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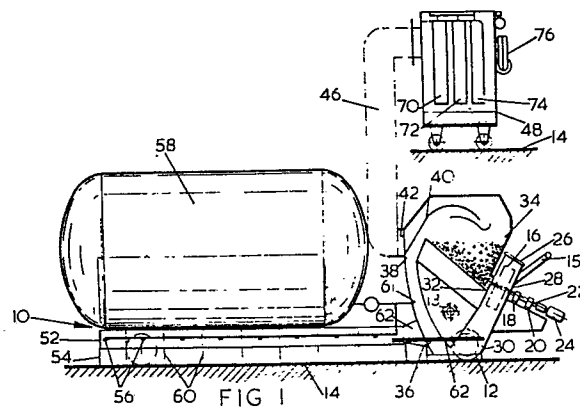
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54 Surface treatment.

57 A surface treatment process comprises removing surface material by bombardment with cooled shot, grit or other suitable particles. The surface under treatment may also be cooled.

Apparatus for such surface treatment comprises means (16) for bombarding the surface (14) with shot grit or other suitable particles and means (61) for cooling the particles before or after impingement on the surface (14).



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The invention relates to a surface treatment process and apparatus for performing the process and is applicable especially, but not exclusively, to removing rubber deposits and generally cleaning and/or texturing surfaces of roadways, airport runways and taxiways, and factory floors.

One particular application of the invention is for restoring the skid resistance of roadways, runways, etc. having a surface layer comprising aggregate and binder, for example coarse stone set in asphalt or bitumen. When this surface layer is new, aggregate protrudes from the asphalt or bitumen and provides good resistance to skidding for the tyres of a vehicle travelling across the surface. In use, however, the skid resistance deteriorates because the exposed aggregate surface becomes smooth due to polishing and deposition of rubber, lubricating oil, dirt and even oil exuded from the asphalt or bitumen itself during hot weather. Skid resistance is further reduced by reduction of the exposed area of aggregate due to sinking of the aggregate into the bitumen or asphalt and also accumulation of rubber, dirt, oil etc.

upon the surface of the bitumen or asphalt surrounding the individual pieces of aggregate. Deterioration is most marked near road junctions or other places where traffic accelerates or brakes.

5 Traditional methods of restoring skid resistance, such as complete replacement of the surface layer or the application of an additional layer of, for example, an epoxy resin with calcined bauxite, are costly, time-consuming and disrupt
10 traffic flow severely.

It has been proposed, therefore (British Patent Specification No. 1,480,482) to restore skid resistance by removing the contamination-rubber, oil, etc. and some of the binder to expose a greater surface area
15 of each protruding piece of aggregate. Specifically, it has been proposed to cool the road surface to embrittle the binder material, loosen the embrittled material between the pieces of aggregate by means of a flail and then remove the loosened material.

20 This proposed process is considered unsatisfactory since it is believed that the flail will tend to strike the protruding aggregate pieces rather than the binder and may even dislodge the aggregate pieces. Moreover, the depth of binder

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removed is difficult to control.

According to this invention there is provided a surface treatment process comprising removing surface material by bombardment with cooled shot, grit or other suitable particles.

The particles may be cooled before being applied to the surface or after especially if they are to be recycled. Such cooling of the particles at least reduces, if not effectively prevents, the risk of agglomeration due to heating by their impact upon the surface being treated, particularly when the surface comprises bituminous material which will become hot and tend to stick to the particles.

During hot weather or when the surface to be treated comprises heat sensitive material such as paint it may be advantageous to cool the surface as well as the particles.

The coolant may be cryogenic fluid such as liquid nitrogen or liquid carbon dioxide. Significant advantages result from particle bombardment as the means of removing surface material. For example, the thickness of material removed can be controlled readily by varying the rate and duration of the bombardment. Furthermore the resultant texture of the treated surface can be controlled by choosing the appropriate size,

shape and mixture of particles. To provide what is known as macrotexture, e.g. on road surfaces where binder such as bitumen is removed to expose greater areas of aggregate, shot is preferably used, the size of shot depending on the depth of material removal. To provide what is known as microtexture, e.g. where aggregate is to be roughened or pitted, angular grit is preferably used. Particle sizes of from 0.25 to 2 mm in diameter have been found suitable.

Particles impinge upon the aggregate and material to be removed with much the same force but the material to be removed, i.e. rubber, oil, asphalt, bitumen or paint, being weaker will be eroded rather than the aggregate.

In practice, particle bombardment sufficient to remove the unwanted deposits and reduce the level of the asphalt or bitumen also causes roughening or pitting of the exposed surface of the aggregate. This roughening or pitting further enhances the skid resistance of the treated surface even to the extent that the aggregate obtrudes more than for a newly laid surface.

