

[54] MACHINE FOR CUTTING RECESS IN CONCRETE BY IMPACT

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Related U.S. Application Data

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[52] U.S. Cl. 299/37; 125/7; 173/32; 404/90

[51] Int. Cl. E01c 23/09

[58] Field of Search 299/37, 38; 125/6, 7; 173/32, 33, 43

[56] References Cited

UNITED STATES PATENTS

332,915	12/1885	Manning.....	125/7
1,830,751	11/1931	Cornett.....	299/37
2,407,976	9/1946	Curtis et al.	173/152 X
2,724,379	11/1955	Swenson.....	299/38 X
3,217,620	11/1965	Mindrum et al.	173/43 X
3,456,738	7/1969	Harry.....	173/32 X

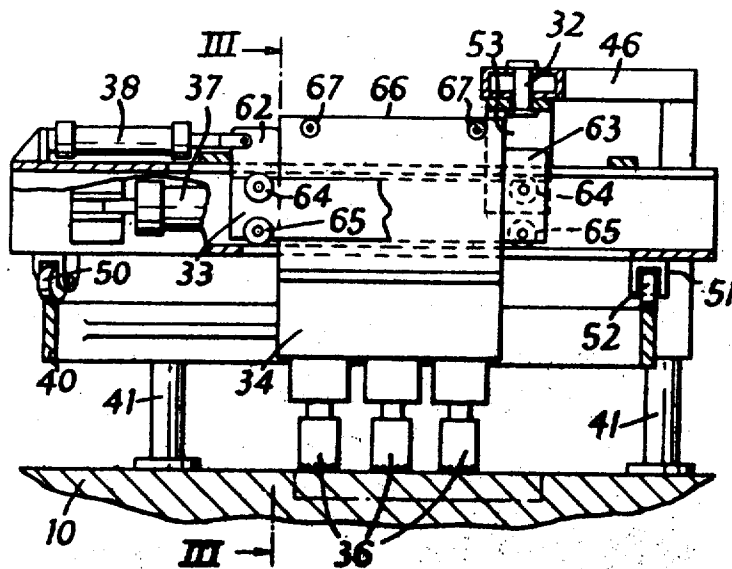
[57] ABSTRACT

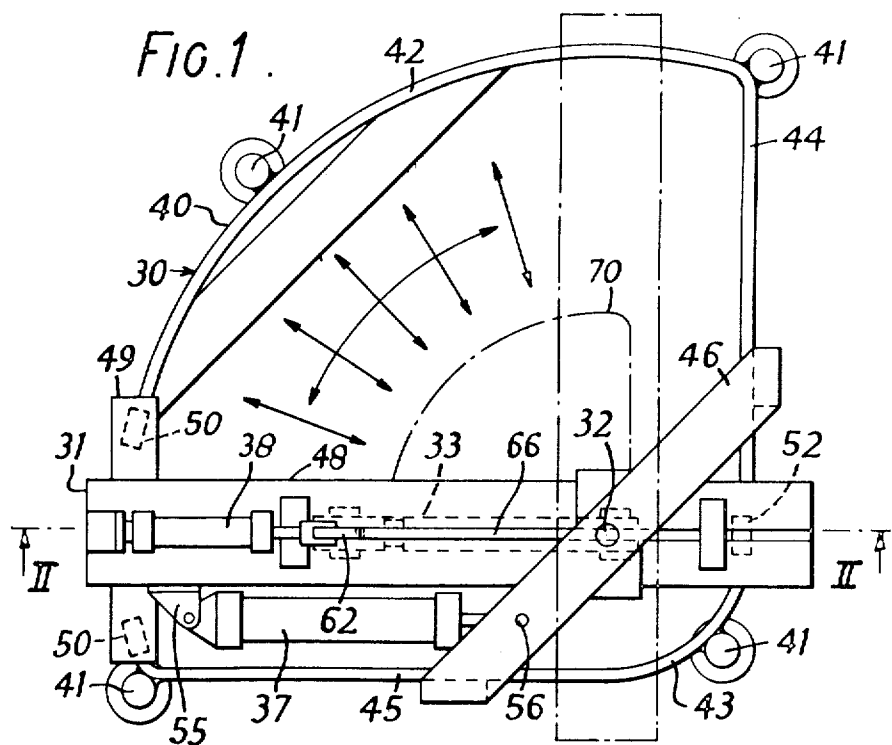
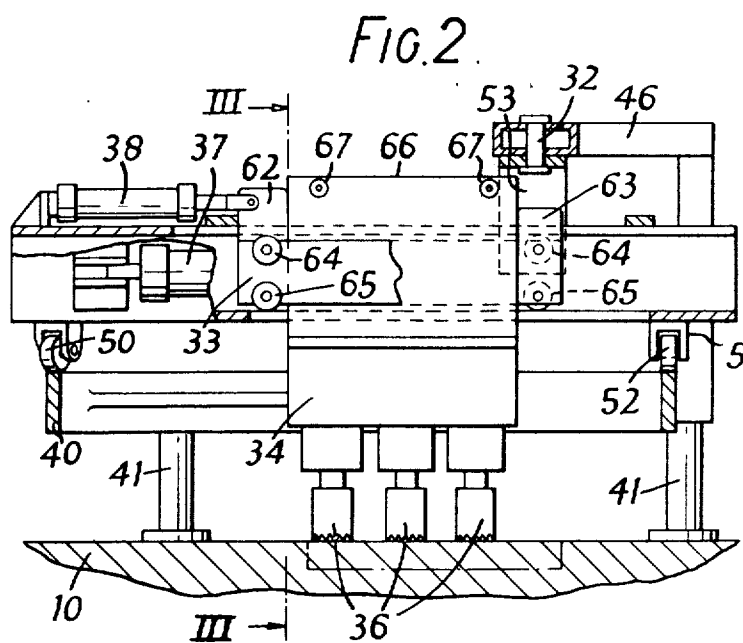
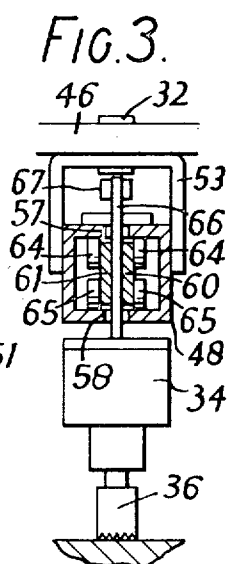
A machine for cutting a recess of a predetermined size and contour in a concrete road comprises a frame, a first carriage reciprocable in one direction on the frame, a second carriage reciprocable on the first carriage in a different direction, and a power driven hammer unit mounted on the second carriage and arranged to reciprocate a cutting member into engagement with the road and impart a succession of impact blows to the road. The two carriages are reciprocated in a pattern arranged so that the hammer unit traverses over the whole area to be cut away. An anchoring device for securing the machine to the road has a metal plate formed with a peripheral skirt, two concentric rubber rings bonded to the underside of the base plate and projecting below the skirt, and means for withdrawing air from the space surrounded by the inner ring. When the device is placed on a road and air is extracted from the chamber enclosed by the inner ring, the base plate and the road surface, the difference between the pressure of air in the chamber and atmospheric pressure clamps the device to the road.

