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EXPANSIBLE PACKING WITH METAL MESH CORE

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2 Sheets-Sheet 1

Fig. 1.

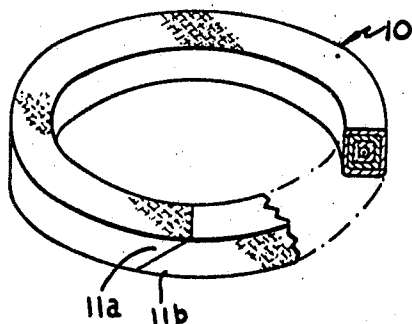


Fig. 2.

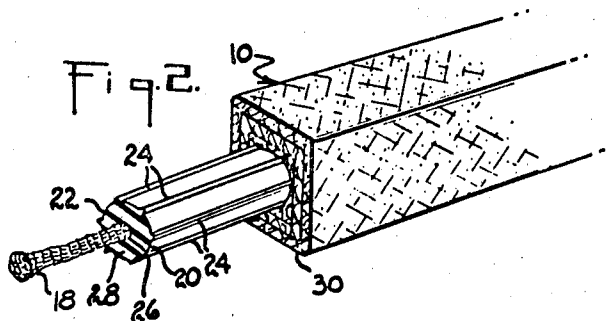
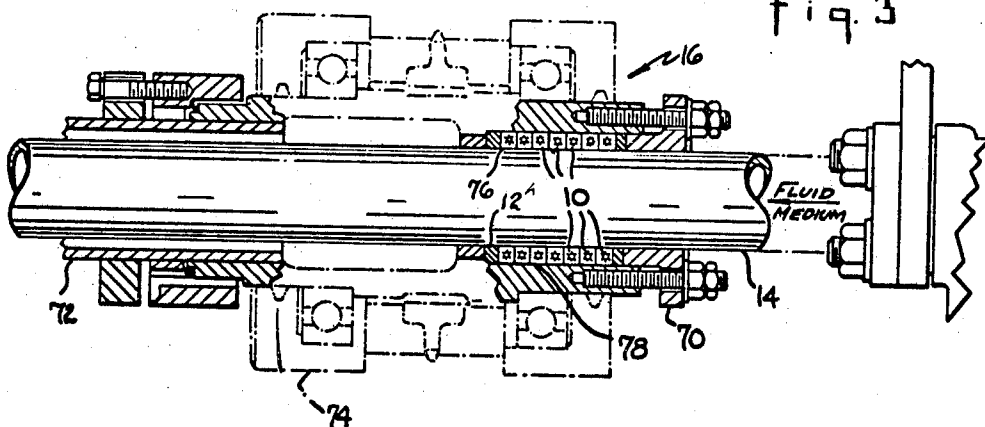


Fig. 3.



