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(54) IMPROVEMENTS IN OR RELATING TO MACHINES FOR TUNNELLING, MINING OR EXCAVATING

(71) We, BOUYGUES, a French Body Corporate of 381 Avenue du General de Gaulle, 92 Clamart, France, do hereby declare the invention, for which we pray that a patent may be granted us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a machine for tunnelling, mining of minerals, or for excavation.

According to the invention, there is provided a machine for tunnelling, mining of minerals, or excavation, comprising a rotary head carrying cutting tools at the front of the machine and also carrying at least one bucket for collecting removed material, the bucket having an inlet opening for collecting removed material and an outlet opening arranged behind and adjacent to the inlet opening, the two openings facing in different directions, with the outlet opening facing in a direction away from the axis of the rotation of the head.

Embodiments of the invention will now be described by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic side elevation of a tunnelling, mining, or excavating machine according to the invention, the machine being shown in a gallery;

Figure 2 shows schematically a collecting bucket of the machine, the bucket being shown in a low, collecting, position;

Figure 3 shows the bucket of Figure 2 in its highest position when the material collected by the bucket in the low, collecting, position, shifts within the bucket;

Figure 4 is a front view of a rotary head of a machine with some parts having been removed and incorporating a modified form of bucket;

Figure 5 is a side elevation of the rotary head of the machine of Figure 4 to an enlarged scale; and

Figure 6 is a schematic front elevation of a deflector against which the outlet of the bucket moves during the rotation of the bucket, the bucket itself being shown in broken lines in this Figure.

Referring now to the drawings, Figure 1 schematically shows the machine in longitudinal view in a gallery 1 being excavated, the maching comprising a frame 2 on which a head 4 is mounted to rotate about axis 3, on which head are mounted tool-holding arms 5 and buckets 6.

The rotating head 4 carries a plurality of tool-holding arms 5 and a plurality of buckets 6, with each bucket 6 being disposed between each pair of adjacent tool-holding arms. In the particular embodiment shown, there are three tool-holding arms 5 and three buckets 6 (see Figure 4).

Each bucket 6 comprises an inlet passage 7 provided at one end with an inlet opening 8 and communicating via a transfer opening 9 at its other end, with an outlet passage 10 provided with an outlet opening 11. The opening 11 is disposed to the rear end of and adjacent the opening 8, but the two openings face in different directions. The opening 8 is substantially parallel to the axis of rotation 3 about which the head 4 and thus the bucket 6 rotates. The opening 11 faces away from the axis of rotation 3, and in the embodiment shown the opening 11 is disposed to describe substantially a truncated surface about the axis of rotation 3.

The operation will now be described.

It has been assumed in the Figures that the head 4 which carries the buckets rotates in anti-clockwise direction.

Figure 2 shows the bucket in its collecting position which corresponds substantially to the lowest position of the bucket. In this position, the excavated material accumulated at the bottom of the face of the gallery is taken through the opening 8 into the

passage 7.

During the following upward movement of the bucket, the material moves towards the other end of passage 7 and is transferred to the adjacent end of the outlet passage 10. This transfer is normally completed when the bucket passes through its highest position, at the end of its upward movement, as shown in Figure 3. The rearwards displacement of the material is thus effected by the movement of the bucket during rotation of the head.

The transfer of the material from the passage 7 to the passage 10 may be effected directly through the opening 9 as shown in Figures 2 and 3 or through an intermediate passage 16 (as shown in Figures 4 and 5).

In the highest position of the bucket, the excavated material accumulated in the bottom of passage 10 cannot leave the passage since the opening 11 is at this moment directed upwardly. The subsequent downward movement of the bucket has for its effect the progressive inclination of the opening 11 downwardly to a maximum inclination which corresponds substantially to the lowest position of the bucket, which is also the beginning of collection position as shown in Figure 2.

In this position, the excavated material which has been progressively displaced towards the outlet opening 11 of the passage 10 drops freely by gravity through opening 11 and is collected by a conveyor 12 which extends along the length of the machine and which shifts the excavated material rearwardly, possibly towards another conveyor 13 (Figure 1).

To ensure that the excavated material falls onto the conveyor, a deflector 14 is provided. The deflector 14 preferably has the shape of part of a frusto conical surface centred on the axis of rotation 3. It is not necessary for the deflector to extend above a horizontal passing through the axis 3 and it is interrupted at the position where the conveyor is located. Figure 6 shows a front view of the deflector 14 with a gap 15 which provides the interruption in the zone of the conveyor. The outlet opening 11 of the bucket is designed substantially to sweep the inner face of the deflector during the rotation of the bucket.

