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**SELF CLEANING SHREDDING DEVICE HAVING MOVABLE CLEANING
RINGS**

The present invention relates generally to
5 machinery, devices or installations used in the material
treatment industries, particularly in the recycling and
waste disposal industries. In particular the present
invention relates to apparatus, appliances and assemblies
that may be used to cut, crush, pulverise, comminute or
10 otherwise reduce in size a wide variety of different
materials, particularly waste or scrap materials, so as to
convert the waste or scrap materials into a size which is
more usable or useful, such as for example, for use in
further processing in the manufacture of recycled goods or
15 of a size which is easier to dispose of or of a size for
more advantageous final disposal of the waste or scrap
material, either in land fill, for recycling or for
consumption, such as a fuel or the like. Even more
particularly the present invention relates to an apparatus
20 or device provided with a cutting assembly having one or
more cutting elements arranged in cutting arrays or
similar for reducing the size of materials in which the
arrays are provided with self-cleaning or self-clearing
means, particularly associated with the cutting elements.
25 Even more particularly, the present invention relates to a
shredding device, particularly for shredding used motor
vehicle tyres, in which the cutting assemblies comprise
cutting elements and spacers arranged in opposed sequences
so that as the cutting elements rotate to shred the
30 material the cutting elements are cleared or cleaned by
movement of the spacers, particularly movement which is
essentially eccentric, preferably rotary movement combined
with linear movement in accordance with rotation of the
cutting elements and contact by the cutting elements. The
35 cutting means, assemblies or sequences including the
cutting elements are arranged in opposed arrays to
cooperate with each other to sever material located



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between respective cutters as they rotate with respect to each other, particularly in opposite directions to each other. One particular application of the device of the present invention relates to an apparatus or device having rotary cleaning rings located alternately with rotary cutters for cleaning the cutters when the device is used for reducing the size of scrap materials such as for example, used motor vehicle tyres or the like so that the shredded material may be used in other applications, such as for example, as a fuel in furnaces, particularly furnaces for producing cement, power or the like, as a filler in paving or road construction materials, such as for example, in forming rubberised footpaths or walkways of the type used in theme parks, recreational areas or the like.

Although the present invention will be described with particular reference to one cutting assembly in the form of a shredder for use in shredding used motor vehicle tyres in which the shredder has a plurality of cutters and spacer rings arranged alternately in rows to form an array in which the cutters are kept clean by rotation of the spacer rings with respect to the cutters, it is to be noted that the present invention is not restricted in scope to the described embodiment or to the described use or described application but rather the present invention is broader in scope so as to include other forms and arrangements of the cutting assemblies, including their use in other devices, other uses of all of the different assemblies, devices and arrangements, including treatment of other materials to produce relatively smaller sized particles in a variety of different sizes, shapes or forms.

It is to be noted that even though the present invention will be described with particular reference to cutting or severing material by the cutters, the scope of the term cutting, cutting elements or cutters is not limited to cutting but includes any operation whereby

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material is reduced in size such as by crushing, slicing, pulverising or the like.

One problem of existing cutting devices and shredders used in recycling waste or scrap materials for reducing the size of the scrap material or waste material to relatively smaller sized particles is that the strips of material formed as part of the size reduction operation have a tendency to wrap around the cutting assemblies or arrays so as to become wound around and/or entangled in the cutters and shaft on which the cutters are mounted during operation of the device which has the effect of reducing the efficiency of cutting of the machinery or even stalling the machinery if there is an excessive build-up of strips of severed material around the cutters and shafts. Previous attempts at providing mechanisms or means for preventing material wrapping around the cutters or becoming lodged in the cutting assembly or clearing severed material away from the cutters, have not been entirely successful for a variety of reasons. Thus, it is one aim of the present invention to provide a shredding device that has an effective anti-wrapping arrangement for reducing or preventing the amount of material which wraps around the cutting elements and/or shafts to become entangled within the cutting arrays and shafts during use of the cutting device.

Another problem of existing shredding devices is that the cutters become clogged with partially cut material that adheres to the cutters. The pressure of partially shredded or shredded material on or around the cutters reduces their efficiency.

Another problem associated with existing shredding devices is that the cutting surfaces of the cutting elements become blunt within a very short period of time by being in constant contact with each other which accelerates the wear of the cutting surfaces and edges. When the cutting surfaces or edges become blunt it is necessary to disassemble the array of cutters and sharpen

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each cutter individually and assemble the array ready for reuse. One reason for the cutting edges or surfaces becoming prematurely blunt is that such cutters are not provided with any self cleaning or self sharpening mechanism to prolong the useful working life of the cutters. The accumulation of debris from severed material between the cutters accelerates the rate of wear of the cutters.

Another reason for existing cutting assemblies becoming prematurely blunt is that foreign objects contaminating the feed material could become trapped between the cutters so that the foreign objects are continually being struck by the rotating cutters of the cutting assembly such as by the foreign objects becoming wedged between adjacent cutters and/or between the cutters and shafts since there was no effective mechanism provided to clean or clear the cutters of such objects. Again, the wear caused by this situation is accelerated by strips of material being wound around the shafts and/or cutters. In some cases the cutting devices are damaged by the foreign objects, whilst in others the cutting devices stall.

