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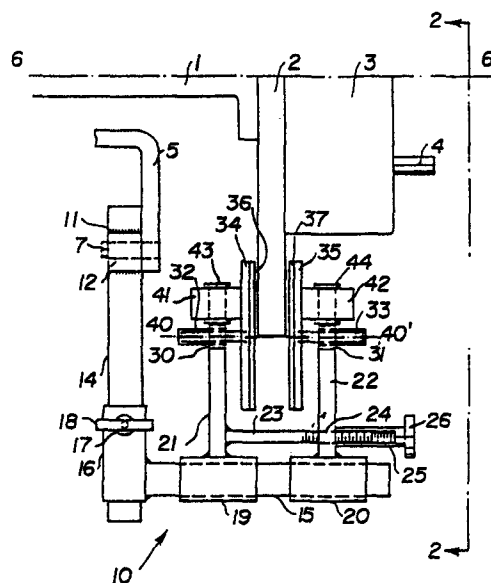
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⑤④ **A method and apparatus for grinding vehicle brake discs.**

⑤⑦ The invention provides a method an apparatus for refinishing a brake disc (2). The brake disc (2) is rotated, and brought into contact with two opposed abrading discs (34, 35), which are rotated as well, thereby grinding the brake disc (2). This can be carried out if desired with the brake disc (2) still in situ on a vehicle.



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A METHOD AN APPARATUS FOR GRINDING VEHICLE BRAKE DISCS

This invention relates to a method of grinding brake discs and to a machine for the regrinding of brake discs which form a portion of disc brakes.

Disc brakes are widely used on motor vehilces, parti-  
5 cularly automobiles. Generally such brakes have a disc  
attached to the vehicle wheel to be breaked, and brake shoes  
which approach the opposite sides of the disc when braking  
is desired, and engage the disc, whereby to slow the wheel  
through friction. The brake shoes suitably have brake  
10 linings of asbestos or other high-friction material, whereas  
the disc itself is usually a suitable metal, which will diss-  
ipate the heat of friction rapidly and which will be sturdy  
during operation.

During the operation of a motor vehicle, brake discs  
15 frequently become contaminated by such material as oil and  
grease, or they may become rusty. Oil and grease reduce the  
friction between the brake shoes and the disc, and may cause  
the brakes to fail to function when they are needed. Rust,  
on the other hand, may increase the friction, causing the  
20 brake to seize or "grab".

In order to remove rust and contamination, and assure  
that the disc surface is smooth so as to be suitable for  
gripping the brake shoes, regrinding of brakes discs is often  
necessary. Thus, a large industry has developed to regrind  
25 brake discs.

Generally, the regrinding of brake discs is done in  
machine tools, which require the brake discs to be removed

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from the vehicle for the regrinding process. Some devices require the further disassembly of the disc from the wheel hub with which it is associated, whereas others, such as, for example, that shown in Canadian Patent 815,782 issued June 24, 1969 to Ammco Tools Inc., permit the disc to be reground while still attached to the wheel hub, after the wheel hub is removed from the vehicle. Some devices such as that shown in Canadian Patent 865,769 of FMC Corp. require a two-stage process, which a first turning step on a lathe and a second, grinding step. In that patent a free-rotating grinding wheel, mounted on a universal mounting, is used to finish the surface of a disc after grinding. Such devices are frequently very expensive, and require a high capital investment by shops wishing to use them. Additionally, the time taken to disassemble the wheel from the vehicle prior to regrinding leads to delay and high cost for the regrinding operation.

Because of the disadvantages of requiring disassembly of the wheel from the vehicle, several attempts have been made to develop a machine which would regrind the wheel discs while they are still in place on a vehicle. West German Published Patent Application 2,316,672 of the present inventor, which was published on March 28, 1974, shows one such proposal. Another generally similar proposal is shown in U. S. Patents 3,521,411 and 3,590,537 of Hennig and Kammermayer.

Experience with devices such as those shown in the German Published Application and U. S. Patents discussed above has shown that these devices are not fully satisfactory for the regrinding of brake discs. In particular, discs reground with such devices frequently exhibit scoring of the disc surface, which may at times be so severe as to render the disc useless. Even when extensive scoring is not present, the discs do not exhibit the same smoothness and uniformity of finish as is available from factory-finishing or refinishing.

The present invention relates to a method for refinishing discs, and an apparatus for carrying out that method, whereby a smooth, uniform finish on such discs is obtained. The invention also has the advantage that, if desired, the

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discs can be reground while they are still in position on the vehicle.

Accordingly, the invention provides a method for regrinding a vehicle brake disc comprising the steps of rotating the  
5 brake disc about a first axis and placing two opposed abrading discs each having an abrading face so that the said abrading face is in frictional face-to-face contact with a face of the vehicle brake disc to be reground; each abrading disc being rotatable about an axis of rotation parallel to said first  
10 axis, and fixedly oriented perpendicular to said abrasive face.

