We, CHICAGO RAWHIDE MANUFACTURING CO., a Delaware corporation, of 900 N. State Street, Elgin, Illinois 60123, U.S.A., hereby apply for the grant of a Patent for an invention entitled "COMPOSITE SEAL ASSEMBLY" which is described in the accompanying complete specification.

This application is a Convention application and is based on the application numbered 171,014 for a patent or similar protection made in United States of America, on 21st March, 1988.

Our address for service is care of CALLINANS, Patent Attorneys, of 48 to 50 Bridge Road, Richmond, Victoria, 3121, Australia.

DATED this 23rd day of September, 1988.

CHICAGO RAWHIDE MANUFACTURING CO.

By its Patent Attorneys:

CALLINANS

To: The Commissioner of Patents
AUSTRALIA
Patents Act 1952-1973

Declaration in Support of
(a) A Convention Application
(b) An Application for a Patent or Patent of Addition.

In support of the Application/Convention Application made by

Chicago Rawhide Manufacturing Co., hereinafter termed "the said Company"

for a patent/patent of addition for an invention entitled:

Composite Seal Assembly

Signed and sealed in the presence of the said Co.

R. V. Oddo, corporate secretary

900 N. State Street, Elgin, Illinois 60123 U.S.A.

I solemnly and sincerely declare as follows:

1. (a) I am/we are the applicant(s) for the patent/patent of addition

(b) I am/we are authorised by

Chicago Rawhide Mfg. Co.

as the applicant for the patent/patent of addition to make this declaration on its behalf.

2. (a) The basic application(s) as defined by Section 141 of the Act was/were made in United States on the 21st day of March 1988

by Steve A. Mins.

3. (a) I am/we are the actual inventor(s) of the invention

(b) I am/we are the actual inventor(s) of the invention referred to in the basic application.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

5. Declared at Elgin, IL this 1st day of September, 1988

SIGN
Claim

1. A composite seal assembly including, in combination, a retainer element, a retainer insert, and an elastomeric sealing unit, said retainer element including an insert facing mounting portion which includes a radially inwardly directed annular surface defining a center opening for receiving and radially positioning a part of said retainer insert, at least one annular shoulder surface for engaging and axially positioning another part of said retainer insert, said retainer element also having a retainer element mounting portion with a generally flat surface for positioning in opposed relation to an associated machine part to which said retainer element will be fastened in use, and means defining plural openings for receiving and positioning retainer element mounting fasteners, said retainer insert including axially and radially extending annular flanges for cooperative engagement respectively with said radially inwardly directed annular surface and said annular shoulder surface of said retainer element, said retainer insert further including an annular...
bonding surface, said elastomeric sealing unit including a bonding portion and a generally annular seal body which includes generally frustoconical oil and air side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with the surface of a relatively movable machine part extending axially through said seal body, said bonding portion being attached in fluid tight sealing engagement to said bonding surface on said retainer insert, said retainer element and said retainer insert each being formed from a resinous synthetic plastics material, with said seal assembly being adapted to be affixed in use to the end face of a machine part having said relatively movable machine part extending therefrom and adapted to be engaged by said elastomeric sealing element.
Complete Specification for the invention entitled
"Composite Seal Assembly"

The following statement is a full description of this invention, including the best method of performing it known to me:
The present invention relates generally to oil seals, and more particularly, to a composite seal assembly adapted for specialized applications. According to the present invention, a novel form of seal is provided which makes possible the elimination of cumbersome, relatively unreliable former designs for certain special applications. In particular, the seal design of the present invention makes installation of rear crankshaft seals much easier and more reliable.

While the present invention has other applications, the primary application, that of a rear crankshaft seal, has historically presented a number of serious problems. In some engine designs, the portion of the crankshaft over which the lip of the oil seal is required to extend is a reduced diameter portion of the crankshaft. Accordingly, it was sometimes customary to wrap a rope-type packing around such reduced diameter crankshaft end portion. In other applications, the seal has been manufactured in two mating halves, and installation required not only positioning one of the seal halves in a narrow recess lying within a part of the engine block above the crankshaft bearing journal, but also required precise mating of the lower half of the seal with the upper half so that there was no leakage along the surfaces at which the two half seals met in end-to-end relation. In
addition, it was often difficult to align the seal so that the seal lip would lie in a single plane to provide an effective seal. In many cases, these problems were aggravated because the material used to form the seal lip was one which lacked mechanical strength and toughness; silicone rubbers for example, were often used in this application. This made a good seal between seal halves but the material lacked toughness and could be damaged during installation.