According to a further aspect of the invention apparatus for performing the surface treatment process comprises means for bombarding the surface with shot, grit or other suitable particle to remove surface material and means for cooling the particles before or after impingement on the surface.

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The apparatus of the invention may further comprise means for cooling the surface material to be removed to a temperature at which it becomes substantially brittle.

5 Means for bombarding the surface to be treated may comprise a motor-driven impeller arranged to impel the particles downwards onto the surface. A duct may then be provided extending upwardly from adjacent the position at which the particles impinge .
10 upon the surface so as to receive the particles as they rebound from the surface. The duct conveys the particles to a hopper from where they can be fed to the impeller again.

 Preferably a fan or vacuum source is provided
15 to maintain a strong flow of air through the duct to draw the removed material usually in powdered form from the surface.

 Separation of the shot, grit or other particles from this powdered material may be effected by a
20 separator disposed between the duct and the hopper. The separator may operate by gravity and so may be a plate positioned between the duct and the hopper so that the heavier shot, grit or other particles will strike the plate and be deflected downwards towards the hopper
25 for the shot, grit or other particles, whereas the

powdered material remains in the air stream.

Alternatively separation of the shot, grit or other particles from the powdered removed material may be by means of sieve screens. The separator may be
5 integral with the impellor carriage or be a separate unit.

The air stream carrying the powdered removed surface material will usually be drawn through a dust collection unit wherein the air stream is drawn
10 through a series of dust filters, usually bags, on or in which the powdered material collects.

It may be advantageous to cool the air stream prior to the separator to avoid agglomeration of the shot, grit or other particles caused by hot, sticky
15 material removed from the surface under treatment. - . Also, this cooling of the air stream will reduce blocking up of the dust filters by still hot, sticky material.

Coolant may be supplied to the particles at any
20 suitable point or points in the apparatus of the invention. Preferably the coolant is supplied in the region of the separator so that recycled particles are cooled prior to returning to the particle hopper. Thus when these particles are projected onto the surface being
25 treated, they will be sufficiently cool to avoid the sticking of binder deposits thereto. A particular

advantage of applying coolant to the shot within the apparatus is that it can prevent heat build up within the apparatus itself and at the surface being treated.

Alternative points of application of coolant to the particles are directly into the impeller region of the apparatus, in the duct leading the particles to the separator or in the passage between the particle reservoir and the impeller.

The means for supplying coolant to the particles may comprise a spray nozzle or series of spray nozzles preferably directing coolant in the direction of travel of the particles or air stream.

The applicator for applying coolant to the surface preferably includes a cowl housing a plurality of nozzles and/or baffles directing the coolant onto the surface over which the applicator is moved. A flexible skirt may depend from the edges of the cowl to seal the surface and limit coolant loss.

If the coolant is a cryogenic liquid, such as liquid nitrogen, when it strikes the surface, it will evaporate thus cooling the surface. However, the gaseous nitrogen will still be very cold. Therefore, it is proposed that the applicator include means for recycling the evaporated coolant so as to utilise the cold content thereof and thus reduce the amount of

coolant needed.

In a preferred embodiment of such an applicator the cowl has a generally horizontal strut fixed between a pair of opposite sides of the cowl so as to provide a flow path for coolant gas within the cowl and gas generated at the surface being treated is circulated in the applicator in a direction counter to the direction of travel of the applicator say by means of a motor driven fan. The plurality of baffles within the applicator will increase turbulence and hence improve heat transfer. To prevent the pressure within the applicator being so great as to cause leaking of the gas from the sealing skirt, an outlet may be provided with an adjustable opening to control the pressure within the applicator. The outlet may allow excess gas to escape to atmosphere or may be connected to the apparatus to permit further use of the gas in cooling the shot, grit or other particles or the air stream.

The apparatus of the invention preferably also includes temperature control means so that the temperature at which the process is carried out can be selected for the particular surface materials being treated and so that the amount of coolant used can be kept to a minimum.

To this end temperature sensing probes may be included in the apparatus at various points and may be

connected to a valve controlling coolant flow so as to operate that valve according to the temperature sensed, i.e. if the temperature within the apparatus is too high the valve will operate to increase coolant flow or if the temperature is too low, the valve will operate to reduce the coolant flow.

Preferred positions for temperature sensing probes are just prior to the separator to measure the temperature of the air stream and just after the separator to measure the temperature of the returned shot grit or other particles. Further temperature sensing probes may usefully be situated just prior to the impeller and in the air stream after the separator at the exit from the apparatus, also on or close to the surface being treated.

The supply of coolant may be from a fixed tank e.g. above the applicator or from a mobile tank connected to the applicator or apparatus by flexible insulated cryogenic hose.

