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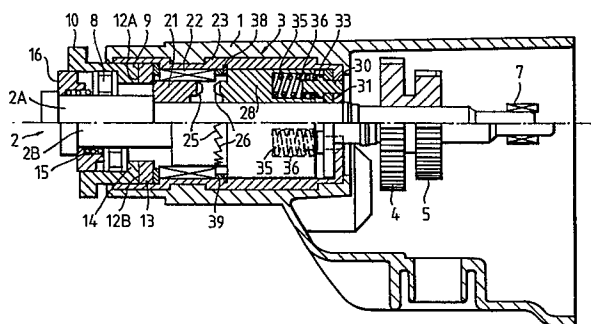
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⑤④ **Portable power-operated drill.**

⑤⑦ A rotary/percussive portable power-operated drill has the percussive action transmitted to the rotary shaft 2 by a ring 21 fixed to the shaft 2 and formed with axially facing teeth 25 biased into engagement with a similar ring of teeth 26 on an annular anvil member 28 which is mounted to yield in an axial direction by means of three axially extending springs 35 surrounding and guided by pins 30 fixed to the housing 1 and located in corresponding counter bores 36 in the anvil member 28.



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Portable power-operated drill

- This invention relates to rotary/ percussive portable, power-operated drills, that is to say drills which can be operated with percussive action in addition to the normal rotary action when required, e.g. for drilling masonry.
5. The percussive action is produced by co-operation between a ring of axially facing teeth formed on a member fixed to the main driving shaft and a similar ring of teeth on an annular member which
10. is held against rotation. As described in our prior patent specification no; 1,366,572, the member which is held against rotation is in the form of a ring which is fixed to the housing of the drill. With such a construction, a large
15. proportion of the vibration generated by the co-operation between the two sets of teeth is transmitted back to the user through the housing of the drill, thus making the operation uncomfortable for the user.
20. A large proportion of this vibration can be eliminated if, instead of being fixed to the housing, the co-operating ring is spring loaded so as to be capable of movement in an axial direction, but being prevented from rotation under
25. the frictional torque produced by co-operation between the two sets of teeth. With this modified construction, the ring needs to have considerable

- inertia in order to ensure that a large proportion of the percussive movement is transmitted to the driving shaft and hence to the bit of the drill. The ring thus takes the form of a spring-loaded
5. anvil member which absorbs a large part of the vibration which would otherwise be transmitted to the user, but ensures that adequate percussive action is transmitted to the bit of the drill. The mounting of this anvil member must be so designed
10. as to prevent rotation while at the same time not impeding the axial movement. For this purpose it has been proposed to mount the anvil member by means of ball bearings located in axially extending grooves in the anvil member and in the inner surface
15. of the housing of the drill respectively. Although producing good results, such a construction is expensive to produce, involving accurate grinding of the surfaces involved.

- According to the present invention, the
20. anvil member is mounted to yield in an axial direction by means of a coupling comprising a number of axially extending springs surrounding and guided by pins located in corresponding counter bores, one part of the coupling being fixed to
25. the housing and the other to the anvil member, whereby to prevent rotation of the latter. Preferably the pins are fixed to the housing of the drill and the counter bores are formed in the anvil member, since this saves space by avoiding the need
30. for a separate part of the housing which is long enough to accommodate the counter bores. Somewhat surprisingly, it is found that such an arrangement, while preventing rotation of the anvil

member, nevertheless imposes very little restriction on the movement in an axial direction. Moreover, by avoiding the need for accurately ground surfaces, the construction is simplified and made considerably cheaper.

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Most conveniently three equi-angularly spaced springs are used together with associated pins and counter bores, but this is not essential and other numbers are also possible.

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An example of a construction in accordance with the invention will now be described in more detail with reference to the accompanying drawing which is a mainly sectional view of the forward portion, i.e. the portion closest to the chuck, of a portable, rotary/percussive drill, the part above the centre line showing one position of the main driving shaft in which a percussion mechanism is dis-engaged and the portion below the centre line showing, in elevation, the alternative position of the shaft in which the percussion mechanism is engaged.

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The housing of the drill is shown as 1 and supports a main driving shaft 2, of which the part above the centre line shown as 2A is shown in a longitudinal position corresponding to dis-engagement of a percussion mechanism indicated generally as 3, while the part 2B below the centre line is shown in a longitudinal position corresponding to engagement of the percussion mechanism 3. The electric driving motor and the reduction gearing are not illustrated, but the gearing terminates in a pair of gear wheels 4 and 5 which are splined to the shaft 2 so as to permit sliding motion of

the shaft between the positions 2A and 2B. The shaft 2 rotates in a pair of bearings, that at the rear end shown as 7 permitting sliding movement of the shaft as illustrated and that at the forward end shown as 8, being a thrust bearing which enables the longitudinal position of the shaft to be adjusted. For adjustment purposes an annular member 9 formed with a grip ring 10 has a helical end face of which the highest point is shown as 12A and the lowest point as 12B. This co-operates with a complementary helical end face on a fixed ring 13 so that when the member 9 is in the angular position illustrated above the centre line, the member is forced to the left and when in the position below the centre line it moves to the right.