Another problem common not only to rear crankshaft applications but to seal installations generally, is the matter of quality control under conditions where part of the seal assembly is made by one manufacturer and the other part or parts are made by one or more other manufacturers. This situation may be aggravated where installation is done by assembly line personnel who represent a still further element in the assembly process. Modern quality assurance concepts call for placing the responsibility for an assembled element with a single person or source, where possible. Accordingly, any arrangement wherein different elements of an assembled part are supplied from different sources or are assembled by different personnel create situations wherein it is difficult to maintain quality, and to pinpoint responsibility in the event of failure.

According to the present invention, a seal assembly can be provided which eliminates the need to machine a counterbore in the end of the engine block. This operation may thus be eliminated.
The present invention provides a composite seal which assures easy alignment and ready fastening to a flat face portion of an engine block or related part. Moreover, the invention provides a retainer element which may be made from a synthetic plastic material at low cost, to close tolerances, and which is susceptible of receiving and precisely locating a retainer insert which in turn carries an elastomeric seal body. The invention is particularly compatible with modern manufacturing techniques, and has a number of incidental advantages as well.

In its preferred form, the invention provides a crankshaft seal assembly which includes a molded plastic retainer element having fastener inserts received therein and which further includes a shoulder surface arrangement for receiving and positioning a retainer insert which may be affixed by ultrasonic welding or the like in fluid tight relationship to the retainer.

The insert carries a fluoroelastomer or similar tough, high temperature resistant seal unit which directly engages a surface on a portion of the crankshaft or a similar surface to be sealed. Still further, according to the invention, the retainer itself includes, in addition to a mounting portion, a portion encircling the rear crankshaft extension, an outer surface adapted to be engaged in fluid-tight, static relation by the engine oil pan. This further simplifies and improves the reliability of installation. The present invention provides these and a number of other advantages, including the advantages of enabling an elastomeric seal unit body of small volume to be made available for this installation.
In accordance with a first aspect of the present invention, therefore, there is provided a composite seal assembly including, in combination, a retainer element, a retainer insert, and an elastomeric sealing unit, said retainer element including an insert mounting portion which includes a radially inwardly facing annular surface defining a center opening for receiving and radially positioning a part of said retainer insert, at least one annular shoulder surface for engaging and axially positioning another part of said retainer insert, said retainer element also having a retainer element mounting portion with a generally flat surface for positioning in opposed relation to an associated machine part to which said retainer element will be fastened in use, and means defining plural openings for receiving and positioning retainer element mounting fasteners, said retainer insert including axially and radially extending annular flanges for cooperative engagement respectively with said radially inwardly facing annular surface and said annular shoulder surface of said retainer element, said retainer insert further including an annular bonding surface, said elastomeric sealing unit including a bonding portion and a generally annular seal body which includes generally frustoconical oil and air side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with the surface of a relatively movable machine part extending axially through said seal body, said bonding portion being attached in fluid tight sealing engagement to said bonding surface on said retainer insert, said retainer element and said retainer insert each being formed from a resinous synthetic plastics material, with said seal assembly being adapted to be affixed in use to the end face of a machine part having said relatively movable machine part extending therefrom and adapted to
be engaged by said elastomeric sealing element.

In accordance with another aspect of the present invention there is provided a composite seal assembly for retaining fluid within a cavity formed at least in part by a first machine part, a second machine part having a portion which is rotatable about a given rotational axis and a third machine part fixed to said first machine part, said composite seal assembly including, in combination, a retainer element having one portion adapted to be affixed to said first machine part and another portion adapted to be positioned so as to encircle said given rotational axis of said second machine part, a retainer insert positioned at least partially within and carried by said portion of said retainer element which encircles said given rotational axis of said second part axis, and a unitary elastomeric sealing unit having a generally annular seal body portion with generally frostoconical oil and air side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with a surface on said second machine part, said sealing unit also having an annular bonding portion spaced apart from said seal band area and having at least one of its surfaces secured in fluid-tight relation to said retainer insert unit, said retainer element and said retainer insert unit being made from relatively rigid, substantially fluid-impermeable synthetic plastics materials, said one portion of said retainer element also including an end face surface portion adapted to be positioned in fluid-tight mating relation with a counterpart mounting surface on said first machine part, and said other portion of said retainer element having a radially outwardly directed static sealing surface formed on a portion of its exterior so as to be engageable with said third machine part in fluid-tight relation, said one portion of said retainer
element further including means for removably receiving a plurality of fasteners to facilitate positioning of said assembly relative to said first machine part.