Thus, there is also a need for a cutting device which is self sharpening during use in order to prolong the useful working life of the cutters by lengthening the periods between sharpening of the cutters.

Thus, there is a need for a cutting device that has a cutting assembly of individual cutters which is self clearing or self cleaning. There is a further need for the cutting assembly being self sharpening. There is a still further need for the cutting assembly to be self-releasing or being provided with an arrangement that allows foreign objects to more or less pass safely through the cutting arrays without causing excessive damage to the cutters and/or which reduces the chances of the cutting assembly stalling or stopping.

Thus, it is one aim of the present invention to provide a self clearing and/or self cleaning cutter. It

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is another aim to provide a cutting assembly which has a longer working life by preventing premature wear of the cutting surfaces of the cutters. It is a still further aim to provide a cutting assembly which is provided with a self sharpening arrangement for the cutters.

According to the present invention there is provided a self clearing cutting assembly, particularly a cutting assembly adapted for use with a shredding device for shredding material into relatively smaller sized pieces, including:

- a first cutting means capable of undergoing a first movement;
- a second cutting means capable of undergoing a second movement; and
- a clearing or cleaning means capable of undergoing a third movement.

wherein said first and second cutting means are located substantially adjacently opposite each other so that material introduced into the cutting assembly between the first and second cutting means is cut by the cooperative interaction of the two cutting means with each other to produce the relatively smaller sized pieces of material,

said cleaning means being located adjacent the first cutting means so that movement of the first cutting means imparts a first component of the movement to the cleaning means and substantially opposite said second cutting means so that when said second cutting means moves the second cutter means can contact the cleaning means to impart a second component of the movement of the cleaning means wherein the third movement of the cleaning means is a combination of at least the first and second components of movement imparted by the first and second cutter means,

whereby movement of the cleaning means with respect to the first cutter means caused by contact from the second cutter means maintains the first cutter means in a condition substantially free of the severed

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relatively smaller size pieces of material thereby reducing or substantially eliminating the relatively smaller sized pieces of material from interfering with or disrupting operation of the first cutter means by wrapping
5 around or remaining in contact with the first cutter means during use of the cutting assembly so that movement of the cleaning means provides self cleaning of the cutting assembly.

Typically the cutting assembly of the present
10 invention is a shredding machine or shredding device. More typically the shredding device shreds material into elongate strips of material. Even more typically the elongate strips of material have a regularly repeating profile or shape, and are typically curved out of the
15 plane containing the lengthwise extending axis of the material. Even more typically, the shredded pieces have a tendency to curl or wrap around the cutters, particularly due to the shape of the shredded pieces being curved or similar, particularly curved about their lengthwise axis.

20 Although one preferred material being treated by the shredder of the present invention is rubber or other resilient material, such as for example, from used motor vehicle tyres, including heavy duty truck and bus tyres, it is to be noted that the present invention can be used
25 to cut or comminute material of any type.

Typically the cutting means is a rotary cutting blade arrangement, typically having one or more cutting surfaces located around the periphery of the blade. More typically, the outer cutting surface of the blade is
30 provided with surface irregularities or discontinuities, such as for example, projections and troughs in the form of teeth, grooves, cleats or the like. More typically, the cutting surface is provided with a retaining means or holding means. Typically the retaining means is a hook,
35 enlarged teeth, projection, spear head or tip or the like. More typically there are two, three, four or more such projections located at regularly spaced apart intervals

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around the circumference of the cutting surface. More typically, the cutting surface comprises three parts, two cutting edges or sections located at or towards the sides of the blades and a central section located between the side sections. More typically, the holding means is located in or about the central section.

Typically there is a plurality of rotating blades arranged to extend in a line or row of similar blades. Typically, the blades rotate in unison.

Typically the first movement of the first cutter is a rotation. Typically the second movement of the second cutter is a rotation. Even more typically the direction of rotation of the first cutter is opposite to the direction of rotation of the second cutter. More typically the first and second cutters rotate in opposite directions at the same speed and in unison with each other. Alternatively, the two rows of cutters can rotate at different speeds. The speeds of rotation can be variable.

Typically, all the cutters are mounted on shafts. More typically, there are two shafts, each shaft having a plurality of cutters. Even more typically, the cutters on each shaft are all the same size. Alternatively, the cutters on the one shaft can be of different sizes. Even more typically, the cutters differ in widths. Typically, there are cutters of two or three sizes mounted on the one shaft. More typically, there are different cutting zones defined by the different sized cutters. More typically, the cutters located substantially opposite each other are of the same size as each other so as to define different zones of the cutting array. More typically, there is a first zone of cutters in which the cutters are about 100mm in width, typically there is a second zone of cutters in which the cutters are about 70mm in width, and typically there is a third zone of cutters in which the cutters are about 40mm in width. The cutters are readily replaceable on the shafts. Typically, the cutters are replaceable in

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blocks in accordance with their wear.