While the invention can of course be used to grind brake discs which have been removed from the vehicle and mounted on a suitable support, it is particularly suited to grinding discs in situ on a vehicle, where there is sufficient space around  
15 the brake disc in situ to place the apparatus. Use in this way avoids the necessity of dismounting the vehicle wheel, with an attendant time saving.

The invention also comprises apparatus for use in grinding brake discs, including two rigid abrading discs with  
20 abrading faces in face-to-face relation and movable towards and away from one another, each disc being mounted for rotation about an associated axle, each axle being perpendicular to the abrading face of its disc, means for positioning the abrading discs with their abrading faces in face-to-face contact with  
25 a brake disc placed between them, and means for holding the abrading discs when so positioned, in frictional contact with the brake disc. In the preferred embodiment, the means for positioning the abrading discs includes a mounting bracket which attaches to the brake caliper mounting bracket of a  
30 motor vehicle.

Preferably, the apparatus according to the invention is used in conjunction with a means for powering the vehicle wheel on which the disc brake is mounted. Suitably, the powering device can be an electric motor, which is attached to a  
35 mounting device boltable to a vehicle wheel such that the motor drives the wheel. However, in cases where the wheel on which the disc brake is located is itself a powered wheel, as

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for example a wheel driven by the vehicle engine, then it is within the scope of the invention (although not preferred) to use the vehicle engine to power that wheel. Preferably, the abrading disc is not powered, but is merely caused to rotate  
5 by the rotation of the vehicle wheel and its associated brake disc in contact with the abrading disc during operation. However, it is within the scope of the invention, if desired, to power the abrading disc as well.

The invention will now be disclosed further by the description of the particular embodiments and illustrated by  
10 drawings.

In the drawings:

Figure 1 shows a view, as seen looking upwardly from below an automobile, showing a vehicle wheel and brake disc, with a  
15 device according to the present invention mounted thereon for grinding the disc.

Figure 2 is a side view, along the line 2-2 of Figure 1.

Figure 3 shows a suitable apparatus for powering a vehicle wheel in order to cause it to rotate while the grinding  
20 operation is taking place, and in addition, an alternate way of mounting the grinding apparatus.

Figure 4 shows a detail of Figure 3 in cross-section, as indicated by the lines 4-4 on Figure 3, with the detail being shown in greatly enlarged scale.

25 The presently preferred embodiment of the invention is the one which is shown in Figures 1 and 2. The preferred embodiment will now be described.

In Figure 1, the vehicle axle is generally shown at 1. The axle has attached to the end of it, as by bolts in conventional fashion, a brake disc 2 and a wheel hub 3. The  
30 wheel hub has extending from it a plurality of wheel studs 4. A bracket 5, secured to the frame of the automobile, is provided for the mounting of brake calipers (which are not shown).

In Figure 1, the axis of rotation of the axle 1, disc 2 and wheel 3, all of which rotate as a unit, is shown at 6-6'.  
35

The inventive device is shown generally at 10. As shown, it has an attachment member 11, which is provided with two

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holes 12 and 13. These holes fit over the caliper-mounting studs 7 and 8, which extend outward from the caliper-mounting bracket 5.

Extending at right angles from attachment member 11 is a connecting member 14, which is rigidly secured, as by welding, to the attachment member 11. Near the end of member 14 remote from member 11, is attached a base member 15. In the figures, member 15 is shown as being slidably mounted on member 14, by means of a sleeve 16 which is rigidly connected thereto and which slides on member 14. A set screw 17, having a handle as shown at 18, attached to it is provided to lock sleeve 16 into position at a desired position on vertical member 14. The member 15 has two sleeves 19 and 20 slidable independently on it. Each of these sleeves bears a grinder supporting member, the two members being respectively designated as 21 and 22. A threaded rod 23 is permanently secured, as by welding or by bolting, to member 21, and passes through member 22 by a suitable hole 24.

An internally-threaded sleeve 25 (shown partially cut-away) having a mating thread to rod 23 is screwed over rod 23. Suitably, the internally-threaded sleeve has a handle 26 for adjustment attached to one end.

In each of the supporting members 21 and 22 is located a hole containing a low friction bushing or ball bearing assembly. These bushings or bearing assemblies are shown as 30 and 31 in the drawings. In each of the bushing or bearing assemblies is journaled a stub axle (shown respectively as 32 and 33). Each stub axle has mounted on it a metal disc (respectively shown as 34 and 35) which is fixed to the axle for rotation therewith. The discs are coated with abrasives as indicated at 36 and 37. Although 36 and 37 are shown as abrasive coatings fixed permanently to the discs 34 and 35, it is of course possible to have the abrasives mounted on removable pads, which can be replaced when the abrasive becomes worn.

