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(54) A machine for cutting a trench in rock.

(57) The invention provides a machine for cutting a trench in rock wherein, in order to avoid cutter head bounce if the cutter were mounted at the end of a boom and to thereby provide an improved cutting action, a telescopic control arm (25) is secured to the end of the boom (11) adjacent to the cutting head (21). The boom (11) is pivotally secured to a trailing crawler chassis (3) and the telescopic control arm (25) is secured to a forward crawler chassis (5).

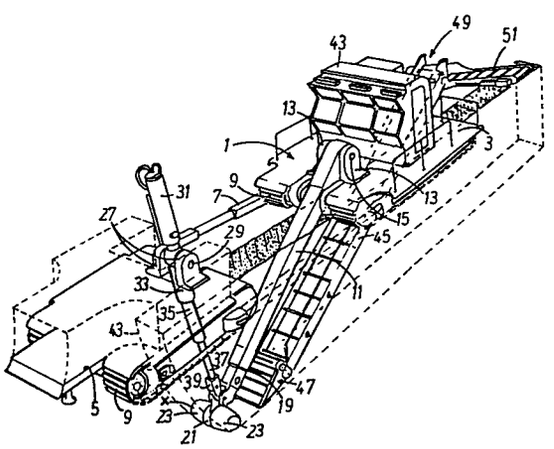


Fig 2.

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DESCRIPTION

"A MACHINE FOR CUTTING A TRENCH IN ROCK"

The present invention relates to a machine for cutting a trench in rock.

Conventional mechanical diggers using buckets or ripper teeth have proved satisfactory for excavating a trench in relatively soft ground, such as soil and clay, but have proved unsatisfactory for cutting a trench in hard rock. There is a need for a machine to perform this task so avoiding the alternative labour intensive methods using percussion tools and explosives.

One known trench cutting machine comprises a giant chain saw mounted on a crawler chassis and equipped with tungsten carbide teeth which literally saw away the rock. These machines can cut a trench from 35 cm to 62 cm in width by using the appropriate width of chain and to a depth of up to 4.5 m. However, this machine suffers from the disadvantage that considerable bounce is generated along the saw, especially when cutting the harder rocks, and this reduces the cutting efficiency. Primarily the problem arises because of the long unsupported length of the cutting arm.

Other rock cutting machines are known for face mining operations and these comprise a rotatable cutting head carried at the end of a boom pivotably attached to a crawler chassis. However, these known machines cannot be used for cutting trenches and furthermore suffer from a similar vibration problem because they too have a long unsupported boom carrying the cutting head.

The present invention sets out to provide a machine for cutting a trench in rock which machine overcomes the problems with the known machine.

According to the present invention there is provided a machine for cutting a trench in rock comprising a

mobile work platform adapted, in use, to straddle the line of the trench, a boom pivotably secured at one end to the work platform and having at its other end a rotatable cutting head, and a telescopic control arm extending between the work platform and that end of the boom adjacent the cutting head.

Advantageously the telescopic control arm, which is in the form of a hydraulically operable ram serves to move the cutting head on an arcuate path having a centre coincident with the pivot axis of the boom. The control arm applies the necessary loading of the cutting head and because of the relatively short distance between the cutting head and the point of support, provided by the connection with the control arm, the problem with cutter head bounce is largely avoided.

In a preferred embodiment the mobile work platform comprises two crawler chassis positioned one behind the other which are coupled by a pair of tie-bars. The forward crawler carries the pivotal connection for the telescopic control arm and the rear crawler carries the pivotal connection for the boom. The boom extends forwardly and downwardly from the rear crawler. Preferably an endless conveyor is carried by the rear crawler and this is disposed aft of the boom and can be lowered into the trench formed by the cutting head so that a feed end, in use, is positioned immediately behind the cutting head so that spoil is removed from the trench and carried up the conveyor where it is transferred from the discharge end onto a transverse loading conveyor for subsequent discharge.

In a preferred embodiment the tie-rods coupling the two crawler chassis are adjustable whereby the distance between them can be varied to accommodate a shorter boom when a shallower trench is required. The boom may be telescopically adjustable in length.