The machine can be used to repair concrete roads by cutting away defective concrete to form a recess which can be plugged by a preformed block of concrete bonded in position by a synthetic resin adhesive.

Primary Examiner—Ernest R. Purser

7 Claims, 10 Drawing Figures





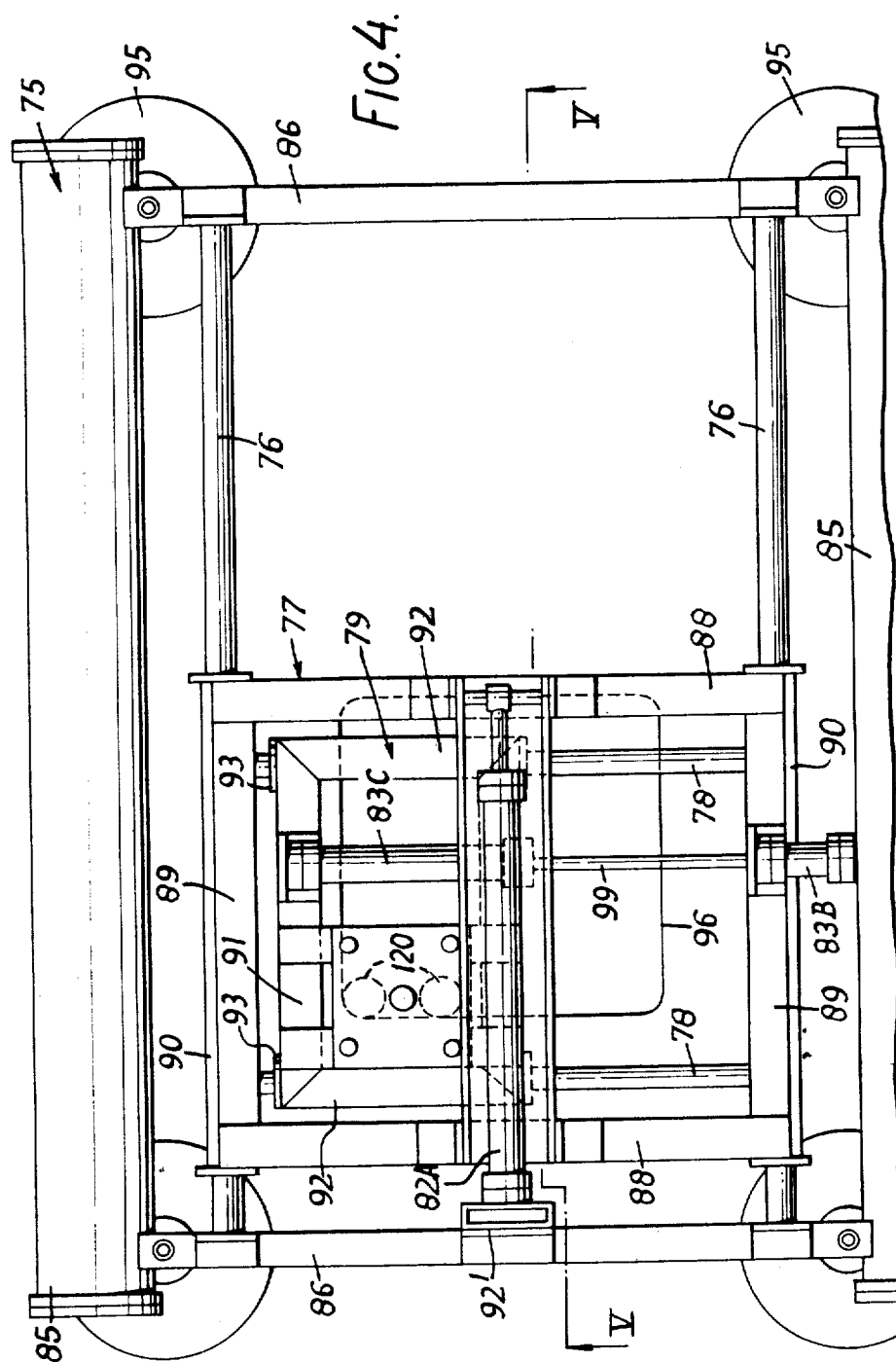


FIG. 5.