In the drawings, the two axles 32 and 33 are shown as having the same axis which is shown by number 40-40'. It will

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be noted that this axis lies outside the periphery of the wheel disc 2. It is not necessary that the two axles have the same axis, although they must be parallel to each other, and, they should be parallel, when the apparatus is in operating position, to the axis 6-6' of the vehicle wheel and axle. It is also important that when the device is operating, the axes of both of the axles 32 and 33 should lie outside the periphery of the wheel disc 2, if discs 34 and 35 are not powered, as will be discussed.

10       To support the discs 34 and 35, and their associated abrasive pads, and to prevent wobble of such discs, bearings 41 and 42 are provided on the upper ends of upstanding members 21 and 22. Suitably, these bearings are rotatable wheels, of any suitable material, which bear on the back of discs 34 and 15 35 respectively, to prevent each disc from bending backwards towards its associated supporting member 21 or 22. The bearings 41 and 42 are journaled on the top of members 21 and 22 by a low-friction mounting, such as, for example, a ball bearing assembly shown generally at 43 and 44.

20       In many present day automobiles, the caliper-mounting bracket is a vertically-oriented crescent shaped piece of metal positioned just to the rear of the axle supporting the wheel with which it is associated, having its mid-point approximately at the level of the axle. The caliper-mounting 25 bracket 5 illustrated in the drawings is of this type. With such an arrangement the member 11 is oriented approximately vertically, with the member 14 being oriented horizontally and extending rearwardly from the mounting bracket. However, it will be appreciated that the invention can be used with any 30 shape of mounting bracket, merely by modifying member 11 to attach to that bracket. In some cases it may be convenient to hang the apparatus from the mounting bracket so that member 14 depends vertically downward, and member 15 extends horizontally under the wheel disc. The precise orientation 35 and form of these members is not important to the invention, provided that the discs 34 and 35 can be positioned as described with respect to the wheel disc 2.

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In Figures 3 and 4, another form of the apparatus according to the invention is shown. In these figures, like parts to those previously described are identified by the same number as those parts previously described.

5 In Figures 3 and 4, the apparatus (generally indicated as 10a) is shown mounted on a wheeled dolley 50, which has wheels 51. A vertical member 14a connects the apparatus to the dolley. In the embodiment shown, all other parts of the apparatus are as previously described, except that the  
10 threaded rod 23 and handle 26 are reversed from their position as shown in Figure 1, and the positions of members 22 and 21 are interchanged. The reason for this reversal is so that handle 26 will be accessible when the inventive apparatus generally indicated as 10a extends under a vehicle.

15 Also mounted on the dolley 50 is a suitable frame 52, which supports a motor (as for example an electric motor) 53. The motor-power take-off 54 is connected to a pulley 55, which is connected through a belt 56 to a second pulley 57 mounted on rotatable member 60, journaled for rotation in a member  
20 66. The entire motor, belt and pulleys are joined together by a rigid frame 65, which slides on frame 52 and is adjustable in its height by handle 59, which is attached to a threaded mating portion of an upstanding member 58 which permits the member to be lengthened. This permits the level of  
25 the motor, the two pulleys and the belt above the ground to be varied.

On member 60 is a second power take-off 61. This is preferably a universal take-off. It is provided, as is shown in Figure 4 with a flange having a plurality of holes  
30 62. These holes are designed to engage wheel studs, and may be slotted, as shown in Figure 4, so that they can accommodate the wheel studs of several different types of vehicles and so that they also have, to some extent, a self-centering feature.

The operation of the apparatus as shown in Figures 1  
35 and 2 will now be described. When it is desired to regrind brake discs the calipers holding the brake shoes are removed from their association with the disc to be reground. The

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vehicle is placed on a jack or other supporting means and the tire associated with the wheel on which the brake disc is to be reground is removed.

The apparatus 10 is then attached to the caliper-mount-  
5 ing bracket 5, as by fitting holes 12 and 13 over the caliper-mounting studs. If desired, the member 11 can be bolted to the studs, but this is usually not necessary and it is more convenient, having regard to the difficulty of working under a vehicle, merely to hang the member 11 from the holes. Then,  
10 the set screw 18 and the handle 26 are operated so that the two abrasive discs are positioned on opposite sides of the disc to be ground, with the abrasive faces 36 and 37 facing the disc. The axis 40 is positioned to be outside the periphery of the disc. In Figure 1, this axis is shown as beside  
15 the disc, but it is evident that it could be slightly outside the periphery but below or above the disc 2, rather than beside it, if there is sufficient space to mount the apparatus in that orientation. The distance from the axis to the periphery of the disc depends on how much overlap is desired between the  
20 abrasive pads 36 and 37 and the disc, which in turn governs how much of the disc will be reground.

The handle 26 is then operated so that the two members 21 and 22 are moved toward each other. This is continued until the two faces 36 and 37 are in tight frictional engagement with  
25 the disc 2 to be reground.

