Sept. 18, 1923. 1,468,216

L. B. SKINNER

RABBLE APPARATUS FOR FURNACES

Filed May 24, 1920 2 Sheets-Sheet 1

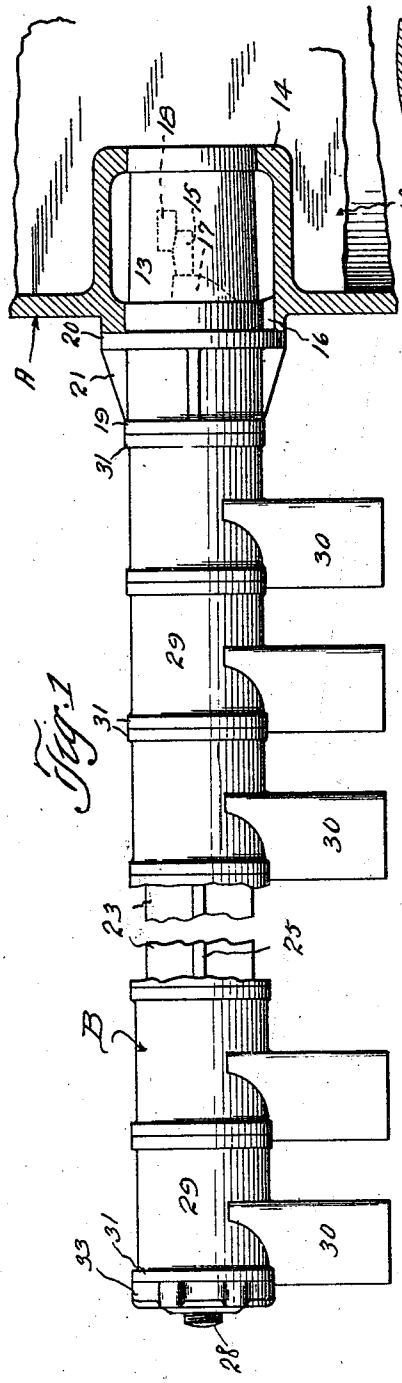

Fig. 1

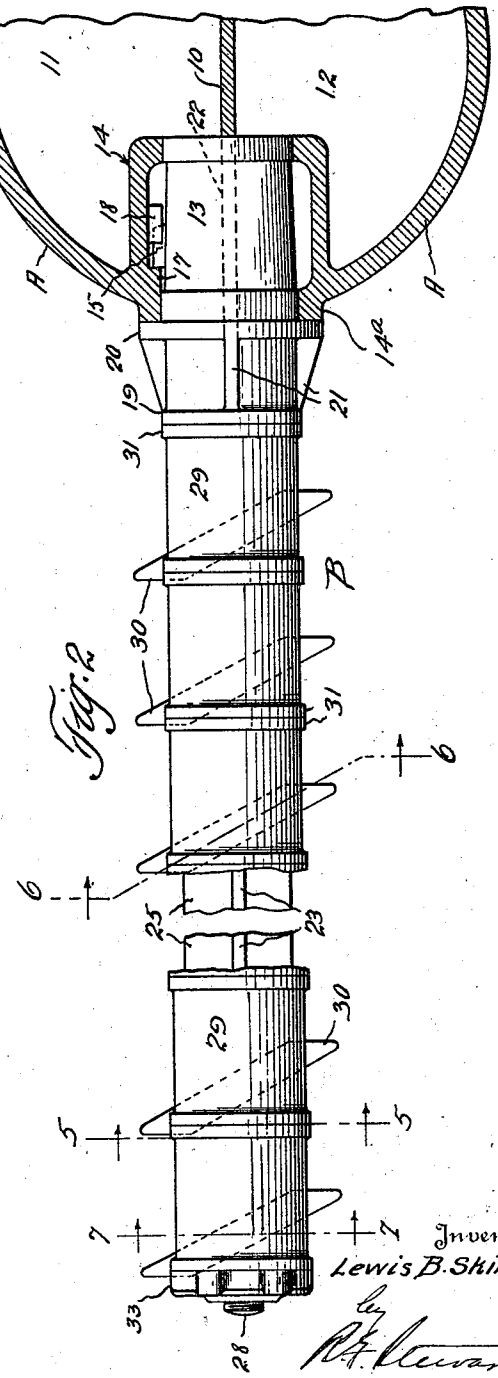

Fig. 2

Inventor
Lewis B. Skinner
by
R. F. Stewart
his Attorney

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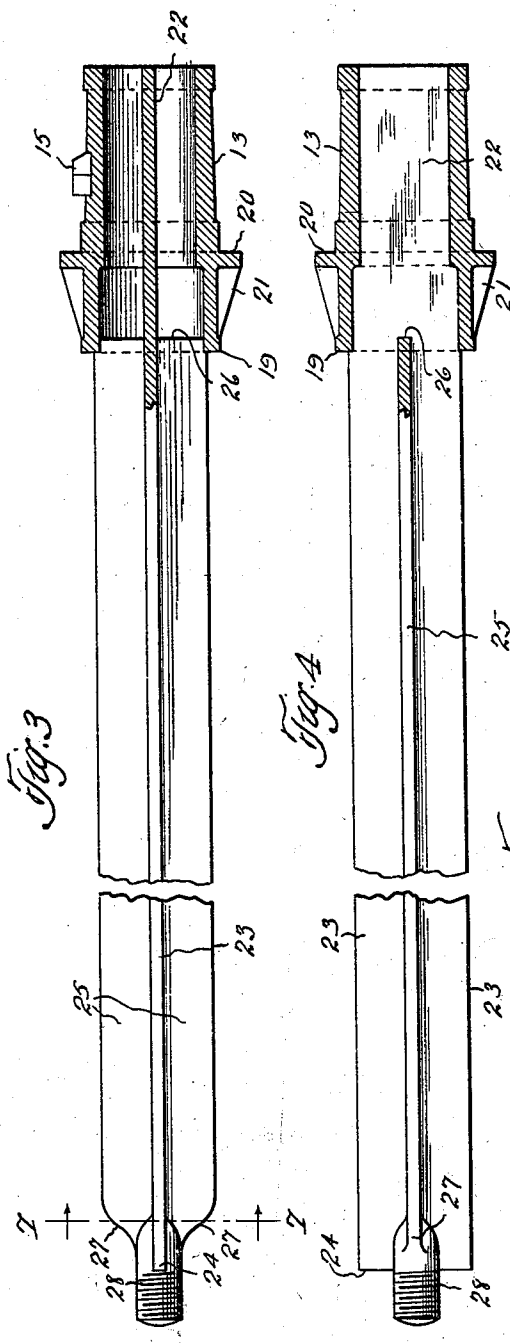

Fig. 3

Fig. 4