In accordance with yet a further aspect of the present invention there is provided a sealed machine assembly including in combination, first and third machine parts, a second machine part movable relatively to said first and third machine parts, and a composite seal assembly for retaining fluid within a cavity formed at least in part by said first, second, and third machine parts, said composite seal assembly including, in combination, a retainer element affixed to said first machine part, one portion of said retainer element having an end face surface engaging said first machine part in fluid-tight relation and another portion being positioned so as to encircle said second machine part, a retainer insert unit positioned at least partially within and carried by said portion of said retainer element which encircles said second part, and a unitary elastomeric sealing unit having a generally annular seal body portion with generally frusto-conical oil and air side sealing element surfaces meeting each other along a generally circular locus and forming a primary seal band contact area on a portion of said second machine part, said sealing unit also having an annular bonding portion spaced apart from said seal band area and having at least one of its surfaces secured in fluid-tight relation to said retainer insert unit, said retainer element and said retainer insert unit being made from relatively rigid, substantially fluid-impermeable synthetic plastics materials, said other portion of said retainer element having a radially outwardly facing static sealing surface formed on a portion of its exterior and engaging said third machine part in fluid-tight relation.

In accordance with yet another aspect of the present invention there is
provided a method of making a composite seal assembly, said method including the steps of molding a retainer insert having an insert body with axially and radially extending annular flanges thereon from a thermoplastic material, treating at least a part of the surface of said radially extending flange to impart a roughened texture thereon, positioning said insert in relation to a seal-forming mold such that said flange with said roughened texture surface lies within the cavity of said mold, forming a generally annular seal body which includes generally frusto-conical air and oil side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with the surface of an associated movable machine part from a curable fluent elastomeric material and permitting said material to cure and a portion of said material to bond to said roughened texture surface portion of said retainer insert radial flange, forming a retainer element from a synthetic plastics material, said retainer element including an insert mounting portion having a radially inwardly directed annular surface defining a center opening for receiving and radially positioning a part of said retainer insert, said retainer element also including at least one annular shoulder surface for engaging and axially positioning another part of said retainer insert, with said retainer element also having a retainer element mounting portion with a generally flat surface for positioning in opposed relation to an associated machine part to which said retainer element will be fastened in use, providing means in said retainer element for receiving and positioning retainer element mounting fasteners, disposing said retainer insert at least partially within said center opening such that said radially inwardly directed annular surface and said annular shoulder surface on said retainer element engage
portions of said retainer insert body, and bonding said retainer element and said retainer insert to each other in fluid-tight sealing engagement.

In order that the invention may be more clearly understood and put into practical effect there shall now be described in detail preferred embodiments of a composite seal assembly in accordance with the invention. The ensuing description is given by way of non-limitative example only and is with reference to the accompanying drawings, wherein:
BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of the composite seal of the invention, showing it in a position of use as a rear crankshaft seal showing an associated engine crankcase and crankcase oil pan in phantom lines;

Fig. 2 is a fragmentary vertical sectional view of a portion of the composite oil seal unit of the invention, showing the same in position of use and showing the fixed and movable machine elements relative to which it is intended to form a seal;

Fig. 3 is a view showing the elements of Fig. 2 in their exploded or pre-assembled relation;

Fig. 4 is a vertical sectional view, partly diagrammatic in nature, showing the manufacture of the retainer insert and the elastomeric sealing units of the invention;

Fig. 5 is a side elevational view of the seal assembly of the invention, showing it in association with other portions of the sealed mechanism;

Fig. 6 is a perspective view of a modified form of composite seal unit of the invention; and,

Fig. 7 is a side elevational view of the composite seal of the invention and the installed position of use.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

While the assembly of the invention is capable of use in a number of environments, and is adapted for a number
of applications, a detailed description of two different forms of seal of the invention will be given, which versions differ slightly from each other and both of which are intended for use as a rear crankshaft seal assembly in an automotive engine application.

Referring now to the drawings in greater detail, Fig. 1 is a perspective view of a composite seal assembly generally designated 10 and shown to be positioned near a mounting surface 12 forming a part of a first machine element 14, which it is intended to be associated in use.