Typically the clearing or cleaning means is a spacer. Typically the spacer is a ring arrangement. More typically the spacer is a simple ring having a reinforcing
5 internally located radially directed flange and an outer circumferential surface. Even more typically, the ring is of a complex structure having one or more inner ring portions, preferably provided with a flange arrangement, an intermediate ring portion, preferably of a material
10 having different mechanical properties or characteristics or an outer ring portion surrounding the intermediate portion.

Typically, the third movement is an eccentric movement being a combination of rotation and linear
15 movement. More typically, the linear movement is longitudinal or transverse movement in a radial direction or tangential direction. More typically, movement of the spacer ring against one or more cutters cleans and/or clears the cutter or cutters and prevents cut pieces or
20 strips of material from remaining against or being associated with the cutter or cutters or being adhered to the cutters. Even more typically, the linear movement, typically radial movement, is superposed on the rotary movement of the ring two, three, four or more times each
25 revolution of the spacer ring.

Typically, the projection of the second cutter means strikes the outer surface of the ring to move the ring with respect to the first cutter to clean or clear the first cutter. More typically, the outer surface of
30 the spacer ring is struck by the tip of the projection of the cutter or the like. Even more typically, the linear movement of the ring is such that the ring extends beyond the tip of the projection so as to push the material away from an adjacent cutter so as to completely clean the
35 cutter.

Typically the spacer ring is not driven by the driving shaft but rather is driven by contact with the

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first cutter located opposite the ring, or by the cutters on either side of the spacer ring in combination with contact by the oppositely located cutter.

Typically, movement of the spacer is against or
5 along the sides of the cutter so that the movement with respect to the cutter cleans material from the cutter, particularly the cutting surfaces of the cutter, and prevents any severed piece of material from wrapping around the cutter as it rotates by knocking the severed
10 material away from the cutter. More typically, the extent of movement of the spacer is sufficient to dislodge any material adhering to the cutter.

Typically, the spacer ring is provided with a wear surface or wear portion. More typically, the wear
15 surface is a ring, either a complete ring or a partial ring, located at or towards one or both sides of the spacer ring. Even more typically, the wear ring is metallic or is a resilient material made from a foam material, or is a plastically deformable material. Even
20 more typically, the foam material is a sound deadening material for reducing the noise of impact of or against the cutters. Even more typically, the wear portion is made from the same material as the spacer ring or from a material which is more durable or harder than the spacer
25 ring.

Typically, the device of the present invention is provided with a recycling assembly for returning items back to the shredder for further shredding so as to produce pieces of a more uniform size. More typically,
30 the recycling assembly is located to one side of the shredder, preferably coaxially to one side. The recycling assembly is provided with means for transporting material to the shredder. More typically, the transporting means is a slide, baskets or similar for holding the severed
35 material.

More typically, the recycling assembly is a trommel or trommel-like device which rotates to

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reintroduce cut pieces into the shredder. Even more typically, the trommel is a rotating wheel-like framework having baskets for transporting cut pieces back to the receiving hopper of the shredder. Even more typically, the trommel is located axially off-set or to one end of the shredder for introducing cut pieces to one region of the counter rotating cutters, preferably the portion of the array having cutters of reduced or relatively smaller widths, such as for example, from about 40 to 70mm wide. More typically, the trommel is provided with a slide, preferably an adjustably movable slide for collecting and/or distributing material.

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

Figure 1 is a top plan view of a shredder having one form of the cutting system of the present invention including two oppositely arranged rows of a plurality of cutters and spacer rings arranged alternately to each other along one row and opposite the other row.

Figure 2 is a partial vertical cross-section along the line 2 to 2 of Figure 1 showing one form and arrangement of the cutter and spacer ring assembly of the present invention in one position of rotation.

Figure 3 is a more detailed close-up cross-section view of the arrangement of the cutters and spacer rings along the line 3 to 3 of Figure 2.

Figure 4 is a partial cross-section view through one form of the spacer ring and a partial side view of the circumference of the side ring.

Figure 5 is a more detailed close-up cross-section view similar to Figure 3 of an alternative form of the cutter and spacer ring arrangement of the present invention in one position of rotation.

Figure 6 is a more detailed close-up cross-section view similar to Figure 3 of a still further embodiment of the cutter and spacer ring arrangement of

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the present invention in one position of rotation.

Figure 7 is a partial side view and a partial cross-sectional view of another form of the spacer of the present invention.

5 Figure 8 is a side perspective view of another form of the cutter useful in the device of the present invention.

10 In Figure 1 there is shown one form of a shredder or shredding machine, generally denoted as 2, suitable for shredding used motor vehicle tyres. Briefly, shredder 2 includes a pair of driven counter-rotating spaced apart shafts 4a, 4b arranged in substantially parallel relationship to each other. Shafts 4a, 4b are driven by suitable motors 6a, 6b arranged in substantial parallel relationship through a suitable transmission 8, such as
15 electric or hydraulic motors and mechanical gearboxes. Couplings 9a, 9b join shafts 4a, 4b to gearbox/transmission 8.

