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(54) REAMERS

(71) We, MAPAL FABRIK FUR PRAZISIONSWERKZEUGE DR. KRESS KG, a German company, of D-7080 Aalen, Obere Bahnstr. 13, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to reamers, and particularly to an improvement in a known reamer in which a plurality of blades, circumferentially distributed about the axis of reamer rotation, radially project from the front end or cutter head of the reamer.

In known multiple-blade reamers, the radially exposed, axial blade edges guide the reamer in the bore or hole in the workpiece. The known blades have approximately cylindrically arcuate edges formed by outwardly-facing lands for adequate guiding action, or they may have straight lands inclined at a very small relief angle to a tangent perpendicular to a radius drawn from the axis of rotation through the blade edge.

It is the primary function of the circumferentially distributed blade edges to remove very small and thin chips from the bore wall in order to improve the dimensional accuracy, precisely circular cross section, smoothness and cleanliness of the bore. The conventional cutting edge configurations constitute a compromise between the contradictory requirements for the guiding and smoothing functions. The unavoidable circumferential width of the lands in known reamer blades reduces the available maximum cutting rate.

It is desirable to increase the permissible cutting speed of a multiple-blade reamer without impairing the smoothness of the bore wall, and to provide a bore of more precisely circular cross section at higher cutting rates than was available heretofore.

According to the invention there is provided a reamer comprising:

(a) a shank defining an axis of rotation;

(b) a cutter head at one axially terminal

portion of said shank;

(c) a plurality of cutting blades mounted on said cutter head,

(1) each cutting blade having a cutting edge extending in the direction of said axis and disposed radially outwardly of said cutter head,

(2) said cutting edges being circumferentially distributed around said cutter head,

(d) adjusting means for individually varying the radial spacing of each cutting edge from said cutter head; and

(e) an axially elongate guide rib radially projecting from said cutter head between a pair of circumferentially adjacent cutting edges.

Thus, in a preferred embodiment, the smoothing and guiding functions of the conventional blades can be distributed between blades shaped for best cutting performance and axially elongate guide ribs circumferentially interposed between adjacent cutting blades. With this arrangement, the reamer is precisely and stably guided in the bore while the wall surface of the bore is machined by the blades under optimum conditions for this task independently of the guide function assumed by the ribs.

The guide ribs may have outwardly-facing lands which are cylindrically arcuate substantially about the axis of reamer rotation and of any desired circumferential width, whereas the cutting blades may be ground to provide very narrow cutting edges formed by outwardly-facing lands at a relief angle much greater than available heretofore, more specifically at least 5°, for efficient and precise finishing of the bore wall.

It is possible to provide one guide rib in the gap between each pair of circumferentially successive cutting blades, approximately centred between the blades, but preferably slightly nearer the blade leading in the direction of reamer rotation, which, as is known, is associated with the orientation of the blades in the head. Reamers equipped with two blades benefit most from having guide ribs arranged according to the invention, but the performance of reamers having three or more blades is also improved.

While a substantial improvement is

achieved if the guide ribs extend over substantially the entire axial length of the cutting edges higher machining speeds without loss in precision may be available if the interposed guide ribs extend axially beyond the blade edges toward the reamer shank. They may be supplemented by at least one auxiliary guide rib at least approximately axially aligned with a respective one of the cutting edges.

Arrangements embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows a reamer of the invention in fragmentary side elevation;

Fig. 2 illustrates a modification of the reamer of Fig. 1;

Fig. 3 is a front elevation of the reamer of Fig. 1; and

Fig. 4 shows the reamer of Fig. 2 in section on the line IV—IV.

Referring now to Fig. 1 in detail, there is shown the axial front end of a reamer shank 1, conventional in itself, which is integrally joined to an enlarged, basically cylindrical cutting head 2. Two axially elongate, reversible cutting blades 3 are set in diametrically opposite slots of the head 2 from which the cutting edges of the blades (known as the secondary cutting edges) are radially spaced. The blades are fixedly, but releasably, fastened to the head 2 by clamping jaws 4. The extent to which each secondary cutting edge projects beyond the cylindrical head surface and the angle defined by each edge and the axis of rotation may be adjusted to some extent by set screws 7, as is described in more detail in our co-pending U.K. Patent Application No. 45523/76 (Serial No. 1,568,078).

As is best seen in Fig. 3, the secondary cutting edges of the blades 3 are diametrically opposite each other, and two straight guide ribs 5 are approximately centered in the respective circumferential 180° gaps between the blades 3, but actually slightly nearer the leading blade, the direction of rotation of the reamer being counterclockwise, as viewed in Fig. 3. As is further evident from Fig. 3, each blade is ground to a sharp edge formed by an outwardly-facing land having a width too small to permit pictorial representation on the scale of the drawing, and the relief angle is approximately 10°.