The composite seal assembly 10 includes three principal elements, which are shown in Figs. 1 - 3; these include a retainer element generally designated 16, a retainer insert generally designated 18, and an elastomeric sealing unit generally designated 20. In the application considered, the first machine element 14 is an automotive engine block; and the mounting surface 12 forming the rear end face surface of the block.

A rear crankshaft extension 22 (Fig. 2) forms a second machine element and the extension 22 protrudes through a center opening generally designated 24 in the seal assembly 10. An engine oil pan generally designated 26 forms the third machine element; the pan 26 is shown in phantom lines to have surface portions 28 which engage a partially cylindrical lower exterior surface 30 of the retainer element 16.

The crankshaft or crank extension 22 has a cylindrical exterior wear surface 32 over which a portion of the elastomeric seal unit 20 rides in fluid tight relation. The seal unit 20 itself is of generally
conventional construction insofar as it includes an elastomeric seal body 34 having air and oil side, generally frusto-conical surface portions 36, 38 which meet along a generally circular locus to form a seal band 40; this is the portion that engages the surface 32 with what is termed a dynamic seal, i.e., a seal between relatively movable elements.

The seal body 34 may optionally include an excluder or dirt lip 42, also of a conventional construction known to those skilled in the art. A garter spring 44 is shown to be received in a groove 46 (Fig. 3) for imposing a radial compressive load on the seal lip or band 40. The seal body 34 also includes a pair of bonding surfaces 48, 50 of annular form, spaced from the seal band 40, and along which the seal body 34 is attached to the retainer insert 18.

The insert unit 18 itself is also of generally annular form and includes a body portion 52 with an axially extending flange 54, a radially inwardly extending seal body mounting flange 56 and a radially outwardly extending locating flange 58. The axial flange 54 and the radially outwardly extending flange 58 respectively include surfaces 60, 62 which are adapted to engage oppositely directed counterpart surfaces on the retainer element 16 in a mechanically secure, fluid-tight relation. As is discussed in greater detail below, the annular retainer insert 18 is preferably made from a synthetic plastic material.

Referring now to the retainer element 16, this unit includes a main body portion 64 also preferably made from
a thermoplastic material; the element 16 may be considered from a functional shank part as having a mounting portion generally designated 66, and an insert receiving portion 68. The body 64 includes an axial flange 70 having a radially inwardly directed cylindrical surface 72 for engaging the surface 60 of the insert flange 54 and an end face or shoulder surface 74 is provided on the flange 70 for engaging the surface 62 on the insert radial flange 58. In use, these abutting pairs of surfaces form fluid-tight joints in the assembled condition of the seal assembly 10.

The body 64 of the retainer 16 further includes a radially inwardly extending protective flange 76, which terminates in three or more individual tab units 78. This flange 76 lies axially inwardly of the seal unit 20, i.e., toward the sealed region or to the right in Figs. 2 and 3.

Referring now to the mounting portion 66 of the composite seal unit 10, this portion is shown to include a mounting body 80 having a flat end face surface 82 adapted to abut the crankcase end face surface 14. A gasket "G" (Fig. 3) may be provided for improved sealing in this area. The retainer body 80 also includes a plurality of spaced apart formed fastener bosses 83, each having an axially extending opening 84.

The openings 84 receive metal insert sleeve 86 in snug relation; the preferred form of insert sleeve 86 includes a radial flange 88 thereon for engaging the undersurface 90 of the cap screw fastener 92 which extends through the central opening in the insert sleeve 86. In this manner, the fasteners 92 "bottom out" on the metal
insert sleeve 86 which extends between the end face
surface 14 of the engine block 12 and the undersurface 90
of the fastener head.

As shown in Fig. 1, the mounting portion 80
preferably includes a peripheral stiffening wall generally
designated 94 and subdivided into an upper wall unit 95, a
pair of lateral stub walls 97, and a semicircular lower
wall 99. A plurality of individual stiffening webs 96,
extend between the upper wall unit 95 and the flange 70 as
well as between parts of the bosses 83 and flange 70 or
wall 95. The stub walls 97 form parts respectively of
left and right hand transverse mounting body extensions
generally designated 98, 100, each of which is shown in
Fig. 1 to be provided with a vertically extending passage
102, 104. The passages receive fasteners extending
respectively through the openings 106, 108 in the oil pan
26.

