flexible rotary grinding discs for cutting and shaping surfaces of compound curvature. As such it is susceptible of a wide range of applications. However, its primary utility appears to be as a dental grinding disc and, accordingly, it will be specifically described with reference to that field, by way of illustration but not limitation.

In the practice of dentistry, it is frequently necessary to shape the margins of cavities and to grind down and shape the filling material. These operations involve the definition of compoundly curved surfaces to conform to the contour of the natural tooth. Several prior art devices are available for the purpose. Generally they comprise grit coated thin discs of paper or plastic, or thin rigid discs of abrasive, having a central aperture to receive a screw, shaft, pin, or the like, by means of which the disc can be secured to a drive shaft or arbor. With these devices the head of the screw, or the like, protrudes from the forward face of the disc and is of substantial diameter to clamp the inner marginal area of the disc against an opposed surface of like substantial diameter comprising that part of the arbor bearing against the rear face of the disc. The head of the fastening means on the outer or forward face of the disc and the large diameter of the disc clamping means reduce the radial working area of the disc. Ideally, this area should be of sufficient radial extent to safely permit the dentist to work down to the gum line between the teeth. However, this is not possible with the prior art devices without increasing the disc diameter to an unacceptable size involving the danger of cutting the patient's cheek. Accordingly, the prior art devices are limited to a relatively small radial area of grinding effectiveness, the inner margin of which involves the danger of hitting the patient with the spinning protruding head of the disc fastener means, e.g., a screw head, or the relatively large diameter of the arbor on the rear face of the disc.

The dental grinding discs of this class usually are single-use disposable items. Accordingly, not only must they be inexpensive in terms of material but, in order to economize in terms of the dentist's time, they must also be capable of being very quickly secured to and removed from the driving arbor. The commonly used prior art devices are deficient in this respect in that the grinding discs are separate from the means for coupling them to the arbor. Thus, a popular paper disc is formed with a central aperture to receive a shaft whose head clamps the paper disc against an opposing end surface of the arbor. This head is formed with rearwardly projecting barbs adapted to pierce inner marginal portions of the paper disc to be received in diametrically opposite slots formed in the end of the arbor. In the case of a popular sheet plastic disc the central aperture is of non-circular configuration, having its margin reinforced by a correspondingly shaped metal grommet that receives a shank of corresponding cross sectional configuration with an enlarged head protruding from the forward face of the disc. In both cases, a separate disc is first separately applied to the corresponding fastener means and the fastener means is then inserted into the corresponding coupling means of the driving arbor. These are exemplary of still other constructions in the prior art which also entail a plurality of steps in the changing of discs, rather than being capable of being applied and removed merely by a snap action between two parts.

SUMMARY OF THE INVENTION

The present invention comprises a thin, flexible imperforate grinding disc that is integrally formed with a connector sleeve centrally located on one side thereof. The invention also includes an arbor whose driving end is of non-circular cross-sectional configuration, preferably square, and also is formed with a plurality of detent grooves. The blind hole in the sleeve part of the unitary member is of a non-circular cross sectional configuration adapted to matingly receive the driving end of the arbor.

This unitary member preferably is made of a rubber or elastomer and either a fibrous or a synthetic plastic stiffening material. The disc portion is made very thin in radial section, e.g., on the order of five thousandths of an inch thick at its periphery. The connector sleeve portion has a cylindrical outer surface of a diameter on the order of one-fourth or one-fifth that of the disc portion. The area of any given cross section of the blind hole in the connector sleeve is slightly less than the area of the corresponding cross section of the driving end of the small arbor, whereby the two pieces are connected with a press fit, the material of the sleeve being radially compressed when fitted to the arbor. Either or both of the forward and rear faces of the disc portion optionally may be coated with an abrasive of a desired grit size which is held in place by means of an appropriate adhesive.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective view, on a greatly enlarged scale, illustrating a presently preferred embodiment of the invention in use in grinding a compound curvature on a tooth and, also, in phantom outline, showing an alternate position of the invention in grinding on an adjacent tooth with force being applied axially of the disc in a direction opposite to the direction of the application of force in the solid outline position.

FIG. **2** illustrates the parts of the invention in disassembled relationship, with a portion of the sleeve of the unitary member being shown in axial cross section to illustrate interior details of construction.

FIG. **3** is a side elevational view showing the two parts of the invention in assembled, operative relationship, with a portion of the sleeve being shown in axial section.

FIG. **4** is a sectional view taken along the line **4—4** of FIG. **3.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings there is shown a conventional handpiece, having an angled end **10,** adapted to drivably mount an arbor, designated generally by the numeral **11.** While not illustrated, it will be understood that the arbor **11,** at its innermost end, is detachably coupled to the drive means of the stem of the handpiece **10** to be rotated at a desired speed, which for dental grinding operations may be as high as on the order of 10,000 rpm. While not illustrated, it will also be understood

that the arbor **11** can be inserted into or removed from the handpiece **10** at will.

A unitary member, designated generally by the numeral **12**, is integrally formed with a disc portion **13** and a connector sleeve portion **14**, the latter being formed with a blind opening to receive a driving end portion of the arbor **11**. As is shown by FIGS. **2** and **3**, these two parts are of matingly complementary configuration. Thus, the outer end of the arbor is formed into a pair of axially and angularly aligned sections **15** and **16** of square cross section and of less cross sectional area than the circular cross section of a shank portion **17** of the arbor. The square sections **15** and **16** are departed by a detent groove **18** and a similar detent groove **19** is formed intermediate the square section **16** and the circular shank **17**. As is indicated in FIG. **4**, the detent grooves **18** and **19** are also of square cross section.

