

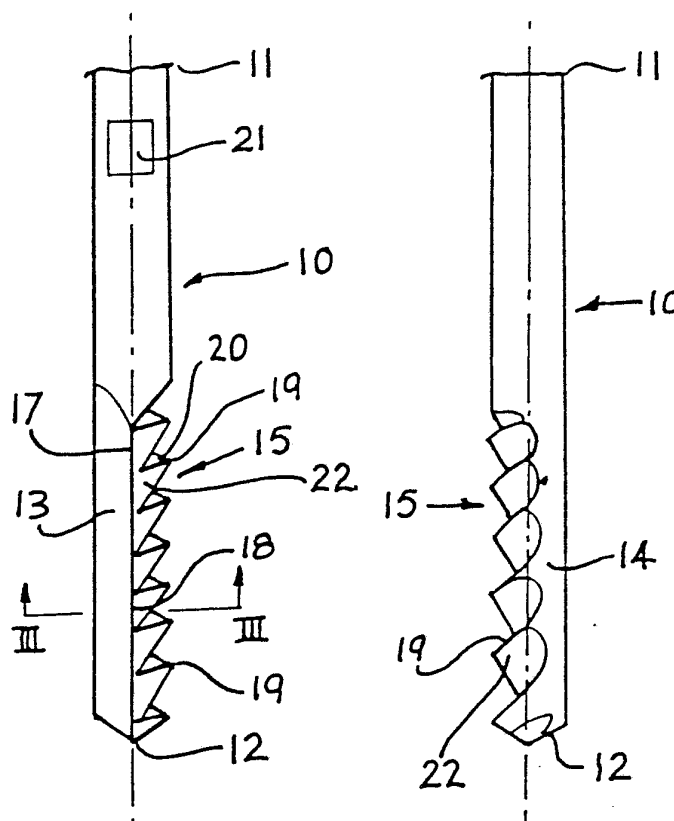


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(21) International Application Number: PCT/AU81/00150 (22) International Filing Date: 21 October 1981 (21.10.81) (31) Priority Application Number: PE 6174/80 (32) Priority Date: 22 October 1980 (22.10.80) (33) Priority Country: AU (71) Applicant (for all designated States except US): McPHERSON'S LIMITED [AU/AU]; 500 Collins Street, Melbourne, Vic. 3000 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): BURT, Arthur, Doug- las [AU/AU]; 310 Greenwood Drive, Watsonia, Vic. 3087 (AU).	(74) Agent: EDWD. WATERS & SONS; 50 Queen Street, Melbourne, Vic. 3000 (AU). (81) Designated States: AT (European patent), AU, CH (European patent), DE (European patent), FR (Euro- pean patent), GB (European patent), JP, NL (Euro- pean patent), SE (European patent), US. Published <i>With international search report.</i>	

(54) Title: CUTTING ELEMENT**(57) Abstract**

A cutting element for use with cutting apparatus, said apparatus including drive means arranged to rotate and reciprocate the cutting element relative to a cutting thrust reaction sleeve or shearing sleeve, the cutting element being formed as an elongated shank (10) adapted for connection to the drive means of the cutting apparatus at an end region of the shank, said cutting element having a cutting region along at least an axial section thereof, said cutting region having an axially extending flute (13) and a plurality of cutting teeth (15) having cutting edges generally transverse to the axis of shank (10) terminating at one axial edge (17) of the flute (13). The cutting element may have a drill point (12) at one end of the shank adapted to cut a starting hole in work material and thereafter a slot can be cut in the work material with the cutting teeth (15) co-operating with the cutting thrust reaction sleeve of the cutting apparatus.



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CUTTING ELEMENT

The present invention relates to a cutting element adapted to cut or profile material to a predetermined or desired shape, whether it be a regular or irregular shape.

5 In the Applicants co-pending Australian Patent Application No. 49052/79, there is disclosed apparatus for cutting sheet material such as sheet metal and a cutting element for use with this apparatus. The cutting assembly disclosed in 49052/79 essentially comprises a pair of relatively re-
10 ciprocable members, one of which includes or comprises a cutting element and the other member comprising a shearing sleeve generally surrounding the cutting element. The cutting element is also adapted to rotate whereby a hole cutting means on the cutting element acts to form an initial or start-
15 ing hole in the sheet material. The cutting element further includes a cutting edge transverse to the direction of reciprocation thereof whereby upon reciprocation of the cutting edge passed the free end of the shearing sleeve, the cutting edge acts therewith to cut or shear away chip particles from the
20 edge of the initial starting hole to form a slot of any desired direction in the sheet material. The relative reciprocation of the cutting element and the shearing sleeve is achieved by co-operating cams upon rotation of the cutting element and the cams are disengageable from one another in
25 the initial hole cutting mode of operation whereby the cutting element acts solely in a rotatable manner while the starting hole is formed.