In this connection, and referring again to Fig. 1, it
will be realized that once the retainer unit 16 is snugly
bolted to the crankcase, the oil pan may then be affixed
not only to the underside surfaces of the crankcase in a
conventional manner but that other fasteners may extend
through the pairs of openings 106, 102, 100, 108, to
secure the parts in fixed relation. In this instance,
captive nuts or other fasteners may be provided for the
passages 102, 104, or tapped inserts may be used, as
indicated.

Fig. 1 also shows that a plurality of webs 112 extend
between the lower surfaces of the retainer axial flange 70
and the semicircular lower wall 99 of the retainer element
16. These webs, walls and bosses provide a stiff construction at minimum weight and are consistent with high volume manufacture using relatively simple molds.

Referring now to Fig. 5, the composite seal 10 is shown in the installed position. Here, a fastener 92 is shown extending through the fastener boss 83 so that the end faces 14, 82 of the crankcase and retainer element respectively are shown in abutting relation. For clarity of illustration, the gasket "G" is not shown. Fig. 5 shows one of a pair of vertically extending fasteners 110 which hold the oil pan 26 to the stub walls 97 of the retainer unit 18.

Referring now to Fig. 6, a slightly modified form of seal assembly 10A is shown. The assembly is the same as that shown in Figs. 1-3 except that the retainer element generally designated 16A in Fig. 6 differs slightly from the retainer element 16 in Fig. 1. In the form shown in Fig. 6, the upper wall unit 95A is continuous and lies entirely radially outside the various fastener bosses 83A.

Additional stiffening webs 96A extend between pairs of lateral stub walls 97A and the semicircular lower wall 99A includes rounded transition sections 101A at its upper ends rather than having upper ends which abut the stub walls at right angles. No auxiliary or vertical fasteners or openings therefore are required to affix the oil pan 26A. In this connection, it will be noted that the mating surface 28A of the oil pan 26A is contoured so as to having flaring transition sections 27A to mate with counterpart sections 101A on the outer ends of the lower exterior wall 99A. In the embodiment shown, a groove 29A
is provided in the oil pan mating surface 28A to receive a gasket 31A to seal the interface between the surfaces 28A and 30A.

Fig. 7 shows the seal assembly 10A in the installed position of use, showing the relation of the engine block 12A, the abutting surfaces 14A, 82A on the engine block or first machine member 12A, the retainer unit 16A and the gasket "G." Fasteners 92A are shown in phantom lines. The engine oil pan 26A and its flange 28A which engages the lower exterior surface 30A of the lower wall 99A of the retainer unit 16A, are illustrated, as is the axial flange 70A of the retainer element 16A, the radial flange 58A of the insert 18A, for example.

Referring now to Fig. 4, there is shown one step in the operation of manufacturing the composite seal which precedes the assembly step shown in Fig. 3. Here, in Fig. 4, the retainer insert 18 is shown disposed within a mold generally designated 200 and shown to include three principal elements, a lower mold plate 202, a center core 204, and an upper insert 206. In this form of the invention, the retainer insert 18 is formed from a plastic material by injection molding in a mold with a suitably shaped cavity so as to provide the body 52 with the axial flange 54, the seal body mounting flange 56, and the locating flange 58.

After formation of the insert 18, the exterior surfaces of the flange 56 are degreased and grit blasted so as to impart a slightly roughened finish thereto. In the alternative, surface roughness may be imparted by chemical etching or by providing rough surfaces on selected portions of the mold interior. In any case,
after surface preparation is complete, an adhesive of a type known to those skilled in the art is applied and allowed to dry. Thereafter, the retainer insert body 52 is placed in the mold 200 as illustrated, and rubber may be injected, as through passage 208, into the cavity formed by the inwardly directed surfaces of the mold parts 202, 204, 206. The in-place formation of the seal body 34, its initial curing and bonding to the radial flange 56 are carried out in a manner known to those skilled in the art and which, forming no part of the invention which is novel per se, is not herein described in further detail.

Assuming that the seal body is made from a fluoroelastomer material, after the mold shown in Fig. 4 is opened, and the part removed, the composite part comprising the elastomeric seal body 20 and the retainer insert 18 is post cured at an elevated temperature, such as 400°F., for 10 hours. This produces a completed, cured subassembly shown in Fig. 3.