The guide ribs 5 radially project beyond the cylindrical face of the head 2 about as far as the cutting edges of the blades 3 and have arcuate outwardly-facing lands which are parallel to the cylindrical head face over a circumferential width which is several times the width of the blade edges. The axial length of each rib 5 is practically identical with that of the cutting edge on a

blade 3, and the front and rear ends of the cutting edges and of the ribs are located in respective common radial planes.

In the modified reamer shown in Figs. 2 and 4, two ribs 5¹ are arranged in the gaps between the two oppositely projecting cutting blades 3 as described with reference to Figs. 1 and 3. However, the ribs 5¹ are almost four times as long as the associated blades 3, and project beyond the blades toward the shank 1, thereby improving the guiding effect. Auxiliary guide ribs 6, identical in cross section with the ribs 5¹, are axially aligned with the two blades 3 in such a manner that their ends near the shank 1 are located in a common radial plane with the rear ends of the ribs 5¹ whereas the front ends of the latter are located in a common radial plane with the front ends of the blades 3.

It should be understood, of course, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the scope of the invention set forth in the appended claims.

WHAT WE CLAIM IS:—

1. A reamer comprising:

- (a) a shank defining an axis of rotation;
- (b) a cutter head at one axially terminal portion of said shank;
- (c) a plurality of cutting blades mounted on said cutter head,

(1) each cutting blade having a cutting edge extending in the direction of said axis and disposed radially outwardly of said cutter head,

(2) said cutting edges being circumferentially distributed around said cutter head,

(d) adjusting means for individually varying the radial spacing of each cutting edge from said cutter head; and

(e) an axially elongate guide rib radially projecting from said cutter head between a pair of circumferentially adjacent cutting edges.

2. A reamer as claimed in claim 1, including a plurality of axially elongate guide ribs projecting from said cutter head, each disposed between a respective pair of circumferentially adjacent cutting edges.

3. A reamer as claimed in claim 1 or 2, wherein the or each guide rib is disposed substantially at the center of the circumferential gap between the pair of cutting edges.

4. A reamer as claimed in claim 1 or 2, wherein the or each pair of circumferentially adjacent cutting edges comprises a leading cutting edge and a trailing cutting edge with respect to a direction in which the reamer is arranged to rotate, the guide rib disposed

between the cutting edges being circumferentially nearer the leading cutting edge than the trailing cutting edge.

- 5 5. A reamer as claimed in any preceding claim, wherein the or each side guide rib extends axially over substantially the entire axial length of the associated cutting edges, and further extends axially beyond the associated cutting edges in a direction from said cutter head toward said shank.

- 10 6. A reamer as claimed in claim 5, further comprising at least one auxiliary guide rib substantially axially aligned with a respective one of said cutting edges, said auxiliary guide rib being axially elongate and extending from said cutting edge in a direction from said cutter head toward said shank.

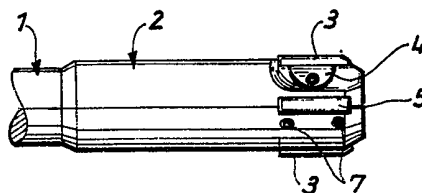
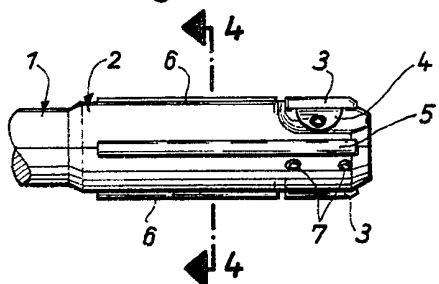
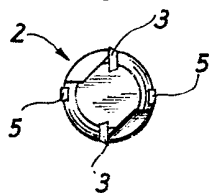
- 15 7. A reamer as claimed in any preceding

claim, wherein each of said cutting edges comprises an axially elongate land defining a relief angle of at least 5° with a tangent perpendicular to a radius drawn from said axis through said cutting edge. 20

8. A reamer as claimed in any preceding claim, wherein said plurality of cutting blades consists of two blades the cutting edges of which are diametrically opposite each other. 25

9. A reamer substantially as described herein with reference to Figures 1 and 3 or Figures 2 and 4 of the accompanying drawings. 30

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Fig. 1**Fig. 2****Fig. 3****Fig. 4**