A helical compression spring 15 enclosed by a cap member 16 acts on the thrust bearing 8 to force it against a shoulder 14 on the member 9. Operating pressure on the drill bit applied to the shaft 2 pushes the cap 16 to the right until the cap engages the bearing 8. When in the position illustrated above the centre line this movement is not sufficient to engage the percussion mechanism 3 and a purely rotary motion is applied to the shaft. When in the position below the centre line, however, the percussion mechanism is engaged and a percussive action is superimposed on the rotary motion as will now be described.

The percussion mechanism 3 includes a ring 21 which is fixed to the shaft 2 and turns in a bearing 22 fixed within a liner 23 within the housing 1. The righthand end face of the ring 21 is formed with a set of teeth 25,

- the configuration of which is best seen from the elevational view below the centre line. A set of corresponding teeth 26 is formed on the end face of an annular anvil member 28 which forms a
5. relatively loose running fit both with the shaft 2 and with the interior of the liner 23. The anvil member 28 is coupled to the liner 23 and hence to the housing 1 by three pins 30 located at intervals of  $120^{\circ}$  around the shaft 2. The three
10. pins 30 are supported by a ring 31, passing through corresponding holes in the ring 31 and into holes in the liner 23. To the left of the ring 31, each pin 30 is formed with an enlargement 33 and the portion of each pin extending to the left
15. beyond the enlargement 33 forms a loose guide for a compression spring 35 located within a counter bore 36 formed in the anvil member 28. The effect of the three springs 35 is to bias the anvil member 28 to the left into contact with a circlip 38 which
20. is spaced from the bearing 22 by a ring 39.

- Accordingly, when the main shaft is in the position 2A, it can rotate freely without affecting the anvil member 28. On the other hand, when it is in the position 2B and the rings of
25. teeth 25 and 26 are in engagement, rotation of the shaft 2 is accompanied by a percussive action as successive teeth ride over one another and then fall into the adjacent recesses. This motion is transmitted to the shaft 2 which is intermittently
30. forced to the left against the effect of the spring 15, but vibration which would otherwise be transmitted to the housing 1 of the drill is absorbed by movement to the right of the anvil member 28



against the effect of the springs 35. As previously mentioned, it is necessary for the anvil member 28 to have appreciable mass and hence corresponding inertia since otherwise a large proportion of the percussive action generated would be absorbed by the anvil member rather than being transmitted to the main shaft and hence to the bit. As it is, a major proportion of the percussive action is transmitted to the shaft and all or virtually all of the remainder is absorbed by the anvil member 28, thus avoiding discomfort to the user.

Since the anvil member 28 is a slack fit both on the shaft 2 and within the liner 23, there is no restraint on its axial movement. The reaction between the sets of teeth 25 and 26, however, also generates a frictional torque and it is found that this is resisted by the combination of the pins 30 and the springs 35 within their counter bores 36 without the generation of excessive heat and without the need for any excessive accuracy in machining the parts in question.

