

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 82302175.3

(51) Int. Cl.³: **B 60 S 5/00**
B 24 B 23/08

(22) Date of filing: 28.04.82

(30) Priority: 23.10.81 GB 8131816

(43) Date of publication of application:
04.05.83 Bulletin 83/18

(84) Designated Contracting States:
BE CH DE FR IT LI NL SE

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(54) Brake disc machining apparatus.

(57) Apparatus for machining brake discs while they remain fitted on the vehicle is provided in which support structure (1) adapted to be located in relation to a brake disc (D) adjustably carries driving means (2) for driving rotary tooling such as a grinding wheel or a pair of opposed grinding wheels (22) in contact with the operative face or faces (F) of the brake disc (D) as the latter is rotated. The support structure (1) is shown including bracket mounting (10) for bolting (100) to the brake caliper bracket (CB), i.e. after removal of the road wheel and brake caliper. For feed and retraction of the grinding wheel or wheels (22) relative to the disc (D) the driving means (2) is axially adjustable on guide rails (12) by screw adjustment mechanism (4).

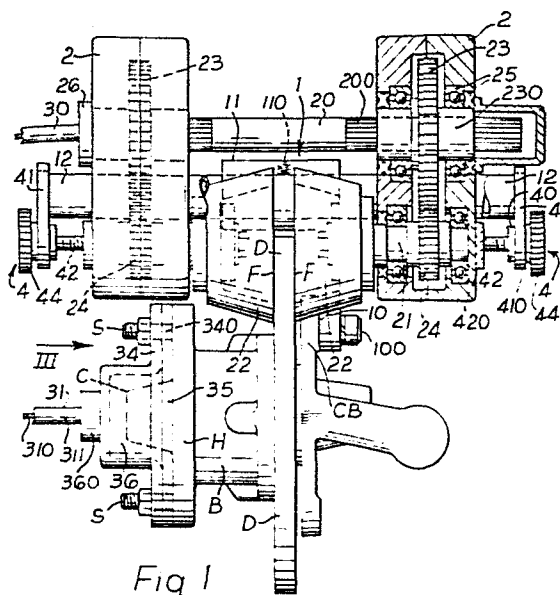


Fig 1

The object of this invention is to provide simple, compact and robust apparatus for grinding or similarly machining or "facing" the operative or swept areas of motor vehicle brake discs whereby the discs can be ground or machined while they remain fitted on the vehicle. Thus the need to remove the discs from the vehicle for grinding is obviated with consequent saving of time and expense. Practical advantages of the invention in this and other respects will be apparent from the following disclosure.

According to the invention apparatus for machining a brake disc when the latter is in position of use fitted on a vehicle, comprises support structure adapted to be located in relation to the brake disc, said support structure carrying adjustably mounted thereon driving means for effecting a drive to rotary tooling whereby the tooling can be brought and driven in face contact with the rotatable brake disc.

Practical examples of the apparatus are shown in the accompanying drawings in which:-

FIGURE 1

is a plan view of one form of the apparatus shown in position of use,

FIGURE 2

is a detail view of a screw adjustment knob assembly,

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- FIGURE 3 is a side elevation taken in the direction of the arrow III of FIGURE 1.
- FIGURE 4 is a plan view of a simplified form of the apparatus.
- FIGURE 5 is a side elevation taken in the direction of the arrow V of FIGURE 4.
- FIGURES 6 to 8 are plan views and a side view of a further simplified arrangement, and
- FIGURE 9 is a detail view of a wheel dressing attachment.

Like parts are designated by the same or similar reference numerals throughout the drawings and any values quoted are given by way of practical example only and may be varied according to requirements. Modifications are subsequently described.

The apparatus is primarily intended for machining or grinding the brake discs of the front steerable wheels of a motor vehicle, but, in some cases, is applicable to the grinding of rear wheel brake discs where fitted. Prior to use in grinding a brake disc D the road wheel and the associated brake caliper are removed to provide access to the mounting or bracket CB for the latter, the vehicle being jacked or otherwise supported

adjacent the road wheel axle. Any fixed shield plate (not shown) adjacent the disc D can be usually left in position.

Referring to FIGURES 1 to 3 the support structure 1 of the apparatus is shown consisting of brackets or arms 10 which, in use, are rigidly bolted at 100 to the brake caliper bracket CB, the brackets 10 being curved or otherwise formed for necessary clearance and fixedly carry through sleeves 11 at their outer ends transverse parallel guide rails 12, e.g. of round section tubular form. The guide rails 12 are thus parallel to the axis of the disc D and slidably carry a pair of gearboxes 2 which in turn each carry a grinding wheel 22 shown of cupped form, the arrangement being such that the two grinding wheels 22 are opposed to one another for grinding contact with corresponding faces F of the disc D extending between the grinding wheels 22. Instead of the brackets 10 a single bracket or plate may be employed of forked or apertured form to provide clearance for the adjacent grinding wheel 22.

The gear drive of each gear box 2 is arranged to effect a drive from a drive shaft 20 to a shaft 21 carrying the corresponding grinding wheel 22, each gear drive consisting of a pair of gear wheels 23, 24 one of which is rotationally

fast with the drive shaft 20 and the other fast with the shaft 21 carrying the grinding wheel 22, appropriate bearing support and seals being provided at 25. The gear drive 23, 24 is also shown providing a step up ratio of 2 : 1 so that where the drive shaft 20 is driven at 3,000 r.p.m. the grinding wheels 22 are driven at 6,000 r.p.m.

In order to permit relative movement of the gearboxes 2 on the guide rails 11 for the purpose of bringing the grinding wheels 22 into contact with the respective faces F of the brake disc D, the drive shaft 20 has a sliding and driving engagement with the hub 230 of the gear 23 of one of the gearboxes 2, such as by a splined engagement at 200 and is preferably axially fast with the corresponding gear 23 of the other gearbox where the shaft 20 is provided with a socket 26 for connection of a flexible shaft drive 30 thereto from a motor such as an electric motor 3 (see FIGURE 3).

