Feb. 18, 1969 J. P. STEFAN ET AL 3,428,035

INTERNAL COMBUSTION ENGINE VALVE SEAT

Filed Dec. 1, 1966 Sheet 1 of 2

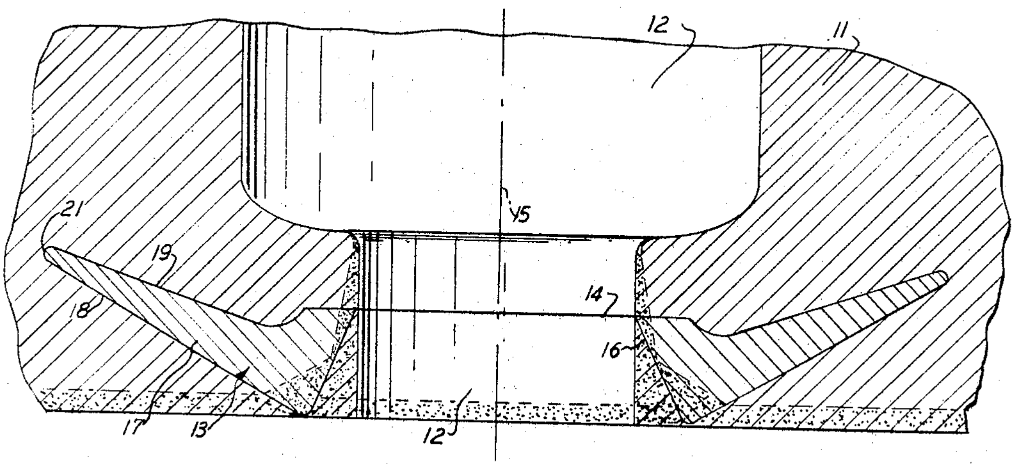

FIG. 1

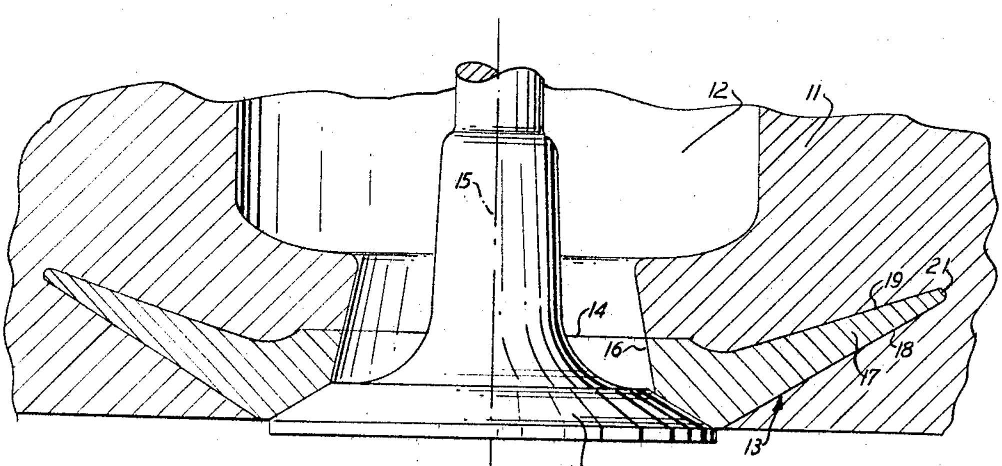

FIG. 2

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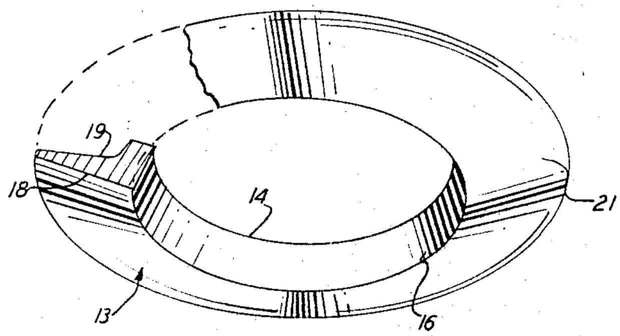

FIG. 3

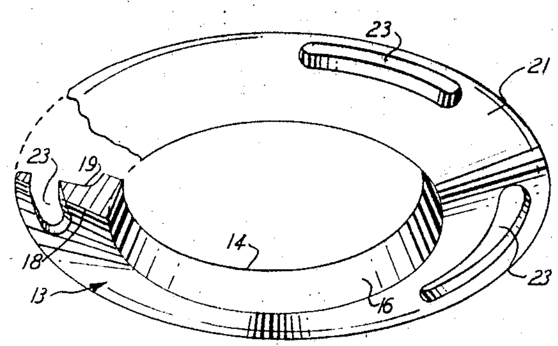

FIG. 4

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INTERNAL COMBUSTION ENGINE VALVE SEAT

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Int. Cl. F01l *3/02, 3/22;* B21k *1/24*

ABSTRACT OF THE DISCLOSURE

A method and means for integrally forming a valve seat in an engine component by casting an alloy valve seat insert into the engine component prior to the machining of the valve seat area. The alloy valve seat is retained through controlled diffusion of its perimeter into the cast material.