Preferably the forward crawler chassis has mounted thereon a diesel engine which drives a generator for supplying all the electrical loads of the machine. For example the cutting head is preferably driven by a water cooled electric motor through an epicyclic gearbox. The telescopic ram is hydraulically operated as are the motors driving the tracks of the two crawler chassis. The necessary hydraulic pump and hydraulic reservoir is preferably mounted on the forward chassis which also accommodates a fuel tank, a water circulating tank, chiller unit and cooling fan for the diesel engine as well as the electrical switch gear and breaker switch.

The machine is operated from a control cab on the rear crawler chassis from where the operator can see the cutting head operating.

The present invention will now be described further, by way of example only with reference to the accompanying drawings in which:-

Figure 1 is a perspective view of one embodiment of a machine according to the invention,

Figure 2 is a perspective view of the machine of Figure 1 showing the cutting head and conveyor,

Figure 3 is a perspective view of a second embodiment of a machine according to the invention, and

Figures 4 and 5 illustrate alternative cutting heads for use with either of the machines of Figures 1 and 3.

Referring to the drawings there is illustrated a trenched cutting trenches through rock. The machine comprises a mobile work platform, generally indicated by reference numeral 1 which comprises two crawler chassis 3,5 disposed one behind the other and coupled together by a pair of tie bars 7. The tie bars 7 may be fixed in length or may be adjustable telescopically by means of hydraulically operable rams, not shown.

Both crawler chassis 3 and 5, i.e. the forward tractor unit 5 and the rear tractor unit 3, are arranged

in use to straddle the line of the trench and are supported on endless tracks 9. The tracks are hydrostatically driven. The machine is manouvered in a conventional manner by driving the tracks either together or independently.

One end 17 of a boom 11 is pivotally mounted on the rear tractor unit 3 by way of mounting blocks 13 and a pivot shaft 15. The other end 19 of the boom carries a rotatable cutting head 21 which is rotated by means of a water cooled electric motor, accommodated in the boom, through an epicyclic gearbox. The cutting head illustrated in Figure 2 is a cross rotating cutter, known as a ripper cutter having two cutters 23 carrying tungsten carbide teeth, which are spaced slightly apart axially on the axis X and rotatable about the axis X. Alternatively, the cutting head may be a longitudinally rotating cutter, known as a milling cutter. Two examples of these are shown in Figures 4 and 5.

The forward tractor unit 5 has mounted thereon a telescopic control arm 25. The control arm is pivotally mounted on the forward tractor unit 5 by way of two mounting blocks 27 and two pivot pins 29. The control arm 25 comprises a cylinder 31 and a number of concentric sleeves 33, 35, 37 which are of progressively smaller diameter and which are slidably received one within the other in a fluid sealing manner to form an extensible piston. Hydraulic fluid is introduced into the cylinder 31 whereupon the control arm is extendable. The control sleeve 37 has a forked mounting bracket 39 which is coupled to the boom 11 by way of a pin 41. The bracket 39 is positioned adjacent to the cutting head 21 at the end 19 of the boom 11. Pressurisation of the fluid in the cylinder 31 causes the control arm to extend and so move the cutting head on an arcuate path, shown by dotted lines 43, whose centre is coincident with the axis of the pivot shaft 15 of the boom 11.

The machine illustrated in Figure 1 or 2 has a boom which is sufficiently long to produce a 5m deep trench with the boom inclined at an angle of 45° to the horizontal. Thus as the boom pivots through an angle of approximately 40° from ground level, the control arm pivots through an angle of approximately 50° from a position 35° to the vertical through vertical to an angle of 15° to the vertical. Thus it will be seen that the force applied by the telescopic control arm to the cutting head has a major vertical component. The position at which the control arm 25 is coupled to the boom 11 adjacent to the cutting head adds to the stability of the cutting head so eliminating the vibration and bounce problems which would be expected if the control arm were omitted and the cutting force was applied by the long boom 11.

The operators control cabin 43 is mounted on the rear tractor unit 3 from where the operator can see the cutting head in operation. The operator has controls for the cutting head speed and for raising and lowering the cutting head by means of the control arm. An endless chain conveyor 45 is mounted on the rear tractor unit and extends from a feed end 47, which in use is positioned in the trench adjacent to the cutting head and just rearwardly thereof, to a discharge end 49. The conveyor 45 may be straight as illustrated or 'S' shaped such that the gradient of the conveyor is shallow of the feed end and the discharge end and steeper inbetween. The conveyor passes through an opening in the centre of the rear tractor unit 3. A transverse endless conveyor 51 is provided which transfers spoil discharged from the conveyor 45 to the side of the machine which is more convenient for subsequent disposal.