Referring now to Fig. 3, there is illustrated the alignment and positioning of the retainer element 16 and the retainer insert 18. When these parts are aligned as shown in Fig. 3 and then moved into an assembled relation, the various illustrated mating pairs of surfaces 60, 72, and 62, 74 are in snug engagement, thereby centering the insert relative to the retainer 16 and insuring the proper axial positioning of the insert 18. Thereupon, the parts may be bonded by well-known ultrasonic welding techniques, with or without the aid of auxiliary adhesives or similar materials. In appropriate cases, the bonding may be achieved by adhesives only.
When molding and assembly operations have been completed, a seal of the kind illustrated in Fig. 2, for example, has been produced and is suitable for shipment to the manufacturer.

As pointed out above, the installation of the seal is then a matter which requires relatively little skill and no post finishing or machining on the machine parts in question, that is, the engine block, crankcase oil pan or the like. The retainer may be positioned as shown in Fig. 1, with the gasket "G" disposed between the face 14 on the engine block and the front or axially inner surface 82 on the retainer unit 16.

In one embodiment of the invention, the gasket "G," while manufactured separately, may be bonded to the retainer surface at the seal making factory, and the gasket may then have its other surface covered protectively by a release paper "R," for example, (Fig. 3) for shipping. The outer, covered face may or may not also have a self-adhesive material affixed thereto. In such case, only surface preparation of the block is necessary, because the seal includes its own gasket and gasket adhesive.

The alignment and fastening of cap screws 92 or the like insures proper alignment of the seal with the rear crankshaft extension, while the tab units 78 on the protective flange 76 insure that the radial excursion of the elastomeric seal unit 20 is limited and thus not damaged during installation. The plastic exterior surface 30 of the lower wall 99 mates in fluid-tight relation with the surface 28 on the oil pan 26, customarily sealed by a part of the oil pan gasket.
Because of the overall rigidity of the retainer 16, relatively high static sealing forces may be applied to the assembly 10 without detrimental affect; if this force were placed on the exterior casing of an ordinary oil seal, distortion of the seal casing or other installation fault might result. The installation of the seal, according to the present invention, is greatly simplified, and greatly increased reliability is achieved.

According to the invention, thermoplastic materials are preferred for use in making the retainer and insert components of the invention. Both these elements may be made from the same material, or the two can comprise dissimilar materials. While many different materials are suitable, filled thermoplastic resins such as glass-filled nylon or other polyamide resins are suitable. High temperature resistant thermoplastics such as polycarbonates, acetalis or other materials may also be used with success.

While ordinary elastomers such as nitriles, carboxylated nitriles, or silicone elastomers may be used in making the seal unit 20, the present invention advantageously uses fluoroelastomer materials which are very high temperature resistant. Accordingly, in use, the seal is effective where fluid temperatures attain a steady 250°F. and occasionally reach temperatures of 400°F. to 500°F.

The use of the ultrasonic welding techniques is an economical way to form a strong secondary or static seal between the retainer and the insert. This eliminates a potential prior art problem of a faulty secondary seal,
i.e., the seal between the exterior of the seal casing and the main bearing web or similar part of the crankcase structure. Another important feature of the present invention is that proper alignment may be achieved without press fitting. Use of a bolt pattern on an exterior flat surface not only eliminates the likelihood of this misalignment, but permits a visual inspection to be made to verify proper fit; this was difficult or impossible with some prior art seals.

It will thus be seen that the present invention provides a number of advantages and characteristics including those pointed out above and others which are inherent in the invention. Preferred embodiments of the invention having been described by way of example, it will occur to those skilled in the art that variations in the exact form of seal and the materials used therein may be made without departing from the spirit of the invention or the scope of the appended claims.
The claims defining the invention are as follows:

1. A composite seal assembly including, in combination, a retainer element, a retainer insert, and an elastomeric sealing unit, said retainer element including an insert mounting portion which includes a radially inwardly directed annular surface defining a center opening for receiving and radially positioning a part of said retainer insert, at least one annular shoulder surface for engaging and axially positioning another part of said retainer insert, said retainer element also having a retainer element mounting portion with a generally flat surface for positioning in opposed relation to an associated machine part to which said retainer element will be fastened in use, and means defining plural openings for receiving and positioning retainer element mounting fasteners, said retainer insert including axially and radially extending annular flanges for cooperative engagement with said radially inwardly directed annular surface and said annular shoulder surface of said retainer element, said retainer insert further including an annular bonding surface, said elastomeric sealing unit including a bonding portion and a generally annular seal body which includes generally frustoconical oil and air side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with the surface of a relatively movable machine part extending axially through said seal body, said bonding portion being attached in fluid tight sealing engagement to said bonding surface on said retainer insert, said retainer element
and said retainer insert each being formed from a resinous synthetic plastics material, with said seal assembly being adapted to be affixed in use to the end face of a machine part having said relatively movable machine part extending therefrom and adapted to be engaged by said elastomeric sealing element.