20 A plurality of rotary cutters 10 are located on one of the shafts 4a arranged alternately with a plurality of spacer rings 12 to form an alternating sequence of cutters 10 and spacers 12 in a row on this shaft. A second shaft 4b is also provided with a plurality of cutters 10 and spacers 12 alternately arranged thereon to
25 also form an alternating sequence of cutters and spacers in a row. The cutters 10 on one shaft 4a are arranged to cooperate with cutters 10 on the other shaft 4b so that each cutter 10 is located between two adjacent spacers 12 on the one shaft and opposite a spacer ring 12 on the
30 other shaft and, similarly, each spacer 12 is located between two adjacent cutters 10 on the one shaft and opposite a cutter 10 on the other shaft. Thus, an alternating array of cutters 10 and spacers 12 are formed on the two shafts in opposed facing relationship to each
35 other to form the array of cutters and spacers as shown in Figure 1 with the cutters arranged adjacently opposite each other. In operation, the shafts 4a, 4b and cutters 10

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are rotated in opposite directions, such as in the directions indicated by arrows A and B of Figure 2, which directions are in a direction towards each other at the top of the array so that material fed to the top of the shredder in use is firstly grabbed by the cutters 10 as the cutters rotate in a direction towards each other at the top of the array and are sliced or otherwise cut into strips by passage between the pair of oppositely adjacent cutters as the cutters rotate in the same direction as each other before rotating away from each other at the bottom of the array to release the cut material allowing it to fall into a hopper or other receiving receptacle located at the bottom of the shredder or be directed to a suitable recycling means for reintroducing material into the shredder for further cutting.

The alternating array of cutters 10 and spacers 12 are held together in contact with each other at a predetermined tension by a suitable tensioning means. In one form the tension is applied by tension spring 18 located on each respective side of the array for applying a force to one end of the array through a suitable connector in the form of a thrust plate 19 or similar.

It is to be noted that each cutter 10 in each row of the array is identical to each other as is each spacer 12 in the array identical to each other. Accordingly, operation of the device by reference to two cutters and one spacer only will be described in detail in which the spacer is located adjacent one cutter and opposite the other cutter and the two cutters have side cutting surfaces facing each other which cooperate with each other to sever material located between them into strips.

With particular reference to Figure 8, in one form, cutter 10 is provided with a hexagonal centrally located aperture 22 through which is received a correspondingly sized hexagonal shaft 4. In use hexagonal shaft 4 is driven by motor 6 so as to rotate cutter 10. A flanged boss 24 is provided to surround hexagonal aperture

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22 on each side of the cutter to provide a drive surface for shaft 4 and to provide a buffer to prevent two adjacent cutters 10 on the one row of cutters from being forced too close to each other to cause unnecessary wear of the respective cutting surfaces. The internal profile of boss 24 is hexagonal whilst the external profile is circular as shown in Figure 8. It is to be noted that the length of boss 24 can vary according to the requirements and wear patterns of the cutters. In some cases boss 24 will be longer to maintain separation of adjacent cutters whereas in other embodiments boss 24 will be relatively shorter allowing the cutting surfaces of adjacent cutters to contact each other for longer periods of time.

The body of cutter 10 is a substantially circular disc 26 which is provided circumferentially around the external circumference of the circular profile of boss 24 to form a disc-like body for the cutter.

A cutting surface, generally denoted as 28, of the cutter 10 is provided around the circumference of the disc 26. Cutting surface 28 can take a variety of different forms, shapes or profiles. One such form of the cutting surface 28 is in the form of a substantially castellated surface comprising a plurality of raised substantially square profiled teeth 30 and a plurality of substantially curved or rounded troughs or grooves 32 arranged alternately with each other along each side edge of the cutting surface 28. The spacing between adjacent raised teeth may be regular, irregular, random or in any pattern or configuration. Teeth 30 and troughs 32 can take any suitable shape, profile or form.

In the embodiment shown in the drawings, particularly Figure 8, the cutting surface 28 is formed of three sections when viewed transversely i.e., in cross-section in the axial direction of the cutter along the lengthwise extending axis of shaft 4 to which the cutter is fitted in use. The three sections include a first edge section 34 located at or towards one side edge of the

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cutting surface, a second edge section 36 located at or towards the other side edge of the cutting surface, and a central section 38 located intermediate the two edge sections. The central section 38 is in substantial
5 alignment in the radial direction with the disc body 26 of the cutter. The first edge section 34 and the second edge sections 36 are each composed of substantially square profiled teeth 30 separated from each other by substantially rounded triangular cut-outs or troughs 32.
10 Additionally, the teeth slope or are inclined outwardly from the centre line of the cutter in both the axial direction and the radial direction to form not only a gripping surface for material introduced into the shredder but also a cutting surface for material located between
15 oppositely adjacent cutters.

The central section 38 is substantially smooth, being relatively free from indentations, projections or other surface irregularities, or surface discontinuities but is substantially undulating, over a portion of the
20 circumference.