In order to provide fine axial adjustment of the grinding wheels 22 against the faces F of the disc D, screw adjustment means 4 is provided to each grinding wheel 22 and is shown consisting of a screw threaded shaft 42 **fixedly** and non-rotatably carried at 420 by the associated gearbox 2 and extending from the latter parallel with the guide rails 12 for engagement by a rotary nut 40 carried in a captive manner by the stem 410 of a T-shaped bracket 41 carried by adjacent

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ends of the guiderails 12. The nut 40 can be turned by a knob 44 for advancing or retracting the threaded shaft 42 and hence the associated gearbox 2 and grinding wheel 22 towards and away from the brake disc D.

The knob 44 includes a torque limiting device (see FIGURE 2) shown in the form of spring loaded balls 43 engaging recesses 400 in the outer periphery of the nut 40 so that feed of the associated grinding wheel 22 too firmly against the corresponding face F of the disc D is avoided or minimised.

In addition to driving the drive shaft 20 the motor 3 may be also employed to effect a further flexible shaft drive 31 preferably via a reduction gear unit 33 carried by the motor 3 to the road wheel carrying hub flange H of the bearing housing/^Band hence to the disc D. For this purpose the inner shaft member 310 of the flexible shaft drive 31 is rotationally fast with a plate 34 or similar^{connection} member such as a spider having holes 340 which engage the wheel mounting studs S on the hub flange H, a pad of rubber or other resilient material being interposed at 35. The plate 34 is shown formed with a housing 36 which accommodates the usual cap C over the outer end of the axle. Thus the inner member 310 of the flexible shaft drive 31 is in driving engagement with the housing 36 and the outer member 311 is received by a socket 360 on the housing 36 for relative rotation of the latter.

The disc D is thus rotated relatively slowly for obtaining grinding of the entire swept area of each face F of the disc.

Flexible shaft drive from a separate motor may be employed for rotating the disc D, or any other suitable driving means may be used including a handle for rotation of the disc by hand, or a friction drive e.g. to the periphery or a face F of the disc D.

In using the apparatus after mounting it and setting it up in the manner described, the motor³ is switched on and the rotating grinding wheels 22 are finely adjusted axially against the faces F of the Disc D by operation of the screw adjustment knobs 44 for required metal removal or facing of the disc faces F.

In FIGURES 1 and 3 the apparatus is shown mounted in a trailing manner in relation to an off side or right hand front wheel disc D and is mounted in a similar but inverted manner in relation to a nearside or left hand disc, similar procedure being followed in the case of rear wheel discs. The offset mounting of the guide rails 12 from the bracket arms 10 by the sleeves 11 enables the grinding wheels 22 to be located in relation to the disc D in either position of use. However, the guide rails 12 may be axially adjustable in their respective sleeves 11 and locked therein e.g. by a grub screw at 110.

According to the particular arrangement of brake caliper mounting bracket or brackets (e.g. for twin callipers) provided in relation to a brake disc D, the apparatus can be mounted

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in a forward or trailing position of use as appropriate.

Referring to FIGURES 4 and 5 a simplified arrangement of the apparatus is shown primarily intended for "do-it-yourself" use. Thus the bracket 101 which is mounted from the

caliper bracket CB at bolt locations 100 rigidly and fixedly carries a single transverse guide rail 12 on which a gearbox 2 is slidably and also pivotally mounted for which purpose the round section tubular guide rail 12 passes through bearing bushes (not visible) in a bore at the adjacent end of the gearbox housing 2. The gearbox 2 has rotatably mounted

through it a shaft 21 carrying at one end a cupped grinding wheel 22, the other end of the shaft 21 being slotted or otherwise adapted to be engaged at 210 by the spindle adaptor 51 of a portable electric drill 5, i.e. in place of its chuck. A socket-like formation 27 of the gearbox housing co-axial about the shaft 21 provides location for the forward end of the drill body 50.

With the apparatus mounted in position and on application of the electric drill 5 in the manner shown in FIGURE 4, the latter can be used to impart movement of the gearbox 2 along the guide rail 12 and thus effect axial feed of the grinding wheel 22 against the adjacent face F of the brake disc D. Operation of the drill 5 to drive the shaft 21

then enables the grinding wheel 22 to be driven in contact with the adjacent face of the disc D, the drill body 50 being held and appropriate axial pressure applied to it for maintaining the grinding wheel 22 at required contact pressure

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with the adjacent disc face F for sufficient metal removal or facing, which pressure and extent of feed can be judged by the user to a sufficient degree of accuracy. If desired the shaft 21 may be axially movable in the gearbox 2 for this purpose

In order to rotate the disc D at a somewhat slower speed so that the whole swept area of the disc face F is ground, the gearbox 2 contains a gear drive 28 to a friction roller 29 which bears against the periphery of the disc D and is maintained in such contact by appropriate angular movement of the gearbox 2 imparted to it by side movement of the drill body 50 and/or by hand pressure on the outer side of the gearbox 2. The axial extent of the friction roller 29 enables such contact to be maintained for necessary axial feed movement of the grinding wheel 22. If desired the gearbox 2 may be provided with a handle at its lower end for use in maintaining the roller 29 in contact with the periphery of the disc D.

After one face^F of the disc has been ground or faced in this way, the apparatus is removed, and turned over and then re-mounted for grinding the other face of the disc D in the same way. The same procedure can be followed for grinding both front wheel discs and any rear wheel discs of the vehicle in either a forward or trailing position according to the available caliper mounting.

The bracket 101 is shown provided with arcuate slots 102 for bolt mounting at 100 to the caliper bracket CB in order to cater for different spacing apart of caliper bolt mounting centres which is found in practice, e.g. between $3\frac{1}{4}"$ (85mm) to 5" (130mm). The arcuate slots 102 are about an axis corresponding to that of the disc D and also enable the bracket 101 to be angularly adjusted to some extent relative to its bolt attachment 100 to the caliper bracket CB where such bolt mounting can lie intermediate the ends of the slots 102 as shown.