Background of the invention

Valve seat distortion, wear, corrosion, and burning are basic problems that shorten the valve life in an engine, thereby reducing the reliability of the valve train. High operating temperatures, a corrosive atmosphere, and high stress applications are responsible for these basic problems. To improve the reliability and durability of the valve train, the present invention proposes that the valve seats comprise alloy inserts which are cast into the cylinder block or valve head prior to machining of the cast engine component.

It is known in the prior art to use pressed-in alloy inserts which are held in place by a nickel brazing alloy, such as is taught by U.S. Patent No. 3,170,452. The disadvantage of this is that the brazing alloy produces a heat transfer dam between the insert and the cast body. This may result in seat distortion and insert fall-out if the fit between the insert and the recess receiving the insert is excessive. The usual method is to press the inserts into carefully machined holes, the inserts sometimes being pre-shrunk by being cooled in Dry Ice before insertion. Here again a poor fit between the insert and the receiving recess can result in short life or excessive fallout characteristics. The present invention avoids such fallout because the insert becomes integrated with the main body of cast material.

Summary of the invention

More specifically, the present invention relates to a composite metal casting comprising a cast metal material and a metal alloy insert embedded in said cast metal material during the casting process. The insert has a surface that forms a wear and corrosion resistant portion of an exposed surface of the composite casting when the latter is machined, in the case of an internal combustion engine, to form a valve port. The alloy insert has an integral portion of the insert is provided with a diminish- the casting into the body of the cast metal material. The integral portion of the insert is provided with a diminishing cross sectional area from its exposed surface into the body of the casting to promote fusion of the perimeter portion with said cast material during casting with minimal fusion in the area of the exposed surface.

The method by which a wear resistant valve seat for a valve port of a cast metal internal combustion engine component is formed according to the present invention comprises the steps of forming an annular valve seat insert of a wear, heat and corrosion resistant alloy. The insert has diminishing thickness from the wall of the aperture therein to the perimeter. When the molten metal forming the cast engine component is cast against the insert, this causes the thinner perimeter portion of the

latter to reach a soft molten state so that the insert bonds itself by fusion with the casting metal. After proper cooling, the main casting and the insert are machined to provide a predetermined valve port configuration, then the insert is further machined to form the valve seat proper.

The control of the fusion area is important because proper fusion at a proper location produces a good seat or insert retention within the casting body and provides good insert cooling. With good cooling, the alloy metal seat or insert is subjected to lower temperatures, thereby reducing valve seat distortion, increasing effective seat hardness, reducing wear and extending valve seat life. This avoids the tendency of metals to lose their hardness qualities at elevated temperatures.

Brief description of the drawing

Other objects, advantages and features of the present invention will be made more apparent as this description proceeds, reference being had to the accompanying drawings, wherein:

FIG. 1 is a fragmentary cross sectional view of a cast engine component with the wear resistant insert cast in place and prior to any machining operations;

FIG. 2 is in part similar to FIG. 1 after the cast engine component and valve seat insert have been machined to receive a valve as shown;

FIG. 3 illustrates one embodiment of a valve seat insert for use in carrying out the present invention; and

FIG. 4 illustrates a second embodiment of a valve seat insert.

Description of the preferred embodiment

Referring now in detail to FIGS. 1 and 2 of the drawings, there is shown generally at **11** a fragmentary cross sectional portion of a cast cylinder head having a valve port **12** formed therein. Integrally cast in the cylinder head casting **11** is a valve seat insert **13**.

The valve seat insert **13** is in the form of an annulus having a flat base **14** which lies in a plane substantially normal to the longitudinal axis **15** of the valve port. The aperture in the annulus has an outwardly inclined circular wall **16**. The annulus has a main body portion **17** of diminishing cross section, the opposite surfaces **18** and **19** being inclined relative to the base **14** to give a modified triangular appearance to the body portion when the latter is viewed in cross section. The direction of inclination of the body portion **17** is such, as seen in FIGS. 1 and 2, that the extremity of peripheral edge **21** is relatively deeply embedded in the cylinder head casting **11**.

FIG. 1 illustrates the cross sectional appearance of the cylinder head and valve insert in the rough casting stage. The stippled area of FIG. 1 indicates the metal that has to be removed by machining operations to provide a finished cylinder head and valve seat to receive the tappet valve **22** (see FIG. 2).

