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(54) **SLIDING BEARING**

(75) Inventors: **Makoto Shibata**, Toyota (JP); **Masao Takahashi**, Toyota (JP)

(73) Assignee: **Taiho Kogyo Co., Ltd.**, Aichi (JP)

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Filed: **Nov. 16, 1995**

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(52) **U.S. Cl.** **428/167**; 428/156; 428/212; 384/114; 384/115; 384/120

(58) **Field of Search** 428/150, 167, 428/172, 141, 212; 384/114, 115, 295, 113, 276, 123, 912

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Primary Examiner—Donald J. Loney
(74) *Attorney, Agent, or Firm*—Oliff & Berridge, PLC

(57) **ABSTRACT**

A helically continuous projection **1**a is formed around a sliding surface **1A** of a sliding bearing **1** at a given pitch p. The surface roughness h of the sliding surface **1A**, including the projection **1**a, is chosen to be equal to or less than one-half the height H of the projection. This provides a sliding bearing **1** which exhibits an improved running-in performance.

14 Claims, 3 Drawing Sheets

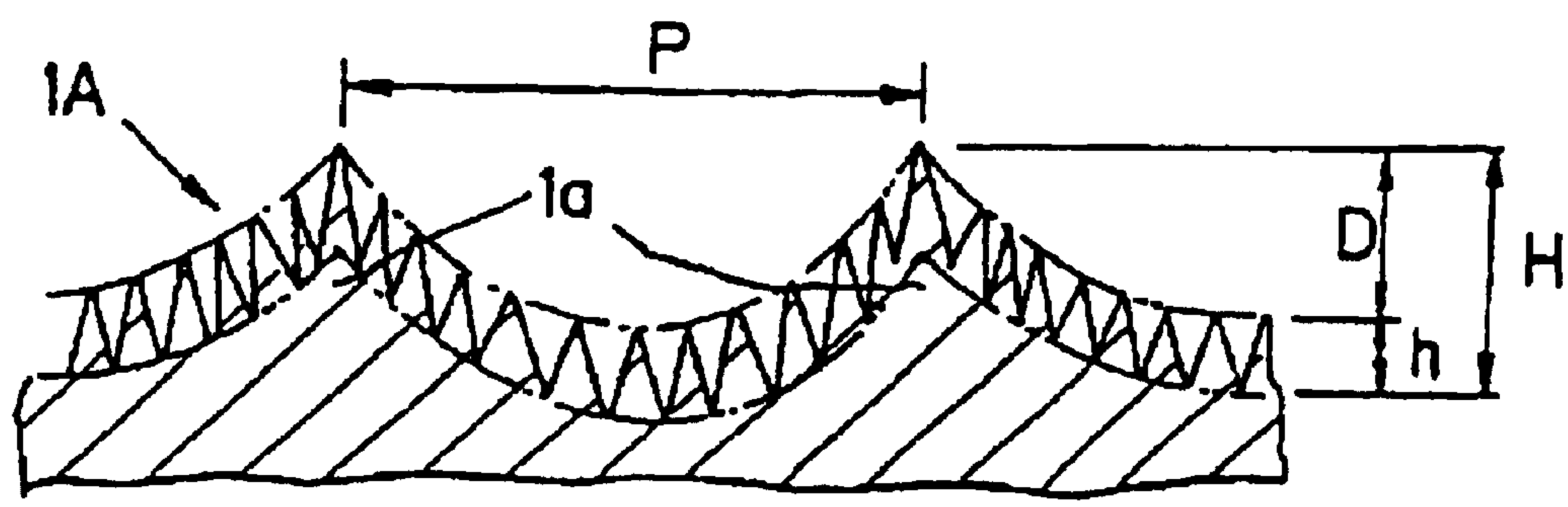


FIG. 1

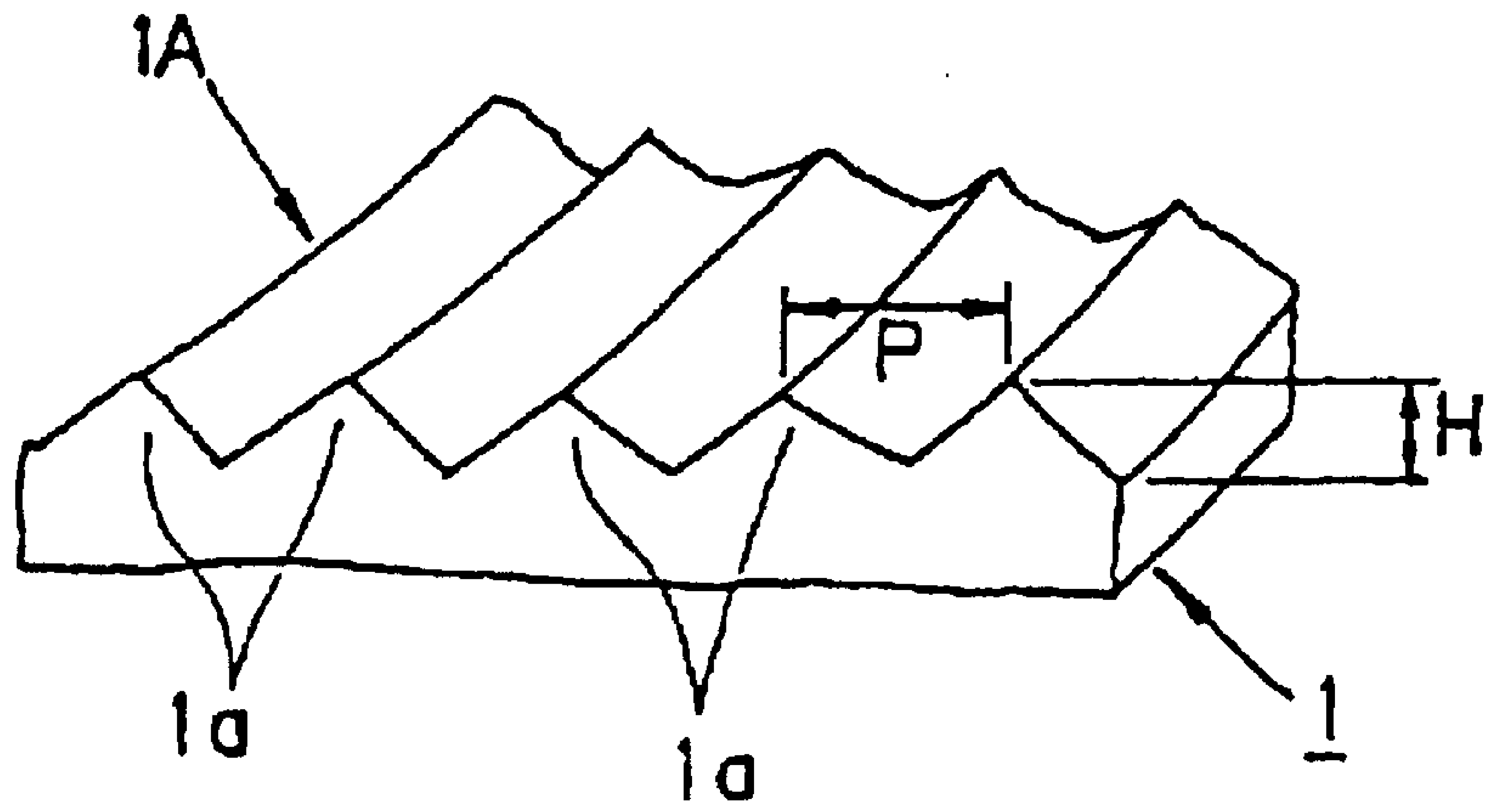


FIG. 2

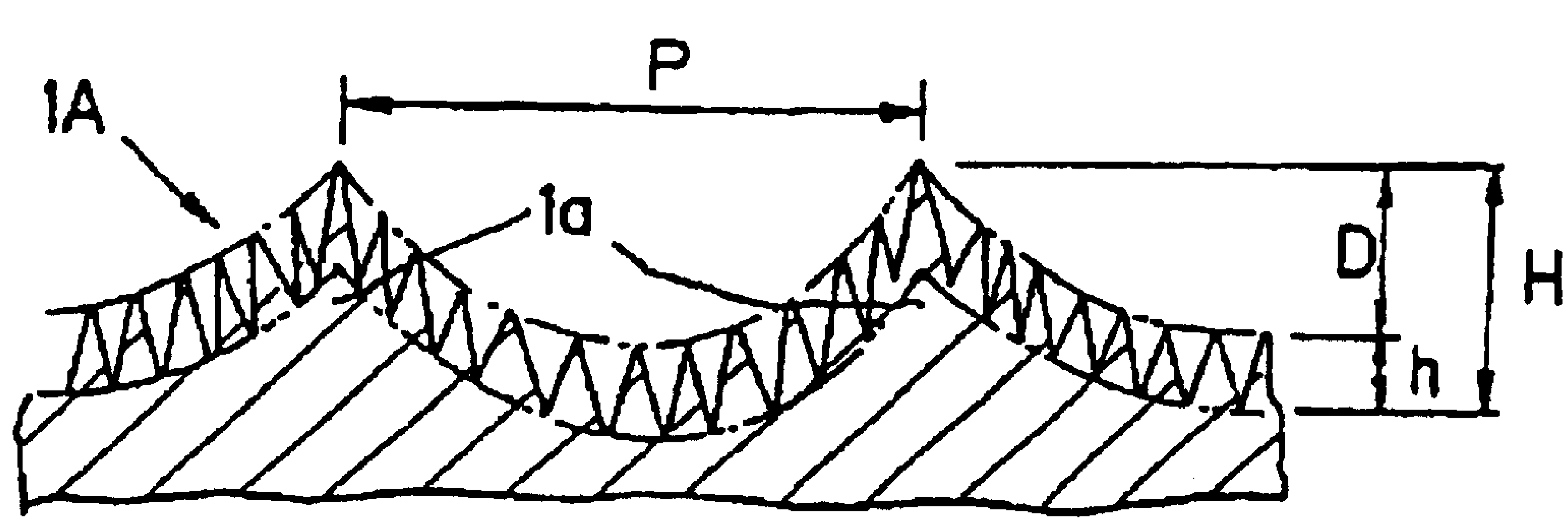


FIG. 3

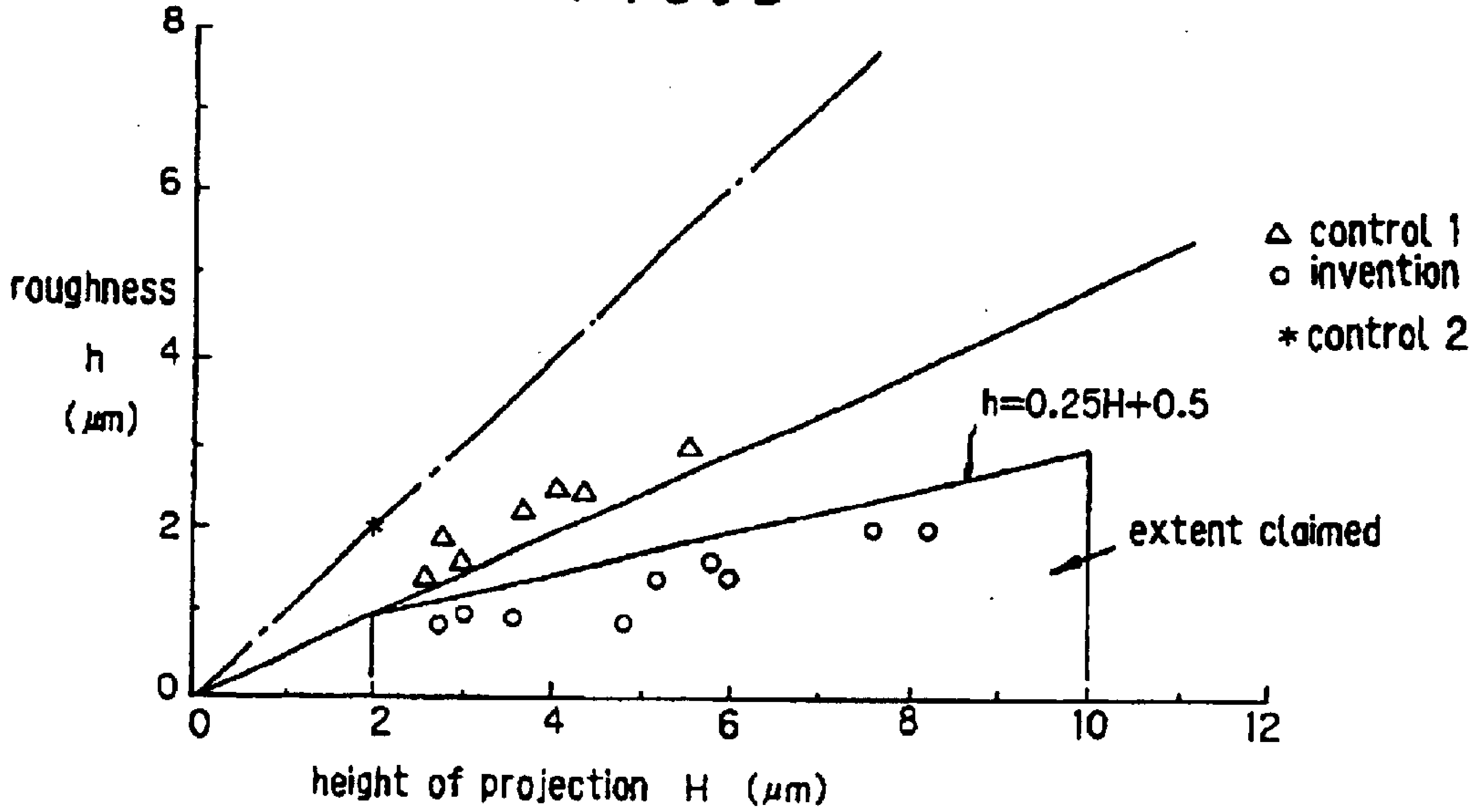

8
6
roughness
h
(μm)
4
2
0
0
2
4
6
8
10
12
height of projection H (μm)
△ control 1
○ invention
* control 2
h=0.25H+0.5
extent claimed