In another simplified arrangement of the apparatus shown in FIGURES 6 to 8 a bracket or plate 10 (see FIGURE 7) is mountable at 100 from the brake caliper bracket CB and carries a pair of sleeves 11 each receiving a round section guide rail 12 of the support structure 1.

A drive transmission unit 2 is slidable on the guide rails 12 and contains a belt drive 223 from a motor 3 carried by the unit 2 to a shaft 21 rotatably mounted in the unit 2 and carrying a cupped grinding wheel 22.

Axial screw adjustment of the grinding wheel 22 towards and away from an adjacent face F of the brake disc D is provided at 4 and consists of ^B/bracket or bar 45 carried by the outer ends of the guide rails 12, which bracket 45 centrally and rotatably carries a hand wheel 46 mounted on a threaded shaft 47 parallel with and between the guide rails 12 and engaging a nut 48 fixedly mounted in or on the unit 2. The hand wheel 46 is constrained against axial movement relative to the bracket 45

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so that on rotation of the hand wheel 46 the unit 2 and grinding wheel 22 can be moved along the guide rails 12 for feed of the wheel 22 towards the adjacent disc face F or retraction therefrom.

After grinding one face F such as in the position of the apparatus shown in FIGURE 6 and in order to grind the other face, the guide rails 12 are withdrawn from the sleeves 11 and then inserted in the latter at the opposite side of the bracket 10 as shown in FIGURE 8. This positions the grinding wheel 22 adjacent the other face F' of the disc with corresponding positioning of the unit 2, motor 3 and hand wheel 46 all of which are moved bodily with the guide rails 12 passing through the unit 2 during such changeover.

In order that the changeover can be readily carried out the sleeves 11 carried by the bracket¹⁰ are longitudinally split and each provided with a pinch bolt 13 so that the guide rails 12 can be released for removal or firmly clamped in the sleeves 11 during use of the apparatus.

During grinding the disc D is rotated and this is shown simply achieved by a tubular handle 9 which is internally threaded at one or both ends at 90 for screwing onto a road wheel mounting stud S (see FIGURE 6).

By the use of a grinding wheel or wheels 22 of appropriate diameter the operative area of each face F of the disc D can be fully ground but, if necessary, the apparatus can include means for radial traverse or plunging of the grinding wheel or wheels 22 in relation to the disc D.

Provision may be also included for dressing the grinding wheel or wheels 22 and in FIGURE 9 a dressing attachment 8 is shown consisting of a forked mounting member 80 adapted to be secured by a clamping grub screw 81 on a brake disc D over the peripheral edge of the latter and carrying a transverse dressing tool holder 82 having dressing tools or tips 88 of diamond or other super hard material at each end for dressing contact across the operative faces of opposed driven grinding wheels 22 by appropriate angular movement of the disc D. For such dressing the grinding wheels 22 are set a suitable distance apart by operation of the screw adjustment means 4.

Where a single grinding wheel 22 is employed as in FIGURES 4 and 5 and 6 to 8, one tip 88 of the same dressing tool can be employed or a single tipped tool may be used.

As well as the manner in which the apparatus can be readily located in position of use and adjusted and operated, it is of compact form having regard to the limited room for access to a brake disc D mounted on a vehicle axle. Furthermore the grinding operation can be quickly carried out, the apparatus removed and the brake caliper and road wheel remounted thus reducing the time during which the vehicle is out of use

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due to partly dismantled brake mechanism, i.e. compared with the previous procedure of removing the brake discs for grinding or exchange replacement.

The apparatus generally described and defined herein may incorporate various modifications. Thus the support structure 1 may be otherwise adapted for location in relation to a disc D such as from the outer end of the road wheel axle and/or from the disc D itself. The apparatus may be also arranged for alternative or additional support to that from the brake caliper bracket CB and may, for example, be provided with one or more legs or the like for support from the floor.

The apparatus may also adjustably carry a motor or motors, e.g. for direct drive of the grinding wheel or wheels 22 whilst other suitable rotary tooling may be employed for machining the faces F of the disc D. Where gear drives are employed such as at 23, 24 or 28, other suitable driving means such as a toothed belt drive may be used.

CLAIMS

1. Apparatus for machining a brake disc (D) when the latter is in position of use fitted on a vehicle comprising support structure (1) adapted to be located in relation to the brake disc (D), said support structure (1) carrying adjustably mounted thereon driving means (2, 21) for effecting a drive to rotary tooling (22) whereby the tooling (22) can be brought and driven in fact contact with the rotatable brake disc (D).
2. Brake disc machining apparatus according to claim 1 wherein the support structure (1) is adapted to be located in relation to the brake disc (D), such as by bolting (100), from the associated brake caliper mounting (CB) after removal of the brake caliper.
3. Brake disc machining apparatus according to claim 1 or 2 wherein the driving means (2, 21) adjustably carried by the support structure (1) is adapted to carry rotary tooling in the form of at least one rotary machining tool such as a grinding wheel (22) whereby the tool can be brought and driven in fact contact with the brake disc (D).

4. Brake disc machining apparatus according to claim 3 wherein the driving means (2,21) adjustably carried by the support structure (1) is adapted to carry rotary tooling in the form of a pair of opposed rotary machining tools such as grinding wheels (22) whereby the tools can be brought and driven in contact with corresponding faces (F) of the brake disc (D).
5. Brake disc machining apparatus according to any of the preceding claims wherein there is provided in association with the support structure (1) or carried or received thereby, motor driving means (3, 5) for effecting a drive to the rotary tooling (22).
6. Brake disc machining apparatus according to any of the preceding claims wherein there is provided further driving means (31, 29, 9) for rotating the brake disc (D) during machining of the latter by the rotary tooling (22).
7. Brake disc machining apparatus according to any of the preceding claims wherein the support structure (1) carries one or more guide members (12) which in use is or are arranged parallel with the axis of the brake disc (D) and adjustably support the driving means (2, 21) for the rotary tooling (22) to enable the latter to be brought into and out of machining contact with a face or each face (F) of the brake disc (D).