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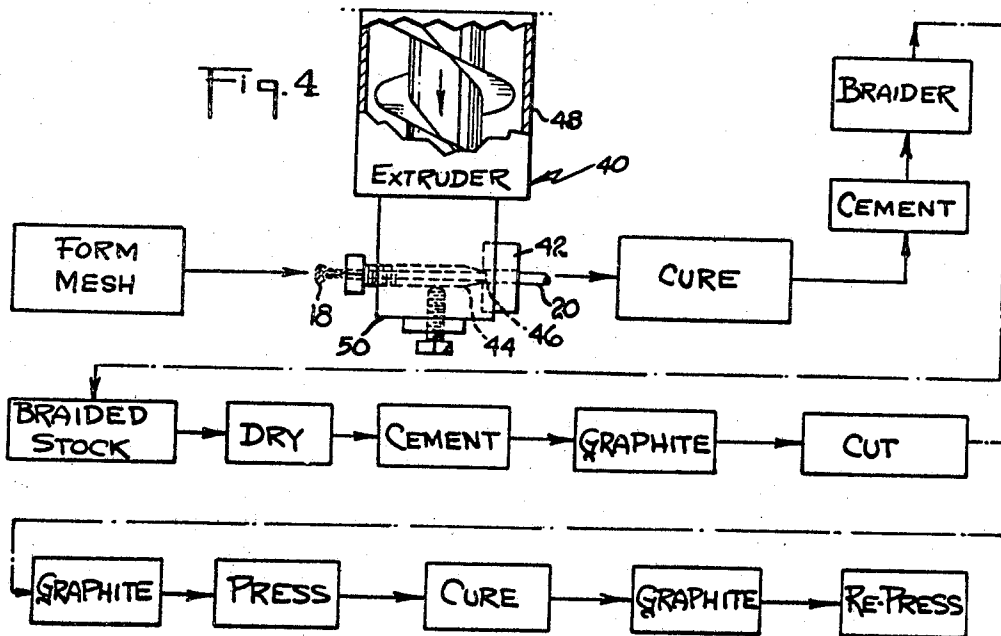
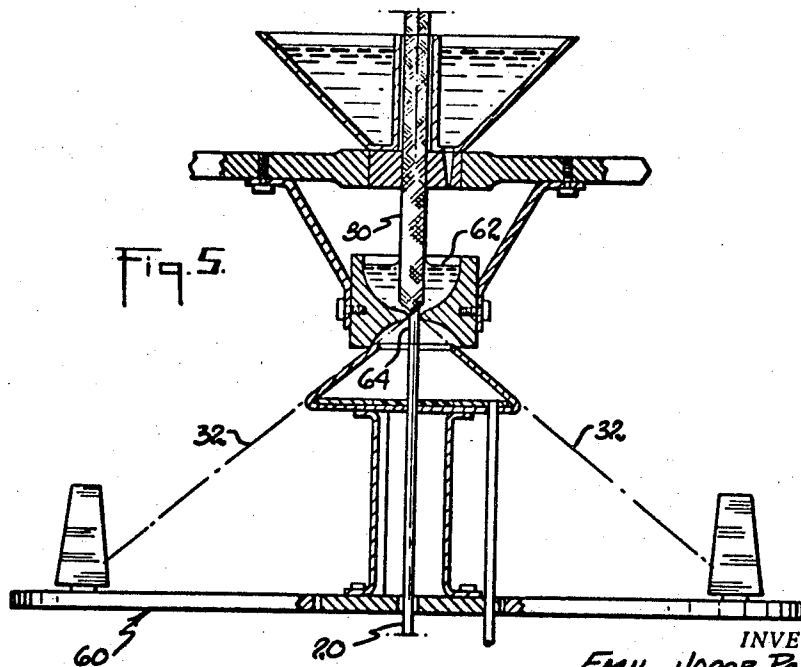
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2 Sheets-Sheet 2



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**EXPANSIBLE PACKING WITH METAL
MESH CORE**

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ABSTRACT OF THE DISCLOSURE

A packing seal for sealing about a rotatable and reciprocal shaft in a high temperature environment, comprising a resilient core including metal mesh, a flexible jacket comprising elastomer material surrounding said mesh forming an expansible tube including therein an air entrapping chamber which expands when air entrapped therein is subjected to heat, and a heat resistant fabric sheath of inorganic fibrous material secured to and surrounding said flexible jacket.

This invention relates to a novel packing adapted to provide an effective seal against fluid passage and having an extended life.

The invention has particular application to soot blowers and will be described in connection therewith. It will be apparent however that other applications for the packing are possible. Fluid heater cleaners or soot blowers of the long retracting type are adapted to be mounted exteriorly of a wall of heat exchanger apparatus such as steam boiler. The soot blower is provided with an extensible lance tube that is adapted to be moved from a retracted position to an advanced position within the interior of the heat exchanger apparatus and for discharging a pressurized cleaning medium such as air or steam toward the heat exchanger surfaces to remove the accumulations of deposits therefrom. The cleaning medium is usually introduced as a swirling stream from a series of ports at the forward end of the lance tube as the tube is rotated and advanced from the retracted position. A carriage assembly provides means for advancing and retracting the blower lance and contains a packing gland for the telescoping blower lance and feed tubes. It is with this packing gland or seal that this invention is particularly concerned. Since the blower lance is operated on an intermittent basis, it would be particularly advantageous to provide a seal that would respond to elevated temperatures under operating conditions, that would not acquire a permanent set normal operating conditions, and that would accommodate and seal against some off-center rotary motion as well as reciprocating motion of the blower lance.