The form of the deflector and of the outlet opening of the bucket may vary from that illustrated, as may the configuration of the bucket between the inlet opening and the outlet opening.

Figures 4 and 4 show by way of example an embodiment in which the bucket 6 is composed of a rectilinear inlet passage 7 of generally square or rectangular section, and a likewise rectilinear outlet passage 10 of substantially rectangular section, these two passages communicating via an intermediate passage 16. Figure 5 shows the opening 8 of the passage 7 and the outlet opening 11 of passage 10, as well as a part of the intermediate passage 16.

More generally, the bucket may be of any shape, but preference is given to shapes which allow uniform displacement of the collected product from the inlet opening to the outlet opening of the bucket.

As shown in Figure 5, the inlet opening 8 is provided with an attachment 17 which facilitates the collecting of the excavated material. The outlet opening 11 is a flat outlet which is oblique with respect to the axis of the outlet passage and with respect to the axis of rotation of the buckets. Figure 5 also shows two of the tool-holding arms between which the bucket 6 is located.

In this construction, the buckets are formed by assembling the three passages of which they are composed. In Figure 4, only one of the buckets is complete and comprises these three passages 7, 16 and 10. The other two buckets have not yet received their passage 7.

In Figures 4 and 5, the tool-holders 5 have been shown without their tools.

The machine particularly described can be used in galleries of small diameter, for example 2 to 3 metres.

WHAT WE CLAIM IS:-

1. A machine for tunnelling, mining of minerals, or excavation, comprising a rotary head carrying cutting tools at the front of the machine and also carrying at least one bucket for collecting removed material, the bucket having an inlet opening for collecting removed material and an outlet opening arranged behind and adjacent to the inlet opening, the two openings facing in different directions, with the outlet opening facing in a direction away from the axis of the rotation of the head.

2. A machine according to claim 1, wherein the openings of the bucket are so located that the outlet opening is in a dumping position when the inlet opening is in a collecting position which is attained when the bucket passes through a low position during rotation of the head.

3. A machine according to claim 1 or claim 2, wherein the inlet opening is substantially parallel to the axis of rotation of the head.

4. A machine according to any one of claims 1 to 3, wherein the outlet opening is disposed to describe substantially a truncated surface about said axis when the head rotates.

5. A machine according to any one of claims 1 to 4, wherein the bucket comprises an inlet passage inside which the material moves during upwards movement of the bucket in the rotation of the head, and an outlet passage inside which the material

moves during downwards movement of the bucket in the rotation of the head.

6. A machine according to claim 5, wherein transfer of the material from the inlet passage to the outlet passage is effected via an intermediate passage as the bucket passes from movement upwardly to movement downwardly in the rotation of the head.

7. A machine according to any one of claims 1 to 6, further comprising a deflector having a face which is swept by the outlet opening of the bucket during rotation of the head, said deflector being provided with an opening through which the material is discharged.

8. A machine substantially as hereinbefore described with reference to the accompanying drawings.

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1592216 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG_1

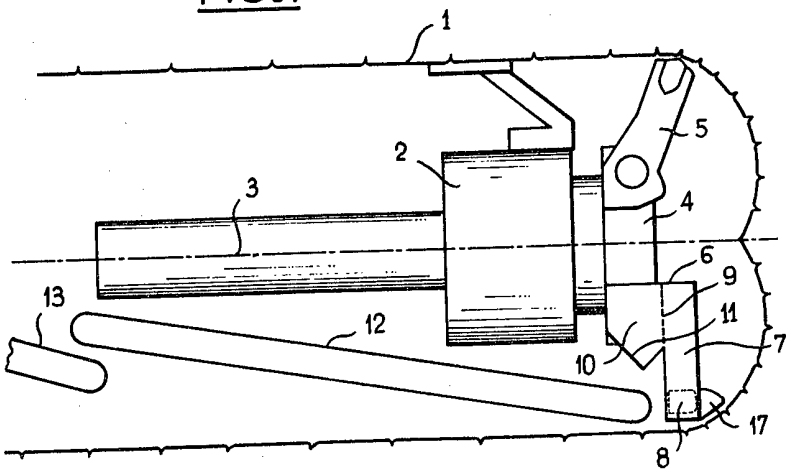
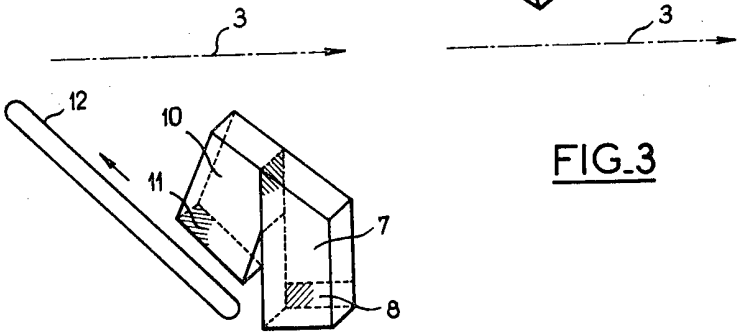