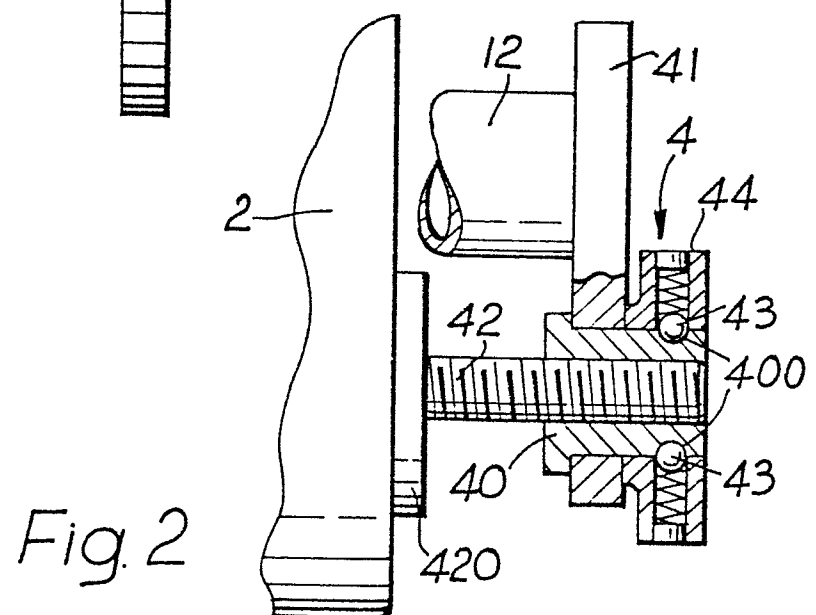
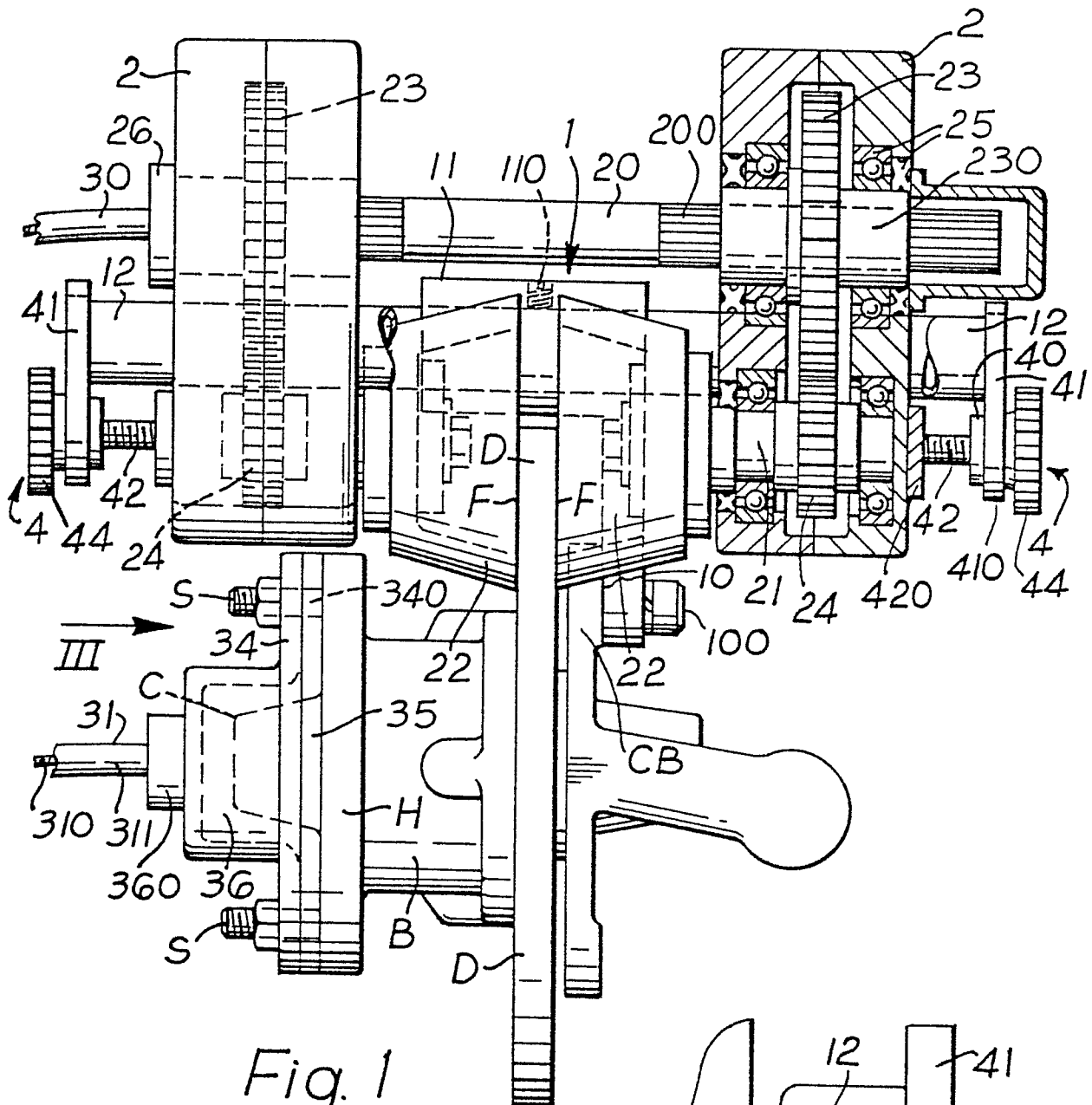
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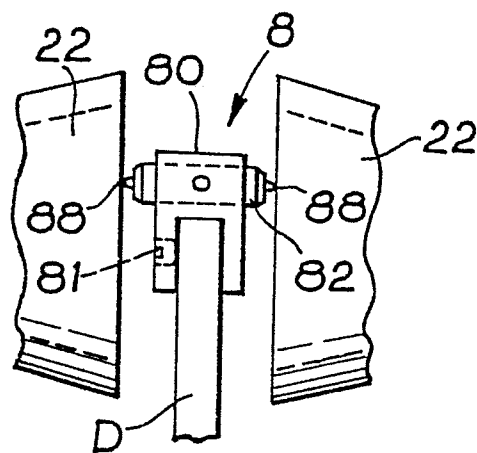
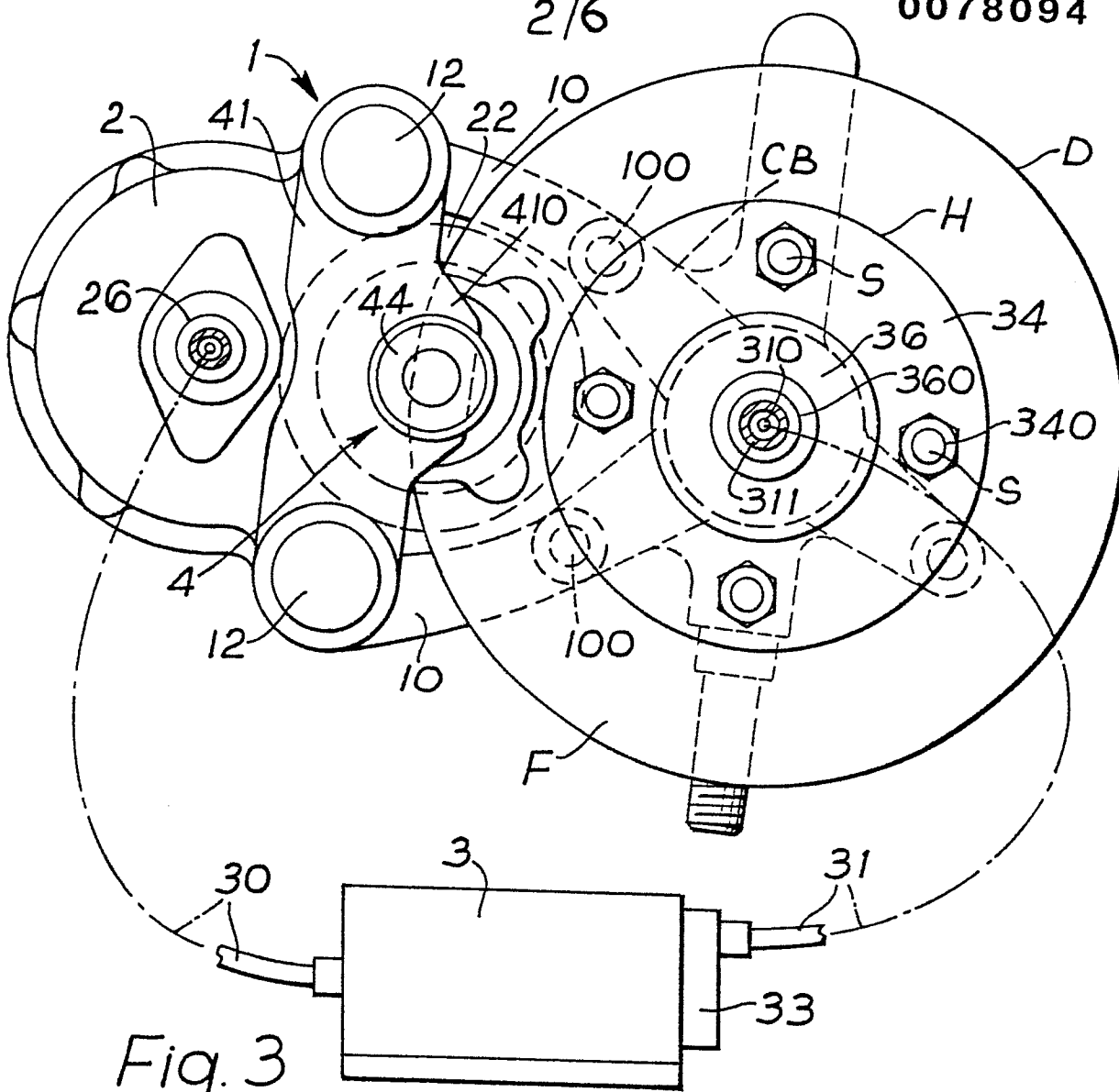
8. Brake disc machining apparatus according to any of the preceding claims wherein the support structure (1) carries adjustment means such as screw adjustment means (4) for adjusting the driving means (2, 21) for the rotary tooling (22) towards and away from a face or each face (F) of the brake disc (D).
9. Brake disc machining apparatus according to any of the preceding claims wherein the driving means (2,21) for the rotary tooling (22) consists of a drive transmission unit (2) carrying a rotatable drive shaft (21) to the tooling (22) which unit (2) is adapted to receive located therewith (at 27) a motor drive such as an electric drill motor (5) for driving engagement with the drive shaft (21).
10. Brake disc machining apparatus according to claim 9 wherein the drive transmission unit (2) carries a drive such as a gear drive (28) from the rotary tooling drive shaft (21) which drive (28) is arranged to drive a wheel or roller (29) for friction driving contact with the brake disc (D), e.g. with the periphery thereof for rotation of the disc during machining.

