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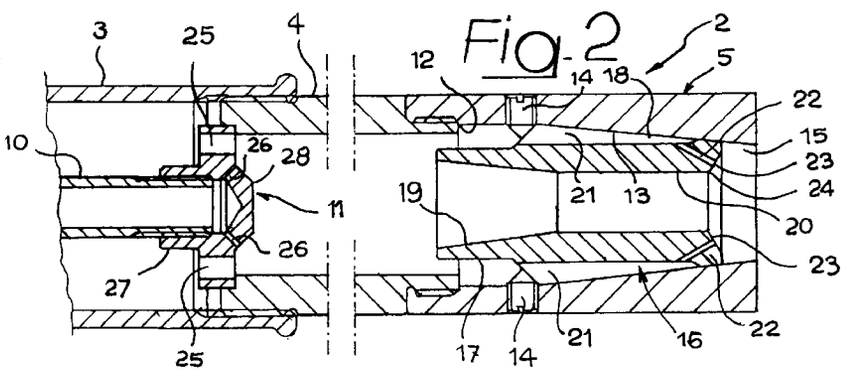
(54) Gas burner, particularly for metallurgic furnaces

(57) A gas burner (1) whose combustion head (5) contains a conical outflow nozzle (16) of the combustibile mixture formed by a hollow member having an at least in part conical outer surface (18), convering towards the flame outlet (15) of the combustion head (5) and provided with a circumferential series of axial grooves defining outflow channels (21) progressively tapering towards the flame outlet (15). These channels (21) communicate with respective oblique passages (22) opening into a crown of front holes (23), arranged coaxially with the cavity of the outflow nozzle (16). The gas burner (1) further contains a peculiar mixer member (11) for mixing the combustibile gas and air.

Fig. 2



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Description

[0001] The present invention is related to gas burners, particularly but not exclusively intended to be applied to metallurgic furnaces for continuous heating of metal pieces, for instance billets or bars. These burners traditionally comprise a tubular body provided with passages for the supply of a combustibile gas and air and forming a combustion head including an outflow nozzle of the combustibile mixture towards a flame outlet.

[0002] The object of the present invention is to provide a gas burner of the above-referenced type having enhanced performance in terms of a more efficient development of the flame under high temperature, greater flame stability and low combustion noise.

[0003] According to the invention, this object is achieved essentially by the fact that the outflow nozzle of the combustion head is formed by a hollow member having an at least in part conical outer surface, converging towards the flame outlet, on which a circumferencial series of axial grooves is formed which are outerly closed by the inner wall having a complementary conical surface of the tubular body so as to define outflow channels progressively tapered towards said flame outlet, said channels communicating with respective oblique passages formed through said tubular member and opening into a crown of front holes arranged, coaxially with the cavity of said hollow member, on the outer end thereof facing towards said flame outlet.

[0004] Subordinatedly, the invention contemplates further geometrical and shape features of the above outflow nozzle.

[0005] According to a further characteristic of the invention, the tubular body of the burner defines, upstream of said combustion head, a combustibile gas and air mixing section, containing a circular mixer member having a radially outer coaxial crown of larger diameter through holes communicating with said air supply passage, and a radially inner coaxial crown of smaller diameter through holes communicating, through a central tubular connector element of said mixer member, with said combustibile gas supply passage.

[0006] The invention further provides peculiar arrangements of said through holes of the outer crown and of the inner crown of the mixer member.

[0007] By virtue of the above features, the gas burner according to the invention enables achieving, as compared with the traditional gas burners, a series of important advantages which are summarized herebelow:

- high range of thermal load,
- enhanced flame development at high temperature,
- high heating speed,
- optimum flame stability,
- wide rate-of-flow ratio between the minimum and maximum values,
- wide air/gas combustion ratio,
- low combustion noise.

[0008] The invention will now be disclosed in detail with reference to the accompanying drawings, purely provided by way of non limiting example, in which:

- figure **1** is a diagrammatic perspective and partially sectioned view of a gas burner according to the invention, applied to a metallurgic furnace,
- figure **2** is a longitudinally sectioned and enlarged view of a part of the gas burner of figure 1,
- figure **3** is a diagrammatic perspective view of a component of the gas burner,
- figure **4** is a perspective view of a second component of the gas burner,
- figure **5** is a front elevational view of figure 4,
- figure **6** is an axially sectioned view along line VI-VI of figure 5,
- figure **7** shows a variant of figure 5, and
- figure **8** is an axially sectioned view along line VIII-VIII of figure 7.