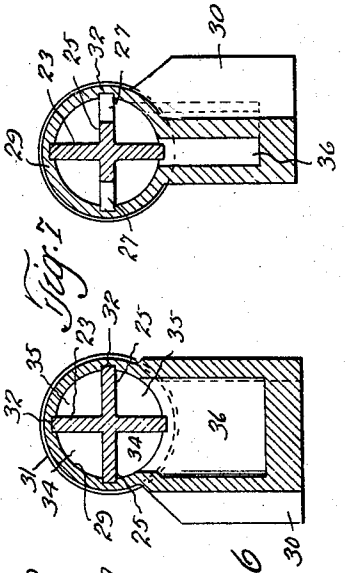

Fig. 7

Fig. 6

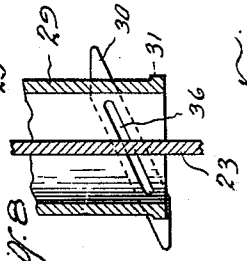

Fig. 8

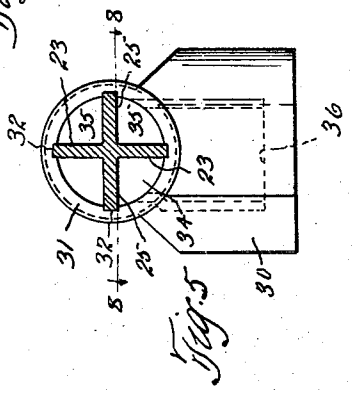

Fig. 5

Inventor
Lewis B. Skinner

By

Attorney

Patented Sept. 18, 1923. 1,468,216

UNITED STATES PATENT OFFICE.

LEWIS BAILEY SKINNER, OF DENVER, COLORADO.

RABBLE APPARATUS FOR FURNACES.

Application filed May 24, 1920. Serial No. 383,842.