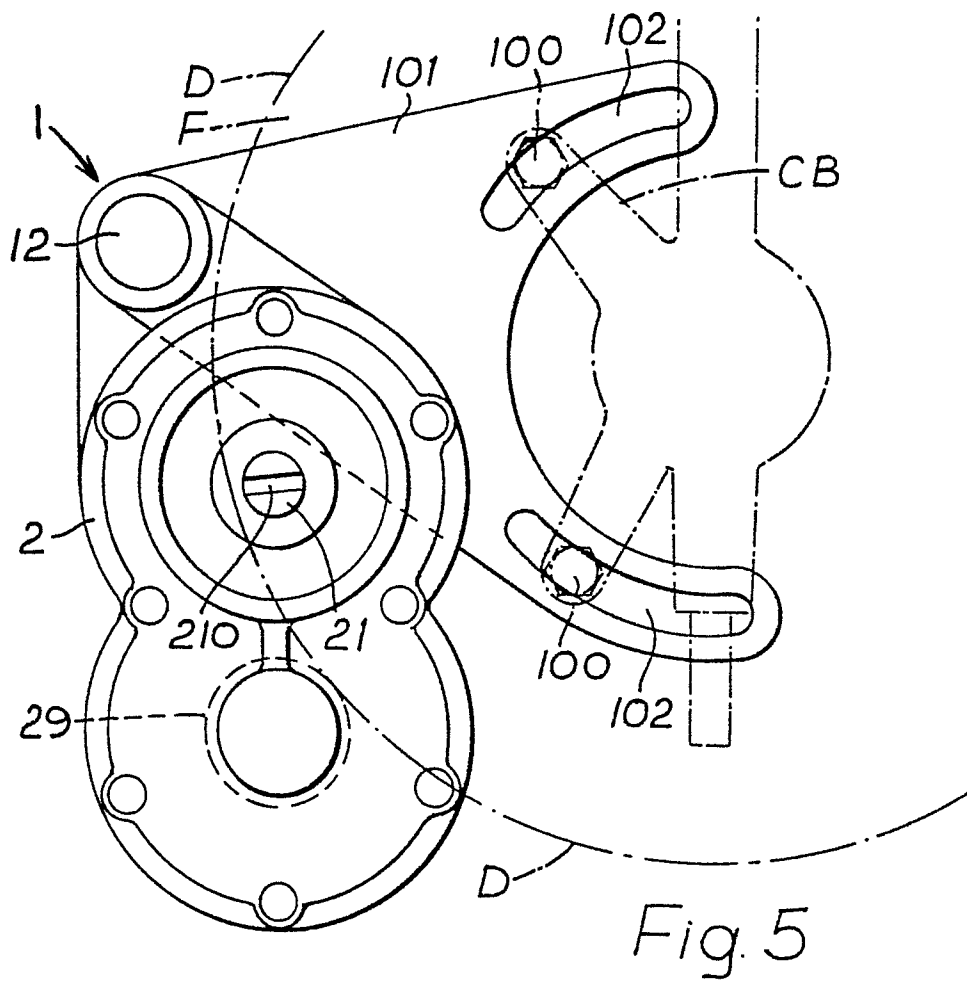
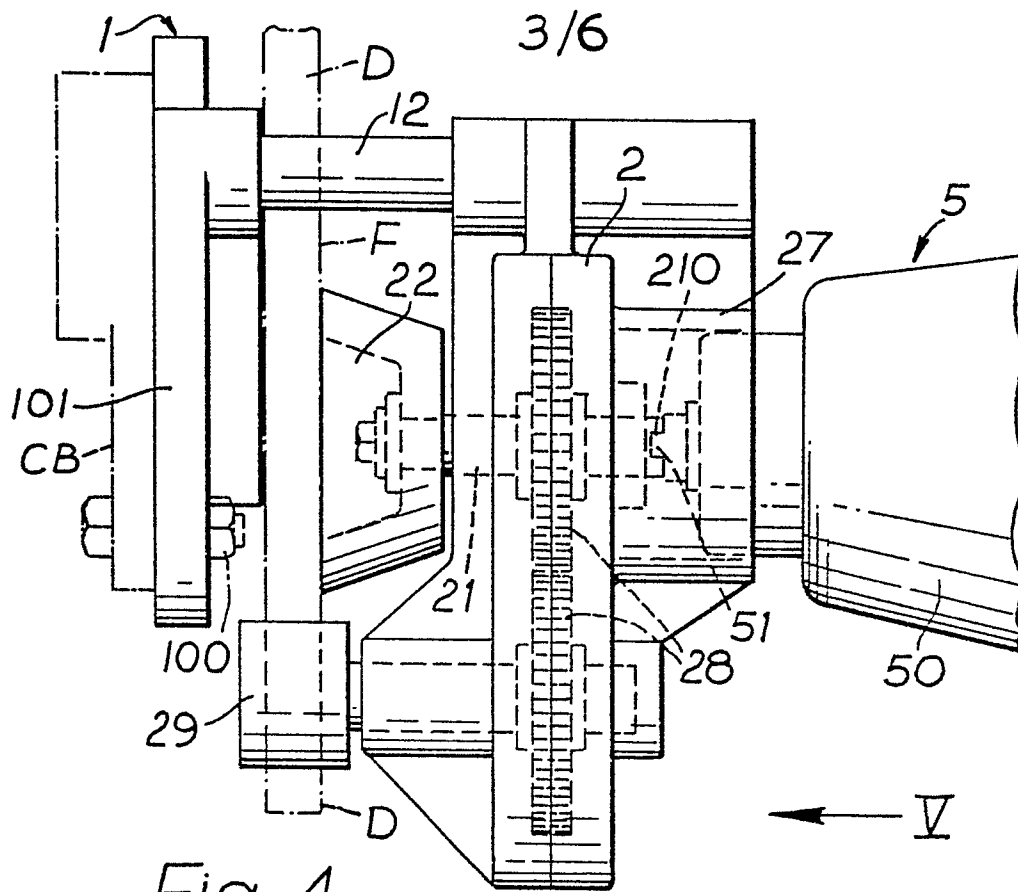
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11. Brake disc machining apparatus according to any of claims 1 to 3 or 5 to 10 wherein the support structure (1) and/or the driving means (2, 21) is arranged for alternate mounting in relation to the brake disc (D) for enabling a corresponding face (F) of the brake disc (D) to be machined by the rotary tooling (22).