Although the circumference of the cutter is described as being substantially circular, some embodiments of the cutter, such as shown in Figures 2 and 8 can be substantially square with rounded corners and/or
25 slightly bulging sides or substantially circular with flattened segments, divided into four substantially identical surface sections 40 as shown more clearly in Figure 2. A hook 42, spear, tip or similar is provided intermediate two adjacent sections 40 so that there are
30 four hooks 42 located at regular spaced apart locations around the surface so as to divide the cutting surface into the four identical sections 40 as indicated particularly in Figure 2.

Hook 42 can take any number of different forms.
35 One such form has the appearance of a shark fin in profile when viewed as a side elevation view. However, when viewed end-on the distal end of hook 42 is spear-like in

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appearance having two oppositely inclined cutting blades terminating in a point so as to form a spear tip or spear head or spear-like projection 44. The sharp end or tip 44 of hook 42 punctures any material introduced into the shredder to hold the material onto the cutter and prevent it from being dislodged between the cutters when being cut or shredded by the two oppositely rotating cutters.

A second boss 24, similar to the first flanged boss 24 is also provided on the other side of the disc-like body 26 to also act as a buffer by contacting the corresponding boss of the cutter located adjacent to this cutter on the shaft to prevent the cutting surfaces 34,38 of one cutter 10 from wearing against the cutting surfaces 34,38 of an adjacent cutter thereby preventing premature wearing of the cutting surfaces 34,38 of both cutters. However, different arrangements of bosses are also within the scope of this invention.

Spacer ring 12 can take many different forms and/or internal profiles and be of many different shapes and/or sizes. With particular reference to Figure 4, one form of spacer ring will now be described. In this form outer circumferential surface of ring 12 is smooth and the ring is of a diameter which is about the same as or similar to the internal diameter of the cutting surface 34, 38 of the cutter. Ring 12 is provided with a radially inwardly directed flange portion 46 in the shape of a T-section when viewed in cross-section extending radially inwards from the inner surface of the circumferential portion or surface of the ring. Other internal profiles of the flange or similar reinforcing arrangement are possible.

With particular reference to Figure 7, another embodiment of spacer ring 12 will now be described. This form of spacer 12 is provided with an inner ring surface portion 50 having a T-shaped radially inwardly flange 46 and an outer annular ring portion 52. A groove is provided in the outer surface of inner ring 50 and another

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groove is provided in the inner surface of outer ring 52 in opposed face to face relationship to each other substantially in alignment with each other. An annular ring or 'O'-ring 54 or similar forming a circular pad or loop of substantially resilient material is located intermediate the inner ring 50 and the outer ring 52 in the oppositely facing grooves.

In use, the resilient pad 54 acts as a cushion between the outer ring portion 52 and inner ring portion 50 to soften the effects of the hits or blows on the outer surface of outer ring 52 by hook 42, particularly tip 44, in use of the shredder as will be described in more detail later in this specification.

Returning now to the description of the cutters, in other embodiments of the cutters, modifications are provided to the disc-like bodies 26 of the cutters as shown in Figure 3. In one embodiment the axially outwardly facing side surfaces of the body discs 26 are provided with groove 60 having a substantially square or rectilinear profile located on either side of the disc body 26. Rings made from material different to the material from which the cutters are made are provided in these annular grooves to act as sacrificial wear surfaces which wear in preference to the cutting surfaces of the cutter wearing which is caused by constant rubbing against the spacers during use of the shredder. In the embodiment of Figure 3 sacrificial wear rings 62 are made from any suitable wearing material, such as for example, metal, plastics material or the like. One preferred material is a metal at least as hard as the metal from which the cutter itself is made, such as a hard wearing steel or similar. In still other embodiments, the cutters can be made with integrated rings or inserts made from the same material as the cutters by being cast or similar when the cutters are being manufactured.

Another form of the cutter is provided with a loop of resilient material on either side of the cutter in

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place of or next to the wear ring or wear segments or blocks. The loop is made from plastically deformable material or other readily compressible material to act as a sound deadening material so as to reduce the noise of the spacer ring rubbing against the side of the cutters or the cutters rotating against each other. In one form, the resilient material is a foamed material or is a foam, such as for example, similar to a natural or synthetic chamois or similar material. It is to be noted that during use of the shredder, the rings move past and beyond the periphery of the cutters, particularly past or beyond the hook of the cutters to completely clean the cutters by completely dislodging material from adhering to or being retained on the cutters particularly dislodging material caught or impaled on the hook.

In a still further modification of the cutters of the present invention as shown in Figures 5 and 6, the cutters 10 are made in a composite or laminate structure in which different sections of the cutter 10 can be made from different materials in different arrangements. In one embodiment, shown in Figure 5, the inner part of the cutter which is the disc like body 26 is made from one material, such as for example, cast iron, steel or the like. An annular ring 64 or 'O'-ring or similar is made from a resilient material or at least a 'softer' material than the body 26 of the cutter and is provided in annular grooves on either side of the iron or steel disc forming the body 26 of the cutter to act as a wear surface or to provide greater sealing between the adjacent cutter and spacer so as to prevent debris, severed material or the like from lodging next to the cutter near the driving shaft 4 or falling through the device and becoming entrapped around the rotating shaft.

In other embodiments as shown in Figure 6 and also one of the cutters of Figure 5 the 'O'-ring 64 or similar is omitted.

