

[54] **ABRASION TOOL**
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51/205, 391, 401; 125/18; 29/76, 78

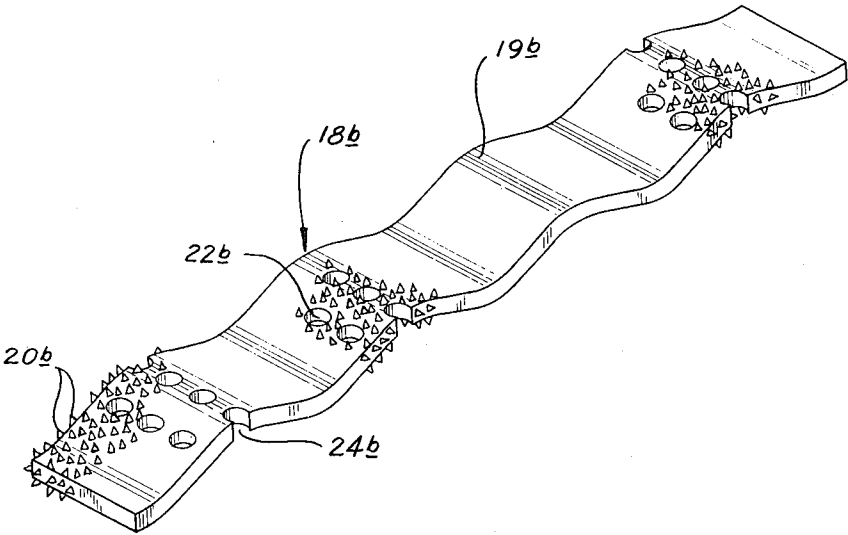
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[57] **ABSTRACT**
An abrasion tool for removing incrustation from the interior surfaces of passages, openings, and conduits such as the cooling passages through the exhaust manifold of a marine engine. The tool includes an elongated metal core that is both relatively stiff and flexible, and the core is provided therealong with a plurality of recesses adapted to receive therein incrustation loosened from the interior surfaces of such passage. Substantially all of the exposed surfaces of the core are covered or coated with outwardly projecting abrasion elements in the form of grit (such as a metallic carbide) that is brazed, adhesively attached, or otherwise bonded to the core so as to be rigidly related thereto.