2. The composite seal assembly as defined in Claim 1, wherein said mounting portion of said retainer element includes a plurality of metal guide inserts received respectively within said openings for said mounting fasteners, said metal inserts being sized so as to engage said fasteners and absorb at least a portion of the axial fastening load, whereby said load is not transmitted entirely to said mounting portion of said retainer element.

3. The composite seal assembly as defined in Claim 1 or Claim 2, wherein said bonding portion of said retainer insert includes an annular, generally radially inwardly extending flange.

4. The composite seal assembly as defined in any one of Claims 1 to 3, wherein said retainer element and said retainer insert are made from different thermoplastic materials.

5. The composite seal assembly as defined in any one of Claims 1 to 3, wherein said retainer element and said retainer insert are made from substantially identical plastics materials.

6. The composite seal assembly as defined in any one of Claims 1 to 5, wherein said retainer element mounting portion is constructed and arranged such that said openings for said
mounting fasteners lie within an arc of not more than about 190° measured from the middle of said center opening in said retainer element.

7. The composite seal assembly as defined in any one of Claims 1 to 6, wherein said retainer insert is affixed to said retainer element by a bond formed by ultrasonic welding.

8. The composite seal assembly as defined in anyone of Claims 1 to 7, wherein said elastomeric sealing unit is made from a fluoroelastomer material.

9. The seal assembly as defined in any one of Claims 1 to 8, wherein said retainer element further includes a generally radially inwardly extending retainer flange, said retainer flange lying axially between of said radially inwardly facing annular surface of said retainer element and said generally flat surface of said retainer element mounting portion.

10. The seal assembly as defined in Claim 9, wherein said radially inwardly extending retainer flange includes a plurality of radially inwardly extending ears circumferentially spaced apart from each other, said ears being adapted for engaging said relatively movable part adapted to extend through said seal assembly for assistance in positioning said composite seal assembly during installation.

11. A composite seal assembly for retaining fluid within a cavity formed at least in part by a first machine part, a second machine part having a portion which is rotatable about a given rotational axis and a third machine part fixed to said first machine part, said composite seal assembly including, in combination, a retainer element having one portion adapted to be affixed to said first machine part and another portion adapted to be positioned so as to encircle said given rotational axis of said second machine part, a retainer insert positioned at least partially within and carried by said
The seal unit 20 itself is of generally annular seal body portion having a portion of said retainer element which encircles said second part axis, and a unitary elastomeric sealing unit having a generally annular seal body portion with generally frusto-conical oil and air side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with a surface on said second machine part, said sealing unit also having an annular bonding portion spaced apart from said seal band area and having at least one of its surfaces secured in fluid-tight relation to said retainer insert unit, said retainer insert unit made from relatively rigid, substantially fluid-impermeable synthetic plastics materials, said one portion of said retainer element being made from relatively rigid, substantially fluid-impermeable synthetic plastics materials, said said retainer element having a radially outwardly directed static sealing surface formed on a portion of its exterior so as to be engageable with said third machine part in fluid-tight relation with a counterpart mounting surface on said retainer insert unit, said retainer element further including means for removably receiving a plurality of fasteners to facilitate positioning of said assembly relative to said first machine part.

12. The seal assembly as defined in Claim 11, wherein said means for receiving said plurality of fasteners includes a plurality of bosses each including a center opening therein with each opening having a metal guide insert received in said opening.
Referring now to the retainer element 16, this unit includes a main body portion 64 also preferably made from

13. The seal assembly as defined in Claim 11 or Claim 12, wherein said retainer element and said retainer insert are made from the same plastics material.

14. The seal assembly as defined in Claim 11 or Claim 12, wherein said retainer element and said retainer insert are made from different plastics materials.

15. The seal assembly as defined in any one of Claims 11 to 14, wherein said end face surface portion of said retainer element and said means for receiving said fasteners both lie within an arc of not more than 190° measured from the center of the portion of said retainer element adapted to encircle said second machine part rotational axis.

