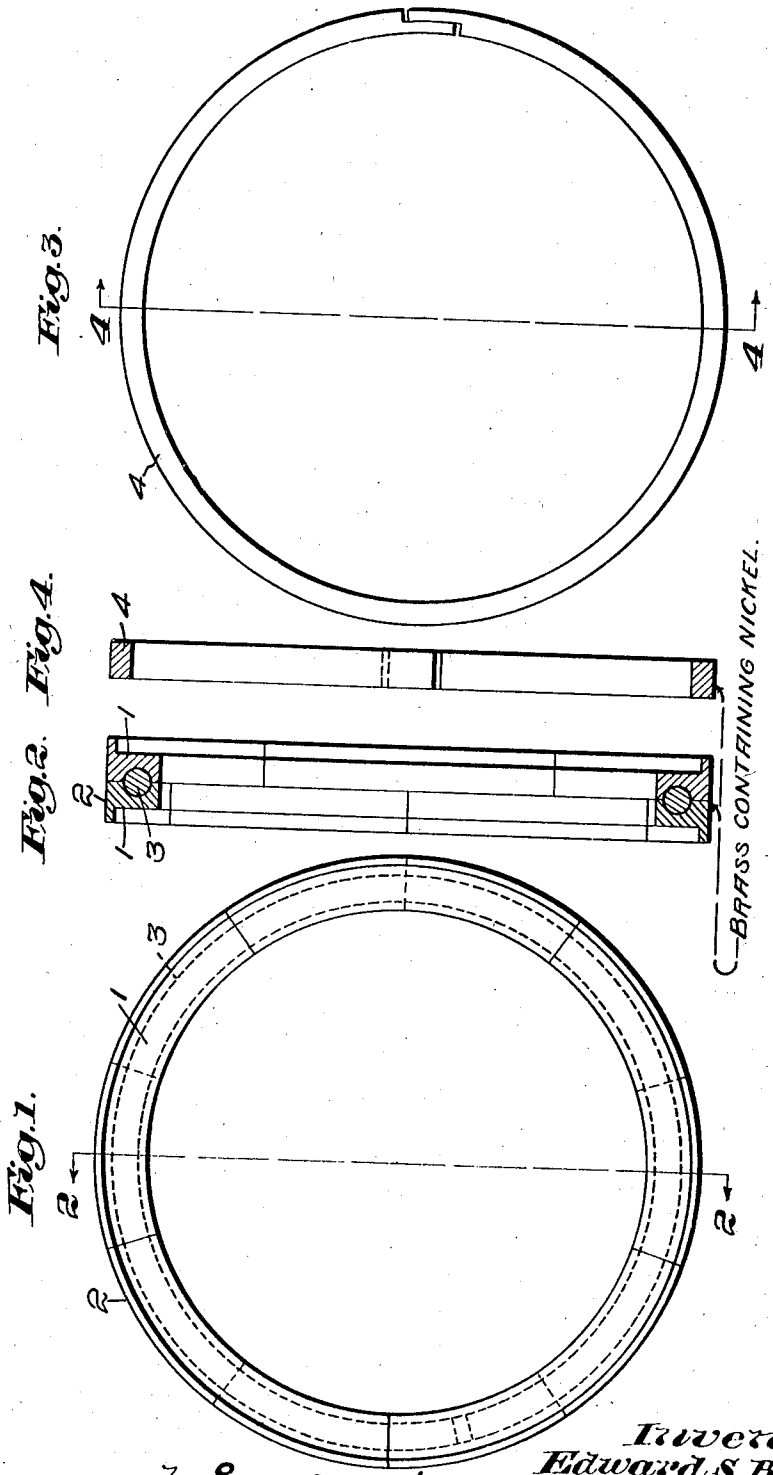
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PISTON AND ROD-PACKING RING

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PISTON AND ROD-PACKING RING

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My invention relates to piston and rod-packing rings formed of copper-base alloys containing ingredients for improving the durability and properties of the rings and for facilitating their fabrication.

The invention will be best understood from the following description of several examples of the rings, the scope of which invention will be more particularly pointed out in the appended claims.