1 Claim, 7 Drawing Figures



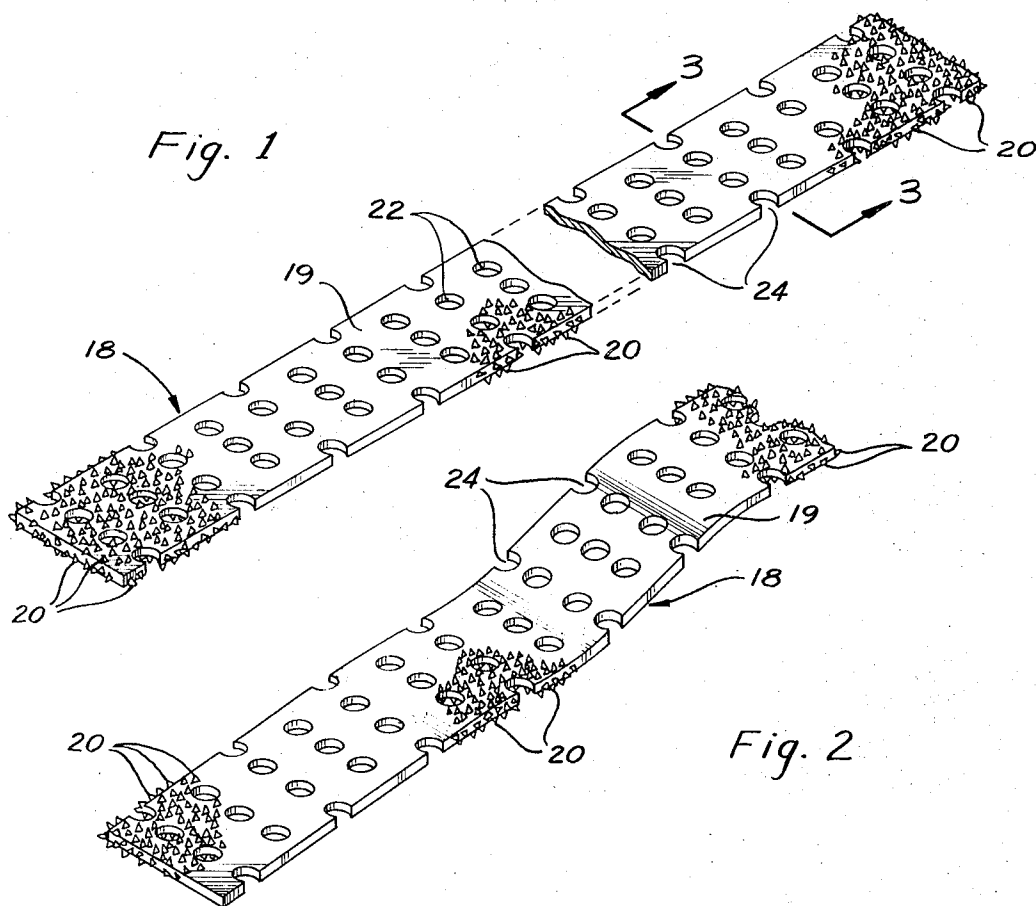
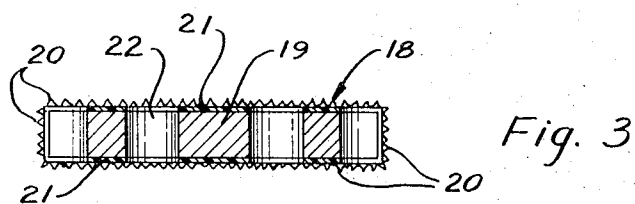
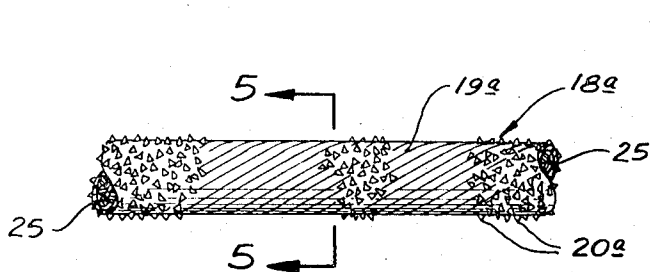