The objective of the present invention is to provide a cutting element which is capable of use in apparatus of
30 the aforementioned type and which is adapted to extend the range of operation of the apparatus. That is, it is desired to increase the thickness through which the cutting element will operate and to be able to cut through such materials as plastics, wood, asbestos cement and other cement based pro-
35 ducts capable of being cut, plaster, ceramics and like materials.

Essentially, conventional wood cutting apparatus such as routers suffer from poor cutting direction stability, that is they tend to wander from a desired cutting direction
40 and accurate steering becomes difficult. It is a preferred



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objective of the present invention to provide cutting apparatus with improved cutting direction stability.

Accordingly, the present invention provides a cutting element having an elongated shank with at least one cutting region along said shank or an axial section of said shank, the or each said cutting region having an axially extending flute and a plurality of cutting teeth having cutting edges generally transverse to the axis of the shank, said cutting edges terminating at one axial edge of said axially extending flute. Preferably a drill point is provided at at least one end of the shank. Advantageously, there is provided a circumferential space between the other end of each of said transverse cutting edges and the other axial edge of the axial flute whereby an axially extending cylindrical land is produced.

Advantageously the transverse cutting edges are inclined or helically formed substantially as an extension of the drill point used to form the initial starting hole. In this way the drill point and the transverse cutting edges can be used to form the starting hole to a depth equivalent to the axial length of the cutting edge region of the shank of the cutting element.

It will be appreciated that the cutting element may be formed in a manner such that it is releasably held within a cutting element holder, the holder co-operating with the remainder of the apparatus. Alternatively the cutting element may itself be of such a configuration that it co-operates with the remainder of the apparatus.

According to a further aspect of this invention, there is provided a cutting assembly comprising a cutting element having an elongated shank, a cutting region extending along said shank or along an axial section thereof, said cutting region having an axially extending flute and a plurality of cutting teeth having cutting edges generally transverse to the axis of said shank, said cutting edges terminating at one axial edge of said axially extending flute, a sleeve member through which the cutting element is adapted to move in the direction of the axis of said shank, and means for establishing relative reciprocation of said cutting element through said sleeve member upon rotation of said cutting element



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whereby at least one of said cutting teeth passes into and out of the sleeve member. Preferably a drill point is provided at at least one end of the shank of the cutting element.

It is generally preferred that the cutting teeth be
5 shaped so as to cut on the inward movement relative to the shear member. Alternatively cutting might be achieved on the outward movement if the cutting teeth are formed as a mirror image of the inward cutting configuration. Advantageously a partially cylindrical land region is formed between the cut-
10 ting teeth and the axial flute. The means for establishing reciprocation of the cutting element through the sleeve member may comprise co-operating cams on both members.

The timing and configuration of the cams is preferably such that the cutting action occurs generally on one
15 radial zone of the cutting element thereby ensuring satisfactory steering of the assembly as a whole. Cutting elements which cut on the entire peripheral region of the element are difficult to steer in a particular desired direction. The cutting action occurs generally by the cutting teeth engaging
20 the work material at the end zone of the slot cut by the assembly in a substantially rotary mode of movement. This may occur for about 85° of rotation during which a plurality of grooves running generally parallel to the main surfaces of the work material are formed in the end zone of the slot.
25 Thereafter the cutting assembly changes the movement of the cutting element to a combined axial (in a single direction) and rotary mode where chips of the work material are sheared from the previously grooved end zone. This combined rotary and axial movement may occur for about 95° of rotation. There-
30 after, the cutting element is moved in a reverse axial direction while continuing the rotary motion before commencing a new cutting action. The chips formed during the cutting operation may be removed via the axially extending flute.

The invention will now be described with reference
35 to the accompanying drawings which illustrate preferred embodiments. In the drawings:

Figure 1 is a side elevation view of a cutting element according to a first preferred embodiment of the present invention;



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Figure 2 is a side elevation view of the cutting element of figure 1 from the opposite side to that shown in figure 1;

Figure 3 is an enlarged cross-sectional view taken
5 along the line III-III of figure 1;

Figure 4 is a side elevation view of a second preferred embodiment of the present invention viewed in the direction IV-IV of figure 5; and

Figure 5 is an enlarged cross-sectional view taken
10 along the line V-V of figure 4.