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

Figure 1 shows a first embodiment of a surface treatment apparatus;

Figure 2 shows a second embodiment of a surface treatment apparatus;

Figure 3 is a section along line aa of Figure 2;

Figure 4 shows schematically one form of cryogenic liquid flow control;

5 Figure 5 shows an alternative form of cryogenic liquid flow control;

Figure 6 shows schematically a simple device for surface cooling;

Figure 7 shows schematically a second form of surface
10 cooling device; and

Figure 8 shows a third form of surface cooling device.

Referring to Figure 1, surface treatment apparatus comprises a carriage 10 supported by wheels
15 12 (only one shown) driven by a motor 13 for traversing across a surface 14 to be treated. A steering and control handle 15 projects from the rear of the carriage. Towards the rear of the carriage 10, an impeller 16 is supported in bearings 18 and 20 for
20 rotation by a drive motor 24 about an axis 22 which is inclined rearwardly and downwardly at an acute angle to the surface 14.

The impeller 16 is located at one end 26 of an elongate chamber 28, the other end 30 of which is open
25 and adjacent the surface. The axial inlet 32 of the

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impeller connects to the bottom of a hopper 34. Shot, grit or other particles fed from the hopper 34 into the rotating impeller 16 are impelled at high speed down the chamber 28 to impinge upon the surface 14.

5 A duct 36 extends upwards and forwards from a position adjacent the lower end 30 of the chamber 28. The duct 36 is curved and its upper end 38 opens, generally vertically, into the hopper 34. A deflector 40 projects upwards from the front interior wall 42 of
10 the hopper, across and above the end 38 of the duct, and then curves towards the bottom of the hopper.

 A pipe 46 connects the uppermost part of the hopper 34 to a dust collection/storage unit 48 which contains several dust bags 70, 72, 74 through which
15 air is drawn from the hopper 34 by a suction fan 76. The air enters the hopper 34 by way of the duct 36, which it enters at the lower end 30 adjacent the surface being treated.

 Material removed from the surface by the shot-
20 blast, in the form of dust together with the shot, is drawn up the duct by the air stream and into the hopper 34. The shot strikes the deflector 40 and falls into the bottom of the hopper 34, whereas the dust remains entrained in the air stream and is thus
25 carried to the dust collection/storage unit 48.

A cowl 52 projects from the front of the carriage 10, adjacent the surface 14, and is sealed at its edges to the surface by a depending skirt 54 of synthetic plastics fibres. A series of spray nozzles 56

5 project downwards from the interior of the cowl 54 and serve to direct liquid nitrogen onto the surface 14 from a storage tank 58 supported on the cowl 52. Baffles 60 are disposed between the spray nozzles 56 to ensure even distribution of the liquid nitrogen.

10 A separate spray nozzle 61 projects into the duct 36 and serves to inject liquid nitrogen into the stream of air and entrained surface material and shot as it passes through the duct.

It will be appreciated that whilst the coolant
15 is applied to the shot immediately after it has impinged upon the surface, the shot will be pre-cooled for subsequent application.

Where the shot is not recycled, as suggested later, the coolant would be applied to the shot after
20 leaving the impeller and before striking the surface. Thus, more specifically, the spray nozzle 61 would be located in the chamber 28.

Cooling of the shot and/or entrained material in this way reduces the risk of agglomeration which
25 might occur due to the heat generated when the shot

strikes the surface.

As the carriage travels forwards the surface 14
is cooled by the liquid nitrogen to such an extent
that the material to be removed (rubber, oil,
5 grease or other deposits; or binder such as bitumen)
is embrittled. The embrittled material is then removed
by the following shot blast. The depth of material
removed can be controlled by varying the application
of the liquid nitrogen and shot and the speed of traverse
10 of the apparatus. Typically surface temperatures of
-25°C or less can be achieved with a traverse of 5-12
feet/minute. It will be appreciated that both the
degree of cooling and the amount of material removed
by the shot are directly dependent upon the time for
15 which the surface is subjected to them, so coolant
and shot application rates can be fixed and the depth
of material to be removed controlled simply by varying
the speed of traverse.

At the rear of the cowl 52 an opening or passage
20 62 communicates with the lower end of the duct 36 so
that cold nitrogen gas is drawn into the duct from the
cowl 52 and mixed with the air stream entraining the
removed material. The nitrogen gas in the duct
assists cooling of the shot, and the removed material.

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Figures 2 and 3 show a surface treatment apparatus generally similar to that of Figure 1 except that an applicator for surface cooling is not shown, although may be added and the apparatus is
5 oppositely orientated to that of Figure 1. For simplicity parts of Figures 2 and 3 will be given the same reference numbers as the corresponding parts of Figure 1 and only the differences will be described in detail.

