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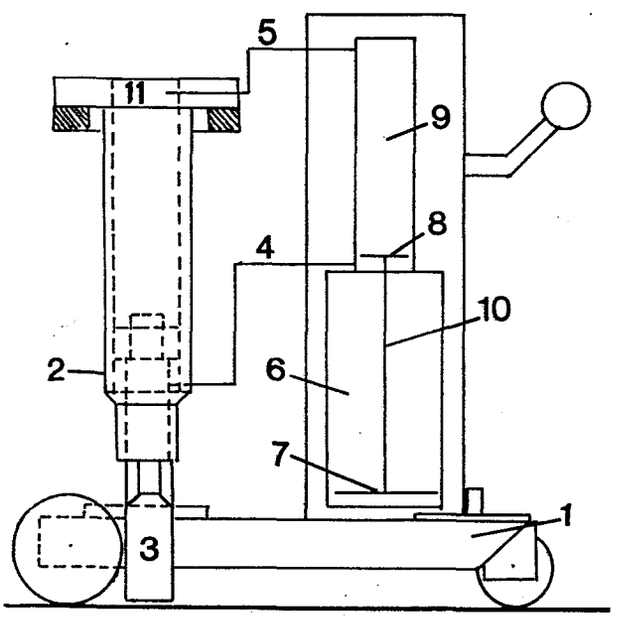
(54) **Hydropneumatic asphalt cutting machine.**

(57) Hydraulic-pneumatic asphalt cutting pneumatic hammer holder equipped with a pressure multiplier consisting of pneumatic piston (7) coaxially joined with hydraulic piston (8), with a smaller surface, so as to transform the pneumatic pressure of approximately seven atmospheres to hydraulic pressure of approximately 50 atmospheres, which then is used to power a hydraulic cylinder (11), equipped with a pneumatic hammer (2), of known type, increasing the extraction power of spade tool (3) and the driving velocity of said tool, and decreasing vibration, absorbed by the hydraulic piston.



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Hydropneumatic asphalt cutting machine

GASTONE BIFFOLI

The invention concerns an asphalt cutting pneumatic hammer holder powered hydropneumatically, based on the increased pressure achieved by pairing joined coaxial pistons of different surfaces.

The asphalt cutting machines were and realized to replace the tiring operation of manually cutting the asphalt covering on roads and the like, for the construction of cuttings, for laying electrical and telephone cables, and gas installations, previously done with pneumatic hammers equipped with spade tools, designed for digging.

Said machines of known type may be subdivided according to the type of power and feed in:

- completely hydraulically powered ashpalt shearer (including the demolition hammer) with no compressed air used.

These are autonomous, powered by a Diesel engine and must be driven by an operator; they are the most sold and the most expensive; however, they have the disadvantage of a very heavy ammortization iwth regard to their occasional use. Moreover, the operator sits on the machine itself and so is subjected to the excessive vibrations

of the hydraulic demolition hammer.

- Completely pneumatically powered asphalt cutter, with automatic feed, with no operator.

This has not been met with enthusiasm given its extremely complex mechanism and the unsuitable application of two penumatic pistons in direct contact with the pneumatic hammer which subject it to continuous breakdown; moreover their complex mechanism requires greater air consumption than simpler machines.

- Pneumatically operated asphalt cutter, with manual feed.

These present the disadvantage that only with great difficulty, if at all, is the demolition tool extracted from the asphalt once fixed in it. This problem is caused by the inadequate dimensions of the rising piston, which is not powerful enough to extract it; on the other hand, if the diameter were adequate, after the initial resistance were overcome, the extraction would occur so fast that it would be dangerous and uncontrollable, to the point of jerking the machine and putting it out of alignment on each cut.

Another problem is that a hammer heavy enough to achieve reasonable results cannot be mounted on the machine, since a heavier hammer would allow the tool to enter the

asphalt faster but would make extracting it difficult. Moreover, the pneumatic hammer bearing piston is simple in effect, that is it can only extract and not push the hammer. Said pneumatic hammer thus operates only by falling, with no possibility of regulating the advancement.