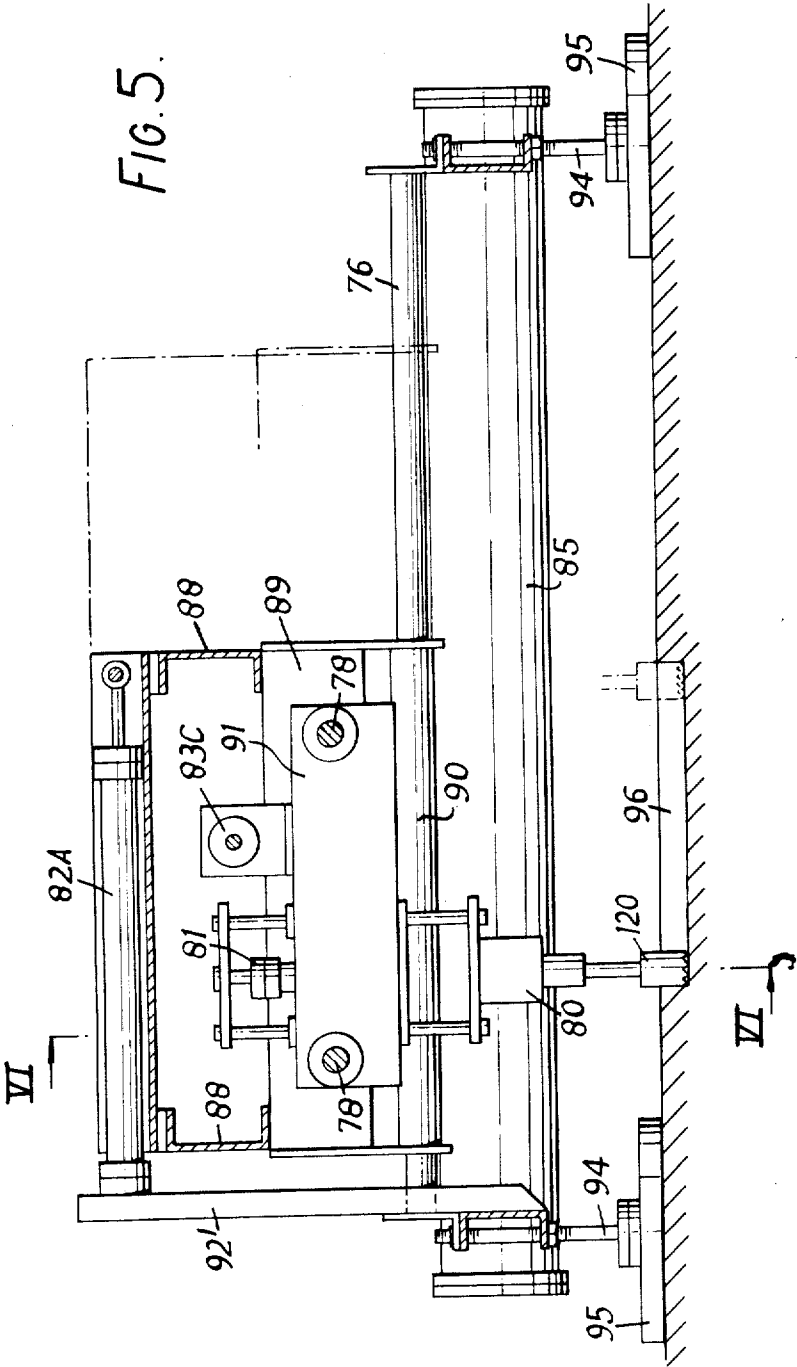


FIG. 6.