In both embodiments shown in Figures 5 and 6 an

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intermediate ring 70 of a different material is provided radially outwardly of and around the circumference of the disc-like body 26. Intermediate ring 70 in one form, has a substantially H-shaped profile when viewed in transverse cross-section as shown in Figures 5 and 6.

In this embodiment there is an outer ring 72 which forms the cutting surface 28 having teeth 30 for cutting and gripping materials fed into the shredder for cutting between the adjacent cutters 10.

Further it is to be noted that the one shredder may have a mixture of different types of cutters ranging from (i) a one-piece cast iron or steel cutter with the cutting surface 28 formed on the outer periphery of the cutter, (ii) a cutter having an intermediate ring 70 between the body 26 and the outer ring 72 in which the outer ring 72 forms the cutting surface 28 to (iii) a cutter having an inner ring 64 of resilient or wear material in addition to an intermediate ring 70 and an outer ring 72 which forms the cutting surface 28 and to (iv) a cutter having a pair of foam loops, one on either side of the cutter for absorbing sound of the impact of the cutter. It is to be noted that whatever form or construction the cutter takes, the outer ring 72 is always provided with the cutting surface 28 comprising the projections, teeth 30, hooks 42, spear tips 44, or the like for holding, puncturing, slicing, cutting of the like the material fed to the shredder.

The shredder of the present invention is provided with an optional feature which is a trommel or trommel-like assembly for recycling partially cut material back into the shredder. In one form, the trommel-like device is in the form of a large wheel like framework having baskets or similar receiving or guiding means for receiving and directing the partially severed lumps of tyre back into the shredder to be recycled through the cutting array. The recycling trommel is located axially to one side of the shredder for recycling partially cut

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material back to the hopper of the shredder for a further pass through the shredder.

Operation of one form of the shredder will now be described.

5 Shredder 2 is operated by driving the two rotating shafts 4a,4b in unison in different directions by operation of the motors 6 provided for this purpose. In figure 1, it is noted that the spear heads 44 of hooks 42 point in the direction of rotation of the shafts 4 and of
10 the two rows of cutters 10. Thus, when viewed from above as in Figure 1 the respective top surfaces of the two rows of cutters rotate towards each other to force material down in between the cutters as they rotate.

 When material is introduced into the shredder 2,
15 the teeth 30 of the outer cutting surface 28 of the cutters 10 firstly grab the material and draw it into the area between the two rows of cutters and then when the material is located between a pair of oppositely adjacent cutters the material is cut into strips by the cooperating
20 action of the opposed cutting edges 34,38 of the two oppositely adjacent cutters. The strip of material is then dragged by the teeth 30 from between the two rows of cutters by rotation of the cutters to fall into a hopper or similar container provided underneath the cutting
25 assembly or array of cutters in the device or into a slide to direct the material into the trommel.

 Hooks 42 assist in holding the material between the cutters and prevent it from being dislodged by tips 44 puncturing the material to securely retain it from being
30 squeezed out of the counter-rotating cutters. As one preferred material being shredded by the shredder of the present invention is rubber, particularly used vehicle tyres, there is a tendency for the cut rubber strips to curl around the cutters and become wound around the
35 cutters and shafts thereby becoming entangled in the array of cutters with the effect that the shredder either stops working or the efficiency of operation of the shredder is

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greatly reduced. By having the spacer rings 12 located on either side of each cutter, the cut strips of rubber tyres are prevented from wrapping around the shafts and cutters thereby maintaining the cutting assembly substantially
5 free of debris and allowing it to continue operating efficiently. Additionally, the spacer rings can be pushed away from engagement with the adjacent or opposite cutters to leave a gap or space to allow foreign objects to pass between the two rows of rotating cutters and to fall into
10 the collection hopper under the cutting assembly hereby reducing the chance of the cutters being damaged by impacting against the foreign objects particularly if the foreign objects are hard.

Each spacer ring 12 is free to move with respect
15 to its shaft depending upon the forces and the direction of the forces acting on the particular ring since it is not mounted on the shaft in driving connection therewith but rather is freely located on the shaft and is able to move eccentrically about the shaft with a combination of
20 rotary and linear movements.

As one pair of adjacent cutters rotate the spacer ring located between them also rotates accordingly since, in effect, the spacer is sandwiched or clamped between the two cutters. The spacer undergoes a rotation in a
25 generally circular path in accordance with the regular rotary movement of the two cutters on either side of the spacer ring.

However, as the cutters rotate, particularly the cutter directly opposite the spacer ring 12 being
30 described, the hooks 42 of this opposite cutter also rotate and as the hooks 42 extend radially outwards of the remaining part of the cutting surface 28 of the opposite cutter, the hooks 42, particularly tips 44, come into contact with the outer circumference 72 of the spacer ring
35 located directly opposite this cutter which forces the spacer ring 12 to be radially or linearly displaced with respect to the shaft 4 so that the inner surface of the

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spacer ring contacts the combined outer surface of the perspective bosses 24 of the adjacent cutters to retain the spacers of the shaft but in a displaced position as compared to the position that it would have adopted under normal rotation by the two adjacent cutters if not struck by the opposite cutter as it rotates. Thus, as the cutters rotate, the spacer rings that are located directly opposite each cutter are being continually knocked sideways along and against the sides of the cutters ie. the spacers are being pushed substantially radially with the effect that the actual movement of the spacer rings is eccentric being a combination of rotary movement and radial movement, i.e., substantially repeatedly eccentric. For each revolution of an opposite cutter the spacer ring is knocked sideways four times along the side of the cutter because the cutter has four hooks 42 and tips 44. Thus, the spacer undergoes two simultaneous movements, in operation, being knocked sideways as it rotates. This occurs four times per each revolution of the cutter.