Once the apparatus is set up in this way, the wheel 3 and the associated disc 2 are rotated. In some cases, where the vehicle wheel is powered by the vehicle engine, this may be done by actuating the vehicle engine. However, in the  
30 majority of cases this will not be feasible. In such cases, it is preferred to rotate the vehicle wheel by applying power to the wheel by external means. One suitable arrangement is that shown in Figure 3 where motor 53 drives power take-off 61. The handle 59 is adjusted until take-off 60 is at the height  
35 of the axle 6 and facing the outside of wheel 3. The slots 62 are fitted over wheel studs 4, and bolts are attached to ensure that the wheel studs remain in position. Then, motor 53 is

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actuated, causing wheel 3 and disc 2 to rotate.

When wheel 3 and disc 2 rotate, they causes discs 34 and 35, which are in tight frictional contact with disc 2, to rotate also. The directions of rotation are shown by arrows 70 and 71 in Figure 2. Because of the right frictional contact between the disc 2 and the abrasive surface of 36 and 37, there will of course be considerable bending torque on the metal discs 34 and 35. However, this bending torque is transmitted to the members 21 and 22, which are much more sturdy and better able to resist it, by means of the bearings 41 and 42. Obviously, the axis of rotation of discs 34 and 35 must be outside the periphery of disc 2, to cause discs 34 and 35 to rotate, if the discs 34 and 35 are unpowered. If the discs were powered independently of the vehicle wheel it would be possible to place the axis of the rotation within the periphery of the brake disc 2. However, this is not preferred, as there is some possibility of scoring the brake disc with this arrangement.

As the discs 34 and 35, with their abrasive coatings 36 and 37 rotate, the abrasive surfaces abrade the opposed faces of wheel disc 2. The effect of the rotatory motion of the abrasive discs, and of the wheel disc 2 provides a smooth uniform grinding of the disc surfaces.

When the disc surfaces have been ground sufficiently, motor 53 is switched off, and the abrasive pads 36 and 37 are moved out of contact with the disc, completing the grinding process. Optionally, an initial grinding can be done with discs 34 and 35 having abrasive coatings 36 and 37 which have a coarse abrasive, followed by a second grinding operation, replacing those discs with discs having finer abrasive coating.

The operation proceeds in an analagous manner when apparatus 10a is used instead of apparatus 10. Using apparatus 10a, it is not absolutely necessary, in all cases, to remove the calipers before grinding a disc. However, the calipers will usually be removed, to give the operator more room in which to work while placing his abrasive discs in position around the wheel disc.

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As mentioned above, the axes of the two axes 32 and 33 need not be the same. It may occur, for example, that it is desired to regrind a larger area on one side of a wheel disc than on the other side. In such a case, a larger disc 34 (for  
5 example) than disc 35 would be provided. While it is possible to have the two discs having the same axis 40-40', it may be convenient to have the larger disc have a different axis of rotation than the smaller disc. This is still within the scope of the invention.

10 As noted above, it is possible to have only a single disc present, when it is desired to abrade only one side of a wheel disc. If this arrangement is used, it will then of course not be possible to have a threaded rod 23 running between the two members 21 and 22, as only one such member  
15 would be used. In such a case, member 21 and its associated disc would be removed, and threaded rod 23 would be welded to member 14, instead of member 21. It is not preferred to abrade a single side of the brake disc in this way, as the considerable pressure of the abrading disc 35 and its abrasive  
20 coating 37 against the wheel disc 2 might cause the wheel disc 2 to wobble on its axis. However, in cases where the wheel disc 2 is firmly seated on its axis, and only one side of the disc needs to be reground, this arrangement can be used. It would of course also be possible to omit the member 22, rod  
25 23 and handle 26 and instead to leave member 21 in position, with a suitable arrangement to force member 21 toward disc 2, so that abrading disc 34 and its associated abrasive coating 36 are in tight frictional contact with disc 2.

Although the abrading discs 35 and 34 have been shown  
30 in the drawings as unpowered, and caused to rotate through their frictional contact with disc 2, it is within the scope of the invention to power such abrading discs. Powering such discs may be advisable where a very polished finish is desired to the disc 2, as the abrading discs can then be caused to  
35 rotate at a higher speed than the disc 2, and, when used with very fine abrasive, this will result in a highly polished finish.

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It is generally preferred to use the arrangement 10 rather than the arrangement 10a, as it is found to be more convenient to mount the disc grinding apparatus on the caliper-mounting bracket, rather than having it mounted permanently on a dolley. However, different motor vehicles have different caliper-mounting brackets, and it is therefore advisable to have the option of placing the device on a dolley, as shown in Figure 3, in cases where the holes 12 and 13 do not correspond with the studs on the caliper mounting bracket of the particular vehicle on which grinding of the brake discs is to take place.