Referring to figure 1 of the drawings there is shown an elongated shank 10. At one end 11 of the shank 10 is a means 21 being a flat region formed in the periphery of the shank adapted for engagement by a grub screw (not illustrated) to hold and locate the cutting regions of the element
15 relative to the cams of the cutting assembly in a cutting tool holder of the type illustrated in Australian Patent Application No. 49052/79. It will of course be appreciated that any other means may equally be used to effect releasable
20 connection with a cutting tool holder. At the other end of the shank 10, a drill point 12 is provided. The drill point 12 may have either a single, double or multiple cutting lips adapted for the type of material intended to be cut by the element.

25 Arranged extending from the point 12 is an axial flute 13 generally parallel to the axis of the cutting element. The flute 13 comprises an indentation or cut out region which acts as a chip clearance region for particles cut during operation of the tool. In addition to the flute 13, there is
30 provided an axially extending plane or partially cylindrical section 14 which extends only partly around the periphery of the shank and a plurality of cutting teeth 15 having cutting edges taking up the remaining periphery of the shank such that the cutting edges extend generally transversely between one
35 edge 17 of the flute 13 and the plane section 14.

Each of the cutting teeth 15 comprise a sharp edge 18 at the flute edge 17 and a further sharp edge 19 following a generally helical path around the periphery of the shank 10. The sharp edge 19 produces a cutting face 20 facing towards



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the end 11 of the cutting element and an angled face 22 facing towards the drill point 12 which acts as a clearance angle. It will be appreciated that the configuration of the cutting teeth formed by edges 18,19 and faces 20 and 22 may well vary depending on the material to be cut. One typical variation might be to make the edges 19 straight rather than helical. Furthermore in a cutting assembly, at least some of the cutting teeth should be arranged to pass the free end of the sleeve member acting as a cutting thrust reaction sleeve.

10 The cutting action of the cutting element illustrated will now be described. It will be appreciated that this cutting action is resultant from movement applied by suitable apparatus, the movement comprising rotary and reciprocable motion of the type described in Australian Patent Application
15 No. 49052/79. Initially, a starting hole is formed by the drill point 12 and rotary motion only applied thereto. Once the starting hole is formed, the motion of the cutting element is such that as the edge 18 of the cutting teeth moves along the side of the material at which the cutting takes
20 place, the element is preferably in a pure rotary mode of operation.

This occurs conveniently for about 85° of rotation during which the leading edges 18 of the cutting teeth form grooves in the face of the slot in the material being cut.
25 This motion is followed by a combined rotary and reciprocating motion generally towards the end 11 of the cutting element, that is towards the apparatus producing the motion of the element. The combined axial and rotary movement occurs for about 95° of rotary motion and during this time the cutting
30 ing edges 19 shears off chips of the work material where it has previously been grooved. This cutting action occurs on one side of the tool assembly. When the cutting element reciprocates back in a reverse direction the plane regions of the element are presented to the work face of the material
35 being cut and consequently cutting does not occur.

Figures 4 and 5 of the accompanying drawings illustrate a further embodiment of the present invention particularly adapted for use cutting masonry or ceramic material. The cutting element comprises an elongated shank 10 having



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one end 11 adapted to be secured in apparatus such as that described in Australian Patent Application No. 49052/79. The opposed end 12 is formed as a drill point having a tungsten carbide tip 23 soldered or brazed to the shank 10 by conventional means. Immediately above the drill point 12 is an axial length of shank 24 formed cylindrically. This shank length 24 may be used as a location device in a guide hole formed in a base plate or block as hereinafter described. An axial section 25 is provided for mounting cutting teeth immediately above the cylindrical shank section 24. The cutting teeth section 25 is formed as a segmental cut out extending axially along the shank 10. The segmental cut out forming an axially extending rectangular surface 26. Furthermore, along this section an axially extending flute 13 is formed by removing shank material from a portion of the periphery of the shank extending from one edge of the segmental cut out surface 26 around a portion of the shank periphery. The amount of material removed progressively decreasing to eventually form a partially cylindrical surface 14 extending to the other axial edge of the segmental cut out surface 26. A tungsten carbide insert 29 having a plurality of cutting teeth 27 is provided with a surface 28 corresponding to the shank surface 26. The surfaces 26 and 28 are conveniently formed by silver soldering or brazing. Advantageously, the shape of the teeth 27 are green pressed into the insert in a presintered condition of the insert. The configuration of the teeth may be of the same general arrangement as the teeth previously described in relation to the embodiment of figures 1 and 3, however, the detailed shape of the cutting teeth may vary depending on the nature of the material to be cut.