Fig. 4

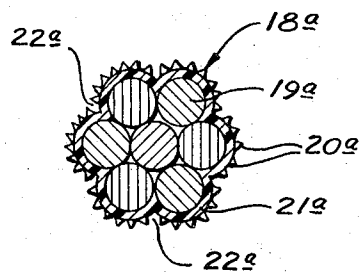
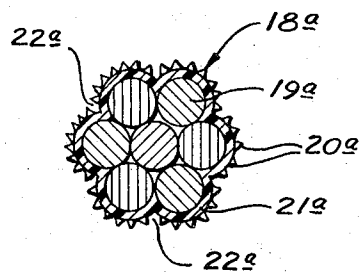
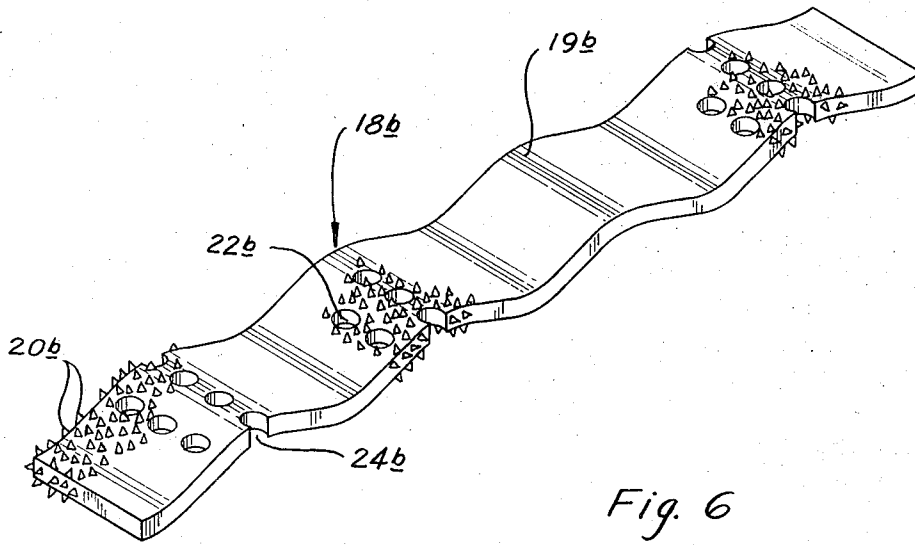
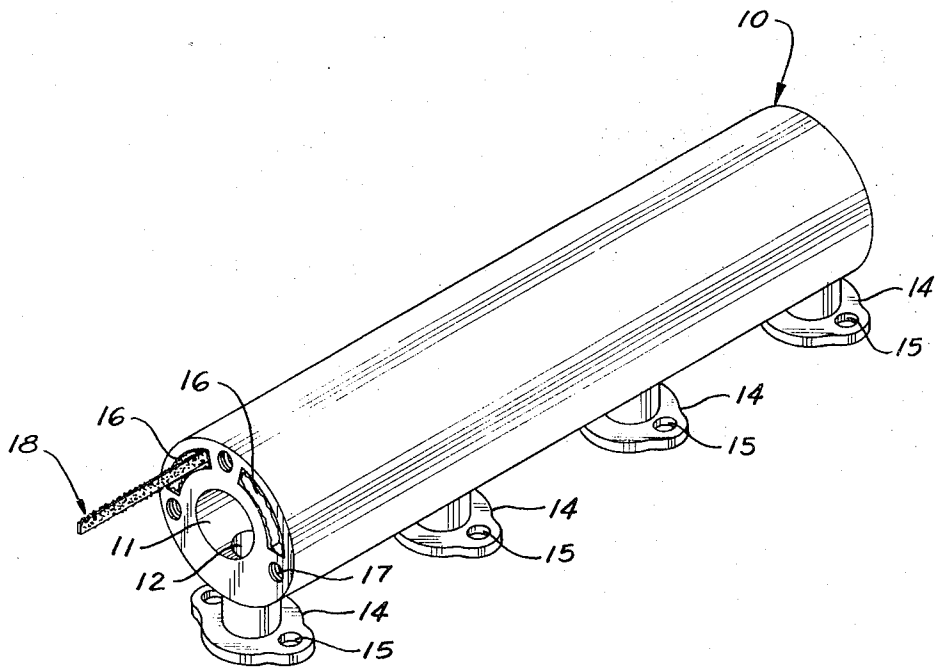


Fig. 5





ABRASION TOOL

This invention relates to tools for cleaning the interior surfaces of pipes, passages, similar conduits and the like; and it relates more particularly to an abrasion tool for removing incrustation from the interior surfaces of such a passage through an abrasive action that loosens the incrustation from the surfaces of the passage. An abrasion tool embodying the present invention is especially useful in removing incrustation from the cooling passages through the exhaust manifold of a marine engine, but it is in no sense limited to use in such environment.

Considering the marine engine and exhaust manifold thereof as an exemplary environmental setting for the invention, such manifolds are generally constructed of cast iron, and they have an exhaust passage extending longitudinally therethrough adapted to be connected as spaced apart locations therealong with the cylinders of the engine so as to receive the exhaust gases being expelled therefrom. The manifold is also provided with one or more longitudinally extending cooling passages through which water is circulated, usually by means of a pump associated with the cooling circuit. Accordingly, the manifold functions as a heat exchanger in which the hot exhaust gases are cooled and the cooling water heated as it flows in heat-exchange relation with the gases.

The cast iron manifolds are relatively porous and, evidently, operate for long periods at elevated temperatures. As a consequence, the porous surfaces of the water passages tend to oxidize or rust especially in the case of the cooling liquid being salt water taken directly from the ocean or other body of salt water in which the engine is being used. In time, the hard rust blisters or incrustation thereby forming along the interior surfaces of the cooling passages tend to close the same, at least in part, thereby inhibiting the flow of water therethrough and causing a deterioration in the efficiency of the heat transfer between the hot exhaust gases and cooling water.

In view of the foregoing, an object of the present invention is to provide an improved abrasion tool for removing incrustation and the like from interior surfaces of pipes, openings, conduits and similar passages and especially cooling passages through an exhaust manifold of a marine engine or the like.