If the brake disc is removed from the vehicle for grinding, then the arrangement 10a can be used. The adapter 61 is replaced by a suitable mounting for the brake disc for rotation by the motor 53, through shaft 60; and the apparatus 10a is brought into contact with the sides of the brake disc as described for grinding.

It will be understood that the invention has been described with respect to particular embodiments, and that obvious modifications thereto will occur to persons skilled in the art. It is therefore intended that the invention shall not be limited to the details of the particular embodiments described, but shall rather be given the full scope as claimed in the appended claims.

It is found that, in many circumstances, brake discs which are to be resurfaced have been worn unevenly. In some cases, the brake disc is thinner, by reason of wear, closer to the centre than it is at the periphery. In other instances, the brake disc is thinner at the periphery than it is at the centre.

It has therefore been found useful to provide apparatus in which the two opposed abrading discs rotate about axes which are substantially parallel to one another and can be adjusted to be slightly non-parallel. The two axes of rotation do not depart greatly from the parallel. In practice, it is found that a departure of about 5 to 15 degrees is adequate to permit the abrading discs to adapt to brake discs found in normal

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use on vehicles. Obviously abrading discs which could be adjusted so that their axes of rotation are at larger angles to one another than 15 degrees could be provided if desired, but such are not needed to grind brake discs most frequently encountered in automobile repair.

The orienting of the abrading discs about axes which are slightly off-parallel also permits the use of conventional thrust bearings, mounted about axles 32,33, to replace bearings 41 and 42 in order to keep the abrading discs in position.

When this arrangement is used, the two abrading discs are adjusted so that their axes of rotation are slightly off-parallel, with the portions of the abrading discs which will engage the brake disc being closer than the portions which will not engage the brake disc. Thus, in Figure 1, the portions of the abrading discs 34 and 35 closest to the wheel 3 would be arranged to be closer together than the portions closest to the member 15. The two abrading discs are then locked tightly against the brake disc to be ground, and the slightly non-parallel arrangement of the axes of rotation puts pressure on the thrust bearings, so that they do not wobble during the grinding operation.

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## CLAIMS

1. A method of regrinding a vehicle brake disc characterized by:

- a) rotating the brake disc about a first axis, and
- b) while rotating the brake disc placing two opposed  
5 rigid abrading discs, each having an abrading face, so that the abrading face is in frictional contact with a face of the brake disc, whereby to grind the brake disc, while rotating the brake disc.

2. The method as claimed in claim 1, carried out while  
10 the brake disc is in situ on a vehicle axle.

3. A method as claimed in claim 1 or claim 2, in which each abrading disc present is caused to rotate only through contact with the rotating brake disc.

4. Apparatus for grinding brake discs, characterized by  
15 two rigid abrading discs with abrading faces in face-to-face relation and movable towards and away from one another, each disc being mounted for rotation about an associated axle, each axle being perpendicular to the abrading face of its disc, means for positioning the abrading discs with their abrading  
20 faces in face-to-face contact with a brake disc placed between them, and means for holding the abrading discs, when so positioned, in frictional contact with the brake disc.

5. Apparatus as claimed in claim 4, characterized in that the means for positioning the abrading disc includes a  
25 mounting bracket which attaches to the brake caliper mounting of a motor vehicle.

6. Apparatus as claimed in claim 4 or claim 5, in which the means for positioning the abrading disc is adapted to position each such disc with its axis of rotation outside the  
30 periphery of the brake disc to be reground.

7. Apparatus for regrinding a brake disc in situ on a vehicle axle, characterized by:

- a base member,
- two relatively movable supporting members upstanding  
35 from said base member,
- journal means mounted on each of said supporting

members,

a stub axle journalled in each of said journal means,  
an abrading disc fixedly mounted at the end of each  
stub axle for rotation therewith, each abrading disc having a  
5 first face and a second face, each of which is perpendicular  
to its respective stub axle, the stub axle joining the disc  
in the centre of the first face, the second face being coated  
with abrasive material, and the first face not being coated  
with abrasive material, the said two abrading discs being  
10 oriented with their respective abrasive faces in face-to-face  
relationship to one another,

bearing means mounted to support said abrading discs  
and means for adjustably urging said discs towards one another.