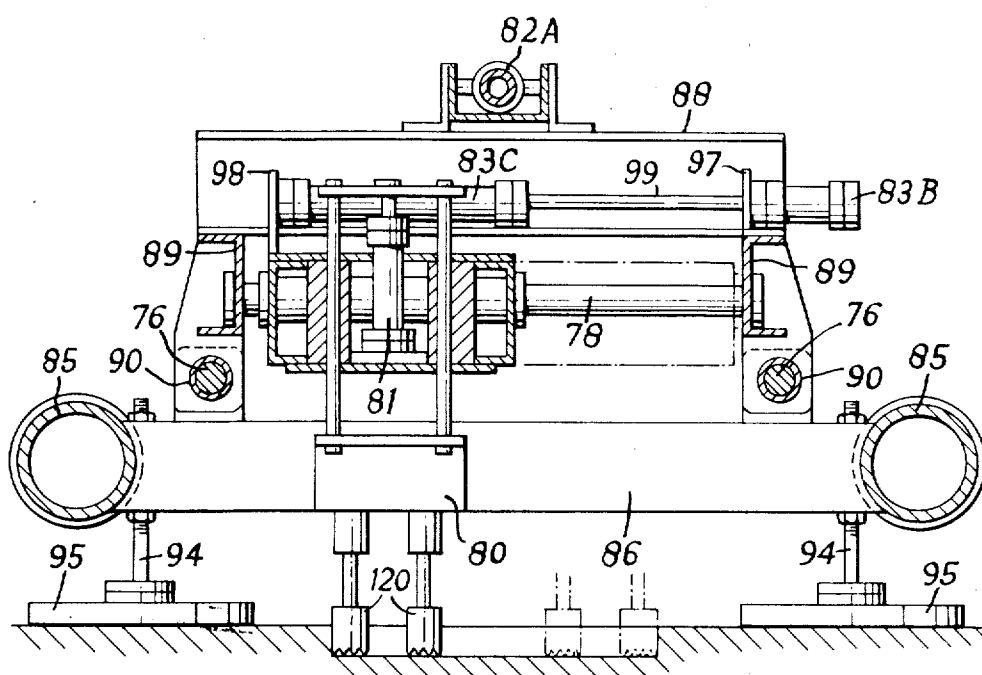


FIG 7

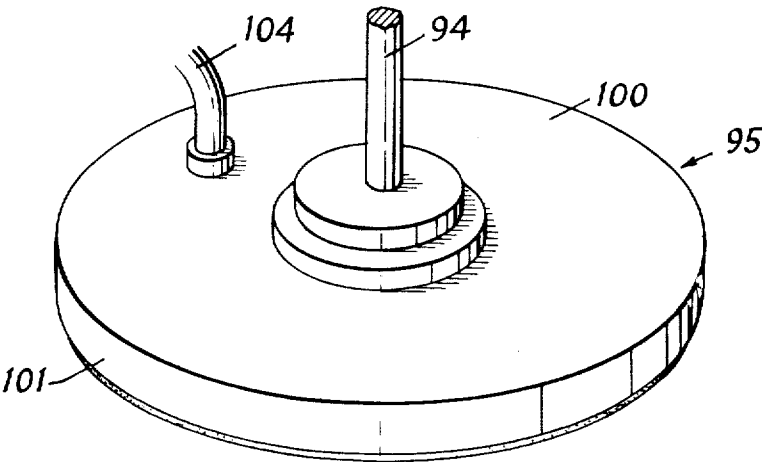


FIG. 9

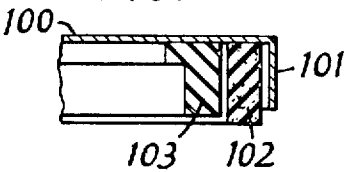
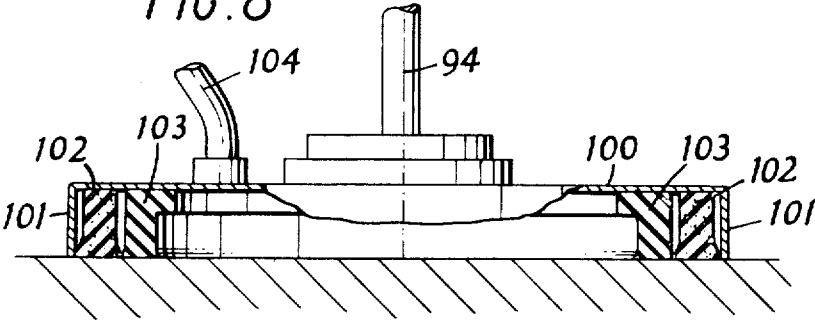
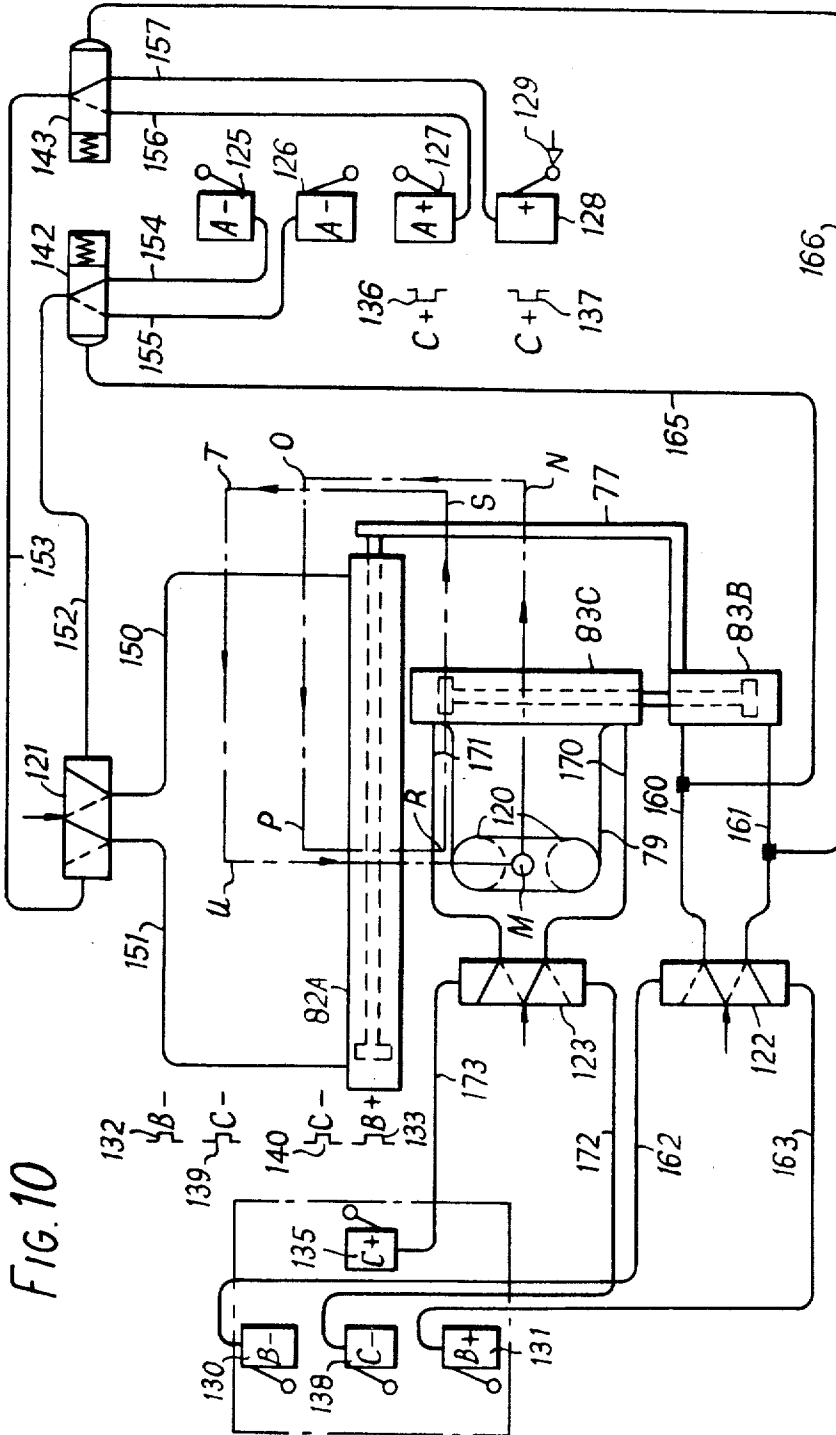


FIG. 8





MACHINE FOR CUTTING RECESS IN CONCRETE BY IMPACT

This application is a division of my co-pending application Ser. No. 191857 filed Oct. 22, 1971, which is a continuation-in-part of my co-pending application Ser. No. 1700, filed Jan. 9, 1970 and now abandoned.

Concrete roads, runways, or other concrete tracks subject to heavy use usually suffer damage which causes crumbling and flaking off of parts of the top surface. Such defects, which generally occur at the corners or along the edges of a cast section or bay of a road, are usually referred to as spalling defects. Spalling in concrete roads has hitherto been repaired by cutting away all the defective part of the concrete and then filling in the resultant recess with either concrete poured in situ or with a synthetic resin filling which hardens when cured.