The forward end of the conveyor 45 may be provided with a flaired snoot where the width of trench cut is

wider than the width of the conveyor. The snoot may be provided with a cam type loading device which pushes spoil from the trench onto the conveyor.

The force applied at the cutting head tends to lift the machine out of contact with the ground and the weight of the mobile platform counteracts this tendency. In certain circumstances additional ballast may be carried by either or both of the forward and rear tractor units 5,3. The front tractor unit forms the power unit and is provided with a diesel engine which drives a generator supplying the necessary electrical requirements for the machine. This is housed within the body work of the forward unit in the compartment B. A cooling fan A, water tank F and chiller unit H is provided for maintaining the diesel engine at the correct operating temperature. In addition the forward tractor unit carries the fuel tank, and necessary electrical switch gear as well as the hydraulic reservoir and pumps for the power hydraulic components such as the telescopic ram and the braking system. The conveyor may be powered by either electric or hydraulic motors.

Figure 3 shows an illustration of a similar machine to that illustrated in Figures 1 and 2 but it will be seen that in this machine the two crawler chassis are closer together. The machine is intended for cutting trenches having a maximum depth of 2m. Consequently the machine employs a different length boom, control arm, and tie rods. However, it will be appreciated that where all these components are telescopically adjustable the same machine can be used for forming trenches 2m or 5m deep. Indeed the machine having a 5m maximum depth capacity can be used for forming 2m holes merely by controlling the movement of the boom 11 by the control arm. However, it is preferred that the boom be at an angle of 45° when working at its maximum depth.

The machine is otherwise identical to the machine of Figures 1 and 2 having corresponding parts. In addition Figure 3 shows stabilising feet 55. These may be provided on the larger machine.

Figures 4 and 5 show two alternative milling cutters for use with either of the described embodiments. The illustrated ripper head is removed and replaced by the milling head which is rotated by an electric motor as previously described. Figure 4 has two contra-rotating cutting heads, Figure 5 has only one cutting head.

In operation the machine is positioned to straddle the line of the trench and the boom lowered into contact with the ground. The cutting head is rotated whilst applying force by way of the control arm to move the cutting head on an arcuate path and to remove rock from the forward end of the trench. The conveyor is positioned on the floor of the trench and the spoil carried away. The boom is raised and the machine moved forward and the process repeated. Initially it may be necessary to excavate the start of the trench by hand before commencing to use the machine for further excavation.

CLAIMS

1. A machine for cutting a trench in rock characterised by a mobile work platform (1,3,5) adapted, in use, to straddle the line of the trench a boom (11) pivotably secured at one end to the work platform (3) and having at its other end a rotatable cutting head (21), and a telescopic control arm (25) extending between the work platform (5) and that end of the boom (11) adjacent the cutting head.

2. A machine as claimed in claim 1 characterised in that the telescopic control arm (25), which is in the form of a hydraulically operable ram, serves to move the cutting head (21) on an arcuate path having a centre coincident with the pivot axis of the boom (11).

3. A machine as claimed in claim 1 or 2 characterised in that the mobile work platform (1) comprises two crawler chassis (3,5) positioned one behind the other with the boom (11) pivotally secured to one chassis (3) and the telescopic control arm (25) secured to the other chassis (5).

4. A machine as claimed in claim 3 characterised in that the two crawler chassis (3,5) are coupled together by a pair of tie-bars (7).

5. A machine as claimed in claim 3 or 4 characterised in that the leading crawler chassis carries the pivotal connection for the telescopic control arm and in that the boom extends forwardly and downwardly from the trailing crawler chassis.

6. A machine as claimed in any preceding claim characterised in that the work platform carries an endless conveyor (45) disposed aft of the boom (11) and having a feed end which, in use, is positioned immediately behind the cutting head.

7. A machine as claimed in claim 4 characterised in that the bars (7) are adjustable in length.

8. A machine as claimed in any preceding claim characterised in that the boom (11) is adjustable in length.

9. A machine as claimed in claim 3 characterised in that one of the crawler chassis (3) carries a diesel engine which drives a generator for supplying energy to the electrical loads of the machine.