[0009] Referring initially to figure 1, reference numeral 1 generally designates a gas burner according to the invention, applied to a wall P, made of a refractory material, delimiting a longitudinal heating chamber of a metallurgic furnace, for instance designed for continuous heating of steel bars. The burner 1 is fitted in correspondence of a transverse passage H of the wall P, communicating with the heating chamber of the furnace and having a substantially cilyndrical outer portion H1 followed by a conical surface inner portion H2, diverging towards the heating chamber.

[0010] The burner 1 is fitted in correspondence of the inner cilyndrical portion H1 and is adapted to produce and direct the flame, through the conical surface portion H2, towards the heating chamber of the furnace.

[0011] Naturally the furnace shall be provided with a plurality of these gas burners 1, for instance arranged along each lateral wall of the heating chamber over two superimposed rows, with the burners of one row offset with respect to the burners of the other row, according to what is disclosed and illustrated in Italian patent application IT-A-TO95A001049.

[0012] The gas burner 1 essentially comprises a tubular body 2 defining an initial supply section 3, an intermediate combustibile gas/air mixing section 4 and a final section defining a combustion head 5 housed within the portion H1 of the passage H.

[0013] The initial supply section 3 comprises a radial tubular connector 6 connected, through a duct 7, with a manifold not shown in the drawings for the supply of air, and an axial-radial tubular connector 8 connected, through a duct 9, with a manifold not shown in the drawings for the supply of the combustibile gas. The connector 8 is not directly communicating with the initial section 3, but is connected to an inner axial tube 10 whose end facing towards the combustion head 5 is secured to a mixing member 11, which shall be disclosed in detail in the following with reference to figures 4 through 8.

[0014] The terminal portion of the tubular body 2 defining the combustion head 5 has an inner wall with an initial section having a cilyndrical surface 12, of a shorter length, followed by a surface having a conical surface 13, converging towards the passage H, of a greater length.

[0015] Within the cavity of the portion 5, whose free end defines a flame outlet 15, an outflow nozzle 16 of the combustibile mixture is axially fitted and locked in a releasable fashion by means of radial screws 14.

[0016] As it can be better seen in figures 2 and 3, this outflow nozzle 16 is formed by a hollow member having an initial portion 17 with an outer cilyndrical surface of a lower diameter than the initial cilyndrical section 12 of the portion 5, and a portion with a conical outer surface 18 complementary to the section 13 of the portion 5. Its inner cavity has an initial section with a conical inner surface 19, converging towards the flame outlet 15, followed by a cilyndrical section 20.

[0017] The conical outer surface 18 is formed with a circumferential series of axial grooves 21, which are outerly closed by the conical inner surface of the section 13 of the portion 5, so as to define outflow channels progressively tapering towards the flame outlet 15. These channels are evidently communicating, in correspondence of the larger ends thereof, with the interior of the cilyndrical wall section 12, and thus with the mixing section 4 of the tubular body 2, while at the opposite ends these channels are communicating with respective oblique passages 22 formed through the wall of the hollow member 16 and converging towards the flame outlet 15. The oblique passages 22 open into a crown of front holes 23 provided, coaxially with the cavity of the hollow member 16, on the outer end 24 of the latter facing towards the flame outlet 15. This outer end 24 has a slightly recessed design, namely is provided with a conical surface diverging towards the flame outlet 15.

[0018] Referring now in more detail to figures 4 through 6, the mixer member 11 has a generally circular design and is coaxially fitted within the outer end of the portion 4 of the tubular body 2. The mixer member 11 is provided with a radially outer coaxial crown of through holes 25 having a larger diameter, communicating with the air supply connector 6, and with a radially inner coaxial crown of through holes 26 having a smaller diameter, communicating with a central tubular connecting element 27 in turn connected, for instance by means of a threaded coupling, to the combustibile gas supply duct 10. The holes 26, which open into a frusto-conical central portion 28 of the mixer member 11, are diverging with respect to the axis thereof, in the direction of the flame outlet 15. As clearly depicted in figure 5, the through holes 25 of the outer crown and the through holes 26 of the inner crown are alternatively offset relative to one another. Moreover the holes 25 of the outer crown may be directed parallelly to the axis of the mixer member 11, and thus of the tubular body 2 as in the case shown in figures 1, 2, 4, 5 and 6, or they can be inclined, namely obliquely diverted in clockwise direction (or counter-clockwise direction) with respect to the axis of the mixer member 11, as in the case of the variant shown in figures 7 and 8. In the latter case, also the holes 26 of the inner crown may be inclined, namely diverted obliquely with respect to the axis of the mixer member 11 in the opposite direction, i.e. in a counter-clockwise (or, respectively, clockwise) direction.