10 The apparatus of Figures 2 and 3 has two pairs of wheels 12, the forward pair being driven by motor 13. The apparatus in use will be driven in the direction of arrow A.

The impeller 16 is at the opposite end of the
15 carriage to the steering and control handle 15. As in the apparatus of Figure 1 shot grit or other suitable particles are supplied to the impeller from hopper 34 via axial inlet 32.

The particles impelled at high speed onto the
20 surface being treated rebound into generally parallel sided curved duct 36.

Adjacent the upper end of the duct 36 is an inclined separator plate 80 extending downwardly and rearwardly thus forming a passage 81 with wall 82 of
25 the apparatus. Again a pipe 46 connects the hopper

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34 to a dust collection/storage unit (not shown)
through which air is drawn by a suction fan.

5 In the passage 81 are a series of spray
nozzles 83 supplied via pipe 84 from a source of
cryogenic liquid. Temperature sensing probes 85, 86
are situated in the exit of duct 36 and below the
spray nozzles adjacent the end of passage 81
respectively.

10 In use, shot, grit or other particles are
supplied to the impeller from hopper 34, are
impelled onto the surface being treated and rebound
into duct 36 where they together with removed surface
material, usually in powder form, are drawn through the
duct by the suction fan of the dust collection/storage
15 unit.

On reaching the separator plate 80, the heavier
shot, grit or other particles are deflected downwards
into the hopper 34 and cooled by the cryogenic liquid
supplied through the spray nozzles 83 which are
20 orientated so as to spray the cryogenic liquid in the
direction of travel of the particles. The lighter
powdered surface material, however, remains in the air
stream and enters the dust collection/storage unit
via pipe 46. The air stream is, of course, also
25 cooled.

As well as cooling the used particles which are recycled, the positioning of the spray nozzles is such that some cooling of the unused particles will take place. Furthermore the apparatus will be kept
5 cool and some cooling of the surface may also take place.

The temperature sensing probes 85, 86 are used to control the amount of cryogenic liquid used. They may provide a visual indication of the temperatures
10 within the apparatus whereby the operator can alter the rate of flow of cryogenic liquid from its storage container or they can be included in an automatic flow control system such as shown in Figure 4 or Figure 5.

15 Referring to Figure 4, cryogenic liquid is supplied to spray nozzles 83 by line 90. The line 90 includes a manual valve 91 usually situated at the liquid storage container of line 90 a relief valve 92 and a solenoid operated valve 93 at the apparatus end
20 of line 90. Operation of the solenoid valve 93 is caused by controller 94 in response to the temperature sensed by probe 95.

The controller 94 can be set to open or close the valve 93 depending on the temperature sensed, so that

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if the temperature rises, the valve opens and if the temperature falls, the valve closes. In this way the amount of cryogenic liquid can be kept to a minimum.

An alternative control system is shown in Figure 5 wherein cryogenic liquid is supplied to spray nozzles 100 from a storage container via line 101. The line 101 includes a manual valve 102 a relief valve 103 and a pneumatically operated valve 104 at the apparatus end of line 101. Pneumatic fluid is supplied to valve 104 via line 105. A temperature sensing probe 106 causes operation of a controller 107 which in turn causes operation of fluid pump 108 in line 101.

The apparatus of Figures 2 and 3 does not require an applicator for cooling the surface to be treated unless the ambient temperature is fairly high say during summer, or in tropical climates, or if the surface to be treated includes very heat sensitive material such as paint.

A simple form of applicator is shown in Figure 6 which comprises a cowl 150 enclosing a series of spray nozzles 152 and having a sealing skirt 154 to limit escape of coolant. Such an applicator can however, result in considerable wastage of coolant. Thus recycling of coolant would be advantageous. Two examples of suitable applicators for this purpose are shown in

Figures 7 and 8.

Referring to Figure 7, an applicator 200 has spray nozzles 201 mounted at one end thereof connected to a supply of coolant (not shown) comprises a cowl 202
5 having a flexible sealing skirt 203 mounted on its bottom edge so as to contact the surface being cooled. Fixed horizontally within the cowl 202 is a strut 204 which provides a coolant flow passage 206. Depending from the strut 204 are a series of baffles 208. The
10 strut 204 also carries wheels 210.

Mounted in the upper part of the coolant flow passage 206 is a fan 212 and leading from the upper part is an outlet 214 for excess coolant gas. The outlet 214 has a rotatable baffle 216 to control the
15 rate of flow of gas through the outlet.