Additional objects, among others, of the present invention are in the provision of an improved abrasion tool of the character described that is elongated and provided with outwardly projecting abrasion particles along substantially all of the exterior surfaces thereof so as to engage incrustation and abrade the same from surfaces encumbered therewith; that is both relatively stiff and flexible so that it is sufficiently self-sustaining to be inserted into such passage and be displaced with respect thereto but can flex to accommodate obstructions along the passage; that is provided with a core to which the abrasion elements are secured, and which core is provided with a plurality of recesses therealong adapted to receive incrustation loosened from the surface of such passage by the action of the abrasion elements; and, at least in certain embodiments, that is effective to supplement the action of the abrasion elements by implementing the natural abrasive forces with a spring-like biasing force that resiliently urges the abrasion elements into tight frictional engagement with

the incrustation and in still other embodiments may supplement the abrasive action by impact forces developed between the tool and incrustation of such passage.

Additional objects and advantages of the invention, especially as concerns particular features and characteristics thereof, will become apparent as the specification continues.

Embodiments of the invention are illustrated in the accompanying drawings, in which:

FIG. 1 is a broken perspective view illustrating one form of a tool embodying the present invention;

FIG. 2 is a broken perspective view similar to that of FIG. 1 but demonstrating the flexibility of the tool;

FIG. 3 is a transverse sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a broken side view in elevation of a modified form of a tool embodying the present invention;

FIG. 5 is a transverse sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a broken perspective view of a further modified tool embodying the present invention; and

FIG. 7 is a perspective view of a water-cooled exhaust manifold of a marine engine showing one of the water cooling passages being abraded by a tool of the type illustrated in FIGS. 1 through 3.

As heretofore noted, a tool embodying the present invention may have utility in a great number of environments in which the inner surfaces of passages, pipes, and other conduits and openings become incrustated or coated in whole or in part by materials that are desirably removed. The particular environment with which the various embodiments of the tool shown in the drawings are especially useful is a marine engine and especially the water-cooled exhaust manifold of such engine. As previously explained, the interior surfaces of such passages are especially susceptible to the accumulation of rust or oxide blisters formed therealong which, if not removed, progressively inhibit the free flow of water therethrough, thereby destroying the effectiveness of the water-cooling process. An exemplary water-cooled manifold for a marine engine is illustrated in FIG. 7, and it is denoted in its entirety with the numeral 10.

The manifold 10 is elongated longitudinally and has a hollow cylindrical configuration forming a somewhat thick-walled tube defining a longitudinally extending exhaust passage 11 therethrough. The exhaust passage 11 communicates with a plurality of exhaust inlets 12 defined by longitudinally spaced fittings 14 adapted to be connected to the block or head (depending upon the particular engine) of the marine engine so as to receive exhaust gases expelled from the cylinders thereof. In the particular exhaust manifold 10 shown, the engine with which it is adapted to be used is a V-Eight engine and the manifold is adapted to be secured to the head of one of the cylinder banks thereof, as by means of bolts extending through openings 15 in each of the four fittings 14. It will be understood that exhaust gases expelled from the cylinders of the engine with which the manifold 10 is associated enter the passage 11 via the ports 12, all as is well known in the art.

The manifold 10 is further provided with a plurality of cooling passages 16, there being two such passages in the particular form of manifold illustrated. The cooling passages 16 also extend longitudinally through the manifold in substantially parallel relation with the pas-

sage 11, and water is pumped through these passages, thereby extracting heat from the hot exhaust gases flowing through the exhaust passage 11 with the result that the water is necessarily heated. Accordingly, the manifold 10 is in the nature of a heat exchanger in which the exhaust gases flowing through the passage 11 are cooled and the water flowing through the passages 16 is heated. All of this is well known in the art, as is the fact that the manifold 10 at each end thereof will be sealingly secured to fittings (not shown) by means of bolts threadedly receivable within the bores 17 provided adjacent each end of the manifold.