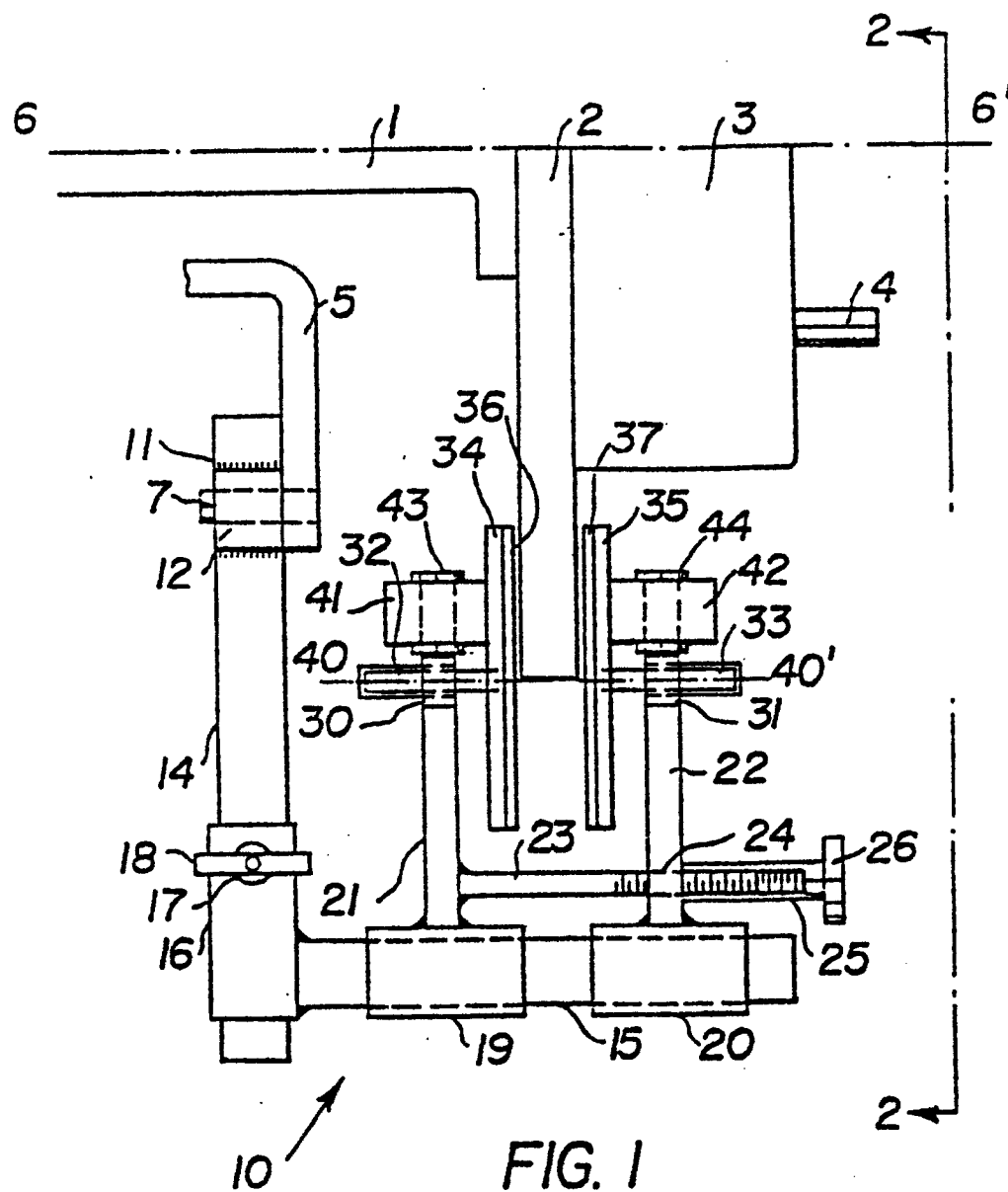
8. Apparatus as claimed in claim 7, in which the axes  
15 of rotation of the two abrading discs are substantially  
parallel to one another, but are adjustable with respect to  
one another so that they may be adjusted to deviate slightly  
from parallel to one another.

9. Apparatus as claimed in claim 7 or claim 8, addi-  
20 tionally including,

positioning means for retaining said apparatus in  
juxtaposition with a vehicle brake disc in situ on a vehicle,  
with the abrasive faces of the abrading discs held in fric-  
tional contact with opposite sides of the wheel disc and  
25 overlapping a portion thereof.

10. Apparatus as claimed in claim 9, in which said  
positioning means includes,

means for removably and adjustably attaching said  
base member to the caliper bracket of a vehicle disc brake  
30 unit.