To all whom it may concern:

Be it known that I, LEWIS B. SKINNER, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Rabble Apparatus for Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to rabble apparatus for furnaces. More particularly the invention relates to a rabble construction adapted for use in ore roasters of the type commonly known in the art as the McDougall type. Such a roaster comprises a plurality of superposed circular hearths or shelves through which extends axially a vertical shaft carrying radially disposed rabble arms equipped with teeth or plows which stir the ore on each hearth as the vertical rabble shaft is slowly revolved, and at the same time advance the ore gradually down from the top hearth to the hearth next below, and so on through the series, the ore being moved alternately toward and from the central shaft over the successive hearths by the rabble devices.

The McDougall type of roaster has been used extensively in roasting sulfid ores, but as the rabble arms and teeth are subjected to severe operating conditions by reason of the heat of the furnace and the corrosive character of the sulfur gases, deterioration and destruction of the rabble mechanism at a comparatively rapid rate is difficult to guard against and has heretofore restricted the use of this type of furnace to roasting operations in which the rabble teeth or plows are not subjected to temperatures higher than a cherry red heat. In practice, the rabble arms and teeth are universally made of metal, usually cast iron, this material complying most nearly with the requirements of strength and durability for structures of this kind. At sufficiently high temperatures, however, iron reacts readily with elemental sulfur and with sulfur gases produced in roasting sulfid ores; and if such temperatures are reached, the destruction of the rabble mechanism is very rapid. If the temperature of the rabble mechanism can be kept below such destructive temperatures, the mechanism will last a comparatively long time, the only destructive factor being the relatively slow mechanical wear on the heavy metal castings. As the tooth or plow devices are the parts subjected to the greatest amount of wear and tear in actual service, it has been found highly desirable that they be constructed as separate units and detachably secured to the rabble arms, so that they can be quickly and easily replaced when worn out or broken. In order to prolong the life of the rabble mechanism, it is common practice in the art to provide means for internally cooling the rabble arm proper, but so far as I am aware, no practical method of cooling the rabble teeth or plows themselves has been known heretofore, especially where the teeth are detachable. In actual operation the rabble teeth are embedded in the ore in the hearth, and the temperature in the mass of ore is substantially higher than that in the space between any two hearths or that indicated by a pyrometer placed above the rabble arm. As a result, the practical application of roasting furnaces of the type in question has been strictly limited to roasting operations in which the maximum hearth temperature required, and hence the temperature of the uncooled rabble teeth or plows themselves, can be kept down substantially to a cherry red heat or lower. Operation at substantially higher temperatures has been out of the question because of the resultant rapid destruction of the rabble teeth.

In certain classes of roasting operations, a roasting temperature very much higher than that for which the McDougall type of roaster has been adapted heretofore is required. For example, the roasting of zinc ores for the retort distillation processes demands such a high temperature to break down the sulfates and to keep the "fault" sulfur down below 1 per cent, that all attempts heretofore to utilize the very desirable McDougall type of roaster have resulted in failure. The inability of the uncooled cast iron rabble teeth to resist the sulfiding action at high temperatures has prevented the application of such roasters to the desulfurizing of blende, and the absence of any practical method of cooling the teeth has made it impossible heretofore to get around this difficulty. As a result, it has been necessary to resort to the use of other and less desirable types of roasters, such as the well known Hegeler kiln, for desulfurizing zinc blende. As compared to the McDougall

type of roaster, the only roasters heretofore applicable in practice for desulfurizing blende, involve far greater initial investment for apparatus and auxiliary equipment, occupy much larger ground space, require more and higher priced labor to operate, and consume much more power and fuel. Moreover, the sulfur dioxid content of the gas produced is not uniform, ranging more or less erratically from 3½ per cent to 5 per cent, whereas a McDougall type furnace, such as that disclosed in my prior patent No. 1,164,130, for example, produces a uniform gas running about 7½ per cent sulfur dioxid.

One of the principal objects of the present invention is therefore to provide a rabble structure of which not only the rabble arm but the teeth or plows can be internally cooled and thereby kept below destructive temperatures even though the hearth temperature of the roaster be very much above the maximum heretofore permissible in the use of such rabble devices, and thus to make it possible to employ roasters of the McDougall or Skinner type for desulfurizing zinc blende or for other roasting operations necessitating hearth temperatures substantially above a cherry red heat.