It is accordingly a principal object of this invention to provide a novel packing which has the property of improved resilience and retains this property substantially indefinitely, and which is unaffected by the temperature and pressure conditions within the ranges normally encountered.

It is a further object of this invention to provide a seal which has an extended life and which thus promotes the economy of operation of the device in which the seal is installed.

It is a still further object of this invention to provide a seal that will maintain its sealing effectiveness even during intermittent operation of the device within which it is installed.

Toward the attainment of the foregoing objects, a preferred embodiment of this invention contemplates a packing comprising a core including resilient metal mesh,

and a flexible jacket comprising elastomer material and covering said mesh, and a treated heat resistant fabric sheath, surrounding said jacket.

This invention is an improvement over prior art braided packings in that better sealing engagement is obtained by providing a compressible but non-collapsible inner filling. Instead of relying mainly upon the compressibility of a completely hollow core, one of the important features of the present invention contemplates the expansion of the flexible jacket by virtue of the expansion of the air entrapped within the jacket when the packing is subjected to elevated temperature conditions.

The invention will be further explained in the following description taken in connection with the accompanying drawing.

FIG. 1 is a perspective view of a seal packing ring constructed in accordance with this invention, with a portion broken away to illustrate in more detail its construction;

FIG. 2 is an enlarged fragmentary view of the ring shown in FIG. 1;

FIG. 3 is an enlarged cross-sectional view of a feed tube/lance tube joint illustrating the position of a set of packings forming a part of this invention;

FIG. 4 is a flow diagram schematically illustrating steps employed in forming the packing of this invention; and

FIG. 5 is a cross-sectional elevational view of a braider illustrating a manner of applying cement to the stock at the time of braiding.

Referring to FIG. 1, there is shown a packing 10 adapted for general purposes but particularly suited for use in conjunction with moving mechanical elements such as shafts, piston rods, and soot blower lance tubes. The positioning of the packing in relation to an element to be sealed is more clearly shown in FIG. 3, where a set of packing rings 10 and a header ring 12 are shown in conjunction with the feed tube 14 of a soot blower, generally designated by the numeral 16. In accordance with this invention, a resilient, flexible, compressible packing inner core filling 18 is fashioned, preferably from knitted metal mesh. In a preferred embodiment, the filling 18 is formed from stainless steel and most preferably from metal known as Inconel. In forming such a filling 18, a strip of fabric knitted from metallic strands may be cut from a tubular knitted metal mesh stocking, as produced by conventional knittling machines employed in the metal textile industry. The stocking may be flattened and rolled on itself, along its longitudinal extent, to comprise plural layers of the fabric.

Surrounding the inner or center filling 18 and forming therewith the core of the packing 10, is jacket 20 comprising elastomer material preferably formulated and compounded in a manner hereinafter to be described. The jacket 20 is preferably formed by direct extrusion over the mesh filling 18 in a cross-head extruder 40, as schematically illustrated in FIG. 4. The forming nozzle 42 of the extruder together with forming pin 44 define an orifice 46 which will permit the extrusion of the jacket 20 in tubular form having an internal diameter corresponding substantially to the diameter of the core filling 18. Upon discharge through the orifice 46 the elastomer compound will swell slightly to hug the filling 18 and draw the filling 18 upon continued extrusion. The jacket 20 is preferably extruded to provide an outer surface 22 which is disrupted or diverted from a regular line and more preferably to provide a series of relatively thin protuberances in the form of fins 24. The extruded tube stock with the mesh insert is suitably cured as by steam in an autoclave.

The tubular jacket 20 is covered with a heat resistant sheath 30 such as by braiding inorganic yarns 32 treated

with a lubricant. In a preferred embodiment, the sheath 30 is formed by braiding wire reinforced asbestos yarn which is subsequently treated with flaked graphite. The wire mesh filling 18 prevents collapsing of the tubular jacket 20 during the braiding operations. Since the yarns 32 are braided under tension the relatively thin jacket 20 might otherwise deform or collapse to such an extent as to block the center core passage 26. The thin fin protuberances 24 also serve as bights into which the yarns 32 may be embedded and thus more firmly secure the braided sheath 30 to the jacket tube 20. A suitable cement may be additionally employed to secure or bond the sheath 30 to the tube 20. The braided stock is suitably coated with a lubricant such as flaked graphite. Subsequently, the stock is cut to the desired length and further pressed into the final ring configuration. The rings are further cured in a steam autoclave and then dusted with flaked graphite.