It is common practice to make piston and rod-packing rings, particularly those of large diameter, by turning and cutting the same, in a lathe or boring mill, from elongated cast sleeves. It has also been proposed to extrude, or, as it is sometimes called, "die-express" rods having the cross-section desired in the ring element and bend lengths of the rods to form these elements either as segments for a segmental ring or as rings of complete, or substantially complete, circumference. Heretofore piston and rod-packing rings machined from castings as above explained have presented many serious defects, particularly that in use they are subject to cracking and breakage, and crumbling away of sharp corners and portions thereof of reduced cross-section such as flanges. Many copper-base alloys suitable for extrusion do not when extruded form satisfactory piston rings.

Applicant has found that by forming the rings of brass into which is incorporated nickel the above mentioned defects of prior rings are eliminated, and at the same time is further presented an alloy admirably suited for extrusion purposes thus enabling the rings to be inexpensively formed by the extrusion and bending process above mentioned. Rods of such alloy further are capable of being hot rolled and forged, enabling rods to be made by either extrusion or hot rolling and the rings to be forged from them. In addition the metal has the property of permitting a slight cold drawing or other cold working to harden or strengthen the ring.

Rings according to applicant's invention are not limited to those of any particular cross-sectional shape or other details of construction. The ring elements for example may be formed as segments or as complete circumferences as shown in the accompanying drawing in which Figure 1 is a plan of one form of ring, Figure 2 is a section on the line 2—2 of Figure 1, Figure 3 is a plan of another form of ring, and Figure 4 is a section on the line 4—4 of Figure 3. The ring according to Figures 1 and 2 is formed of segments 1 made according to applicant's invention, the outer surfaces 2 of which segments are held against the cylinder wall by a split steel ring 3. The ring element 4 according to Figures 3 and 4, instead of being segmental and of complex cross-section, is in the form of a split ring of complete circumference and is of rectangular cross-section.

Excellent results may be secured with a brass having, approximately, 54 to 75% copper and with 0.25 to 5% nickel substituted for an equal amount of the zinc. Rings formed of such an alloy in addition to the properties mentioned above have excellent resistance to abrasion, toughness, high strength, good wearing properties, and reasonably good corrosion resistant properties, and may be machined. These additional properties are imparted largely by the nickel, and as a result of them the above mentioned defects of prior rings are effectively eliminated.

Preferably the amount of nickel does not exceed approximately 2.5% as its maximum effects are secured at that percentage, and the addition of more nickel does not materially improve the alloy except making it harder and tougher at the expense of its workability. In practice, amounts of nickel in excess of 4 or 5% are generally undesirable.

Preferably, in addition to nickel, the alloy of which the ring elements are formed also contains iron, which latter may be substituted for an equal amount of the zinc. The iron, particularly in conjunction with the nickel, materially increases the hardness and toughness of the ring and its resistance to abrasion and wear. Preferably the amount of iron should not exceed about 2% because this is the maximum amount which is soluble in the alloy, and any excess amount would be present as free metallic iron which would make the ring subject to fatigue failure. In practice, appreciable results are secured with about 0.25% iron, and to keep to a minimum the amount of free iron present the alloy preferably should contain no more than about 3% iron.

Arsenic also preferably is added to the alloy as it is found that, among other things, it increases the toughness of the ring and reduces its tendency to crack and crumble away. It secures this increase in toughness without detracting from the facility with which the alloy may be worked, and thus when present does not reduce the ease with which the ring may be fabricated. It has also been found that arsenic in a brass piston ring acts to prevent deterioration of the ring by inhibiting the tend-

ency of the zinc to volatilize when the ring is subjected to high temperatures during use. This volatilization of zinc othewise would render the rings unsuitable for use in many situations. Preferably the amount of arsenic should not exceed 1%, and appreciable results will be secured with an amount as low as 0.05%.