The conventional tool for cutting concrete is a pavement breaker which has a wedge shaped cutting head and means for imparting a series of impact blows to the cutting head. It is however not possible to cut concrete to any desired shape with this tool since it breaks away the concrete in relatively large chunks. In operation, the tip of the wedge shaped head initially rests on the concrete and the blows imparted to the head cause the head to chip away the concrete to form a small hole. The wedge shaped head then becomes jammed in this hole, so that when the head is driven further into the concrete, it forces the walls of the hole apart and causes the concrete to crack. Any recess cut in concrete by a pavement breaker thus has jagged edges and moreover it is not even possible to cut approximately along any given line. Concrete can be cut to a predetermined size by grinding tools, but this is a slow and costly method requiring copious supplies of water. Concrete can also be cut by rotary cutters, but this method of course only forms circular holes.

The object of the present invention is to provide a machine suitable for cutting a recess of predetermined shape and size in a concrete road, runway, or other concrete track without damage to the surrounding concrete.

According to the present invention there is provided a machine for cutting a recess of a predetermined size and contour in the top surface of a concrete road, comprising a main frame adapted to be mounted on the road to be cut, said frame having means defining a first track thereon, a first carriage movable along said first track, said first carriage having means defining a second track thereon extending in a different direction from that of the first track, a second carriage movable along said second track, a power driven hammer unit coupled to the second carriage for movement therewith and having cutting means adapted to engage the road surface, the hammer unit being operable to impart through the cutting means a succession of impact blows to the road, a first drive means operable to reciprocate the first carriage along said first track and second drive means operable to reciprocate the second carriage along said second track so that in operation the cutting means traverses continuously over the area of the road defined by the range of movement of the carriages on their tracks and cuts a recess of a predetermined size and contour in the road surface.

In the operation of the machine of the invention, the hammer unit carrying the cutting means moves continuously over the whole area of the concrete to be cut so

that successive blows do not occur in exactly the same point on the concrete. This has the effect of chipping away the concrete in very small pieces and ensuring that no cracks develop in the walls of the recess being cut.

The machine of the invention preferably includes control means operable to regulate the operation of the first and second drive means so as to move the carriages in a predetermined sequence, in each cycle of which the cutting means traverse over the total area of the road surface to be cut. This ensures that the recess cut in the concrete has substantially the same depth throughout. In addition, the cutting means preferably trace paths, which extend along the periphery of the recess to provide clearly defined edges to the recess.

The hammer unit may be mounted in vertical guides on the second carriage so that it rests on the road surface to be cut. Alternatively, the hammer unit may be supported on a hydraulic dashpot mounted on the second carriage and operable to lower the hammer unit at a controlled rate during cutting operations.

The hammer unit can be of conventional construction well known in the art. Thus the hammer unit may comprise a cylinder block having several cylinders arranged parallel to one another, each cylinder having an air-operated piston, a piston rod extending out of the cylinder, a cutting head rigidly secured on the end of the piston rod, and valve means for feeding compressed air alternately to opposite ends of the cylinders so as to reciprocate the pistons therein. In use, the cylinder block is positioned with the cylinders vertical and the cutting heads resting on the ground. When air is supplied alternately to opposite ends of the cylinders, the cylinder block "floats" above the road and the pistons reciprocate within the cylinders so that the cutting heads impart a succession of impact blows to the road. The cutting action on the concrete is due more to the speed and frequency of the impact blows rather than to the actual thrust exerted on the pistons.

Operation of the hammer unit causes the machine to vibrate. The machine is therefore preferably fixed to the road, or made sufficiently heavy, either by the weight of its components or by weighting down the frame, so that the vibrations do not cause any movement of the machine across the road. The machine may if desired be mounted on a large vehicle having means for lowering the machine into a cutting position and raising the machine into a position clear of the ground for transport to another site.

The frame of the machine may be secured to pegs driven into the bitument filling separating concrete bays of a road. The frame is however preferably provided with anchoring devices, each of which comprises a base member, two annular seals fitted on the underside of the base member and disposed one within the other, the outer seal projecting below the inner seal and having an appreciably lower resistance to deformation than the inner seal, and means for extracting air from the space surrounded by the inner seal, the outer seal and base member being adapted to co-operate with a road surface to define a closed chamber, and the inner seal being compressible against the road surface by thrust exerted on the base member due to difference in pressure between the atmosphere and the air in the chamber to define therewith a smaller closed chamber. The base member is preferably formed with a downwardly projecting flange, and the inner seal adapted to

be compressed by thrust exerted on the base member due to difference in pressure between the atmosphere and the air within said smaller chamber to engage said flange against the road surface.

In operation, the relatively soft outer seal is compressed against the road surface by the weight of the machine supported on the device. The outer seal permits the pressure in the chamber to be reduced to a value at which the inner seal is pressed sufficiently hard against the road to provide an air-tight closure. The inner seal can withstand a greater pressure differential than the outer seal due to its greater resistance to deformation, so that the pressure in the chamber can be reduced to a value at which the flange on the base member engages the road surface to provide a firm anchorage.

The inner seal preferably comprises an annular band of relatively hard rubber and the outer seal an annular band of foam rubber. The outer seal may however be inflatable and comprise an annular flexible wall of rubber or like resilient material arranged to be urged by air under pressure into sealing contact with the road surface.

The machine of the present invention is particularly suitable for use in cutting away spalling or other defects in a concrete road to enable the road to be repaired by the method claimed in my co-pending application Ser. No. 191857 filed Oct. 22, 1971 in which the road is cut to form a recess of a predetermined shape and size and the recess then plugged with a preformed block of concrete or other hard wearing material secured in position by a layer of adhesive disposed between and bonded to the wall of the recess and the preformed block. The machine can of course also be used to cut recesses in a concrete road for the reception of equipment such as lighting or signal apparatus.