With the above general object in view, and some others which will appear from the description hereinafter, the invention consists in the features, details of construction and combination of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

While the invention is not limited in its application to rabble constructions adapted for use in roasters of the McDougall or Skinner type, such a rabble construction will be hereinafter described as an illustrative embodiment of the principles underlying the invention. An especially desirable practical embodiment of the invention, adapted for employment in a roasting furnace of the type disclosed in my prior U. S. Patent No. 1,164,130, is for example illustrated in the accompanying drawings, in which

Figs. 1 and 2 are a side elevation and plan, respectively, partly broken away and in section, showing the novel rabble structure mounted in position on the vertical rabble shaft of the furnace;

Figs. 3 and 4 are a plan and side elevation, respectively, of the skelton supporting member or arm, upon which the hubs of the rabble teeth or rakes are mounted, the socket ends of said arms being shown in longitudinal section;

Figs. 5, 6 and 7, are cross-sections taken, respectively, on the lines 5—5, 6—6, of Fig. 2, and 7—7 of Figs. 2 and 3; and

Fig. 8 is a plan of one of the rabble tooth devices, the hub portion thereof being shown in horizontal section on the line 8—8 of Fig. 5.

Referring to the drawings, A represents the revoluble vertical rabble shaft of a roasting furnace, while B represents generally the complete rabble arm structure mounted in place on the vertical rabble shaft A in a manner to be hereinafter described. The vertical rabble shaft is divided into two conduits 11 and 12 for inflow and outflow of a cooling medium such as air, for example. The rabble arm structure is provided with a hollow cylindrical socket end 13, which may be slightly tapered to fit into a socket 14 provided in the shaft A. In order to secure the rabble arm in proper position, the socket end 13 is provided with a locking lug 15, adapted to pass through a slot 16 provided in the rim at the entrance of the socket 14, and to engage the sloping inner edge of a locking shoulder or cam surface 17 provided in another location on the inner wall of said socket, whereby the socket end 13 can be thrust into the socket and then given a 90° turn to engage lug 15 behind shoulder 17 and draw the end of the rabble structure into the socket. A stop shoulder 18 is provided on the inner wall of the socket to prevent further turning movement of the rabble arm when the parts have been brought into proper position. The arrangement thus far described is substantially that disclosed in my prior patent aforesaid.

The cylindrical or enclosed portion of the arm or tooth-supporting member proper terminates at the shoulder 19, the outer vertical face of which is accurately machined to present a plane bearing surface. Another shoulder or flange 20 abuts against the annular boss 14^a of the rabble shaft socket when the rabble arm is locked in position, and stiffening webs 21 may extend between shoulders 19 and 20. The interior of the cylindrical socket end of the supporting arm proper is divided into inflow and outflow conduits by a diametral partition wall 22 which extends vertically when the rabble arm is locked in position on the rabble shaft and which then abuts the cooperating vertical edge of the shaft partition 10, forming in effect a continuation thereof. As clearly shown in Figs. 3 and 4, said partition wall 22 continues as a vertical web 23 beyond the cylindrical socket end of the skeleton supporting arm proper, terminating at 24 adjacent the extreme outer end thereof. In the present construction the vertical web 23 is intersected medially by a horizontal baffle and stiffening web 25 which does not extend the full length of the supporting arm and which in this instance has its inner end 26 adjacent the shoulder 19 and its outer end at

27, where it terminates somewhat short of the outer end 24 of the vertical partition. While this horizontal partition is not an indispensable feature of the invention in its broader aspects, it is nevertheless highly advantageous as will hereinafter appear. The skeleton supporting member thus formed by the intersecting webs characterizing the present illustrative embodiment of the invention may terminate in a threaded tip or stud 28, the purpose of which will appear later.