In respect to the copper and nickel, and also iron and arsenic if either or both of these last two are present with the copper and nickel, the balance of the alloy, neglecting impurities, is substantially zinc in the sense that such balance is all zinc or all zinc except for small amounts of elements added for imparting special properties to the alloy without eliminating its characteristic properties, or added for insuring the existence of or for modifying those characteristic properties. It will therefore be understood that in the appended claims by the words "balance substantially zinc" is meant that the balance is zinc in the sense defined. Among such other elements is manganese, small amounts of which may be added to the melt to insure against the deleterious effects of sulphur that may be present in the alloy. The sulphur if present will unite with the manganese to form manganese-sulphide which in small amounts has little or no effect on the properties of the alloy, but in the absence of manganese the sulphur will unite with the nickel to form nickel-sulphide which, even in small amounts, it has been found has a deleterious effect on those properties of the alloy which enable the rings readily to be fabricated therefrom. Preferably the manganese should not exceed 1% of the final alloy, and ordinarily it should be present in amounts exceeding 0.05%. Another of such additional elements is lead, which may be added in small amounts to facilitate the ease with which the ring element may be machined and to improve its properties as a bearing. Lead from 0.1 to 1% will have appreciable effects in respect to improving the bearing properties and may be added up to 2.5% for improving the machining properties, without particularly modifying any of the characteristic properties of the alloy, except, for the reason that it constitutes a soft material entered into an otherwise hard alloy and being dispersed but not dissolved in that alloy, it acts to improve its machining, wearing and bearing properties. Still another of such elements which may be added is silicon, although ordinarily that element will not be needed. Silicon acts as a deoxidizer in the melt and also acts somewhat to increase the tensile strength of the ring, and its resistance to corrosion when subjected to oil and steam at high temperatures. As little as 0.25% silicon will give appreciable results. Preferably, however, the silicon should not exceed 1%, so as not materially to decrease the ease with which the rings may be fabricated.

It will be understood from the foregoing that the preferred alloy for an extruded ring contains between 54 and 64% copper, 0.1 and 2.5% nickel, 0.10 and 2% iron, 0.05 and 1% arsenic, 0.05 and 1% manganese, and 0.2 and 1% lead, with the balance zinc. The alloys containing the lesser amounts of copper and the greater amounts of other constituents within the ranges mentioned have the best hot working properties in respect to fabricating the ring, and require a minimum of cold working to develop maximums of strength in the ring, whereas the alloys having the greater amounts of copper and the lesser amounts of the other constituents are not so easily hot worked to form the ring. Nevertheless the alloys containing the greater amounts of copper have sufficient plasticity when heated to a temperature range of 1200 to 1500° F. to enable them readily to be formed into rings, or rods from which rings may be formed, by hot rolling or hot forging, and further may be hot extruded to form the rods of which the rings are made, but not with the same ease as the alloys containing the lesser amounts of copper.

It will be understood that within the scope of the appended claims wide deviations may be made from the rings above described without departing from the spirit of the invention.

I claim:

1. A piston or packing ring element of an alloy which basically is a brass containing nickel, the amount of copper being approximately 54 to 75% of the alloy, the amount of nickel approximately 0.25 to 5% thereof, and the amount of zinc being not less than about 11.5% or more than about 46% thereof.

2. The ring element according to claim 1 containing, approximately, 0.05 to 1% arsenic.

3. The ring element according to claim 1 having, approximately, not more than 69% copper and not more than 4% nickel, and containing, approximately, 0.25 to 3% iron.

4. The ring element according to claim 1 having, approximately, not more than 69% copper and not more than 4% nickel, and containing, approximately, 0.25 to 3% iron and 0.05 to 1% arsenic.

5. An extruded metal piston or rod packing ring element consisting of an alloy which basically is a brass containing nickel, the amount of copper being approximately 54 to 75% of the alloy, the amount of nickel approximately 0.25 to 5% thereof, and the amount of zinc being not less than about 11.5% or more than about 46% thereof.

6. The ring element according to claim 5 containing, approximately, 0.05 to 1% arsenic.

7. The ring element according to claim 5 having, approximately, not more than 69% copper and not more than 4% nickel, and containing, approximately, 0.25 to 3% iron.

8. The ring element according to claim 5 having, approximately, not more than 69% copper and not more than 4% nickel, and containing, approximately, 0.25 to 3% iron and 0.05 to 1% arsenic.

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