FIG. 4

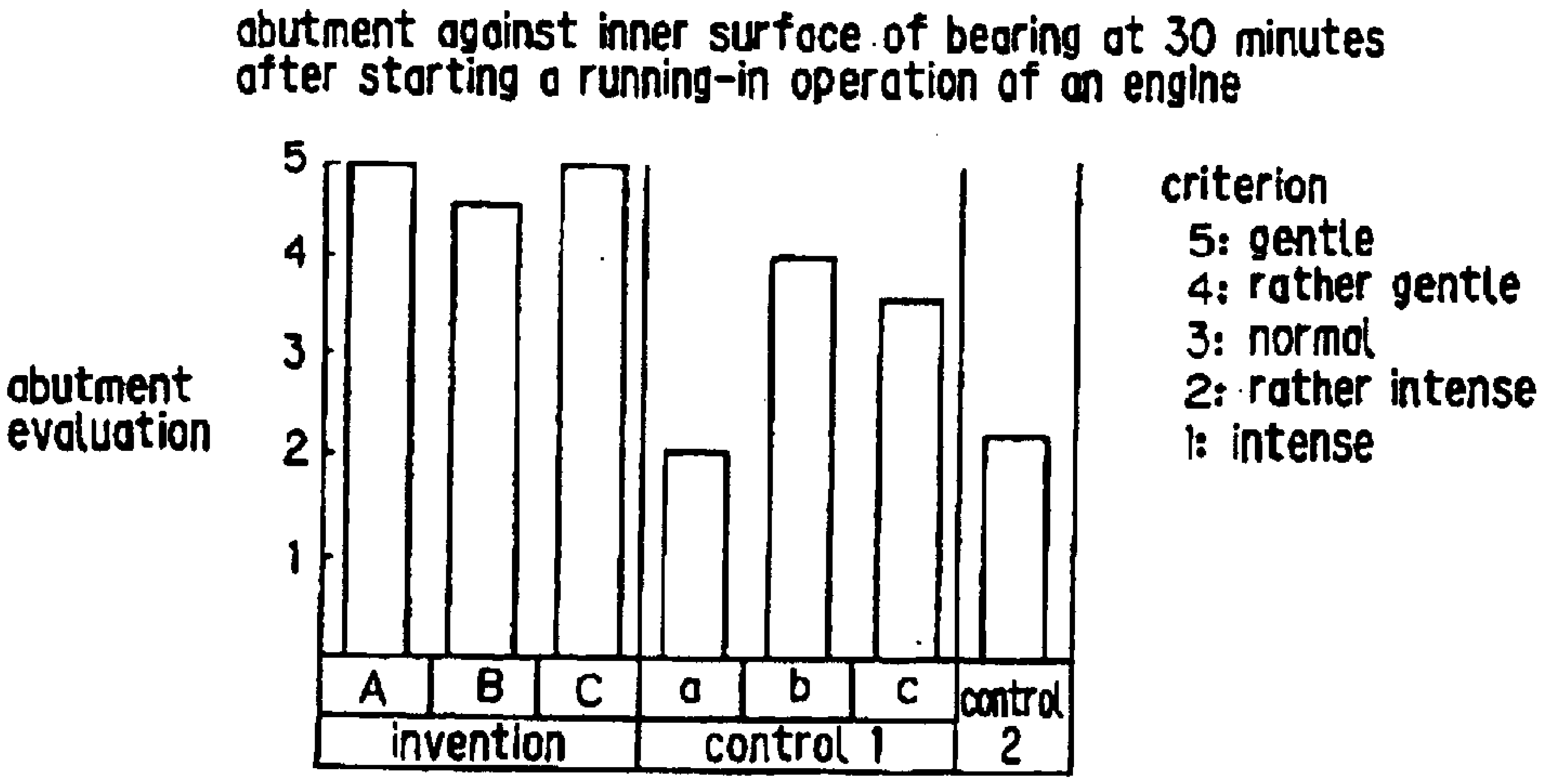