The applicator 200 travels in the direction of arrow B and coolant liquid is sprayed onto the surface via the spray nozzles. As the coolant liquid strikes the surface it evaporates thus cooling the surface.
20 The resultant gas is drawn along the passage 206 by the fan 212 and eventually strikes the baffles 208 as it reaches the surface under treatment. This increases the turbulence of the gas and enhances heat transfer and thus cools the surface ahead of the spray nozzles.
25 Thus the consumption of coolant can be significantly reduced.

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As the pressure builds up within the cowl, the outlet can be opened to allow excess gas to escape to atmosphere or to be used for further cooling say within the shot blasting apparatus.

5 Turning to Figure 8, the applicator shown is similar to that of Figure 7 except that the spray nozzles 201 are situated adjacent the fan 212, so that the coolant liquid will already be in gaseous form before it strikes the surface.

10 It will be appreciated that the apparatus of Figures 1 and 2 might be modified in various ways. For example, direct recycling of the used shot might be dispensed with, the used shot being allowed to fall to the floor behind the machine and being
15 collected by a sweeper or the like. Alternatively the used shot and dust might be removed, together, to a separate dust collection unit/hopper, possibly containing sieve screens for separating the shot from the dust.

20 As previously mentioned embodiments of the invention are of particular advantage for restoring skid resistance of aggregate/binder road surfaces since they permit accurate and uniform reduction of the binder matrix and, at the same time, roughen the
25 exposed surface of the aggregate. However, it should be noted that the invention is also applicable to

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5 removing material from other surfaces, for example soap, fat, adhesives, etc. from concrete factory floors; rubber, resin and bituminous coatings from steel (e.g. bridge decks); removing traffic markings, such as painted or thermoplastics white lines, from roadways; preparing asphalt or bituminous road surfaces to provide a key for an additional coating of asphalt or bitumen.

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CLAIMS

1. A surface treatment process comprising removing surface material by bombardment with ^{cooled} shot, grit or other suitable particles.
2. A process as claimed in claim 1 wherein the particles are cooled prior to being applied to the surface.
3. A process as claimed in claim 2 wherein the particles are cooled after being applied to the surface and then recycled.
4. A process as claimed in claim 1, 2 or 3 wherein the surface material is cooled prior to bombardment with the particles.
5. A process as claimed in any one of claims 1 to 4 wherein cooling is achieved using a cryogenic fluid.
6. A process as claimed in claim 5 wherein the cryogenic liquid is sprayed onto the particles or the surface being treated.
7. A process as claimed in claim 5 or 6 wherein the cryogenic liquid is liquid nitrogen or liquid carbon dioxide.
8. Apparatus for treating surface material comprising means for bombarding the surface material with shot,

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grit or other suitable particles to remove surface material, and means for cooling the particles before or after impingement on the surface.

9. Apparatus as claimed in claim 8 further
5 comprising means for cooling the surface material to a temperature at which it becomes substantially brittle.

10. Apparatus as claimed in claim 8 or 9 wherein the means for bombarding the surface with said particles
10 comprises a motor-driven impeller arranged to impel said particles downwards onto the surface.

11. Apparatus as claimed in claim 10 further comprising a duct extending upwardly from adjacent the position at which the particles impinge on the surface
15 so as to receive the particles as they rebound from the surface.

12. Apparatus as claimed in claim 10 or 11 further comprising a hopper for supplying the particles to the impeller.

20 13. Apparatus as claimed in claim 12 wherein the duct conveys the rebounded particles to the hopper.

14. Apparatus as claimed in claim 11, 12 or 13 further comprising a fan or vacuum source to maintain a flow of air through the duct sufficient to draw the
25 removed material from the surface.

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15. Apparatus as claimed in any one of claims 11 to 14 having means for separating rebounded particles and removed material.

16. Apparatus as claimed in claim 15 wherein the separating means is situated between the upper end of the duct and the hopper.

17. Apparatus as claimed in claim 16 wherein the separating means operates by gravity.

18. Apparatus as claimed in claim 17 wherein the separator is a plate positioned between the duct and the hopper whereby the particles will strike the plate and be deflected downwards into the hopper, wherein the removed surface material remains in the air stream.

19. Apparatus as claimed in claim 16 wherein the separating means comprises a sieve screen.

20. Apparatus as claimed in any one of claims 8 to 19 wherein coolant is supplied in the region of the separator.

21. Apparatus as claimed in any one of claims 10 to 20 wherein coolant is supplied to the impeller region.

22. Apparatus as claimed in any one of claims 11 to 21 wherein coolant is supplied to the upwardly extending duct.

23. Apparatus as claimed in claim 20, 21 or 22 wherein the coolant is supplied via one or more spray nozzles.

24. Apparatus as claimed in claim 23 wherein the

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spray nozzles are orientated so as to direct coolant in the direction of travel of the particles or air stream.