[0019] When the above disclosed burner 1 is operating, air supplied through the duct 7 and the connector 6 passes through the holes 25 of the mixer member 11, while the gas fed through the duct 9, the connector 8 and the tube 10 passes through the holes 26 of the mixer member 11. Gas and air are thus mixed together within the section 4 of the tubular body 2, along either axial or helical or rotating flows, depending on whether these holes 25 and 26 are directed axially or, respectively, are inclined. The combustibile mixture then reaches the combustion head 5, splitting into a central flow going axially through the conical section 19 and the cilyndrical section 20 of the cavity of the outflow nozzle 16, and a crown of peripheral flows which travel along the channels 21 and reach the oblique passages 22. The central flow and the peripheral flows are progressively accelerated and conveyed towards the flame outlet 15, where the combustibile mixture reaches the maximum speed. Accordingly the flame produced in correspondence of the flame outlet 15 is particularly stable, with a very high thermal load range and a remarkably reduced combustion noise.

[0020] Naturally the details of construction and the embodiments may be widely varied with respect to what has been disclosed and illustrated, without thereby departing from the scope of the present invention, such as defined in the appended claims. Thus, for instance, the combustion head 5 and the related outflow nozzle 16 may be provided with a swinging construction, for instance according to what is disclosed and illustrated in Italian patent application IT-A-TO95A001048,so as to enable adjusting the orientation of the flame outlet 15 at least in a plane passing through the axis of the tubular body 2.

Claims

1. Gas burner (1), particularly for metallurgic furnaces, comprising a tubular body (2) provided with combustibile gas and air supply passages (10, 3) and forming a combustion head (5) including an outflow nozzle (16) of the combustibile mixture towards a flame outlet (15), characterized in that the outflow nozzle (16) is formed by a hollow member having an at least in part conical outer surface (18), converging towards the flame outlet (5), on which a circumferential series of axial grooves (21) is formed which are outerly closed by the inner wall having a complementary conical surface (13) of said tubular body (2) so as to define outflow chan-

nels (21) progressively tapered towards said flame outlet (15), said channels (21) communicating with respective oblique passages (22) formed through said tubular member (16) and opening into a crown of front holes (23) arranged, coaxially with the cavity of said hollow body (16), on the outer end (24) thereof facing towards said flame outlet (15).

2. Gas burner according to claim 1, characterized in that the cavity of said hollow member (16) has an initial portion (19) with a conical inner surface converging towards the flame outlet (15), followed by a cilyndrical portion (20).

3. Gas burner according to claim 1 or claim 2, characterized in that the outer surface of said hollow member (16) has an initial cilyndrical portion (17) of a reduced diameter.

4. Gas burner according to any of claims 1 to 3, characterized in that said outer end (24) of the hollow member (16) onto which said front holes (23) are opening has a conical surface diverging towards said flame outlet (15).

5. Gas burner according to any of claims 1 through 4, characterized in that said hollow member (16) is releasably secured within said combustion head (5).

6. Gas burner according to one or more of claims 1 through 5, characterized in that the tubular body (2) of the burner (1) defines, upstream of said combustion head (5), a combustibile gas and air mixing section (5) containing a circular mixing member (11) having a radially outer coaxial crown of larger diameter through holes (25) communicating with said air supply passage (6, 7), and a radially inner coaxial crown of smaller diameter holes (26) communicating, through a central tubular connector element (27) of said mixing member (11), with said combustibile gas supply passage (8, 9, 10).

7. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) are oriented parallelly to the axis of the mixing member (11).

8. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) are inclined with respect to the axis of the mixing member (11).

9. Gas burner according to claim 6, characterized in that said through holes of the inner crown (26) are converging towards said combustion head (5).

10. Gas burner according to claim 6, characterized in that said through holes of the inner crown (26) are inclined with respect to the axis of the mixer member (11).

11. Gas burner according to claim 6, characterized in that said through holes of the outer crown (25) and said through holes of the inner crown (26) are alternatively offset relative to one another.