A packing 10 having a tubular core filled with metal mesh, in accordance with this invention, exhibits better sealing engagement over an extended life, particularly in conjunction with mechanical elements that are operated on an intermittent basis than the packings heretofore employed. Generally, the prior art packings have been of the type embodying a solid core which core rigidifies and which loses its resiliency during service. Consequently, upon take-up such packings lose some of their sealing effectiveness. In other packings of the so-called hollow core type, upon take-up the hollow inner chamber collapses and the packing is deformed to such an extent that it loses its sealing effectiveness. The instant invention provides a filled hollow core but yet defines a fluid pervious chamber. The filling of metal mesh imparts resiliency and compressibility to the packing and also deters collapsing of the packing upon take-up. Some air is always entrapped and retained in the fluid pervious chamber or passage 26 even under high loading on the packing gland. In service, the high temperature of the fluid being sealed will heat and expand the entrapped air. The expanding air urges the tubing wall 28 to exert pressure on the outer sheath 30 to maintain sealing engagement with the machine elements to be sealed.

To provide a further disclosure of this invention, an exemplary procedure and a formulation for a preferred embodiment will now be described.

A continuous length of mesh is knitted from metal wire to provide a strand 18 approximately $\frac{1}{8}$ " in diameter. The mesh is fed into a cross-head extruder 40 for drawing with an extrudable compound, comprising elastomers to form an extruded jacket 20 over the mesh.

The jacket 20 may be extruded from a compound having the following general formulation, wherein the indicated percentages are by weight:

Ingredient:	Percent
Chlorinated elastomer such as Neoprene WB	20-35
Chlorosulfonated polyethylene elastomer such as "Hypalon" No. 40	20-35
Fillers, lubricants, vulcanizing agents	30-60

The chlorinated elastomer is chosen for its ability to be readily extruded and the chlorosulfonated polyethylene elastomer is selected for its excellent heat resistance. The elastomers are suitably banded and blended with the other ingredients on a conventional rubber mill and sheeted to form stock material for the extruder.

A more detailed and specific formulation for the extrudable compound may comprise the following, wherein the indicated percentages are by weight:

Ingredient:	Percent
Chlorinated elastomer-chloro-butadiene	28-29
Chlorosulfonated polyethylene elastomer	28-29
Pulverized magnesium silicate (Miston vapor) inorganic filler	24-25
Stearic acid	.2-.6
Powdered graphite	6-7

Ingredient:	Percent
Paraffin wax (130° F.—melting point)	2-3
Seal grease	2-3
Vulcanizing agent for chlorinated elastomer—red lead	8-9
Vulcanizing agent for chlorosulfonated elastomer — dipentamethylene thiuram tetrasulfide (Tetron A)	.2-.6

The ingredients are mill mixed, blended and sheeted to form batch stock. The batch stock is extruded as a tube over the mesh core 18 in the cross-head extruder 40 through a die 42 having the desired configuration. A preferred configuration of the tube 20 has an internal diameter corresponding substantially to the diameter ($\frac{1}{8}$ ") of the mesh strand 18 and a series of bights 24 on the outside surface. The temperature of the extruder barrel 48 is preferably maintained at 100° F. and the temperature of the extruder head 50 is preferably maintained at 180° F.

As the tube 20 is extruded through the die 42, it will swell slightly and hug and draw the mesh core 18 through the head 50 of the extruder as additional material is extruded. The extruded material is sufficiently viscous to retain its tubular shape and not fill all of the interstices of the metal mesh 18. Thus the tube 20 defines a chamber or passage 26 filled with metal mesh 18.

The extruded jacket 18 is then coiled and placed in an autoclave for steam curing (60# steam) for 30 minutes.