Referring now to FIGS. 1 through 3 in particular, the tool there disclosed is denoted in its entirety with the numeral 18, and it is intended to remove incrustation and similar collections from interior surfaces and, in particular, the interior surfaces of the cooling passages 16 through the manifold 10. The tool 18 in the embodiment thereof shown in FIGS. 1 through 3 includes a core or base 19 that is essentially flat or planar and has a substantially rectangular configuration. It is elongated longitudinally and is both stiff and relatively flexible and is adapted to be inserted into each of the passages 16 and displaced with respect thereto, as shown in FIG. 7. Such displacement may be in the form of reciprocal movements along the length of each passage 16, or it may be unidirectional displacement there-through from one end to the other thereof. The core 19 is quite stiff in the transverse direction but is flexible longitudinally along the length thereof, as shown in FIG. 2, so as to enable it to conform more readily to any passage 16 and obstructions formed along the length thereof. By way of example, the core 19 may be formed of spring brass or spring steel so as to provide the requisite stiffness and flexibility, however other materials can be employed.

The core 19 is provided along the length thereof with a plurality of outwardly projecting abrasion elements 20 that are fixedly secured to the core so as to be rigidly related thereto. The abrasive elements 20 may take various forms, but in all cases are hard grit-like elements effective to abrade the inner surfaces of the passages 16 upon insertion of the tool 18 therein. By way of example, the abrasion elements 20 may be any one of a number of metallic carbides such as tungsten, silicon, titanium, and similar carbides and elements that are very hard and durable and are characterized by having sharp edges that effectively engage and dislodge incrustation formed along the inner surfaces of the passages 16. It will be evident in FIGS. 1 through 3 that the abrasion elements 20 cover all of the surfaces of the core 19 including the opposite faces thereof, the longitudinal edges, and the transverse edges or ends. However, the elements may be confined to a reduced number of surfaces and/or to restricted portions of any particular surface or surfaces.

The abrasion elements 20 may be secured to the core 19 by any one of a number of techniques generally considered herein to be bonding techniques. That is to say, the elements or particles 20 are bonded to the core or base 19 by a matrix or bonding layer 21, as shown in FIG. 3 (the bonding layer not being specifically depicted in FIGS. 1 and 2 for purposes of simplifying the same). By way of example, the layer 21 may constitute a coating of copper or nickel paste placed on the various surfaces of the core 19 and sprinkled with carbide particles 20, after which the core is baked within an

oven at a temperature of the order of 2,000°F to braze the particles 20 to the core. Other bonding arrangements may be used, however, such as adhesives and, in particular, various synthetic plastic materials including the acrylics, epoxies, etc. which are effective to adhere the particles 20 to the core 19 with the same degree of tenacity as any brazing procedure.

The core 19 is also provided along the length thereof with a plurality of recesses adapted to receive incrustation loosened from the inner surfaces of the passages 16 upon displacements of the tool relative thereto. In the form of the invention illustrated in FIGS. 1 through 3 such recesses take the form of openings or apertures 22 that extend through the core 19 from face-to-face thereof. The distribution and concentration of the openings 22 may vary considerably, and as shown in FIGS. 1 through 3, they are intermixed with the abrasion elements 20. Certain of the openings 22 are located along the longitudinal edges of the tool 18 and core 19 thereof, and for purposes of identification these openings are denoted with the numeral 24. They are seen to be incomplete in the sense that the longitudinal edges cut the same, and preferably the edge openings 24 are a little greater than semicircular and are preferably of the order of two thirds of the complete circle.

A modified form of the invention is shown in FIGS. 4 and 5 and will now be described. As respects its general function and structural characteristics the modified form of tool is generally similar to the tool 18 heretofore described, although the exact structural form of the tools vary, and for this reason the same numerals are used to identify respectively corresponding parts except that the suffix "a" is used in conjunction with the numerals applied to the modified form of invention for purposes of differentiating the same from the tool 18. Accordingly, the modified tool 18a includes a core 19a, a plurality of abrasion elements 20a secured along the surface of the core, and a bonding medium 21a securing the particles to the core.

The entire tool 18a is elongated longitudinally and is generally in the form of a long flexible cable having sufficient rigidity to enable it to be inserted into the passage 16 and displaced with respect thereto. In this latter reference, the tool may be secured within the chuck of an electric drill and rotated, thereby causing the cable to whip or bow into engagement with the interior surfaces of the passage 16 which effects removal of the incrustation thereon both due to the abrading action of the elements 20a and to impact of the particles against the incrustation as the cable whips through an arcuate path as it is rotated. It will be apparent that an excellent removal of incrustation results from the combinative action of the impact and abrasive forces thereagainst. The core 19a may vary considerably in its specific configuration, and in the form shown, it comprises a plurality of elongated wires or strands 25 spirally wound into a generally helical configuration. In the usual instance the strands or wires 25 will be metal (generally steel), and the diameters of such wires are selected so that the tool 18a is provided with a plurality of recesses 22a therealong. In more particular terms, the recesses 22a are in the nature of spiral or helical grooves defined between adjacent strands 25. The grooves or recesses 22 perform essentially the same function as the recesses or openings 22 heretofore described in association with the tool 18.