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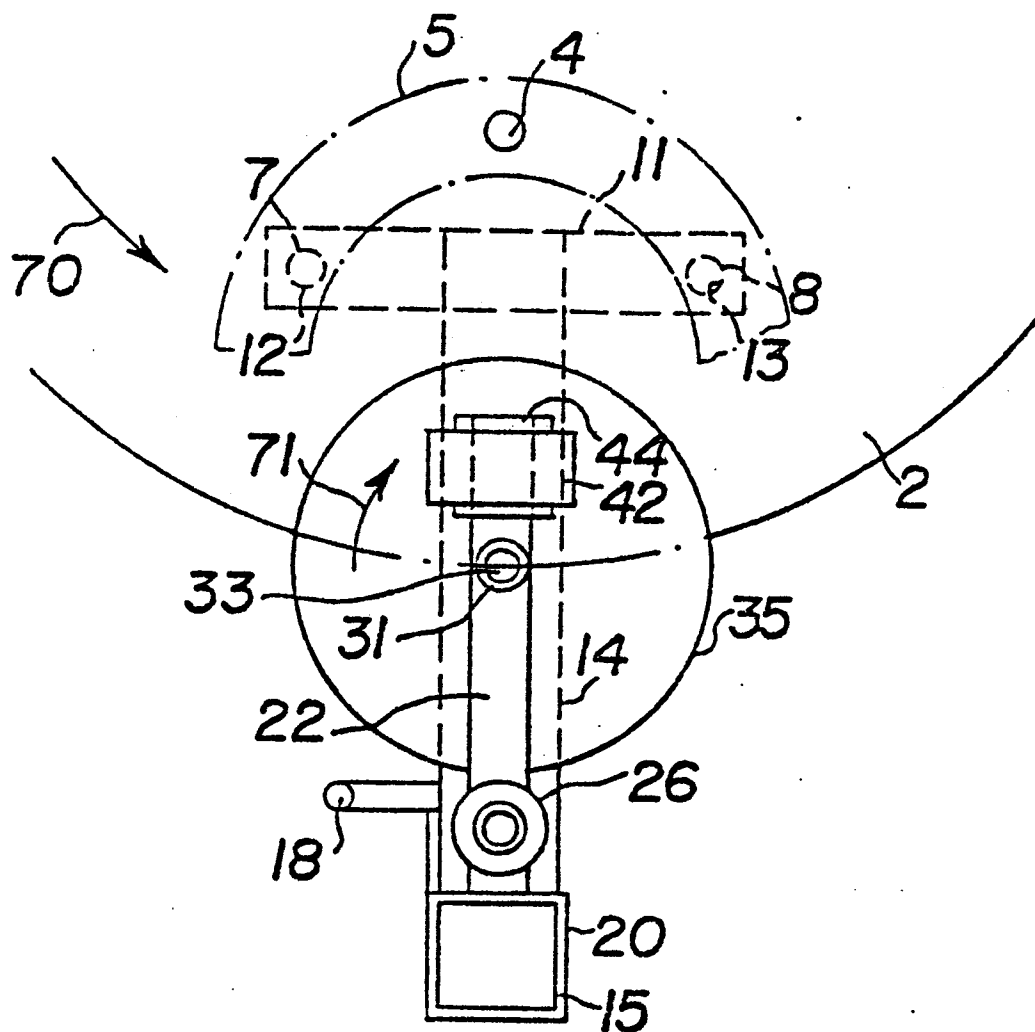