The extruded jacket 18 is subsequently fed to a braider 60 where a cement 62 is applied to the jacket 18 prior to its reaching the braiding point 64. The cement 62 is generally of the following composition, where the ingredient designated as elastomer compound is one of the elastomer formulations from which the jacket tube is extruded and the indicated percentages are by weight:

Ingredient	General percent	Preferred percent
Elastomer compound.....	23-33	28-29
Low friction synthetic resinous material—Teflon.....	3-6	4-5
Hydrocarbon solvent—Solvesso.....	50-60	53-55
Toluene solvent—Toluol.....	10-15	12-13

The sheath 30 is then braided over the cement coated jacket 20. The braided sheath 30 is preferably formed from asbestos yarn ASTM designation 1031 and from ASTM Grade AAA asbestos. The braided stock is dried and first drawn through a cement, which may be of the same composition as described above, and then through flaked graphite. The graphited stock is then cut in lengths to provide the desired circumferences of the final rings. Optionally, the stock may be calendered prior to cutting. After cutting, the graphited stock lengths are then pressed into the desired final configuration. Preferably, the stock is cut into lengths having biased ends 11a and 11b and pressed into a final form which is slightly oversize on both the internal diameter and the outside diameter to provide a better overlap for the jointed ends when the packing 10 is installed, for example, where the arrangement is such to call for a standard size packing having an internal diameter of 2.383 inches and outside diameter of 3.093 inches, the packing of this invention is formed with an internal diameter of 2.420 inches and an outside diameter of 3.130 inches.

The packings 10 of this invention may be installed in a soot blower 16 by unbolting the packing follower 70 and removing the old packing circumposing the feed tube 14. A lance tube 72 surrounds a forward position of feed tube 14 and is mounted for reciprocable and rotating movement along the axial extent of and about tube 14 by means of joint mechanism 74, shown in phantom lines. The packings 10 are adapted to seal against the loss of the fluid medium, fed through tube 14 and into lance tube 72, through the juncture 76 formed between the joint mechanism 74 and feed tube 14. A header ring 12, which may be of the same material as the braided

sheath 30 of ring 10, may be first installed in the packing well 78 formed between the joint mechanism 74 and feed tube 14. The header ring 12 is primarily employed to prevent extrusion of the packing rings 10 upon subsequent take-up and hence need not employ the inner core construction of the rings 10.

In service, as steam or other heated fluid medium is fed through feed tube 14, the air entrapped in passage 26 of tubular jacket 20 will expand and tend to expand jacket 20 and thereby urge sheath 30 into better sealing engagement with joint mechanism 74.

Having provided a complete description of the invention in a manner to distinguish it from other inventions, and having provided a description of the best modes presently contemplated of carrying out the invention, the scope of patent protection to be granted is defined by the following claims.

What I claim is:

- 1. A packing comprising:
 - (a) a resilient core including metal mesh;
 - (b) a flexible jacket comprising elastomer material surrounding said mesh forming an expansible tube including therein an air entrapping chamber which expands when air entrapped therein is subjected to heat; and
 - (c) a heat resistant fabric sheath of inorganic fibrous material secured to and surrounding said flexible jacket.
- 2. A packing as described in claim 1, wherein: said sheath is braided fabric from wire reinforced asbestos strands.
- 3. A packing as described in claim 1, wherein: said flexible jacket is extruded from an elastomer composition comprising; by weight:

	Percent
Chloro-butadiene	28-30
Chlorosulfonated polyethylene	28-30
Inorganic fillers	24-25
Lubricants	10-11
Vulcanizing agents	8-9

- 4. A packing as described in claim 1, wherein: said sheath is impregnated with a composition comprising the elastomer compound, corresponding to that from which said jacket is composed, dissolved in suitable solvents, and a low friction synthetic resinous material.
- 5. A packing comprising:
 - (a) a resilient compressible core including a knitted metal fabric;
 - (b) a flexible jacket comprising heat resistant elastomer material surrounding said metal fabric core extruded to form an expansible tube including therein an air entrapping chamber which expands when air entrapped therein is subjected to heat; and
 - (c) a sheath braided over and surrounding said jacket said sheath comprising inorganic fibrous material impregnated with heat resistant material and coated with a lubricant.

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