16. The seal assembly as defined in any one of Claims 11 to 15, wherein said sealing unit is made from a fluoroelastomer material.

17. A sealed machine assembly including in combination, first and third machine parts, a second machine part movable relatively to said first and third machine parts, and a composite seal assembly for retaining fluid within a cavity formed at least in part by said first, second, and third machine parts, said composite seal assembly including, in combination, a retainer element affixed to said first machine part, one portion of said retainer element having an end face surface engaging said first machine part in fluid-tight relation and another portion being positioned so as to encircle said second machine part, a retainer insert unit positioned at least partially within and carried by said portion of said retainer element which encircles said second part, and a unitary elastomeric sealing unit having a generally annular seal body portion with generally frusto-conical oil and air side sealing element surfaces meeting each other along a generally circular locus.
and forming a primary seal band contact area on a portion of said second machine part, said sealing unit also having an annular bonding portion spaced apart from said seal band area and having at least one of its surfaces secured in fluid-tight relation to said retainer insert unit, said retainer element and said retainer insert unit being made from relatively rigid, substantially fluid-impermeable synthetic plastics materials, said one portion of said retainer element also including an end face surface portion affixed to a counterpart mating surface on said first machine part in fluid-tight mating relation and said other portion of said retainer element having a radially outwardly directed static sealing surface formed on a portion of its exterior and engaging with said third machine part in fluid-tight relation.

18. The sealed assembly as defined in Claim 17, wherein said retainer element is affixed to said first machine part by removable fasteners and wherein said one portion of said retainer element further includes means for removably receiving a plurality of said fasteners to facilitate positioning of said assembly relative to said first machine part.

19. The sealed machine assembly as defined in Claim 17 or Claim 18, wherein said retainer element and said retainer insert are made from the same plastics material.

20. The sealed machine assembly as defined in Claim 17 or Claim 18, wherein said retainer element and said retainer insert are made from different plastics materials.

21. The sealed machine assembly as defined in any one of
between the lower surfaces of the retainer axial flange 70 and the semicircular lower wall 99 of the retainer element.

Claims 17 to 20, wherein said elastomeric sealing unit is made from a fluoroelastomer material.

22. A method of making a composite seal assembly, said method including the steps of molding a retainer insert having an insert body with axially and radially extending annular flanges thereon from a thermoplastic material, treating at least a part of the surface of said radially extending flange to impart a roughened texture thereto, positioning said insert in relation to a seal-forming mold such that said flange with said roughened texture surface lies within the cavity of said mold, forming a generally annular seal body which includes generally frusto-conical air and oil side sealing element surfaces meeting each other along a generally circular locus to form a primary seal band area of intended contact with the surface of an associated movable machine part from a curable fluent elastomeric material and permitting said material to cure and a portion of said material to bond to said roughened texture surface portion of said retainer insert radial flange, forming a retainer element from a synthetic plastics material, said retainer element including an insert mounting portion having a radially inwardly directed annular surface defining a center opening for receiving and radially positioning a part of said retainer insert, said retainer element also including at least one annular shoulder surface for engaging and axially positioning another part of said retainer insert, with said retainer element also having a retainer element mounting portion with a generally flat surface for positioning in opposed relation to an associated machine part to which said
retainer element will be fastened in use, providing means in said retainer element for receiving and positioning retainer element mounting fasteners, disposing said retainer insert at least partially within said center opening such that said radially inwardly directed annular surface and said annular shoulder surface on said retainer element engage portions of said retainer insert body, and bonding said retainer element and said retainer insert to each other in fluid-tight sealing engagement.

23. The method as defined in Claim 22, wherein said bonding includes ultrasonically welding said retainer element to said retainer insert without the use of adhesives.

24. The method as defined in Claim 22, wherein said bonding steps is a step which includes applying an adhesive to selected surfaces of at least one of said retainer element and said retainer insert.

25. A composite seal assembly, substantially as described herein with reference to the accompanying drawings.

26. A sealed machine assembly, substantially as described herein with reference to the accompanying drawings.

27. A method of making a composite seal assembly, substantially as described herein with reference to the accompanying drawings.

D A T E D this 23rd day of September, 1988.

CHICAGO RAWHIDE MANUFACTURING CO.

By its Patent Attorneys:

CALLINANS
The surface 28 on the oil pan 26, customarily sealed by a part of the oil pan gasket.
between the retainer and the insert. This eliminates a potential prior art problem of a faulty secondary seal.