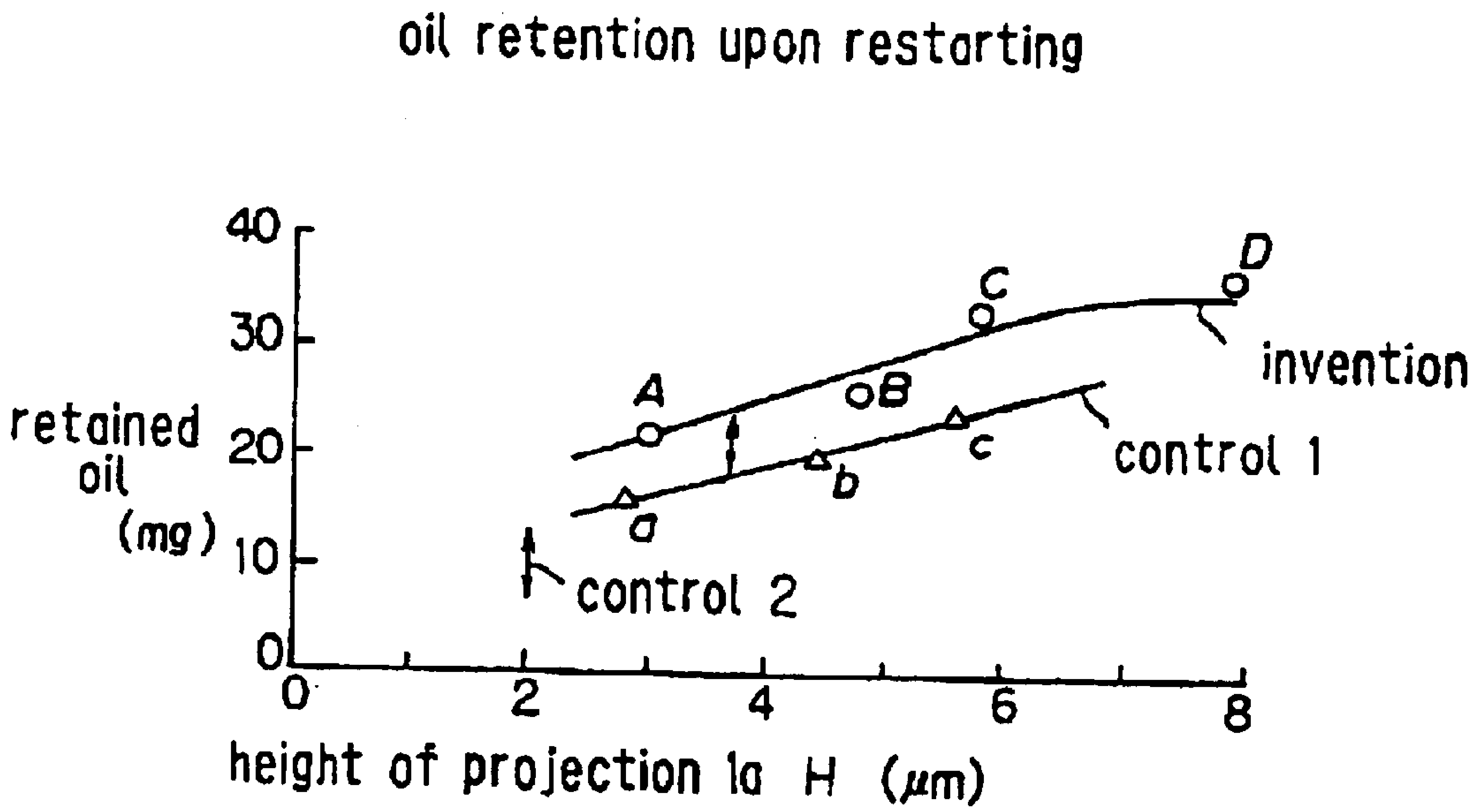