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

FIG. 1 is a plan view of a machine suitable for cutting a quarter circle recess at the corner of a concrete bay in a road,

FIG. 2 is an elevation view taken along the line V—V in FIG. 1,

FIG. 3 is a detail view along the line VI—VI in FIG. 2,

FIG. 4 is a plan view of a machine suitable for cutting a rectangular recess in a concrete road,

FIG. 5 is a view along the side VIII—VIII in FIG. 4,

FIG. 6 is a view along the line IX—IX in FIG. 5,

FIG. 7 is a perspective view of one of the anchoring pads of the machine of FIGS. 4-6 shown on an enlarged scale,

FIG. 8 is an elevational view of the pad of FIG. 7 partially cut away to show details of the construction,

FIG. 9 is a detail view of part of the anchoring pad before engagement with a road surface, and

FIG. 10 illustrates the pneumatic circuit of the machine of FIGS. 4-6.

The machine of FIGS. 1-3 is for use in cutting away defective concrete at the corner of a concrete bay in a road, and for this purpose the machine is designed to cut a quarter circle recess with the arcuate edge of the recess terminating at the side edges of the bay, so that there are no sharp corners within the periphery of the bay.

The machine shown in FIGS. 1-3 comprises a frame 30 mounted on the concrete bay 10 of the road to be cut, a turntable 31 mounted on the frame for angular movement about a vertical pivot pin 32 on the frame, a carriage 33 mounted on the turntable for radial movement towards and away from the axis of the pivot pin 32, a hammer unit 34 slidable in vertical guides on the carriage and having three cutting heads 36 spaced along a radial line through the axis of the pivot pin 32, a hydraulic piston and cylinder unit 37 for oscillating the turntable about the pivot pin 32, and a hydraulic piston and cylinder unit 38 for reciprocating the carriage and hammer unit on the turntable.

The frame 30 consists of a continuous vertical rail 40 mounted on legs 41, the rail having two arcuate portions 42, 43 interconnected by straight portions 44, 45, the arcuate portions being centered on the pivot pin 32 and serving as tracks for the turntable. The pivot pin is secured in an aperture in the cross piece of an inverted U shaped bracket 46, the legs of which are secured to the two straight portions 44, 45 of the rail.

The turntable comprises a square section tube 48, one end of which is provided with an arm 49 fitted with rollers 50 which run on the track 42 and the other end of which is provided with a lug 51 fitted with a roller 52 which runs on the track 43. The turntable is pivotally connected to the pivot pin 32 by an inverted U shaped bracket 53 having the legs thereof secured to the sides of the tube 48, the pivot pin 32 being rotatably mounted in an aperture in the cross piece of the bracket 53. The cylinder of the unit 37 is secured to a lug 55 on one side of the tube 48 and the piston rod is pivotally mounted on a pin 56 on the bracket 46 so that extension of the unit 36 swivels the turntable into the broken line position shown in FIG. 1. The upper and lower walls of the tube 48 are provided with slots 57, 58.

The carriage 33 is mounted inside the tube 48 and comprises two side plates 60, 61 spaced apart by two end plates 62, 63 and upper and lower rollers 64, 65 mounted on the side plates in rolling engagement with the inside surfaces of the upper and lower walls of tube 48 respectively. The end plates extend upwards through the slot 57 and form the vertical guides for the hammer unit. The cylinder of the unit 38 has the cylinder connected to a lug on the tube 48 and the piston connected to the end plate 62 on the carriage. The hammer unit is mounted on the lower end of a support plate 66 which extends through the space between the plates 60-63 of the carriage. The upper end of the support plate is fitted with rollers 67 adapted to engage the tube 48 to limit downward movement of the hammer unit.

The machine is fitted with suitable control mechanism operable to actuate the cylinder unit 38 at a much higher speed than the cylinder unit 37, and automatically to reverse the movement of both the cylinder units at the end of their strokes. The carriage and hammer unit thus reciprocate several times during each movement of the turntable across the frame, as shown by the arrows in FIG. 1, so that the cutting heads 36 traverse over a quarter circle area 70 shown in broken lines in FIG. 1. The control mechanism may if desired include trip switches mounted on the rail 40 and adapted to actuate the cylinder unit 38 at given angular settings of the turntable so that the cutting heads follow a set pattern. The hammer unit, in use, slides down the

vertical guides formed by the end plates 62, 63 of the carriage as the concrete is cut away.

The machine shown in FIGS. 4-6 comprises a main frame 75 fitted with two parallel slide bars 76, a main carriage 77 slidably mounted on the bars 76, the carriage 77 being fitted with two parallel slide bars 78 arranged perpendicular to the slide bars 76, an auxiliary carriage 79 slidably mounted on the bars 78, a hammer unit 80 supported on a hydraulic dashpot 81 on the carriage 79, and cylinder units 82A, 83B, 83C operable to reciprocate the main carriage on the bars 76 and the auxiliary carriage together with the hammer unit on the bars 78. The main frame consists of two side members 85, and two cross members 86 interconnecting the ends of members 85, the slide bars 76 being mounted on brackets on the cross members 86. The main carriage 77 consists of two side members 88, two cross members 89 interconnecting the ends of the members 88, and two tubes 90 connected to the cross members 89 and receiving the bars 76 as a close sliding fit, the two slide bars 78 extending between the cross members 89. The auxiliary carriage 79 consists of two side members 91, two cross members 92, and two tubes 93, which are secured to the cross members and receive the slide bars 78 as a close sliding fit. The cylinder unit 82A has the cylinder thereof mounted on a bracket 92' on one of the cross members 86 of the frame and the piston rod thereof connected to one of the side members 88 of the main carriage. The cylinder unit 83B has the cylinder thereof mounted on a bracket 97 on one of the cross members 89 of the main carriage and the cylinder unit 83C has the cylinder thereof mounted on a bracket 98 on one of the side members of the auxiliary carriage, the cylinders of the two units 83B and 83C being coaxial and having their pistons mounted on opposite ends of a common piston rod 99.

The frame 75 is provided with legs 94 fitted with anchoring pads 95 adapted to secure the frame securely to a concrete road, as described hereinafter.