25. Apparatus as claimed in any one of claims 9 to
5 24 wherein the means for applying coolant to the surface being treated includes a cowl housing a plurality of spray nozzles and/or baffles directing the coolant onto the surface over which the applying means is moved.

10 26. Apparatus as claimed in claim 25 wherein a flexible skirt depends from the edges of the cowl to seal the surface and limit coolant loss.

27. Apparatus as claimed in claim 25 or 26 wherein the cowl of the coolant applying means has a generally
15 horizontal strut fixed between a pair of opposite sides thereof so as to provide a flow path for coolant gas within the cowl, and means for circulating the coolant gas.

28. Apparatus as claimed in claim 27 wherein the
20 circulating means is a motor driven fan.

29. Apparatus as claimed in claim 27 or 28 wherein the cowl has an adjustable outlet for exhaustion of excess coolant gas.

30. Apparatus as claimed in claim 29 wherein the
25 outlet is connected to the apparatus to permit further

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use of the gas in cooling the particles or the air stream within the apparatus.

31. Apparatus as claimed in any one of claims 8 to 30 including means for controlling the temperature within the apparatus.

32. Apparatus as claimed in claim 31 wherein the temperature controlling means includes one or more temperature sensing probes.

33. Apparatus as claimed in claim 32 wherein the temperature sensing probes gives a visual indication of the temperatures within the apparatus.

34. Apparatus as claimed in claim 32 wherein the temperature sensing probes are connected to a valve controlling flow of coolant to the apparatus.

35. Apparatus as claimed in claim 32, 33 or 34 wherein temperature sensing probes are situated just prior to the separator and just after the separator.

36. Apparatus as claimed in claim 35 wherein temperature sensing probes are also situated just prior to the impeller and/or in the upwardly extending duct.

37. Apparatus as claimed in any one of claims 8 to 36 wherein coolant supply is from a fixed tank or from a mobile tank connected to the apparatus by flexible cryogenic hose.