abutment against inner surface of bearing at 30 minutes after starting a running-in operation of an engine
abutment evaluation
5
4
3
2
1
A
B
C
a
b
c
control 2
invention
control 1
criterion
5: gentle
4: rather gentle
3: normal
2: rather intense
1: intense

FIG. 5


oil retention upon restarting
retained oil (mg)
40
30
20
10
0
0
2
4
6
8
height of projection 1a H (µm)
A
oB
C
D
a
b
c
invention
control 1
control 2

SLIDING BEARING

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

TECHNICAL FIELD

The invention relates to a sliding bearing, and more particularly, to a sliding bearing having an annular projection formed on a sliding surface thereof.

BACKGROUND

A sliding bearing having an annular projection formed around its sliding surface is disclosed, for example, in Japanese Patent Publication No. 11,530/1988. However, in the disclosed sliding bearing, no consideration is paid to the relationship between the roughness of the sliding surface including the surface of the annular projection and the height of the annular projection.

DISCLOSURE OF THE INVENTION

The present inventor has found that running-in performance of the sliding surface of a sliding bearing can be improved by a suitable choice of the roughness of the sliding surface, including the surface of the annular projection, and the height of the annular projection. Specifically, in a sliding bearing having a plurality of annular projections formed to a given height around the sliding surface, in accordance with the invention, the roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections. With this arrangement, the running-in performance of the sliding bearing can be improved over the prior art, as will be demonstrated by results of experiments conducted, which will be described later.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a sliding surface of a sliding bearing according to one embodiment of the invention;

FIG. **2** is an enlarged view of part shown in FIG. **1**;

FIG. **3** graphically demonstrates differences in construction between a product according to the invention and controls **1** and **2**;

FIG. **4** is a chart indicating results of a test conducted concerning the running-in performance of the sliding bearing; and

FIG. **5** graphically shows results of tests conducted to examine the running-in performance of the sliding bearing.

BEST MODE FOR CARRYING OUT THE INVENTION

The invention will now be described with reference to an embodiment shown in the drawings. FIG. **1** is a perspective view of a sliding surface **1**A of a sliding bearing **1**. In this embodiment, a projection **1**a which continues in a helical form is formed at a given pitch p and to a height H around the sliding surface **1**A.

As shown to an enlarged scale in FIG. **2**, in this embodiment, the height H of the projection **1**a is chosen in a range from 2 to 8 μm, and the pitch p is chosen in a range from 0.1 to 0.4 mm. Preferably, $h \leqq 0.25H+0.5$, while H ranges from 2 to 10 μm. More preferably, the height H is chosen in a range from 3 to 5 μm in favor of the load capacity. h shown in FIG. **2** represents a surface roughness over the entire sliding surface **1**A.

In this embodiment, the surface roughness h over the entire sliding surface **1**A, including the surface of the projection **1**a, is chosen to be equal to or less than one-half the height H of the projection **1**a. Thus, when a height H of 4 μm is chosen for the projection **1**a, the surface roughness h over the entire sliding surface **1**A is chosen to be equal to or less than 2 μm.