In operation, the cutting element of figures 4 and 5, cuts an initial hole in the material to be cut using the drill point 12. Thereafter, the shank region 24 may pass downwardly into a bore in a base plate or block which will act as a guide for the element in its reciprocating movement mode. The cutting action is generally as described in relation to the embodiment of figures 1 and 3 with cutting by the teeth 27 occurring on the upward movement direction. When using a base plate with a guide bore the apparatus operating



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the cutting element is held stationary and the work material is progressively moved passed the cutting element to form a slot of any desired configuration. This has particular advantages in that substantial radial pressure may be applied
5 against the cutting element and the substantially plain section 24 of the shank 10 will not damage or enlarge the guide bore in the base plate. This arrangement is useful in cutting ceramic material such as ceramic tiles. In such applications it is also useful to employ a plastic or leather washer
10 against the sleeve member and press the washer against the ceramic material being cut to prevent cracking of the material and to minimize chipping.

The cutting element according to the present invention has good characteristics in respect to freedom from clogging with the material cut as unlike jigsaws where chips tend
15 to get trapped in their reciprocating teeth, the combined rotary and reciprocating action transfers the chips to the cut side of the slots for disposal. In addition, during the cutting part of the cycle when the cutting tool is drawn
20 towards the cutting apparatus, the work material may be supported against a sleeve member (which surrounds the cutting element) associated with the cutting apparatus. The sleeve member then forms a support surface to support the cutting reaction. This supports the work adjacent to the cutting zone
25 and ensures a very clean cut edge free from burrs or torn material on the tool side of the work. No burr is formed on this other side due to the inwards direction of the cut from that side. This is of particular advantage when cutting such materials as plywood, particle board and the like which tend
30 to splinter badly.

It should also be appreciated that the cutting element hereinbefore described, is not restricted to cutting slots and openings. For example, the cutting element illustrated and described in relation to figures 1 to 3 of the accompanying drawings may be employed to produce blind cavities.
35



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A cutting element having an elongated shank with at least one cutting region along said shank or an axial section of said shank, the or each said cutting region having an axially extending flute and a plurality of cutting teeth having cutting edges generally transverse to the axis of the shank, said cutting edges terminating at one axial edge of said axially extending flute.
2. A cutting element according to claim 1 wherein a drill point is provided at at least one end of said shank.
3. A cutting element according to claim 1 or claim 2 wherein the transverse cutting edges are inclined to the axis of the shank or helically formed relative to the axis of the shank.
4. A cutting element according to claim 2 or claim 3 when appended to claim 2 wherein said axially extending flute extends from a position adjacent said drill point and said transverse cutting edges are formed substantially as an extension of said drill point along said shank.
5. A cutting element according to claim 2 or claim 3 when appended to claim 2 wherein said axially extending flute extends a predetermined distance along said shank and is spaced from said drill point by a substantially cylindrical length of said shank.
6. A cutting element according to any one of claims 1 to 5 wherein a substantially part cylindrical land is provided in said cutting region extending axially along said shank circumferentially between said axially extending flute and said cutting teeth.
7. A cutting element according to any one of claims 1 to 6 wherein said cutting teeth are formed on an insert secured in a recess extending along said shank.
8. A cutting element according to claim 7 wherein said insert is produced from tungsten carbide.
9. A cutting assembly comprising a cutting element having an elongated shank, a cutting region extending along said shank or along an axial section thereof, said cutting region having an axially extending flute and a plurality of cutting teeth having cutting edges generally transverse to



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the axis of said shank, said cutting edges terminating at one axial edge of said axially extending flute, a sleeve member through which the cutting element is adapted to move in the direction of the axis of said shank, and means for establishing relative reciprocation of said cutting element through said sleeve member upon rotation of said cutting element whereby at least one of said cutting teeth passes into and out of the sleeve member.