10. A machine as claimed in any preceding claim characterised in that the cutting head is driven by a water cooled electric motor through an epicyclic gearbox.

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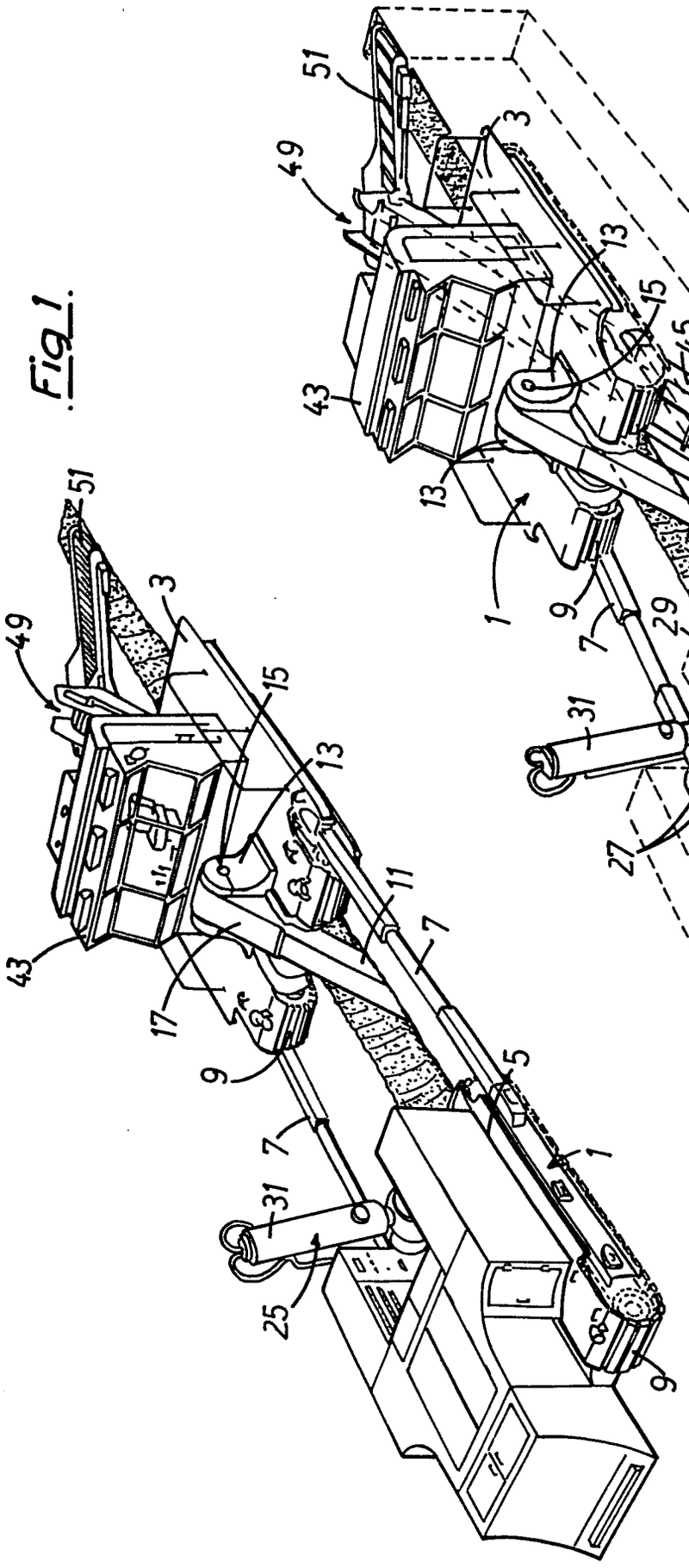


Fig.1.

Fig.2.