FIG_2



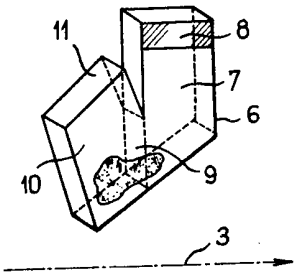


FIG_3

1592216 COMPLETE SPECIFICATION
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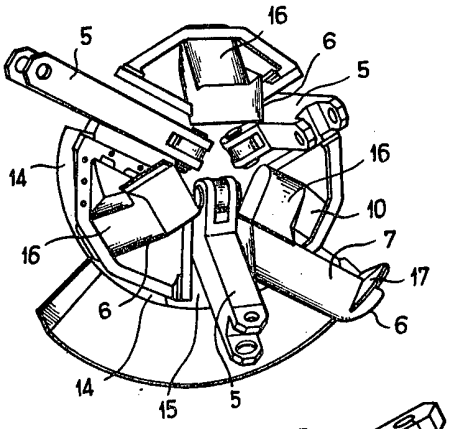
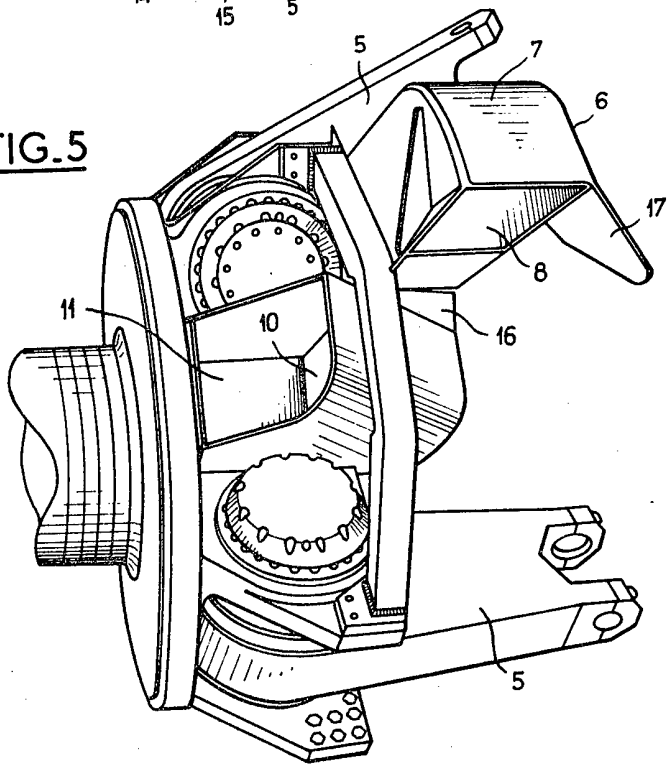


FIG_4

FIG_5



1592216 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

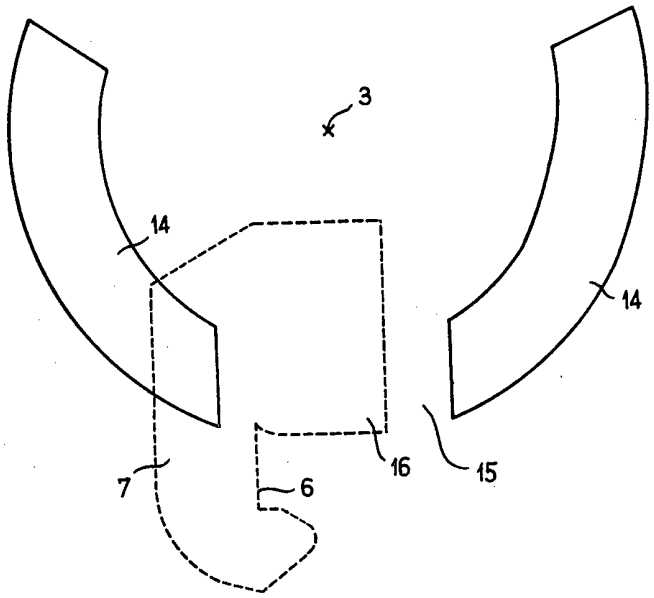


FIG.6