The aim of this invention is to eliminate all the inconveniences of the machines described.

This aim is achieved with an asphalt cutting machine of the pneumatic type equipped with a pressure multiplier which transforms the pneumatic pressure to hydraulic pressure increasing it from the 7 atmospheres supplied by the penumatic compressor to the approximately 50 atmospheres present in the hydraulic piston; said 50 atmosphere pressure obtained with the pressure multiplier is then fed into the hydraulic piston cylinder on which the pneumatic hammer is mounted, achieving the following advantages in succession:

1) possibility of mounting a 40Kg pneumatic hammer on the still light structure of the machine, since the extraction power obtained with the pressure multiplier allows it;
2) fast driving rates of the tool, obtained by increasing the hammer weight and by regulating the descent by adjusting the air pressure;
3) the vibrations of the pneumatic hammer are absorbed by the hydraulic piston and transmitted to the pneumatic one which in this case acts as shock absorber as well, thus preventing the vibrations from being ab-

sorbed by the carriage and so by the operator's arms;

4) certainty of extracting the tool using the hydraulic pressure in the pneumatic hammer bearing piston; possibility of adjusting both pressure and stroke, with the flow regulator, to adjust the hammer to the hardness and thickness of the asphalt to be cut;

5) elimination of mechanisms (levers, stroke stops, mechanical devices, etc.) subject by the vibrations present to wear and continuous breakdown, and presence in the automation system of pneumatic and hydraulic components only;

6) use of a small capacity air compressor (m3/2.4min) since the pneumatic components absorb a modest quantity of air.

The invention is shown in a preferred embodiment in the attached drawings, which show:

- figure 1, a schematization of a cross section of the machine;
- figure 2, a top view;
- figure 3, a side view;
- figures 4 and 5, a variant of the device for automatic step by step feed;
- figure 6, a possible hydropneumatic operating circuit.

The figures show in detail the wheeled carriage 1 bearing pneumatic hammer 2, with spade tool 3, powered by means of hydraulic tubes 4 and 5 from the pressure multiplier, consisting of cylinder 6 with pneumatically pow-

ered piston 7, coaxial and joined via hsaft 10 with hydraulic piston 8, sliding in overlaying cylinder 9 so that the force developed by inlet of air in cylinder 6 is transferred via shaft 10 to piston 8, smaller in surface than piston 7, and causes a considerable increase in the pressure exerted by piston 8 itself, which pumps the oil in its separate circuit, alternatively, by means of tubes 4 and 5, inside and outside cylinder 11, joined to hammer 2, which is in this way lowered and raised, while the base of shaft 13 and piston 14 remain joined to carriage 1. The hammer can operate behind carriage 1 as shown in dotted lines in figure 2 or may be shifted 90°, as shown by the arrow, to operate next to it for sidewalks and the like.

At the same time the simulator shown in figure 4, by means of rotation of a wheel of carriage 1, allows the cutting distance of hammer 2 to be adjusted automatically, causing a step by step feed since the single, or multiple, cam A, depending on the cutting distance, operates valve 15 which, via timer 16, which supplies the delay necessary to block the wheel in the position of maximum elevation of cam A, switches over valve 17 to brake the wheel by means of cylinder 18. Then when the slide of hammer 2 returns to the top position, it pushes against stroke stop 19 which, by means of timer 20, repositions valve 17 to unlock brake 18.

The hydropneumatic circuit shown in figure 5 functions

as follows: the operator presses valve 21 to switch over valve 23, which inverts the feed to cylinder 6 of lwo penumatic pressure, of the pressure multiplier; the oil then flows from cylinder 9, of high hydraulic pressure, through flow regulator 25, into the rear side of cylinder 11 to which hammer 2 is joined, thus causing the latter to begin to descend; at this point by pressing valve 22, valve 24 is operated to send air to hammer 2 and that is, to begin to place it in operation; once the cut is effected by the spade 3 of hammer 2, this automatically with its movement, presses stroke stop valve 26, which repositions valves 21 and 22 and, therefore, valve 21 takes air from hammer 2, closing valve 24, and valve 22 incerts 23, bringing the hammer back to its initial position.

