METHOD FOR REPAIRING WORN VALVE SPINDLES

The invention relates to a method for repairing worn valve spindles comprising a valve body and sheath sections forming a sheath body in the region of the valve head of a Ni-base alloy, at least in the region of the head bottom and the head circumference and having a hard-facing in the seat region.

Valve spindles comprising a plurality of metal components, at which the present repair method is directed, are known in numerous embodiments (EP 0521821 B1, DE 102007031927 A1, DE 19508069 C1, DE 689211 A).

Such types of valves are for example employed in large number for example in large engines of ships and in large two-stroke and four-stroke engines for generating electric energy.

Worn valves of such engines are either reworked for reuse according to rules generally known by the experts or, if the wear is far advanced, disposed of.

Here, the valves intended for reworking are individually processed, i.e. the degree of the wear is determined; following this, the originally present sheath body is restored in the region of the valve head through deposition welding. Since the original shapes before the deposition welding are not defined, sever deviations in the sheath body thickness sometimes occur, which during the course of the further operation can result in quality losses. For example, cracks can appear in the region of the head circumference if the sheath thickness there is incorrectly dimensioned, particularly if it happens to be too thick. In the region of the head bottom, where the sheath body thickness can be dimensioned thicker depending on the valve size, service life losses can be occasionally observed

when, taking into account the final valve shape, the thickness of the finished sheath body had to be dimensioned small.

In contrast with this, the object of the present invention is to avoid the disadvantages shown, to make possible the reworking of valves even with severe signs of wear and to dimension the sheath body such that adequately long valve service lives are obtained.

According to the invention, this object is solved according to the features of Claim 1.

In that according to Feature 1.1 the worn valve is turned off to a minimum dimension in the region of the valve body in order to be subsequently built-up again into a suitable first head shape through deposition welding by means of an austenitic steel alloy, a valve body of adequate thickness is again obtained from a cost-effective iron alloy.

In that according to Feature 1.3 the first head shape formed through deposition welding is again turned off up to a defined inner shape of the valve head a same basic shape as inner shape is obtained for all comparable valves. This is an important prerequisite for making it possible that through the subsequent deposition welding of the sheath body of a Ni-base alloy (Feature 1.4) its economic use is guaranteed and that in the process according to Feature 1.5 a controlled sheath body thickness can be obtained in all regions of the valve head. Here, it is of significance on the one hand that the expensive Ni-base alloy can be used as economically as possible; on the other hand, there is the possibility that the sheath body thickness can be dimensioned in accordance with the loads, wherein the region of the head bottom, the head circumference and the valve seat have to be distinguished.

As far as the dimensioning of the sheath body is concerned, a Ni-base layer of at least 2.5 mm has proved to be practical, particularly in the circumferential region following the head bottom. Through a sheath body dimensioned such cracks are largely avoided in the process. On the other hand, larger sheath thicknesses in the region of the actual head bottom are practical. Longer service lives of the valves are obtained there with sheath thicknesses of 6-12 mm, depending on the valve size.

According to a particularly advantageous embodiment of the invention it is provided that the sleeve body in the seat region is provided with a groove, in which a hard-facing of a Co-base alloy is introduced through deposition welding. Here it is possible that the Co-base alloy can be realized with a smaller seat width, so that this expensive material, preferably of the type marketed under the designation "stellite" can be employed economically yet effectively.

The valve materials common with valve spindles and commercially available under the designations Inconel 625 and Inconel 718 are possible suitable Ni-base alloy filler materials. The central valve body itself preferentially consists of X45CrNiW18.9, which is also available under the designation SNCRW, or of a corresponding austenitic iron-base alloy, which are available commercially for example under the designation type 316 or 3162 (2CrNiMo 1912) as iron-base alloy suitable for deposition welding.

In that within the scope of the teaching according to the invention the original shapes for the two coating processes can each be precisely dimensioned on the one hand to an initial shape with a minimum dimension of the valve head through controlled turning off, and on the other hand to an inner shape prior to the deposition welding of the sheath material, the thickness of the respective material to be deposition-welded can be accurately adjusted and

subsequently makes possible precision working for the respective next operation through turning off. The result is a reworked valve with always the same inner shape of the central valve body and always the same end shape within the scope of the respective valve size while accurately maintaining the sheath body thickness in the respective section of the valve head.