In order to matingly receive the driving end of the arbor **11**, the connector sleeve **14** has its blind hole formed into sections **20** and **21**, adapted to receive the square sections **15** and **16** of the arbor, and radially inwardly protruding integrally formed ribs **22** and **23**, adapted to seat in the grooves **18** and **19**, respectively, of the arbor. All of the elements **20** through **23** of the blind hole are of square cross section but smaller in area than the corresponding cross sections of the driving end of the arbor **11**, whereby the two parts must be press-fitted together.

The disc **13** comprises a very thin, imperforate flange formed integrally with the forward end of the sleeve **14**. A front face **25** of the disc is disposed at 90° to the axis of the sleeve **14** and, preferably, defines an included angle of between 7° to 10° with an annular rear face **26** of the disc. Thus, the annular area rear face **26** preferably defines an included angle of 90° to 100° relative to the cylindrical external surface of the sleeve **14**, and, for all practical purposes, has its outer diameter coincident with the outer diameter of the circular area front face **25** of the disc.

The unitary element **12** may be made by injection molding. Preferably, the material employed is a mixture or compound of a rubber or an elastomer with a stiffener. Shell Chemical Co. Krayton 3204, a rubber, may be stiffened with a small amount of a fine fibrous material, such as Celluflock, a cotton flock, e.g., in a ratio of 100 parts to 17 parts, by weight, with the addition of a compatible oil or solvent, say 1.7 parts, by weight, in the compound. Alternatively, a member made of Shell Chemical Co. Krayton 2104, a rubber, may be stiffened by the addition of up to an equal amount by weight of Shell polystyrene DP 3020. Such mixtures yield an injection molded product of optimum characteristics of softness and flexibility. The resulting disc **13** is readily transiently deformable, in its radial flange area, while undergoing rotation up to 10,000 rpm., into substantial conformity with a compoundly curved surface, eg., as indicated in the solid and phantom outline views of the disc in FIG. **1**. Accordingly, when the disc **13** has been coated with a suitable abrasive on either or both or the rear faces **25** and **26** thereof, undersired excess material can be ground away readily and the compoundly curved surface shaped as desired.

As there are no protrusions on the front face **25** of the disc **13** and since the diameter of the coupling sleeve **14** is relatively small as compared to the diameter of the disc **13**, it will now be apparent that for any given diameter of grinding disc our invention provides a grinding area of greater radial extent than do the prior art discs. As a result, as indicated in FIG. **1** by the phantom outline position, the dentist is enabled to grind down to the gum line, between teeth, without as much danger of cutting a patient's cheek as would be involved in utilizing a larger diameter disc of the prior art which would afford the same radial working area as our improved disc. Further, the entire radius of the front face **25** of the disc is available to grind exposed outer surfaces.

As indicated in FIG. **1**, when the front face **25** of the disc is employed for grinding, a forward axial load is imposed thereon, as indicated by the directional arrow **28**. For such an operation a disc element **12** would be employed with a safe rear side **26**, i.e., a side which does not have an abrasive coating. In other operations between the teeth an element **12** would be employed having the forward face **25** as the safe side, with only the rear face **26** having an abrasive coating. Such an operation is indicated in phantom outline in FIG. **1** and in such operations a rearwardly directed axial load, as indicated by the directional arrow **29**, would be imposed on the element **12** to force the rear face **26** into bearing contact with the tooth being ground. These loads are heavy for the small sizes of the parts **11** and **12**. Accordingly, a reliable detent means must be devised to keep the element **12** on the arbor **11** during such operations but, at the same time, such detent means must not be such as to unduly inhibit removal and replacement of different elements **12**. In this connection, it has been found that the press fit connection between the arbor **11** and element **12**, in conjunction with the detent means indicated at **18**, **19**, **22** and **23**, is very effective.

For the same reasons, it has been found that not all means of keying the mandrel and element **12** together for co-rotation are satisfactory. While several non-circular cross sectional configurations may be employed it has been found that the square cross-sectional configuration illustrated is the most satisfactory.

While a presently preferred embodiment of the invention has been described and illustrated, it will be understood that it is intended to be purely illustrative and not limitative of the invention.

What is claimed is:

1. A unitary, disposable, grinding disc and quick coupling sleeve comprising:

a disc having a forward face and a rear face and having a coupling sleeve formed as a coaxially rearwardly extending projection on said rear face;

said disc having an imperforate forward face of circular area disposed at substantially 90° to the axis of said sleeve;

said sleeve being of cylindrical external surface configuration and including an angle of 90° to 100°, approximately, relative to said rear face;

said rear face comprising an annular area whose outer diameter is at least double that of said sleeve and substantially coincident with the outer diameter of said forward face;

said disc and sleeve being made of a flexible material such that said disc, outwardly of said sleeve, is deformable to transiently conform to compoundly curved surfaces on which said disc is rotating;

said sleeve being internally formed with an axially extending blind hole that opens into the rear end of said sleeve for drivably receiving one end of a driving arbor.

2. A unitary disc and coupling as in claim **1** in which at least one of said circular forward and annular rear faces is coated with an abrasive material.

3. A unitary disc and coupling as in claim **1** in which the angle included between said forward and rear faces is on the order of 7° to 10°.

4. A unitary disc and coupling as in claim **1** in which said blind hole of said sleeve is of non-circular cross-sectional configuration.

5. A unitary disc and coupling as in claim **1** that is made of a rubber-like material.

6. A unitary disc as coupling as in claim **5** that includes up to 50 percent approximately, by weight, of polystyrene.

7. A unitary disc and coupling as in claim **5** that includes a fibrous stiffener material.

8. A unitary disc and coupling as in claim **7**, that includes a rubber-like material and a flock material in the approximate ratio of 100 parts to 17 parts by weight, respectively.

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