The effect of the transverse movement of the spacer ring as it rotates is to knock the tyre strips curling around the cutters and shafts away from the cutting surface of the cutters and the cutters themselves thus cleaning the cutters and clearing any debris or strips of cut material away from the cutters which prevents the rubber strips from wrapping around the cutters, ie the strips are knocked away from the cutters before they have a chance to wind around the rotating cutters. It is to be noted that the extent of movement of the spacer ring is such that it extends beyond the end of the hook projections when hit by the opposite cutter so as to dislodge any material retained on the hook thereby cleaning the cutter. Thus, the linear movement of the spacer ring is greater than the radius of the widest point of the cutter.

If fitted, the recycling trommel picks up relatively larger sized pieces of shredded material or

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uncut strips in the rotating baskets or similar provided on the wheel-like rotating framework and transports these pieces back to the inlet of the shredder for further shredding by being passed through the shredder again.

5 In one embodiment, the recycling mechanism includes a slide for directing partially cut material from the shredder to the trommel and/or another slide for directing material from the trommel back into the inlet of the shredder. In other embodiments the slide is
10 stationary or is movably adjustable or is regularly repeatedly movable so as to distribute material more uniformly. The slide is provided to one side of the trommel so as to direct pieces to the centre of the trommel where they can be transported back to the inlet of
15 the shredder. Other arrangements of the trommel arrangement are possible.

The described arrangement has been advanced by explanation and many modifications may be made without departing from the spirit and scope of the invention which
20 includes every novel feature and novel combination of features herein disclosed.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described.
25 It is understood that the invention includes all such variations and modifications which fall within the spirit and scope.

Advantages of the present invention include that the cutting assemblies are substantially self cleaning
30 and/or self clearing by the eccentric movement of the spacer with respect to the cutter which has the effect of increasing the effective working life of the cutting assembly by keeping the cutting surfaces, blades and the like of the cutters sharper for longer periods of time.

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CLAIMS:

1. A self clearing cutting assembly, including a first driven cutter provided on a first shaft for driving movement in a first rotary direction, and a second driven cutter mounted on a second shaft for driven movement in a counter rotating direction to the first cutter, wherein said first and second cutters are located substantially adjacently opposite each other so that material introduced into the cutting assembly between the first and second cutters is cut by the cooperative interaction of the two cutters undergoing counter rotation with respect to each other, so as to produce relatively smaller pieces of material, characterised in that the cutting assembly further includes a floating non-driven clearing or cleaning means freely mounted on the first shaft and capable of undergoing a third movement, wherein said cleaning means is located adjacent the first cutter so that movement of the first cutter imparts a first component of the third movement to the cleaning means and the cleaning means is located substantially opposite the second cutter, so that movement of the second cutter imparts a second component of the third movement to the cleaning means so that the third movement of the cleaning means is a combination of the first and second components of the third movement imparted by the first and second cutters respectively, whereby movement of the cleaning means with respect to the first cutter caused by contact from the second cutter maintains the first cutter in a condition substantially free of severed, relatively smaller sized pieces of material cut by the two cutters, thereby reducing or substantially eliminating the relatively smaller sized particles of material from interfering with or disrupting operation of the first cutter by wrapping round or remaining in contact with the first cutter during use of the cutting assembly, thereby providing the self cleaning cutting assembly.

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2. A self clearing cutting assembly according to claim 1, characterised in that the cutting assembly is a shredding machine, installation or device.
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3. A self clearing cutting assembly according to claim 2, characterised in that the shredding device shreds material into elongate strips of material, preferably elongate strips of material that have a regularly repeating profile or shape.
- 10
4. A self clearing cutting assembly according to any preceding claim, characterised in that the material is a rubber or other resilient material, preferably used motor vehicle tyres, including heavy duty truck and bus tyres.
- 15
5. A self clearing cutting assembly according to any preceding claim, characterised in that the outer cutting surface of the blade is provided with surface irregularities or discontinuities.
- 20
6. A self clearing cutting assembly according to claim 5, characterised in that the surface irregularities or discontinuities includes projections and/or troughs, preferably teeth, grooves, cleats, recesses, rebates, spaces, gaps or the like.
- 25
7. A self clearing cutting assembly according to claim 5 or 6, characterised in that the cutting surface is provided with a retaining means or a holding means.
- 30
8. A self clearing cutting assembly according to claim 7, characterised in that the retaining means or holding means includes a hook, enlarged teeth, projections, spearhead or tip, nose, finger or other protuberance.
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9. A self clearing cutting assembly according to any preceding claim, characterised in that there are two, three, four or more projections located at regularly spaced apart intervals around the circumference of the cutting surface of the cutter.