In FIG. **3**, the surface roughness h over the sliding surface **1**A, taken on the ordinate, is plotted against the height H of the projection **1**a, taken on the abscissa, in order to demonstrate differences in the construction between the product according to the invention and controls **1** and **2**. An experiment to determine the running-in performance has been conducted for the sliding bearing **1** and the controls **1** and **2**, exemplified in FIG. **3**, and results are shown in FIGS. **4** and **5**.

FIG. **4** indicates the evaluation of the abutment experienced by the inner surface of the sliding bearing when a crankshaft of an engine is journalled therein at 30 minutes after the start of operation. In FIG. **4**, samples A, B and C are sliding bearings manufactured according to the invention, so that the surface roughness h is equal to or less than one-half times the height H of the projection **1**a, and samples a, b and c are of the control **1**, representing sliding bearings in which the surface roughness h of the sliding surface is greater than one-half the height H of the projection **1**a. The control **2** represents a sliding bearing in which the sliding surface is finished flat by a conventional boring operation. In this instance, the height H, which is equivalent to the height of the projection **1**a, is substantially on the same order as the surface roughness h or about 2 μm, and there is essentially no difference therebetween. As will be noted from FIG. **5**, the remaining oil amount is reduced and has a large variation for the control **2**. It will be seen from FIG. **4** that the samples A, B and C according to the invention provide better results than the controls **1** and **2** in respect of the abutment.

FIG. **5** shows results of experiments conducted to determine the amount of a lubricating oil which is retained by the sliding bearing when the engine is re-started. It will be seen from FIG. **5** that the retention of the lubricating oil of the samples A, B and C according to the invention is by 20 to 30% higher than that of the control **1**. In addition, a variation in the amount of remaining oil is reduced in the samples according to the invention, and in these samples, such amount is on the order of twice that of the control **2**. In this manner, the present embodiment provides an improved running-in performance of the sliding bearing **1**.

In the embodiment described above, the projection **1**a is formed so as to be continuous in a helical configuration, but a plurality of annular projections which are spaced apart axially at a given pitch may be used instead as well.

What is claimed is:

1. A sliding bearing having a plurality of annular projections formed to a given height around a sliding surface; characterized in that a surface roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections*, and in which the height of the projections is in a range from 2 to 10 μm, and the height of the projections in microns is denoted by H and the roughness in microns is denoted by h, these parameters being related by the following inequality:*

$$h \leqq 0.25H+0.5.$$

[2. A sliding bearing according to claim **1** in which the height of the projection in microns is denoted by H and the roughness in microns is denoted by h, these parameters being related by the following inequality:

$$h \leqq 0.25H+0.5.]$$

[3. A sliding bearing according to claim **1** in which the height of the projections is in a range from 2 to 10 μm.]

4. A sliding bearing [according to claim **1**] *having a plurality of annular projections formed to a given height around a sliding surface; characterized in that a surface roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections, and* in which the height of the projections is in a range from 3 to 5 μm.

5. A sliding bearing according to claim **1** in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

6. A sliding bearing according to claim 4, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

7. A sliding bearing according to claim 1, in which the height of the projections is in a range from 3 to 5 μm.

8. A sliding bearing according to claim 7, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

9. A sliding bearing having a plurality of annular projections formed to a given height around a sliding surface; characterized in that a surface roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections, and the height of the projections is in a range from 2 to 6 μm.

10. A sliding bearing according to claim 9, in which the height of the projection in microns is denoted by H and the roughness in microns is denoted by h, these parameters being related by the following inequality:

$$h \leqq 0.25H+0.5.$$

11. A sliding bearing according to claim 9, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

12. A sliding bearing according to claim 10, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

13. A sliding bearing having a plurality of annular projections formed to a given height around a sliding surface; characterized in that a surface roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections, and the height of the projections is in a range from 2 to 5 μm.

14. A sliding bearing according to claim 13, in which the height of the projection in microns is denoted by H and the roughness in microns is denoted by h, these parameters being related by the following inequality:

$$h \leqq 0.25H+0.5.$$

15. A sliding bearing according to claim 13, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

16. A sliding bearing according to claim 14, in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

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