A further modified tool is illustrated in FIG. 6 and it departs from the tool 18 only in that it is provided with a plurality of transversely extending corrugations disposed at longitudinally spaced intervals along the length of the tool. Again, the same numerals are used to identify respectively corresponding parts in the embodiment of the invention shown in FIG. 6 as were used with the tool 18 except that the suffix "b" has been added to each such numeral for purposes of differentiating between the two embodiments. In view of the close similarity of the tools 18 and 18b, no further description of the details of the latter will be included.

The tool 18b is characterized by having sufficient inherent stiffness to enable it to be inserted within the passage 16 and reciprocated with respect thereto, and it also is characterized by sufficient flexibility to enable the corrugations to compress or be diminished in height so as to permit the tool to conform to passages 16 having different radial widths. The spring forces inherent in the tool 18b bias the same toward the configuration shown in FIG. 6 in which the successive corrugations tend to assume their maximum dimensions so that the tool will expand to the maximum permissible extent within any passage 16, thereby causing the same to apply a firm frictional engagement with the interior surfaces of such passage (assuming that the thickness of the passage is not significantly greater than the overall or maximum ridge-to-valley dimension of the configurations). Thus, a firm interengagement of the tool 18b with the incrustation along any passage 16 is provided which results in excellent abrasion and removal of the incrustation therefrom.

In use of any of the embodiments of the tool described, it is inserted into the passage 16 and is displaced with respect thereto so as to engage the incrustation along the interior surfaces of the passage and thereby remove the same therefrom. The displacement of the tool within the passage may constitute a unidirectional movement therethrough, it may comprise a reciprocatory movement of the tool relative to the passage, it may comprise a combination of such movement, and in the case of the tool 18a it may constitute a rotational displacement either individually or in combination with one of the movements previously described. In all cases, however, the abrasion particles engage the incrustation and abrade the same from the interior surfaces of the passage. Whereas the tool 18 is generally limited to a relatively simple engagement between the particles 20 and interior walls of the associated passage, the tool 18b enhances such engagement by enforcing a tight frictional resilient or spring-type engagement of the particles with the passage walls and

the tool 18a tends to also impart an impact action to the incrustation.

The recesses provided along the tool afford a place within which the loosened incrustation may collect, thereby tending to prevent the abrasion particles from being clogged by the scale or other material removed from the passage, and also to prevent such material from serving as a lubricant to inhibit the abrasion otherwise defined by the tool. That is to say, the incrustation is frequently wet because the passages 16 are water-cooling passages, and the loosened incrustation together with the water admixed therewith is somewhat like a mud. This mud-like mass is accommodated by the recesses and can be washed or otherwise flushed therefrom when the tool is removed from the passage. The flexibility of the tools enables the same to accommodate some curvature and other irregularities along any passage 16, and the character of the tool 18a enables it to pass through passages that have rather sharp turns and curvatures therealong.

While in the foregoing specification embodiments of the invention have been set forth in considerable detail for purpose of making a complete disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

What is claimed is:

1. An abrasion tool for removing incrustations and the like from interior surfaces such as the cooling passages through an exhaust manifold of a marine engine, comprising: an elongated substantially flat spring metal core adapted to be inserted into such passage and to be displaced with respect thereto; said core having along opposite sides and edges thereof a covering surface engageable with such interior surface, said covering surface comprising a plurality of outwardly projecting carbide abrasion elements anchored directly to said sides and edges and having exposed sharp edges projecting therefrom to abrade said incrustations from said interior surfaces; and said core being provided with a plurality of recesses therealong positioned to receive said incrustations loosened from said interior surface by said abrasion elements, said core being relatively inflexible about any longitudinal axis of the core and relatively flexible about any transverse axis thereof, and said core is provided with a plurality of transversely extending corrugations each parallel to one another and disposed along its length and extending from one longitudinal side of the core to the other.

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