The cylinder units 82A, 83B, 83C are operated by air under pressure in controlled sequence, as hereinafter described, so as to reciprocate the carriages 77, 79 along their slide rods in a predetermined succession of movements in which the cutting heads on the hammer unit traverse over the whole area to be cut, shown at 96 in FIG. 4, and also trace out paths which extend along the sides of the area 96 and across the ends of the area, so that the recess cut in the concrete has clearly defined straight edges. The cutting heads are circular so that the corners of the recess are rounded. The hydraulic dashpot 81 lowers the hammer unit at a predetermined rate during the cutting operation.

As shown in FIGS. 7-9, each anchoring pad 95 comprises a horizontal circular metal plate 100 having the outside margin turned down to form a peripheral skirt 101, a thick outer ring 102 of soft foam rubber of rectangular section bonded to the underside of the plate 100 adjacent the skirt, and a thick inner ring 103 of relatively hard rubber of rectangular section bonded to the underside of the plate 100 adjacent the ring 102. In the unstressed condition as shown in FIG. 9, the outer ring 102 extends below the inner ring 103, and both rings extend below the skirt. An air extraction pipe 104 is sealed in a port in the plate 100 and opens into the space bounded by the inner ring 103.

In operation, the anchoring pad is positioned on a road to which it is to be anchored, the weight of the ma-

chine on the pad being supported on the road by the inner ring 103, with the outer ring 102 of foam rubber compressed against the road surface. The outer ring 102 which is relatively soft and deformable conforms to the irregularities in the surface of the road and provides a seal between the surface of the road and the metal plate 100. The air extraction pipe is then connected to a vacuum pump (not shown) which is run continuously to withdraw air from the chamber formed between the plate 100, the inner ring 103 and the road surface. When the pressure in the chamber is reduced below that of the atmosphere, the differential pressure acting on the plate 100 forces it downwards to compress the inner rubber ring 103 against the road and engage the lower edge of the skirt 101 against the road. The inner ring 103 then provides a seal which reinforces that provided by the outer ring in restricting seepage of air into the chamber. The relative depths of the inner ring 103 and the skirt 101 are arranged so that the ring is subjected to a substantial compressive force before the skirt engages the road surface, so that the rubber inner ring is forced into any small cavities in the road surface and provides an effective seal. Upon further reduction of the pressure in the chamber, the lower edge of the skirt is forced hard against the road to provide a firm anchorage.

The outer ring 102 of the anchoring pad may be replaced by a thin-walled annular rubber tube mounted as a loose fit in the annular recess defined by the plate 100, ring 103 and skirt 101, the tubes being inflatable so that its wall makes sealing contact with the walls of the recess and the road surface. The tube can conveniently be of the type used as the inner tube in a pneumatic tyre, the valve stem for inflating the tube extending through an aperture in the plate 100.

The hammer unit 80 on the cutting machine of FIGS. 4-6 is provided with two cutting heads 120 of equal diameter spaced apart a distance equal to the diameter of each head, and the cylinder units 82A, 83B, 83C are operated in a predetermined sequence so as to move the hammer unit along paths MN, NO, OP, PR, RS, ST, TU, UM as shown in FIG. 10, in which paths MN and RS and also paths OP and TU are spaced apart a distance equal to the diameter of each cutting head 120 and paths OP and RS are spaced apart a distance equal to three times the diameter of each cutting head, whereby the cutting heads traverse over the whole area to be cut. For this purpose, the cylinder unit 83B has a stroke equal to the diameter of each cutting head, the cylinder unit 83C has a stroke equal to three times the diameter of each cutting head, and the cylinder units are operated in sequence by the pneumatic circuit shown in FIG. 10. For convenience, the cylinder units 82A, 83B, 83C are referred to hereafter as cylinders A, B, C respectively, the switches and operating cams for initiating expansion of the cylinders A, B, C are denoted in FIG. 10 by the references A+, B+, C+ respectively, and the switches and operating cams for initiating contraction of the cylinders A, B, C are denoted in FIG. 10 by the references A-, B-, C- respectively.

The pneumatic circuit comprises three spool valves 121, 122, 123 controlling expansion and contraction of the cylinders A, B, C respectively, four switches 125, 126, 127, 128 operable by a single cam 129 and controlling movement of the spool of valve 121, two switches 130, 131 operable by cams 132, 133 respectively and controlling movement of the spool of valve

122, a switch 135 operable by cams 136, 137 and a switch 138 operable by cam 139, 140 the two switches 135, 138 controlling movement of the spool of valve 123, a selector valve 142 for selecting one or other of the switches 125, 126 and a selector valve 143 for selecting one or other of the switches 127, 128.

Each of the spool valves 121, 122, 123 comprises a valve body having an inlet port connected to a supply of air under pressure, two service ports connected one to each end of the associated cylinder, two exhaust ports, and two control ports one at each end of the valve body and connected by a switch either to a supply of air under pressure or to exhaust. Supply of air to one control port moves the spool to a first setting position in which a first of the service ports is connected to the inlet port and the second service port is connected to an exhaust port, and supply of air to the other control port moves the spool to the second setting position in which the second service port is connected to the inlet port and the first service port is connected to an exhaust port. Such valves are well known in the art. Each of the selector valves 142, 143 comprises a valve body having an outlet port, two inlet ports and a control port in one end of the valve body, and a valve spool biased by a spring towards the control port. When the control port is connected to exhaust, the spring holds the spool in a first setting position, in which the outlet port is connected to one inlet port and the other inlet port is blanked off. Supply of air to the control port moves the spool against the action of the spring into a second setting position in which the outlet port is connected to the other inlet port and said one inlet port is blanked off. Such selector valves are also well known in the art.

The switches 125, 126, 127, 128 are mounted on the frame and their cam 129 is mounted on the auxiliary carriage and arranged so that switch 125 is actuated when the hammer unit is on path TU, the switch 126 is actuated when the hammer unit is on path OP, the switch 127 is actuated when the hammer unit is on path RS, and the switch 128 is actuated when the hammer unit is on path MN. The switches 130, 131, 135, 138 are mounted on the auxiliary carriage 79 (the switches being shown separate from the auxiliary carriage 79 in FIG. 10 for clarity), and the cams 132, 133, 136, 137, 139, 140 are mounted on the frame and arranged so that the switches 130, 138 are actuated when the hammer unit is at point U on its path of travel, the switches 131, 138 are actuated when the hammer unit is at point P, and the switch 135 is actuated when the hammer unit is at point N and also when it is at point S.