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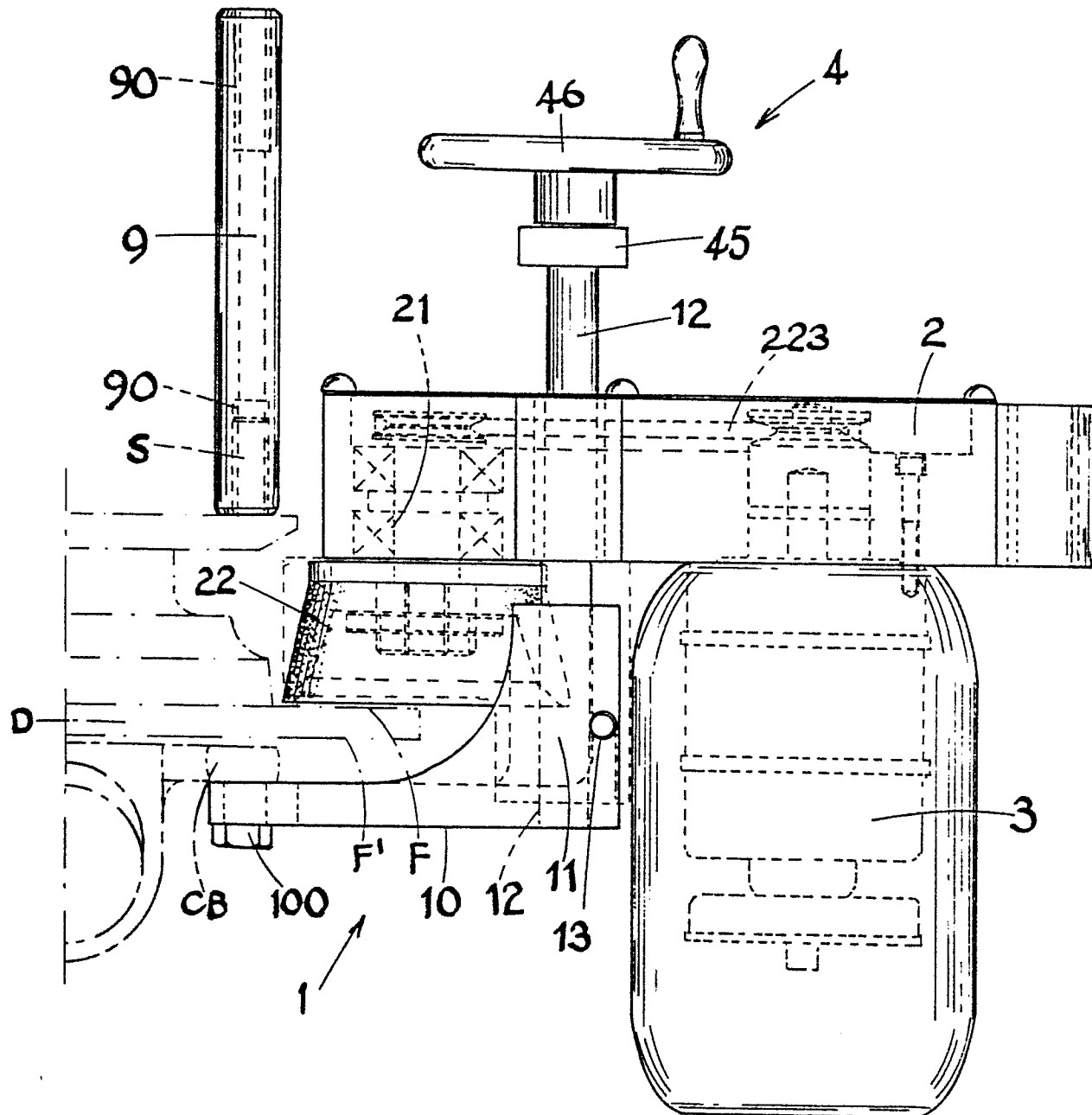