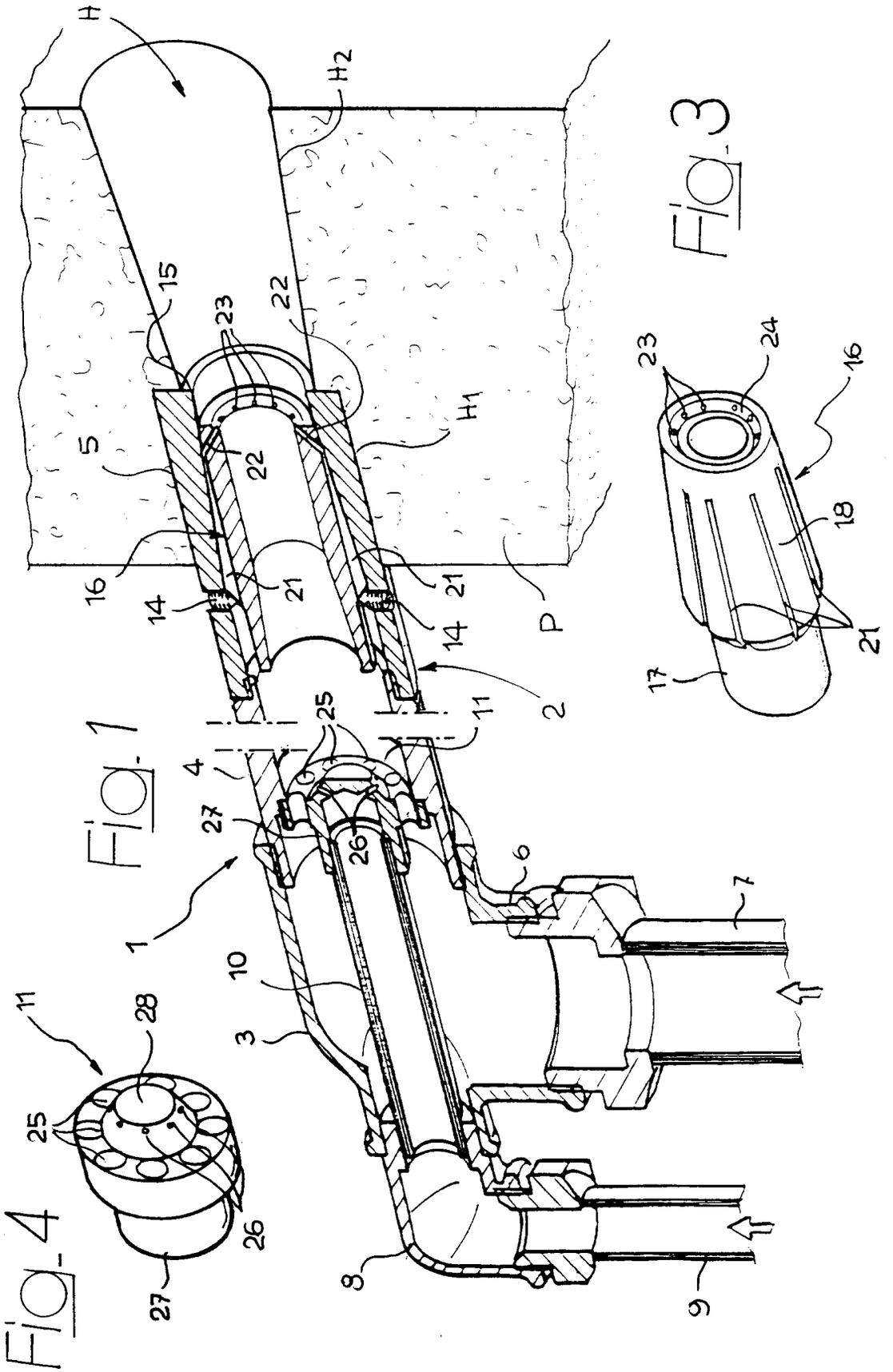

FIG. 1

FIG. 3

FIG. 4

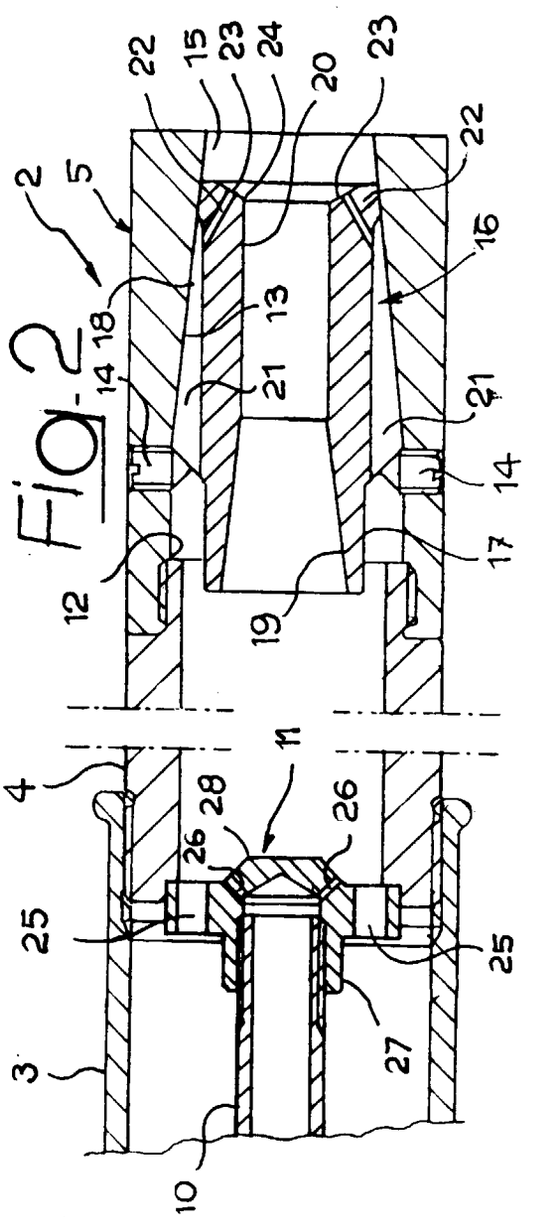

Fig. 2

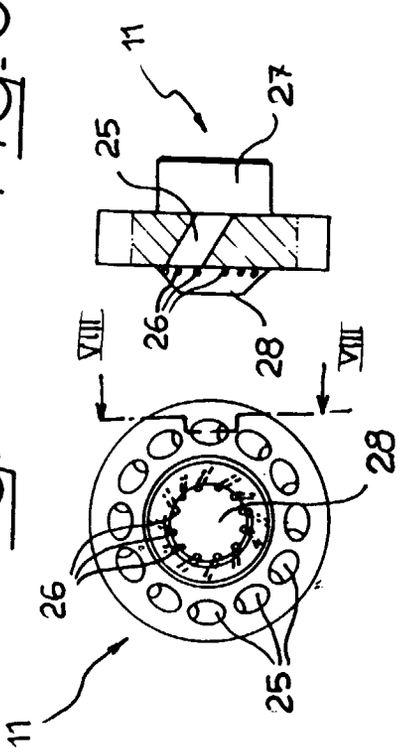

Fig. 7

Fig. 8

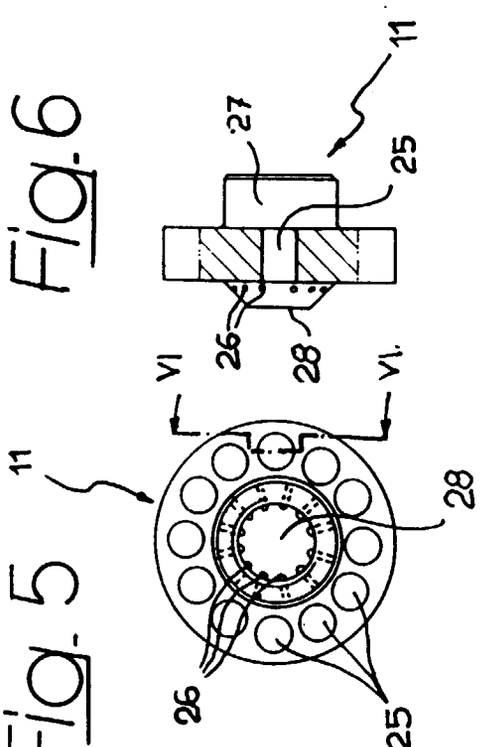

Fig. 6

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 98 83 0147

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE 15 29 163 A (OIDTMANN HERMANN) 12 June 1969 * page 2, paragraph 4 - page 3, paragraph 1 * * page 4, paragraph 1 - paragraph 4 * * page 6, line 6 - line 12 * * page 7, paragraph 4 * * figures 9,10 *	1,3,5	F23D14/26 F23D14/62
A	GB 1 420 047 A (ADAPTOGAS LTD) 7 January 1976 * the whole document *	1,2,4,5	
A	FR 79 283 E (CHOMAT LOUIS) 20 February 1963		
A	DE 20 33 117 A (PENSENSKIJ KOMPRESSORNYJ SAWOD) 13 January 1972		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 August 1998	Coquau, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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