The processing steps within the scope of the method according to the invention not only make possible an economical use of the expensive materials, particularly of the sheath body material of Ni-base alloy; because of this, even that sheath body thickness, which corresponds to an optimal sheath body thickness, is repeatably guaranteed. In this manner, the valves to be reworked can be industrially processed always in the same manner so that a technically highly reliable end product of high quality is obtained.

In the following, an exemplary embodiment of the invention is explained by means of the drawing. It shows

Fig. 1 the view of a valve head with circumferential seat region and

Fig. 2 an axial section within a detail II of Fig. 1.

Fig. 1 shows a valve head 1 with valve stem cut off at 2 with longitudinal axis 3. The head bottom of the valve head 1 is followed by the conical seat region 4 of the valve head. The seat region 4 of the valve head is followed towards the top by its valve fillet 5 with a small shoulder 6 towards the seat region 4.

Fig. 2 shows an axial section through the valve head through its seat region 4 and continuously as far as to the head bottom 7. Head bottom 7 and seat region 4 together with a connecting region usually called head circumference

8 form the sheath body 9 of the valve head 1 on its outer circumference. The sheath body 9 of the valve head 1 surrounds an inner shape 10 of the valve head 1. This inner shape 10 is created when reworking a worn valve, which at the start of its reworking has been turned off to an initial shape 11 in the region of the valve head. Onto this initial shape 11 an austenitic iron-base alloy is deposition welded, which, through subsequent turning off, corresponds to the inner shape 10 of the valve head 1. The sleeve body 9 of a Ni-base alloy is only welded on thereafter.

Thus, the valve head 1 comprises the original valve body 13 of an iron alloy, a layer 14 of an austenitic iron-base alloy created through deposition welding and the sheath body 9 of a Ni-base alloy created through deposition welding.

However, the layer structure explained above is created in each case through turning off subject to the creation of an initial shape 11, an inner shape 10 and an end shape 12. Thus, precise dimensioning of each individual layer is realized. As a result of the repair method, a valve head is created which corresponds to the highest demands on such bi-metal valve spindles. Its sheath body 9 meets all requirements in terms of service life, temperature and corrosion resistance especially also for exhaust valves.

Within the seat region 4 with the seat surface 15 a groove 16 is drawn into the sheath body 9, which during the production of the sheath body 9 is molded-in for a valve variant. This valve variant consists in that a particular seat material, preferably on a Co-base alloy is introduced in the groove 16 through deposition welding in order to increase the strength and wear and corrosion properties of the seat region 4 even further. A suitable Co-base alloy is the valve material known under the trade name stellite,

which with respect to its service life even surpasses the usually employed valve materials of Ni-base alloys.

PATENT CLAIMS

1. A method for the repair of worn valve spindles comprising a valve body (13) of iron-base alloy and sheath sections forming a sheath body (9) in the region of the valve head (1) of Ni-base alloy, at least in the region of the head bottom (7) and of the head circumference (8), as well as with a hard facing in the seat region (4), characterized

   1.1 in that the sheath sections are completely turned off to an initial shape (11) of the valve head (1) until a defined minimum dimension of the valve head (1) with bright metal surface is obtained;

   1.2 in that the initial shape (11) is deposition welded by means of an austenitic steel alloy subject to the formation of a first head shape;

   1.3 in that the first head shape is turned off until a defined inner shape (10) of the valve head (1) is obtained;

   1.4 in that the inner shape (10) is welded on by means of a Ni-base alloy for forming a second head shape and

   1.5 in that the second head shape is turned off until a certain end shape (12) of the valve head (1) is obtained in such a manner that the thickness of the sheath body amounts to at least 2.5 mm.

2. A device according to Claim 1,

   characterized in that

during the turning-off of the second head shape in the seat region (4) of the sheath body (9) a groove (16) is turned out in which a hard facing (15) of a Co-base alloy is introduced through deposition welding.

3. The device according to Claim 1,

characterized in that

the thickness of the sleeve body (9) in the circumferential region amounts up to 5 mm.

4. The device according to Claim 1,

characterized in that

the thickness of the head bottom (7) amounts to 6 mm to 12 mm depending on the valve size.

5. The device according to Claim 1,

characterized in that

the valve body (13) consists of a valve material X 45 CrNi W189 or of the type SNCRW.

6. The device according to Claim 1,

characterized in that

an austenitic iron-base alloy of the type 316 or 316L is used for deposition-welding of the initial shape (11).

7. The device according to Claim 2,

characterized in that

as hard-facing (15) a Co-base alloy of the type stellite is used.