Of course, while the principle of the finding remains the same, the forms of realization and the particulars of construction may be varied widely with respect to that described and illustrated here, without going beyond the bounds of this invention.

Claims:

1. Hydropneumatically operated asphalt cutting machine characterized by the presence of a pressure multiplier consisting of cylinder 6 with pneumatically powered piston 7, coaxial and joined via shaft 10 with hydraulic piston 8, sliding in overlaying cylinder 9 so that the force developed by inlet of air in cylinder 6 is transferred via shaft 10 to piston 8, smaller in surface than piston 7, and causes a considerable increase in the pressure exerted by piston 8 itself, which pumps the oil in its separate circuit, alternatively, by means of tubes 4 and 5, inside and outside cylinder 11, joined to hammer 2, which is in this way lowered and raised, while the base of shaft 13 and piston 14 remain joined to carriage 1.

2. Asphalt cutting machine as claimed in claim 1 characterized by the presence of a hydropneumatic circuit in which pressing valve 21 switches over valve 23, which inverts the feed to cylinder 6 of low pneumatic pressure, of the pressure multiplier; the oil then flows from cylinder 9, of high hydraulic pressure, through flow regulator 25, into the rear side of cylinder 11 to which hammer 2 is joined, thus causing the latter to begin to descend; at this point by pressing valve 22, valve 24 is operated to send air to hammer 2 and that is, to begin to place it in operation; once the cut is effected by the spade 3 of hammer 2, this automatically with its movement, presses the stroke stop valve 26, which repositions valves

valves 21 and 22 and, therefore, valve 21 takes air from hammer 2, closing valve 24, and valve inverts 23, bringing the hammer back to its initial position.

3. Asphalt cutting machine as claimed in the preceding claims characterized by an automatic step by step feed of carriage 1 caused by single, or multiple, cam A, which depending on the cutting distance, operates valve 15 which, via timer 16, which supplies the delay necessary to block the wheel in the position of maximum elevation of cam A, switches over valve 17 to brake the wheel by means of cylinder 18; then when the slide of hammer 2 returns to the top position, it pushes against the stroke stop 19 which, by means of timer 20, repositions valve 17 to release brake 18.

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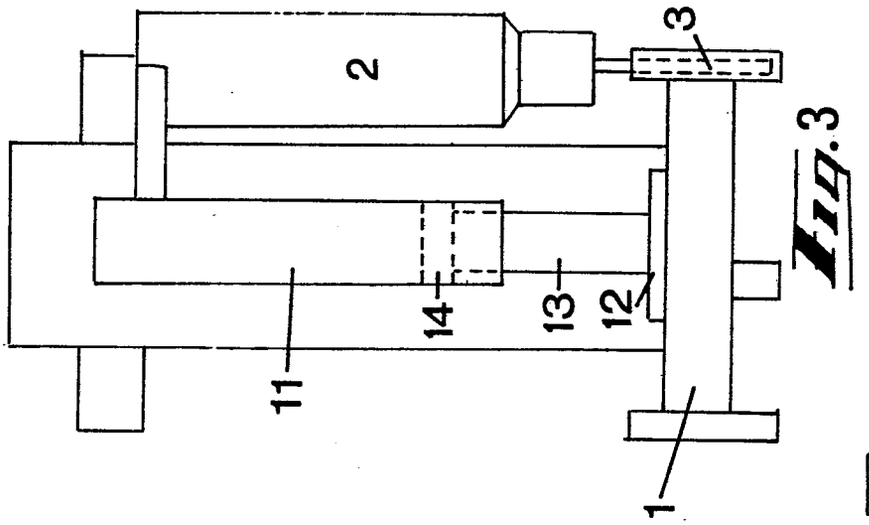