The spool valve 121 has its two service ports connected by lines 150, 151 to opposite ends of cylinder A, one control port connected by line 152 to the outlet port of selector valve 142 and the other control port connected by line 153 to the outlet port of selector valve 143, the two inlet ports of valve 142 being connected by lines 154, 155 to switches 125, 126 respectively, and the two inlet ports of selector valve 143 being connected by lines 156, 157 to switches 127, 128 respectively, the arrangement being such that actuation of switches 125, 126 causes air to be supplied to cylinder A to contract it and actuation of switches 127, 128 causes air to be supplied to the opposite end of cylinder A to expand it. The spool valve 122 has its two service ports connected by lines 160, 161 to opposite ends of cylinder B, one control port connected by line 162 to the switch 130, and the other control port connected

by line 163 to the switch 131, the arrangement being such that actuation of switch 130 causes air to be supplied to cylinder B to contract it and actuation of switch 131 causes air to be supplied to the opposite end of cylinder B to expand it. Line 160 is connected by line 165 to the control port of selector valve 142, and line 161 is connected by line 166 to the control port of selector valve 143. The spool valve 123 has its two service ports connected by lines 170, 171 to opposite ends of cylinder C, one control port connected by line 172 to the switch 138, and the other control port connected by line 173 to the switch 135, the arrangement being such that actuation of switch 138 causes air to be supplied to cylinder C to contract it and actuation of switch 135 causes air to be supplied to the opposite end of cylinder C to expand it.

When the cylinders A, B, C are fully contracted as shown in FIG. 10, the hammer unit is at point M and the control valves are in the setting positions providing the air flow shown by full lines in FIG. 10. Switch 128 is then actuated and air flows through line 151 and causes the cylinder A to expand and the hammer unit to travel along path MN. At point N, cam 137 actuates switch 135 to cause cylinder C to expand and the hammer unit to travel along path NO. At point O, switch 126 is actuated to cause cylinder A to contract and the hammer unit to travel along path OP. It will be noted that, throughout paths MN, NO, the selector valve 142 is actuated by air from lines 160, 161 to connect the switch 126 to valve 121 and block switch 125. At point P, cams 133, 140 actuate switches 131, 138 to cause cylinder B to expand and cylinder C to contract so that the hammer unit travels along path PR. Air is also fed from line 161 through line 166 to actuate the selector valve 143 and thereby connect switch 127 to the valve 121. At point R, switch 127 is actuated to cause cylinder A to expand and the hammer unit to travel along the path RS. At point S, cam 136 actuates switch 135 to cause cylinder C to expand and the hammer unit to travel along path ST. During travel along the path ST, the hammer unit actuates the switch 126 at point O but this switch is blocked by the selector valve 142. At point T, switch 125 is actuated to cause cylinder A to contract and the hammer unit to travel along path TU. At point U, cams 132, 139 actuate switches 130, 138 to cause both the cylinders to contract so that the hammer unit travels along path UM. During travel along the path UM, the hammer unit actuates the switch 127 at point R but this switch is blocked by the selector valve 143.

It will be appreciated that the paths NO and ST overlap, as do the paths PR and UM, but they have been shown spaced a small distance apart in FIG. 10 to avoid confusion.

The cutting machine illustrated in FIGS. 4-6 may be used to remove the skin on the top of a concrete road before resurfacing the road. This exposes the aggregate in the concrete and enables a good bond to be made between the concrete base and the resurfacing layer. For this purpose, the machine is preferably of large size and fitted with several hammer units so as to reduce the time required for treating each area covered by the machine.

The cutting machine may be connected to the anchoring pads by knuckle joints which enable the pads to be inclined relative to one another in a case in which the road surface is uneven.

I claim:

1. A machine for cutting a recess of a predetermined size and contour in the top surface of a concrete road, comprising a main frame adapted to be mounted on the road to be cut, said frame having means defining a first track thereon, a first carriage movable along said first track, said first carriage having means defining a second track thereon extending in a different direction from that of the first track, a second carriage movable along said second track, a power driver hammer unit coupled to the second carriage for movement therewith and having cutting means adapted to engage the road surface, the hammer unit being operable to impart through the cutting means a succession of impact blows to the road, first drive means operable to reciprocate the first carriage along said first track, stop means restricting movement of the first carriage along said first track to a distance corresponding to one dimension of the desired recess, second drive means operable to reciprocate the second carriage along said second track, further stop means restricting movement of the second carriage along said second track to a distance corresponding to another dimension of the desired recess, and control means adapted to regulate operation of the first and second drive means automatically in a plurality of successive cycles, in each of which the carriages reciprocate in a predetermined sequence arranged to cause the cutting means to traverse over the total area defined by the range of movement of the two carriages determined by said stop means.

2. A machine as claimed in claim 1, wherein the con-

trol means are operable to move the cutting means along paths which extend along the periphery of the area defined by the range of movement of the carriages so that the recess cut in the concrete has clearly defined edges.

3. A machine as claimed in claim 1 and adapted to cut substantially rectangular recesses in a road, wherein said first and second tracks are substantially perpendicular to one another.

4. A machine as claimed in claim 1 and adapted to cut part-circular recesses in a road wherein the said first carriage is pivotally connected to the frame for annular movement about a vertical axis, said first track being arcuate and coaxial with said vertical axis, and said second track extends in a substantially radial direction relative to said vertical axis.

5. A machine as claimed in claim 1, wherein the hammer unit is mounted in vertical guides on the second carriage and rests on the road surface to be cut.

6. A machine as claimed in claim 1, wherein said drive means comprise piston and cylinder units, the ends of the cylinders co-operating with the pistons to form said stop means for the carriages.

7. A machine as claimed in claim 1, wherein said hammer unit comprises a cylinder, a piston, and means for reciprocating the piston in the cylinder, and said cutting means are rigidly secured to the piston for axial movement therewith, the piston and cutting means being free to rotate relative to the cylinder.

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