Each of the rabble tooth or rake devices assembled with the skeleton supporting member to form the complete rabble apparatus of the invention comprises a cylindrical hub portion 29 and a tooth or blade portion 30 cast integral therewith. The hub portion 29 is provided at its ends with flanges 31, the end faces of which are accurately machined to form tight joints with the end faces of cooperating hubs or sleeves 29 assembled therewith. The form of the joint between the abutting faces of these flanges may be of any suitable character that will serve to provide a close fitting joint adapted to prevent substantial leakage of cooling medium therethrough. In the particular construction illustrated, the abutting faces of said flanges 31 are plane, but other suitable forms for said faces are not excluded. The inner walls of the hub members 29 are provided with longitudinal keyways 32 adapted to receive the outer edges of the webs 23, 25, turning movement of the hubs on the webbed supporting member being thus prevented. The series of rabble tooth devices or rakes may thus be strung in position on the skeleton supporting arm by pushing the hub portions 29 on over the outer end of said supporting member one after the other, and then clamping the whole series tightly in position against the flange 19 by means of a closure cap 33 which is internally threaded to engage the threaded tip 28 and which is provided with a wrench face whereby it may be turned up solid against the outer end of the series. The inner face of the cap 33 is plane and adapted to make a tight joint with the abutting face 31 of the adjacent tooth hub; and the arrangement is preferably such that the inner face of said cap lies close to or substantially abuts the edge 24 of web 23 when the cap is in place. The assembled series of tooth hubs and closure cap therefore form in effect a hollow or tubular rabble arm enclosing the skeleton supporting member from the shoulder 19 outward. It will be seen that the vertical web 23 of said supporting member divides the hollow rabble arm construction centrally to provide separate passages or ducts 34 and 35 on opposite sides thereof, and that each of said passages 34, 35, is horizontally divided by the transverse web 25 into upper and lower portions communicating only at the opposite ends 26, 27, of said web 25. Each of the teeth or plows 30 is hollow or interiorly recessed as at 36, such recess extending transversely, in this instance obliquely, below and across the center line of the rabble arm device, and opening into the lower half of both the aforesaid conduits 34, 35, within the rabble arm. In other words, the recesses or passages 36 afford a plurality of transverse parallel connecting passages between the longitudinal inflow and outflow passages or conduits 34 and 35, so that cooling medium supplied, say, from conduit 11 of the rabble shaft 10 may pass into conduit 34 of the rabble arm, thence through passages 36 into conduit 35, and thence into passage 12 of the rabble shaft. The provision of the cross-web 25 not only lends mechanical strength and stiffness to the construction but it tends to effect uniform distribution of the cooling medium to the teeth. Cool air entering duct 34 from the rabble shaft will flow both above and below the horizontal partition 25, that flowing above being compelled to pass to the outer end of the arm, thus ensuring a supply to the outermost teeth. In the absence of the horizontal baffle, there would be some tendency to favor the teeth nearest shaft A, because they afford the shortest path of travel for the air.

It will be understood that a plurality of the described rabble structures may be mounted in pairs on opposite sides of the vertical shaft 10, as shown in my aforesaid prior patent, for example, and that, owing to the arrangement of the parts, each of the longitudinal passages 34, 35, may serve as the inflow passage or the outflow passage, indifferently. While only one type of rake or tooth is here shown, say a "push in" tooth, it is obvious that "push out" teeth, oblique in the reverse sense, will be employed on the rabbles in alternating arrangement on the superposed furnace hearths in accordance with the usual practice.

Although a specific embodiment of the principles of the invention has been herein above described for the sake of a concrete example, it is to be understood that numerous changes in detail can be resorted to without departing from the scope and spirit of the invention.

Throughout the foregoing specification, the terms "teeth," "plows" and "rakes" have been variously employed, in accordance with the customary usages of the terms in this art, to denote the structural elements, indicated by the numeral 30 in the drawings of applicant's illustrative embodiment of his invention, mounted on the rabble arm and functioning to stir the ore on the hearth. The terms "tooth" or "teeth" where employed in the appended claims are to be understood in

the like generic sense to include plows, rakes or the like functioning to stir the ore on the hearth.

What I claim is:

1. In a rabble structure, the combination, with separable tooth units each having a cooling medium passage assembled end to end to form a rabble arm provided with an internal cooling medium passage, of means maintaining the said units in assembled relation.

2. In a rabble structure, the combination, with a supporting body, of hollow teeth removably assembled therewith, said supporting body being formed to direct a cooling medium into the teeth.

3. In a rabble structure, the combination, with a supporting body, and hollow teeth removably assembled therewith and having portions co-operating therewith to provide parallel incoming and outgoing cooling medium passages connected by the said hollow teeth whereby the teeth are cooled.

4. In a rabble structure, the combination, with a webbed supporting body, of teeth having hollow hubs assembled end to end on said supporting body and cooperating therewith to form a hollow rabble arm interiorly divided into cooling passages.

5. In a rabble structure, the combination, with a supporting body having intersecting webs, of hollow teeth removably assembled therewith and co-operating with said webs to form cooling medium passages.

6. In a rabble structure, the combination, with a supporting body having intersecting webs, of hollow teeth keyed to said body by the webs and co-operating therewith to form cooling medium passages.