Fig.3

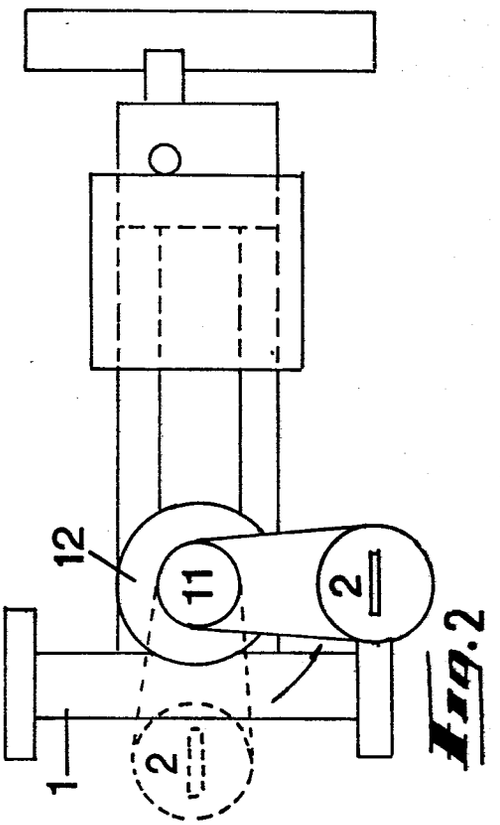

Fig.2

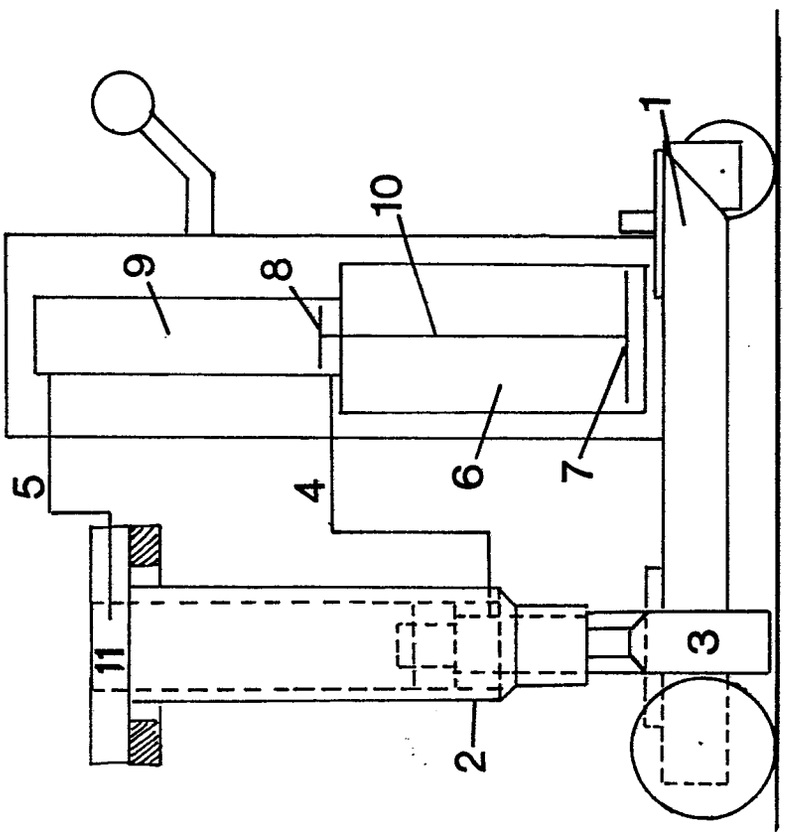

Fig.1

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Fig.4

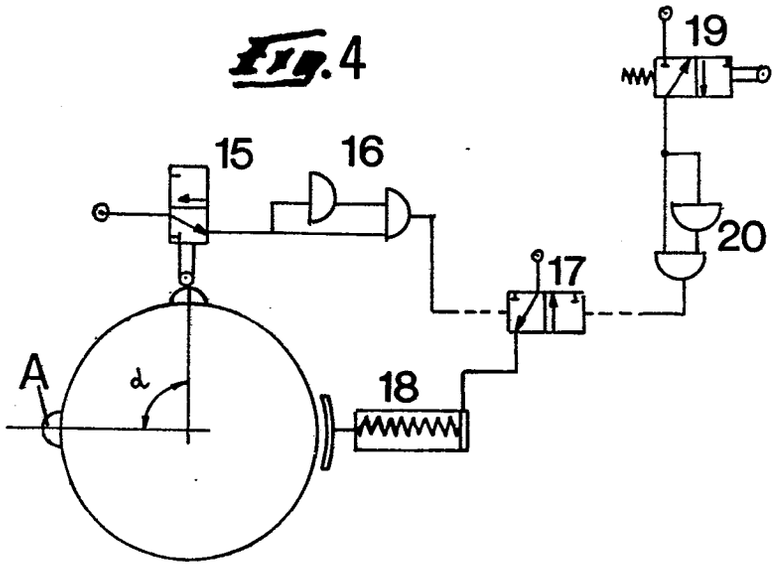
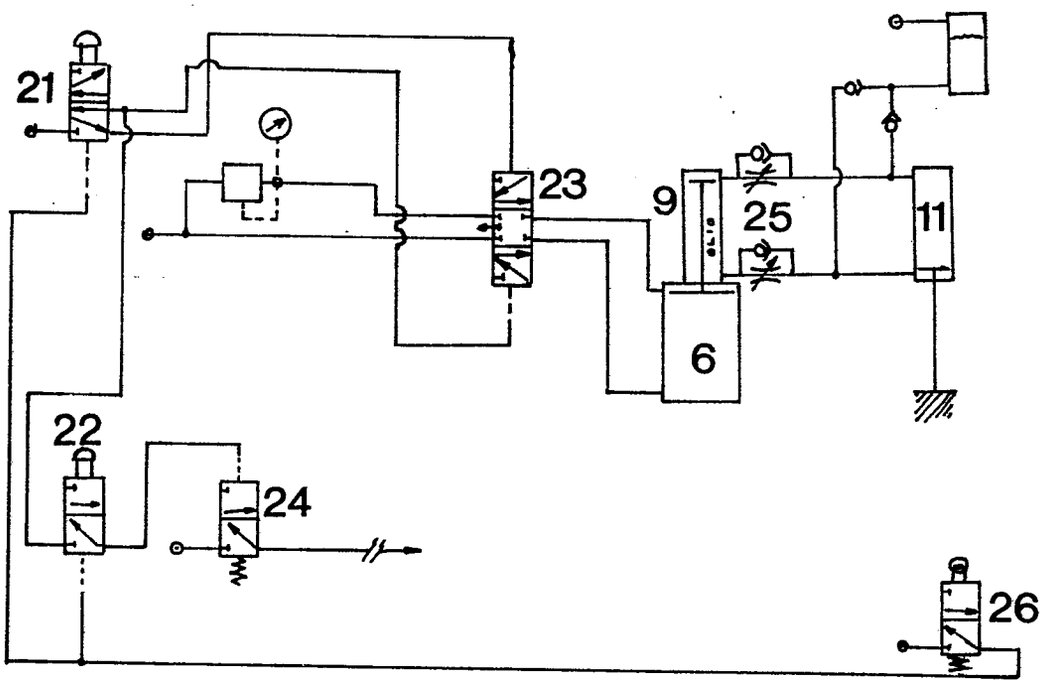


Fig.5



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EUROPEAN SEARCH REPORT

Application number
0110002

EP 82 83 0293

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)
A	US-A-3 049 097 (KERSHAW) * Column 2, line 49 - column 6, line 2; figures *	1	E 01 C 23/09
A	US-A-3 552 501 (WEISS) * Column 1, line 55 - column 3, line 41; figures *	1	
A	GB-A-1 124 649 (BODINE) * Page 2, line 42 - page 5, line 31; figures *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

E 01 C
B 25 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-03-1984	DIJKSTRA G.

CATEGORY OF CITED DOCUMENTS

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