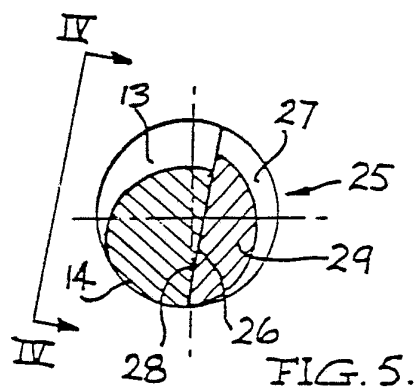
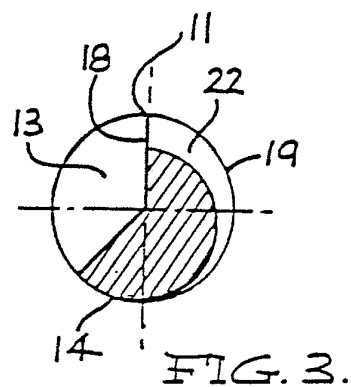
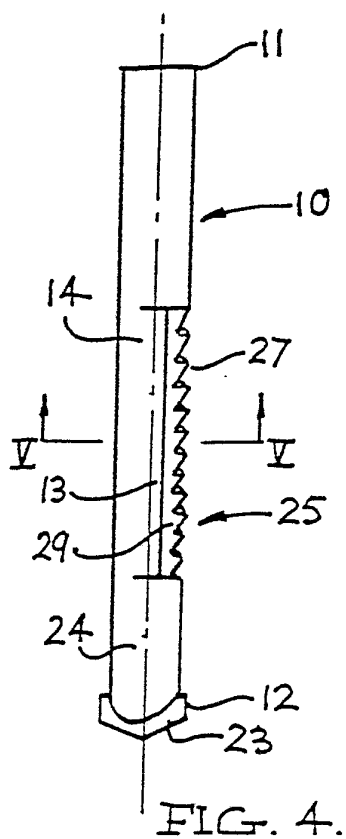
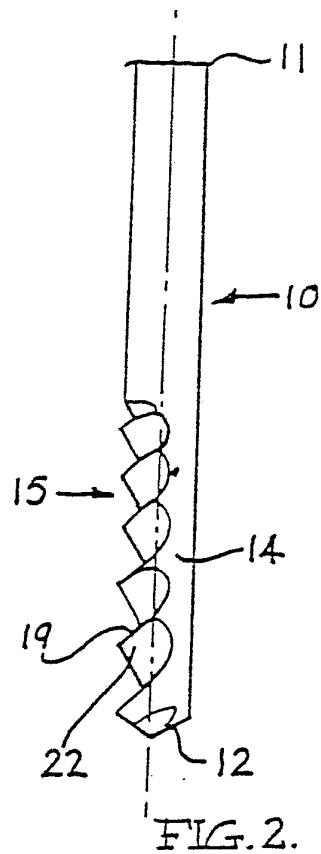
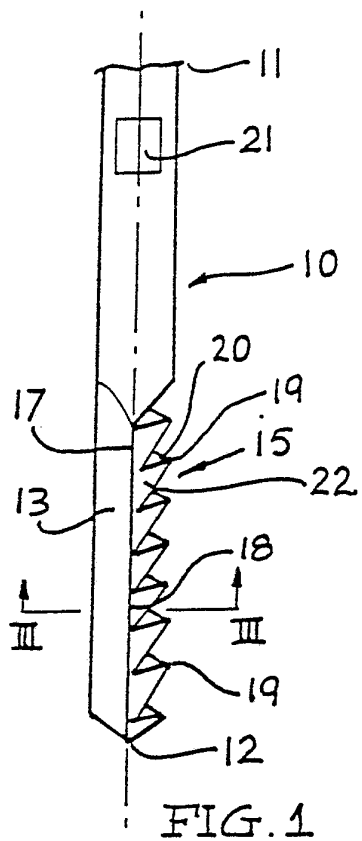
10. A cutting assembly according to claim 9 wherein a drill point is provided at at least one end of the shank of said cutting element.

11. A cutting assembly according to claim 9 or claim 10 wherein cam means is provided to effect said relative reciprocation of the cutting element.

12. A cutting assembly according to claim 11 wherein a part of said cam means is either integrally formed with said cutting element or formed on a holding member with which the cutting element is releasably held.