Fig. 6

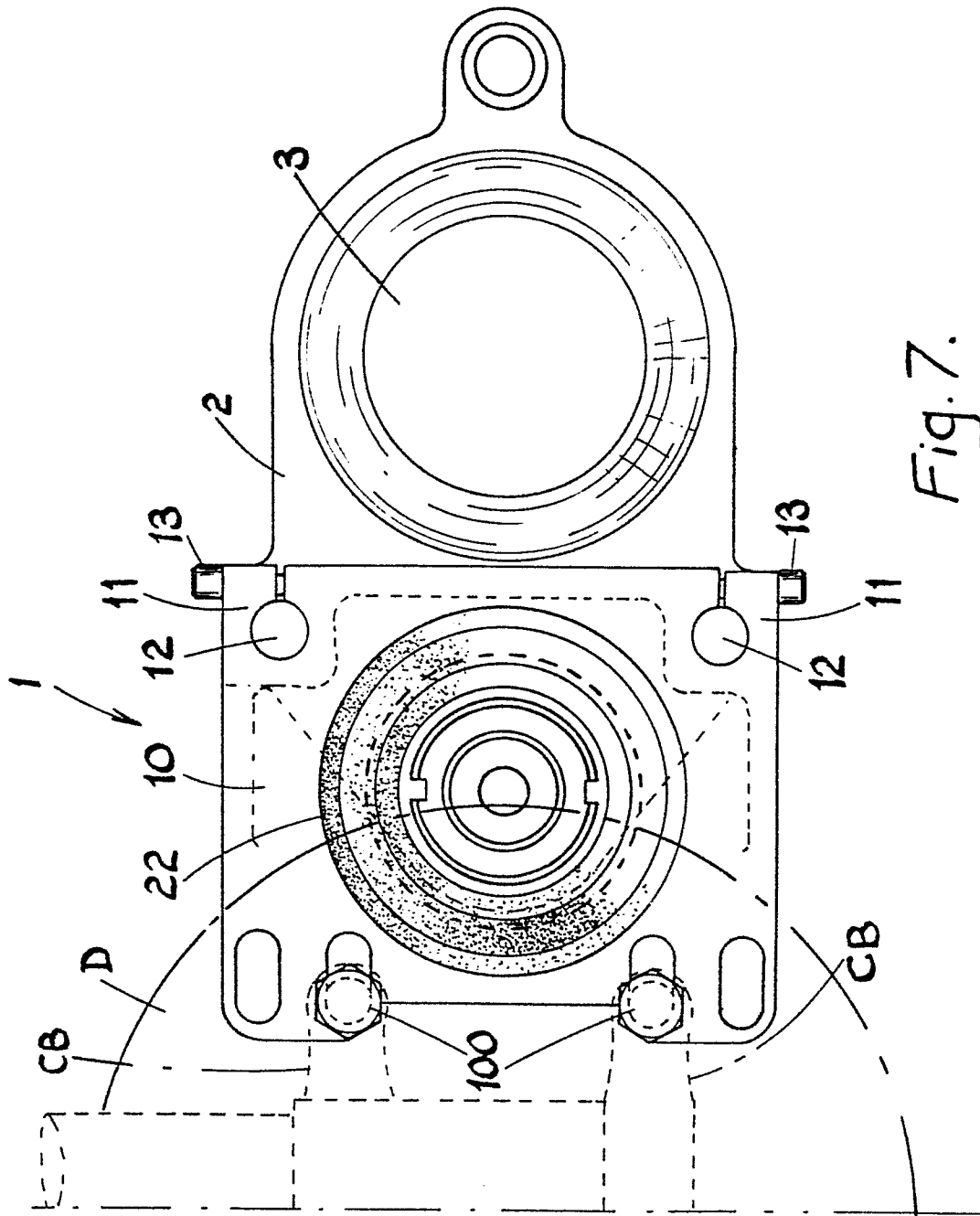
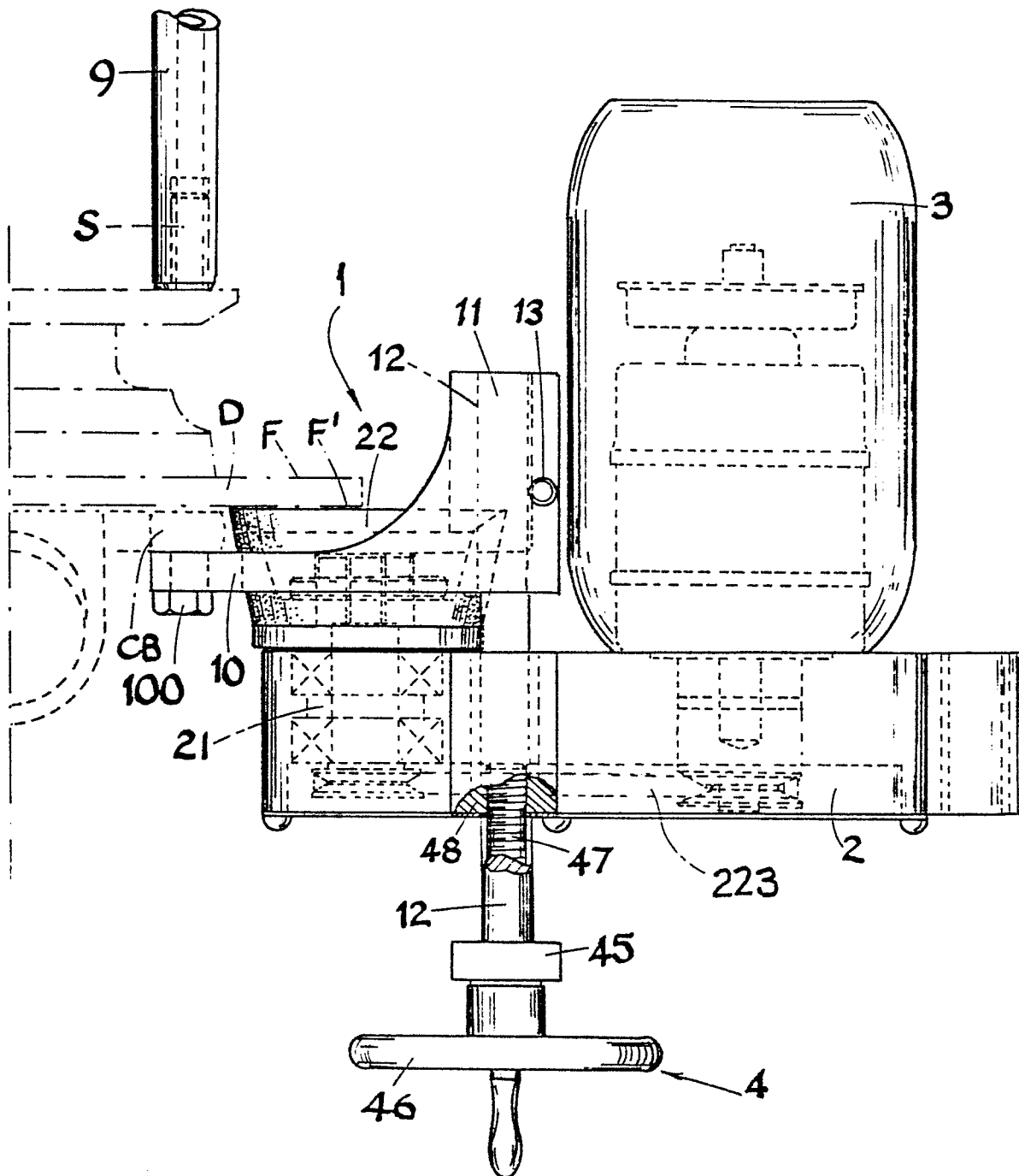


Fig. 7.

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*Fig. 8.*



European Patent
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EUROPEAN SEARCH REPORT

0078094

Application number

EP 82 30 2175.3

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	EP - A1 - 0 006 764 (H. GRAMLICH) * claims 9, 10 *	1-5,7, 8	B 60 S 5/00 B 24 B 23/08
X	DE - U - 1 905 891 (A. WANPOUILLE) * claim 1 *	1	
A	US - A - 4 262 452 (F.R. LOPEZ) * fig. 1 *	6	
A	DE - U - 1 906 407 (A. CIPOLLONI)		TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
A	DE - U1 - 7 813 879 (H. SCHWENKKRAUS)		B 24 B 7/00 B 24 B 23/00 B 60 S 5/00
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons
☒ The present search report has been drawn up for all claims			&. member of the same patent family, corresponding document
Place of search Berlin		Date of completion of the search 29-07-1982	Examiner BECKNER