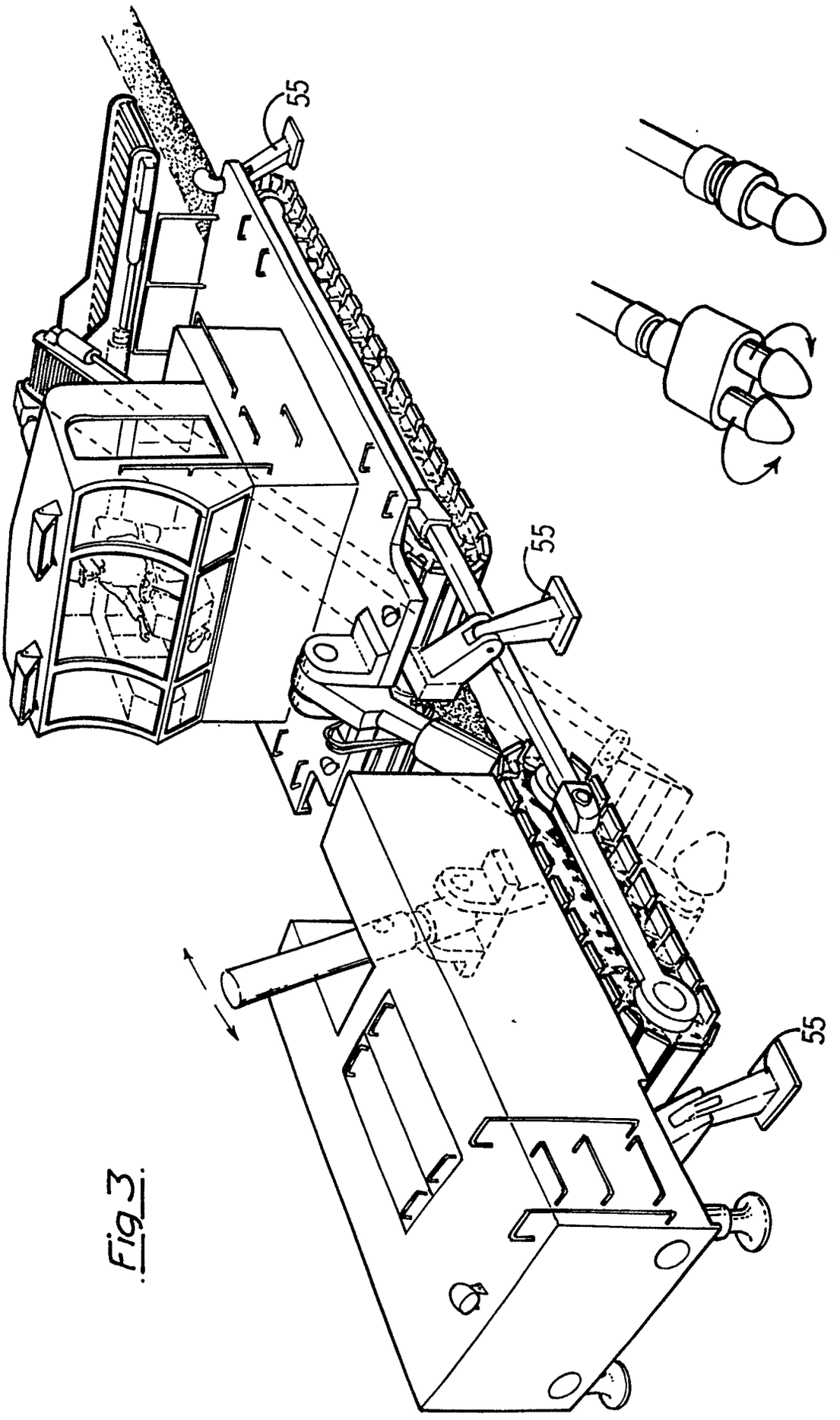


Fig 3.

Fig 4.

Fig 5.

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EUROPEAN SEARCH REPORT

0080802
Application number

EP 82 30 5455

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl. ³)
Y	DE-A-2 164 116 (HOHENSCHLÄGER) * Figure 2 *	1-4,6	E 02 F 5/08
Y	DE-B-R210 III/45a (RATHJENS) * Figure 3 *	1-4	
Y	CH-A- 239 498 (ENTREPRISE DES GRANDS TRAVAUX) * Figure 1 *	1,6	
Y	US-A-3 308 564 (PERRY et al.) * Figure 4 *	1,3-6	
Y	US-A-3 526 047 (ROESSLER et al.) * Figure 2, reference no. 152, 160 *	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
Y	US-A-3 711 970 (BRIAR) * Figure 1 *	1,3-5	E 02 F 5/00 E 21 D 9/10

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	19-01-1983	ZAPP E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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