1/1



INTERNATIONAL SEARCH REPORT

International Application No **PCT/AU81/00150**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC Int. Cl.³ B23D 27/02 B23D 51/08																													
II. FIELDS SEARCHED Minimum Documentation Searched ⁴ <table style="width: 100%; border: none;"> <tr> <td style="width: 30%; border: none;">Classification System</td> <td style="border: none;">Classification Symbols</td> </tr> <tr> <td style="border: none; text-align: center; padding-top: 10px;">IPC</td> <td style="border: none; text-align: center; padding-top: 10px;">B23D 27/02 B23D 51/08 B23D 43/02</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵ AU IPC as above Australian Classification 72.7, 72.9			Classification System	Classification Symbols	IPC	B23D 27/02 B23D 51/08 B23D 43/02																							
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; font-size: 0.8em;">Category *</th> <th style="width: 70%; font-size: 0.8em;">Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="width: 20%; font-size: 0.8em;">Relevant to Claim No. ¹⁸</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">X</td> <td>AU, B, 937/36 (MILLER, et al) 26 November 1936 (26.11.36)</td> <td style="text-align: center;">1 - 8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>AU, B, 13787/52 (162503) (OFFICINE MECEANICHE MAGAR SOC.) 15 January 1953 (15.01.53)</td> <td style="text-align: center;">1 - 8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>McPHERSON'S LTD, CATALOGUE, 1966 Edition, McPHERSON'S LTD, MELBOURNE PP 62 and 73</td> <td style="text-align: center;">1 - 8</td> </tr> <tr> <td style="text-align: center;">X</td> <td>AU, A, 20417/48 (McPHERDRAN) 8 July 1948 (08.07.48)</td> <td style="text-align: center;">1 - 8</td> </tr> <tr> <td style="text-align: center;">P</td> <td>EP, A, 7-523 (McPHERSON'S LTD.) 6 February 1980 (06.02.80)</td> <td style="text-align: center;">1 - 8</td> </tr> <tr> <td style="text-align: center;">P</td> <td>GB, A, 1583 818 (VENTIVE, AB.) 4 February 1981 (04.02.81)</td> <td style="text-align: center;">1 - 12</td> </tr> <tr> <td style="text-align: center;">A</td> <td>DE, A, 2426 072 (LARIKKA) 19 December 1974 (19.12.74) See fig 1 - 3</td> <td style="text-align: center;">9 - 12</td> </tr> <tr> <td style="text-align: center;">A</td> <td>AU, A, 27990/49 (THOMAS DE LA RUE CO. LTD.)</td> <td style="text-align: center;">9 - 12</td> </tr> </tbody> </table>			Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸	X	AU, B, 937/36 (MILLER, et al) 26 November 1936 (26.11.36)	1 - 8	X	AU, B, 13787/52 (162503) (OFFICINE MECEANICHE MAGAR SOC.) 15 January 1953 (15.01.53)	1 - 8	X	McPHERSON'S LTD, CATALOGUE, 1966 Edition, McPHERSON'S LTD, MELBOURNE PP 62 and 73	1 - 8	X	AU, A, 20417/48 (McPHERDRAN) 8 July 1948 (08.07.48)	1 - 8	P	EP, A, 7-523 (McPHERSON'S LTD.) 6 February 1980 (06.02.80)	1 - 8	P	GB, A, 1583 818 (VENTIVE, AB.) 4 February 1981 (04.02.81)	1 - 12	A	DE, A, 2426 072 (LARIKKA) 19 December 1974 (19.12.74) See fig 1 - 3	9 - 12	A	AU, A, 27990/49 (THOMAS DE LA RUE CO. LTD.)	9 - 12
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Continued * Special categories of cited documents: ¹⁵ "A" document defining the general state of the art "E" earlier document but published on or after the international filing date "L" document cited for special reason other than those referred to in the other categories "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but on or after the priority date claimed "T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention "X" document of particular relevance																													
IV. CERTIFICATION <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> Date of the Actual Completion of the International Search ² 1 December 1981 (01.12.81) International Searching Authority ¹ Australian Patent Office </td> <td style="width: 50%; border: none; vertical-align: top;"> Date of Mailing of this International Search Report ² 08 DECEMBER 1981 (08-12-81) Signature of Authorized Officer ²⁰ D. B. Cypit </td> </tr> </table>			Date of the Actual Completion of the International Search ² 1 December 1981 (01.12.81) International Searching Authority ¹ Australian Patent Office	Date of Mailing of this International Search Report ² 08 DECEMBER 1981 (08-12-81) Signature of Authorized Officer ²⁰ D. B. Cypit																									
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FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

	4 August 1949 (04.08.49) pages 7-9 and fig 7	
A	FR,A, 701547 (FOUQUET) 17 March 1931 (17.03.31) fig 4	9 - 12
A	US,A, 2214 584 (HEYDENBURG) 10 September 1940 (10.09.40) figures 3 and 4	9 - 12

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.