FIGS. 3 and 4 illustrate two embodiments of the valve seat insert, the FIG. 4 embodiment differing from that of FIG. 3 only in that it is provided with secondary apertures **23** adapted to form a mechanical interlock with the cast metal of the cylinder head.

The triangular or tapered section of the alloy seat insert results in selective fusion between the alloy seat insert and the cast iron of the cylinder head. The triangular or tapered section of the insert brings about the bonding or fusion near the area of the apex of the insert section since the thinness of the section near the perimeter of the insert results in the insert alloy reaching a molten state. In this perimeter area, hard carbides are formed which in no way affect the machinability of the insert at the valve seat area since the thicker section or areas of the insert do not reach the soft molten state.

The triangular or tapered section of the alloy valve seat insert provides another important advantage. The molten metal of the engine component when cast is not always at a definite temperature. If the metal is 100° cooler than an established norm not as much of the tapered section will fuse. If the molten metal temperature is higher than the norm, fusion will take place further toward the center of the insert. The taper and its length is easily designed to obtain fusion within the permissible minimum and maximum temperatures for casting the engine component metal.

Suitable materials for satisfactory valve seat inserts that are satisfactorily wear and corrosion resistant and are readily machinable include the following:

Example 1.—Haynes Alloy No. 25

	Percent
Nickel	9.00–11.00
Chromium	19.00–21.00
Tungsten	14.00–16.00
Iron (max.)	3.00
Carbon	0.05–0.15
Silicon (max.)	1.00
Manganese	1.00–2.00
Cobalt	Balance

Example 2.—Multimet Alloy

	Percent
Nickel	19.00–21.00
Cobalt	18.50–21.00
Chromium	20.00–22.50
Molybdenum	2.50–3.50
Tungsten	2.00–3.00
Carbon	0.08–0.16
Nitrogen	0.10–0.20
Columbium and Tantalum	0.75–1.25
Silicon (max.)	1.00
Manganese	1.00–2.00
Iron	Balance

It will be understood that the invention is not to be limited to the exact construction shown and described, but that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined in the appended claims.

We claim:

1. A valve seat construction for an internal combustion engine comprising a cast metal body and an annular valve seat insert of a wear resistant metal,

said insert being embedded within the cast metal body prior to the machining of the latter to form a valve port,

said insert having at least two edge portions adjacent the annulus aperture wall projecting into the valve port area of said casting body and said insert and casting body being machined together to provide the finished valve port,

said insert having a main body portion of substantially triangular diminishing cross section extending at an angle into the cast metal body,

said insert being retained in place in the cast metal body by the fusion of its main body portion in the area of its diminished cross section to the cast metal body.

2. A valve seat construction for an internal combustion engine according to claim **1** in which:

the two edge portions adjacent the annulus aperture wall are machined in angular relationship to each other, the edge portion adjacent the outer surface of the cast metal body being machined at a flatter angle than the edge portion forming a continuation of the valve port in the cast body to form a valve seat.

3. A method of forming a wear resistant valve seat for a valve port of a cast metal internal combustion engine component comprising the steps of:

forming an annular valve seat insert of a wear, heat and corrosion resistant alloy,

said insert having substantially triangular diminishing thickness from the wall of the aperture therethrough to the perimeter,

casting molten metal against said insert causing the thinner perimeter portion of the latter to reach a molten state and to fuse with the casing metal,

the extent to which the insert is fused into the casting metal being a function of the decreasing thickness of the perimeter portion of the insert and the temperature of the casting molten metal,

then after cooling, machining the casting metal and insert to provide a predetermined valve port configuration,

and then further machining said insert to provide a valve seat thereon.

4. A composite metal casting comprising a cast metal material and a metal alloy insert, the metal insert having been embedded in such cast metal material during the casting process,

said insert having an annular body portion a surface of which forms at least a portion of an exposed machined surface of said composite casting,

said insert also having an integral portion of substantially triangular diminishing cross sectional area extending from said annular body portion into the body of said cast material,

said insert and said cast metal material being fused together with the greatest degree of fusion occurring between said integral portion adjacent the perimetrical apex and the cast metal material,

the extent of the fusion having been a function of the cross sectional thickness of said insert integral portion and the temperature in the molten state of the cast metal material in which the insert is embedded.

5. A composite metal casting according to claim **4**, in which:

the annular body portion has a base surface defining a plane normal to the axis of the annulus and an aperture wall diverging from the base plane, and

the insert integral portion extends angularly from said base plane and said aperture wall into the body portion,

said integral portion having converging walls creating the substantially triangular diminishing cross sectional area.

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U.S. Cl. X.R.

123—193; 29—156.7