10. A self clearing cutting assembly according to any preceding claim, characterised in that the cutting surface of the cutter includes three parts, which are two cutting edges or sections located at or towards the sides of the blades defining a central section therebetween.

11. A self clearing cutting assembly according to claim 9, in which the projections or protuberances are located on or about the central section of the cutting surface between the side sections.

12. A self clearing cutting assembly according to any preceding claim, characterised in that the clearing or cleaning means is a spacer.

13. A self clearing cutting assembly according to claim 12, characterised in that the spacer is a ring arrangement.

14. A self clearing cutting assembly according to claim 13, in which the ring is freely mounted on the shaft having the first roller for floating movement in accordance with movement of the first and second cutters and the ring is not substantially driven by the shaft.

15. A self clearing cutting assembly according to claim 13 or 14, characterised in that the spacer is a simple ring having a reinforcing, internally located, radially directed flange, and an outer circumferential surface.

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16. A self clearing cutting assembly according to any one of claims 13 to 15, characterised in that the ring is a complex structure having one or more of an inner ring, an intermediate ring or an outer ring.

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17. A self clearing cutting assembly according to any preceding claim, characterised in that the third movement is an eccentric movement being a combination of a rotation or rotary movement imparted by the first cutter and a linear movement imparted by the second cutter.

10

18. A self clearing cutting assembly according to claim 17, characterised in that the linear movement is a longitudinal or transverse movement in a radial or tangential direction.

15

19. A self clearing cutting assembly according to any preceding claim, characterised in that the movement of the spacer ring against one or more cutters, preferably one or more cutters located adjacent the spacer ring, cleans and/or clear the cutter or cutters and prevents cut pieces or strips of material from remaining against or being associated with the cutter or cutters, or being adhered to the cutter or cutters.

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20. A self clearing cutting assembly according to claim 17 to 19, characterised in that the linear movement, typically the radial movement, is superposed on the rotary movement of the ring two, three, four or more times each revolution of the spacer ring.

30

21. A self clearing cutting assembly according to any preceding claim, characterised in that the number of linear movements imparted to the spacer or cleaning ring is in accordance the number of projections on adjacent cutters.

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22. A self clearing cutting assembly according to any preceding claim, characterised in that the outer surface of the spacer ring or cleaning ring is struck by the tip of the projection of the cutter located opposite the clearing or cleaning ring.

23. A self clearing cutting assembly according to any preceding claim, in which the cutter having the projection for striking the ring, is located in opposed relationship to the spacer ring so that the cutter is located on the second shaft and the ring is located on the first shaft, said first and second shafts being arranged in opposed relationship to each other.

24. A self clearing cutting assembly according to any preceding claim, in which movement of the spacer is against or along the sides of the cutter so that movement with respect to the cutter cleans material from the cutter, particularly the cutting surfaces of the cutter, and prevents any severed material from wrapping around the cutter as it rotates by knocking the severed material away from the cutter.

25. A self clearing cutting assembly according to any preceding claim, in which the cutting blade or spacer is provided with a wear portion in which the wear portion may be continuous or discontinuous, by being segmented or the like.

26. A self clearing cutting assembly according to claim 25, characterised in that the wear portion is a sacrificial wear portion made from a material which is at least as hard as the material of the cutter or spacer or from another material such as a foam or resilient foam material.

27. A self clearing cutting assembly according to

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claim 25 or 26, in which the sacrificial wear material, particularly the foam material, quietens operation of the device by reducing the noise of impact of the cutters with the spacer ring or against the sides of the cutters.

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28. A self clearing cutting assembly according to any preceding claim, characterised in that the cutters located on the one shaft have different widths.

10

29. A self clearing cutting assembly according to any preceding claim, characterised in that the cutters in opposed relationship to each other are substantially of the same size.

15

30. A self clearing cutting assembly according to any preceding claim, characterised in that there are two or more different cutting zones located axially along the length of the cutting array.

20

31. A self clearing cutting assembly according to any preceding claim, characterised in that the device further includes a trommel or trommel-like arrangement for recycling partially cut items back to the shredder for further cutting.

25

32. A self clearing cutting assembly according to any preceding claim, characterised in that the trommel is a wheel-like framework having a plurality of baskets for receiving partially cut material for recycling the material by reintroducing the material for subsequent severing in the shredder.

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33. A method of reducing in size material using a self clearing cutting assembly according to any preceding claim, characterised in that the material to be cut is introduced to the device where it is cut between two counter rotating cutters located on opposed shafts, such

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that the cut material is prevented from wrapping around the cutters and/or shafts by operation of a clearing or cleaning means, wherein movement of the clearing or cleaning means is effected by rotation of the cutters.

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34. A self clearing cutting assembly, substantially as hereinbefore described with reference to the accompanying drawings.

10 35. A method of cutting a material using a self clearing cutting assembly, substantially as hereinbefore described with reference to the accompanying drawings.