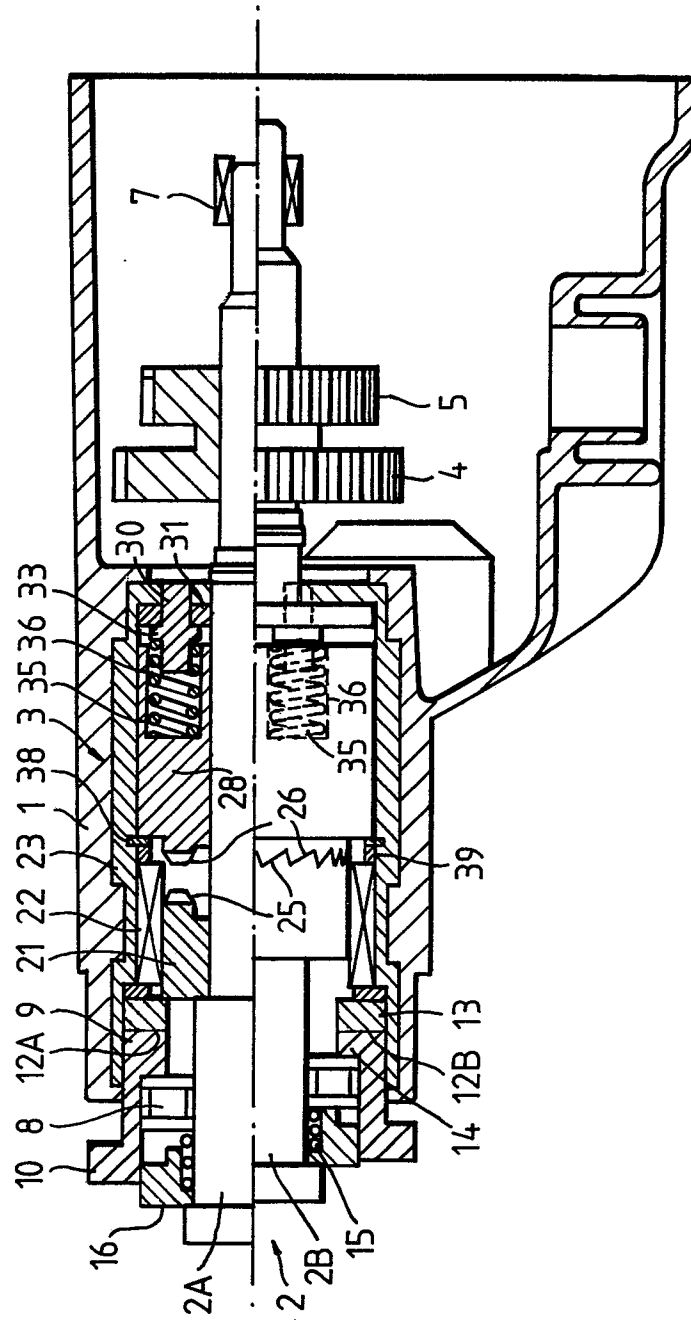
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C L A I M S

1. A rotary/percussive portable, power-operated drill in which percussive action is transmitted to the rotary shaft by a ring fixed to the shaft and formed with axially facing teeth
5. biased into engagement with a similar ring of teeth on an annular anvil member which is mounted to yield in an axial direction characterised in that the anvil is mounted to yield by means of a coupling comprising a number of axially extending
10. springs surrounding and guided by pins located in corresponding counter bores, one part of the coupling being fixed to the housing and the other being fixed to or formed in the anvil member, whereby to prevent rotation of the anvil member.
15. 2. A power operated drill according to claim 1 in which the pins are fixed to the housing and the counter bores are formed in the anvil member.
3. A power operated drill according to claim 2 in which the pins extend from a ring fixed
20. to the housing of the drill.
4. A power operated drill according to claim 1 or claim 2 in which there are three, substantially equi-angularly spaced springs and associated pins and counter bores.
25. 5. A power operated drill according to claim 1 in which the coupling is substantially as described and as illustrated with reference to the accompanying drawing.







European Patent  
Office

# EUROPEAN SEARCH REPORT

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Application number

EP 81 30 4672

| 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 |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>GB - A - 981 492</u> (R. BOSCH)<br><br>* page 2, lines 17-43; page 2, line 127 to page 3, line 1; figures 1 and 3 *<br><br>--- | 1,2               | B 25 D 16/00<br>B 23 B 45/00                                                                                                                                                                                                                                                                                                                                                                                                   |
| D/A                                                        | <u>GB - A - 1 366 572</u> (WOLF ELECTRIC TOOLS)                                                                                   |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>FR - A - 2 264 634</u> (R. BOSCH)                                                                                              |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>US - A - 3 867 988</u> (H.P. KOEHLER)                                                                                          |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>US - A - 3 433 082</u> (K.D. BITTER)                                                                                           |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>GB - A - 847 888</u> (F. MUTHMANN)                                                                                             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A                                                          | <u>GB - A - 747 255</u> (W. LICHTBLAU)<br><br>-----                                                                               |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                            |                                                                                                                                   |                   | TECHNICAL FIELDS SEARCHED (Int.Cl. 3)                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                            |                                                                                                                                   |                   | B 23 B<br>B 25 D<br>E 21 C                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                            |                                                                                                                                   |                   | CATEGORY OF CITED DOCUMENTS                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                            |                                                                                                                                   |                   | X: particularly relevant if taken alone<br>Y: particularly relevant if combined with another document of the same category<br>A: technological background<br>O: non-written disclosure<br>P: intermediate document<br>T: theory or principle underlying the invention<br>E: earlier patent document, but published on, or after the filing date<br>D: document cited in the application<br>L: document cited for other reasons |
|                                                            |                                                                                                                                   |                   | &: member of the same patent family, corresponding document                                                                                                                                                                                                                                                                                                                                                                    |
| The present search report has been drawn up for all claims |                                                                                                                                   |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Place of search                                            | Date of completion of the search                                                                                                  | Examiner          |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| The Hague                                                  | 16.02.1982                                                                                                                        | JAUNEZ            |                                                                                                                                                                                                                                                                                                                                                                                                                                |