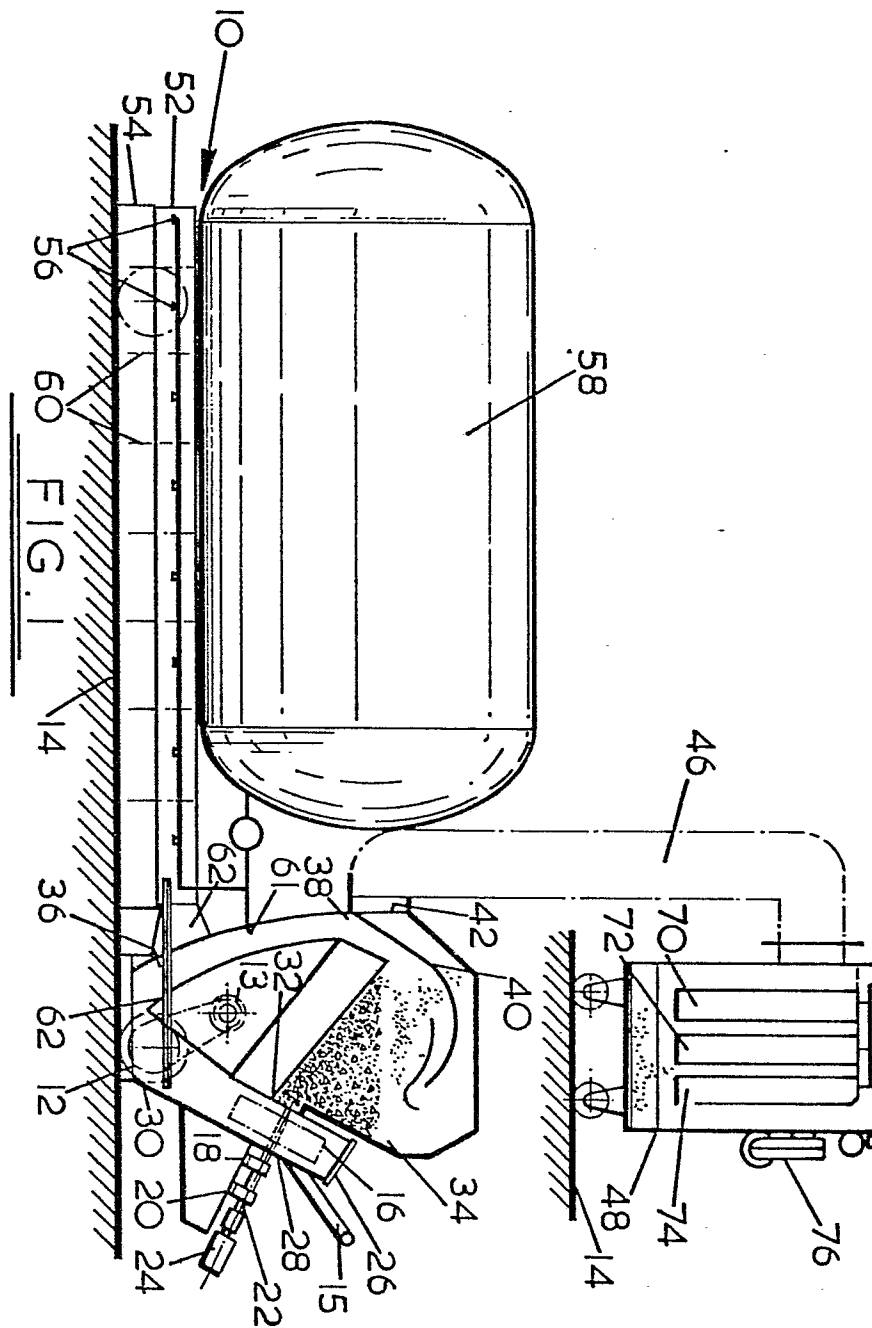
- 27 -

38. Apparatus as claimed in claim 37 wherein the tank is fixed above the coolant applying means.

39. A method as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

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40. Apparatus for surface treatment substantially as hereinbefore described with reference to and as illustrated in Figure 1 or Figures 2 and 3 together with any one of Figures 4 to 8.