FIG. 2

FIG. 4

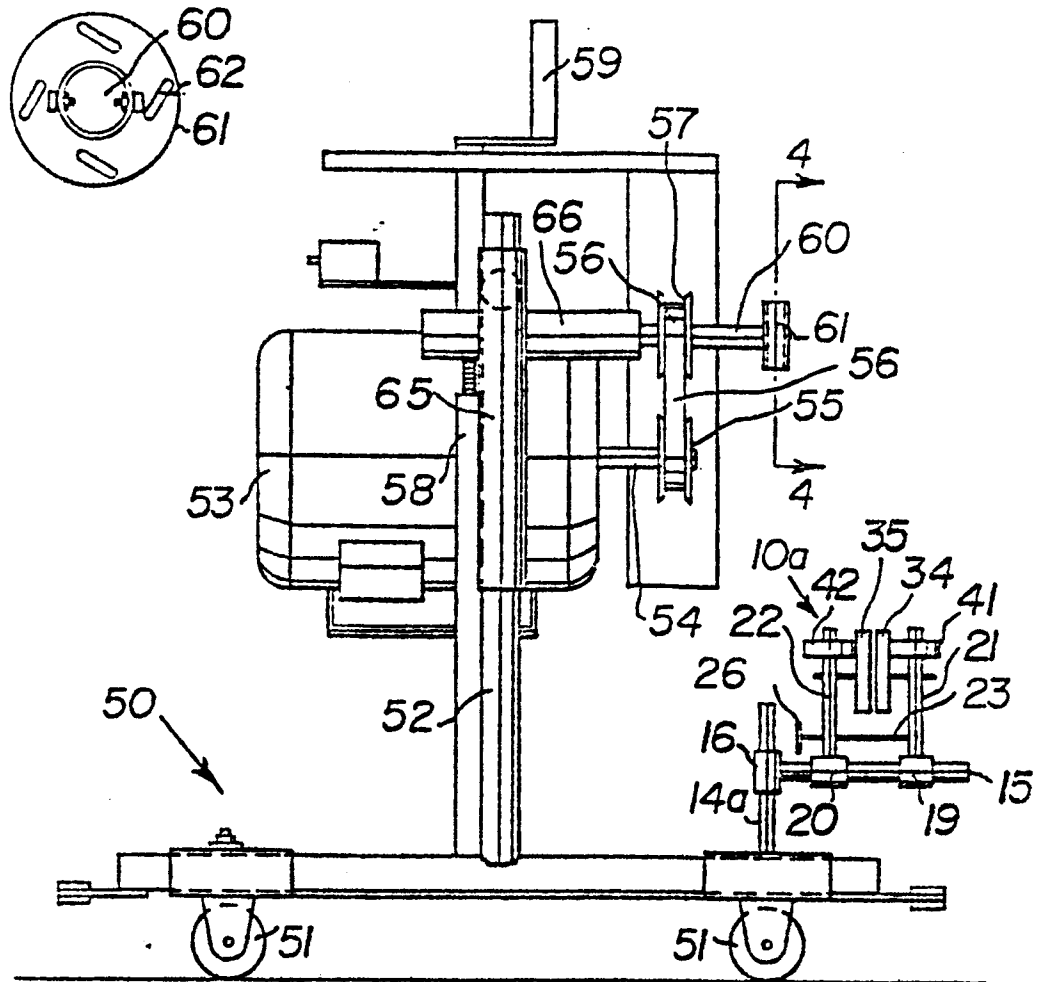


FIG. 3

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European Patent  
Office

# EUROPEAN SEARCH REPORT

Application number

EP 79 301 271.7

| DOCUMENTS CONSIDERED TO BE RELEVANT                                 |                                                                                                             |                                  | CLASSIFICATION OF THE APPLICATION (Int. Cl.)                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Category                                                            | Citation of document with indication, where appropriate, of relevant passages                               | Relevant to claim                |                                                                                                                                                                                                                                                                                  |
| X                                                                   | FR - A - 1 352 248 (J.-L. BRUNELLA)<br>* complete document *                                                | 1,2,4                            | B 24 B 7/16                                                                                                                                                                                                                                                                      |
| X                                                                   | DE - U - 1 905 891 (A. WANPOUILLE)<br>* page 2, lines 1 to 12; page 5,<br>line 20 to page 6; fig. 1 and 2 * | 1,2,4                            |                                                                                                                                                                                                                                                                                  |
| X                                                                   | US - A - 3 619 952 (P.W. LEMING<br>et al.)<br>* claim 1; column 3, lines 36 to 62 *                         | 1,3,4                            | TECHNICAL FIELDS<br>SEARCHED (Int. Cl.)                                                                                                                                                                                                                                          |
|                                                                     | DE - U - 1 906 407 (A. CIPOLLONI)<br>* claim 1, 5 and 6; fig. 1 *                                           | 1,4                              | B 23 B 5/00<br>B 24 B 7/16                                                                                                                                                                                                                                                       |
|                                                                     | US - A - 3 500 589 (W.B. ELLEGE)<br>* column 3, line 19 to column 4,<br>line 54; fig. 2 and 4 *             | 1,3,7                            |                                                                                                                                                                                                                                                                                  |
| A                                                                   | US - A - 3 456 401 ( W.P. KUSHMUK)<br>* complete document *                                                 | 1                                | CATEGORY OF<br>CITED DOCUMENTS                                                                                                                                                                                                                                                   |
| D                                                                   | DE - A - 2 316 672 (H. GRAMLICH)<br>* complete document *                                                   | 1                                | X: particularly relevant<br>A: technological background<br>O: non-written disclosure<br>P: intermediate document<br>T: theory or principle underlying<br>the invention<br>E: conflicting application<br>D: document cited in the<br>application<br>L: citation for other reasons |
| D                                                                   | US - A - 3 521 411 (E. HENNING<br>et al.)<br>* complete document *                                          | 1                                |                                                                                                                                                                                                                                                                                  |
|                                                                     | ./...                                                                                                       |                                  |                                                                                                                                                                                                                                                                                  |
| <p>X The present search report has been drawn up for all claims</p> |                                                                                                             |                                  | <p>&amp;: member of the same patent family,<br/>corresponding document</p>                                                                                                                                                                                                       |
| Place of search                                                     |                                                                                                             | Date of completion of the search | Examiner                                                                                                                                                                                                                                                                         |
| Berlin                                                              |                                                                                                             | 10-09-1979                       | MARTIN                                                                                                                                                                                                                                                                           |

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# EUROPEAN SEARCH REPORT

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| 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 |                                               |
| D                                   | <p><u>US - A - 3 590 537</u> (E. HENNING et al.)</p> <p>* complete document *</p> <p>-----</p> | 1                 |                                               |
|                                     |                                                                                                |                   | TECHNICAL FIELDS SEARCHED (Int. Cl.3)         |
|                                     |                                                                                                |                   |                                               |
|                                     |                                                                                                |                   |                                               |