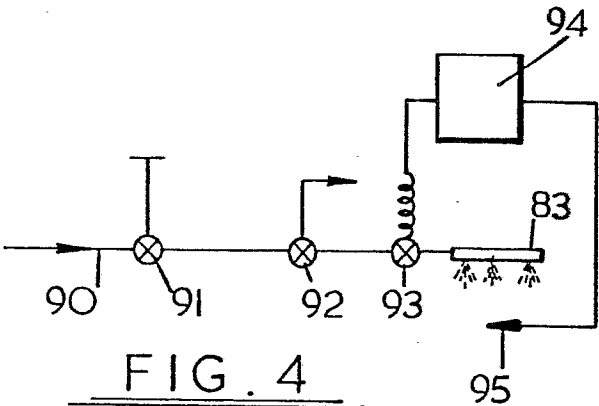


FIG. 4

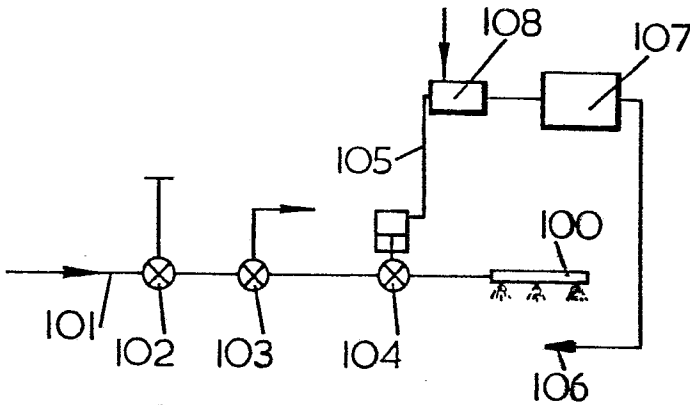


FIG. 5

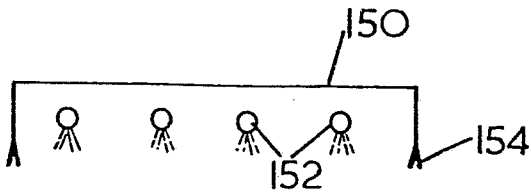


FIG. 6

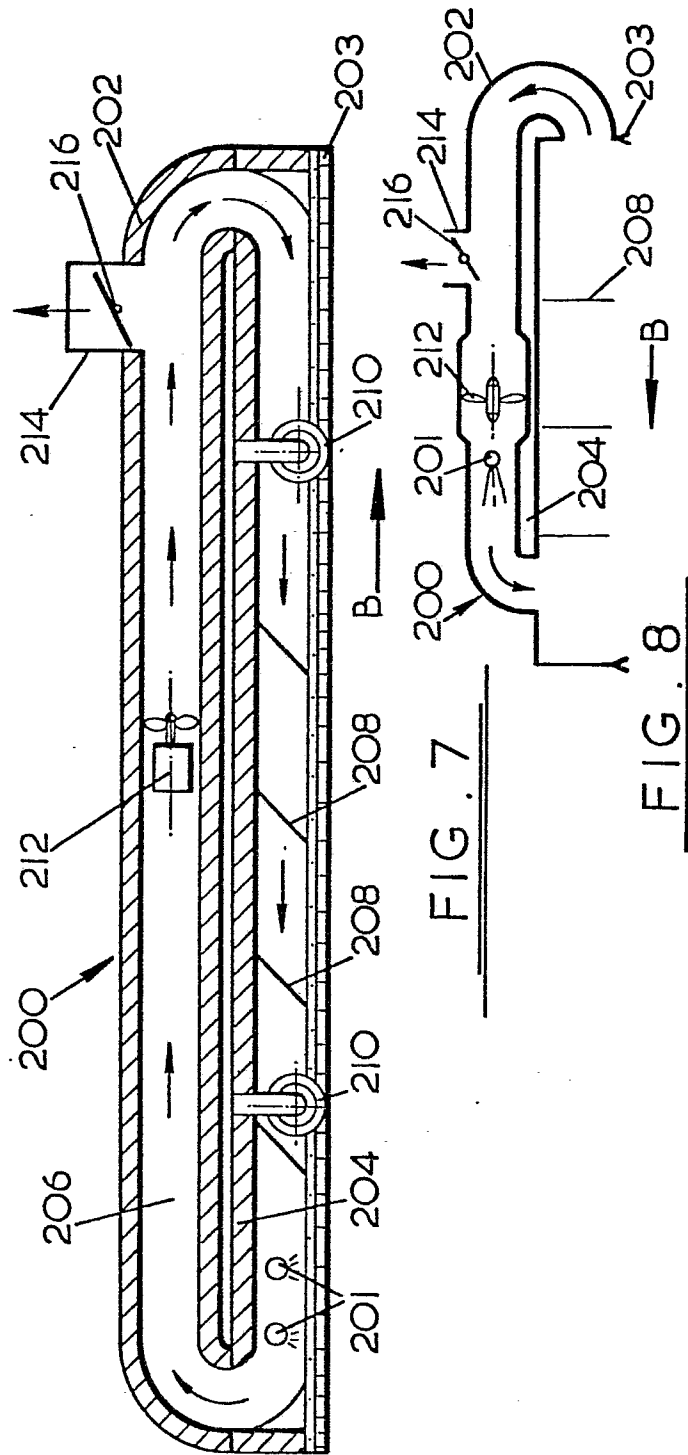


FIG. 7

FIG. 8



DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
D	<u>US - A - 3 824 739</u> (B. MORET et al.) * complete document * --	1,2, 4-10,12, 15,19, 21,23, 31-33, 37,38	B 24 C 1/00 B 24 C 3/06 E 01 C 11/24 E 01 C 23/08 E 01 H 1/10
	<u>US - A - 2 996 846</u> (R.M. LELIAERT) * claims 1, 2; column 4, lines 8 to 27; column 5, lines 64 to 73; fig. 1 * & CH - A - 380 363 --	1,2, 4-10,12, 15,21, 23	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
	<u>US - A - 3 276 234</u> (W.J. PHYSIOC III) * column 1, lines 9 to 14; column 2, line 23 to column 3, line 2; fig. 1 to 4 * --	1,4-7, 9,10, 21,23	B 24 C 1/00 B 24 C 3/00 B 29 C 17/12 B 29 H 3/06 E 01 C 41/24 E 01 C 23/00 E 01 H 1/00
	<u>US - A - 3 934 379</u> (N.R. BRATON et al.) * claims 1 to 13; column 4, lines 27 to 68 * --	1,4-7, 9,10, 21,23	
	<u>GB - A - 1 480 482</u> (AMEY ROADSTONE CONSTRUCTION LTD.) * page 1, line 10 to page 2, line 8 * --	1,4-7, 9,25, 37	CATEGORY OF CITED DOCUMENTS X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
	<u>FR - A1 - 2 342 821</u> (WHEELABRATOR-FRYE INC.) * page 3, line 34 to page 7, line 7; fig. 1, 2 * -- ./...	10-18	&: member of the same patent family, corresponding document
X The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Berlin		28-08-1981	MARTIN



European Patent
Office

EUROPEAN SEARCH REPORT

0041797

Application number
EP 81 30 2356.1
- page 2 -

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>US - A - 3 945 155</u> (R.M. LELIAERT) ---		
A	<u>US - A - 3 877 175</u> (C.A. SNYDER) ---		
A	<u>US - A - 3 858 359</u> (R.M. LELIAERT) ---		
A	<u>US - A - 3 676 963</u> (E.E. RICE et al.) ---		
A	<u>US - A - 3 528 201</u> (R.D. JONES et al.) ---		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	<u>DE - A - 1 479 859</u> (WHEELABRATOR CORP.) ---		
A	<u>DE - A - 2 312 406</u> (ETAT FRANCAIS) -----		