7. In a rabble structure, the combination, with a supporting body having a passaged socket and a portion consisting of intersecting webs, of a plurality of tooth devices having hubs keyed to said body by the webs and co-operating therewith to form cooling medium passages.

8. In a rabble structure, the combination, with a supporting body having intersecting webs, of a plurality of hollow teeth each comprising a cylindrical hub and a hollow blade, the hubs being assembled on the supporting body to form a closed cylinder having passages divided by the webs but connected through said teeth.

9. In a rabble structure, the combination, with a supporting body having a socket end divided interiorly into passages by a partition and terminating in a shoulder, a web constituting a continuation of said partition beyond the shoulder, and an intersecting baffle web extending intermediate the ends of the first web, of hollow teeth each comprising a cylindrical hub and a hollow blade of which the interior opens into said hub, the hubs being assembled on the supporting body to form a closed cylinder having parallel passages on opposite sides of the first web, each such passage being longitudinally divided by said baffle web.

10. In a rabble structure, the combination, with a supporting body having a passaged socket end and a portion comprising intersecting webs, a shoulder on the socket end, and a plurality of hollow tooth units, each comprising a cylindrical hub portion, mounted on such webbed portion, the hubs of said units having machined faces adapted to abut said shoulder and each other to form close joints, and a retaining disk engaging the face of the end tooth unit.

11. In a rabble structure, the combination, with a supporting member formed by intersecting webs of which one terminates short of the other at both ends, said member being formed at one extremity to provide a tubular socket end having an inflow passage and an outflow passage separated by the longer web, of a plurality of tooth units assembled with said supporting member, each unit comprising a hub portion and a tooth or blade integral therewith and provided with an internal cooling recess opening into said hub, said unit being strung on said supporting member with said hubs in end to end abutment and with the cooling recessses of said teeth transversely underlying the longer web and connecting the longitudinal passages formed on opposite sides thereof as continuations of the inflow and outflow passages in said socket end.

12. In a rabble structure, the combination, with a rabble arm comprising separable units provided with inflow and outflow cooling passages, of hollow rabble tooth means mounted thereon and affording communication between said passages.

13. A rabble structure comprising a rabble arm composed of separable units and teeth interiorly formed to provide passages for conducting a cooling medium into said arm, through said teeth, and out again through said arm.

14. A tubular rabble arm composed of a skeleton supporting member and a plurality of sleeves mounted end to end directly thereon, the interior of said arm being divided into longitudinally extending passages having walls formed by said sleeves and said skeleton supporting member for inflow and outflow, respectively, of a cooling medium, in combination with rabble teeth carried by said sleeves.

15. A tubular rabble arm composed of a supporting member and a plurality of sleeves mounted end to end thereon, the interior of said arm being divided into longitudinally extending pasages for inflow and outflow, respectively, of a cooling medium,

in combination with rabble teeth integral with said sleeves and provided with passages through which a cooling medium may flow from the inflow passage of said arm into the outflow passage.

16. In a rabble structure, the combination, with an elongated skeleton supporting member, of a plurality of rabble devices mounted thereon, each of said rabble devices comprising a tubular hub embracing said supporting member and a tooth attached to said hub, the hubs of said rabble devices being assembled end to end on said supporting member, and the construction of said hubs and said supporting member being such that when so assembled, they form a rabble arm having internal passages for circulation of a cooling medium.

17. In a rabble device, the combination, with a skeleton rabble support, of a plurality of rabble tooth devices mounted thereon, each said device comprising a sleeve fitting over said support and an attached tooth or scraper provided with a cooling passage therein, the assemblage of said tooth devices with said sleeves end to end on said support forming a tubular rabble arm interiorly divided into cooling passages connected by the cooling passages in said teeth or scrapers.

18. A rabble structure comprising an elongated skeleton supporting member having a plurality of tubular members assembled thereon end to end to form a tubular rabble arm provided with an internal cooling passage, and rabble teeth carried by said tubular members.

19. In a rabble structure, the combination, with an elongated webbed member having one extremity enclosed to form a tubular socket end interiorly divided into cooling passages, of hollow tooth-supports assembled end to end on said webbed member and cooperating therewith to form a hollow rabble arm having internal cooling passages communicating with said cooling passages in said socket end.

20. In a rabble structure, the combination, with a hollow rabble arm comprising separable units having one end adapted for connection to a rabble shaft and provided internally with inflow and outflow cooling passages adapted to cooperate, respectively, with inflow and outflow passages in such rabble shaft, of rabble teeth carried by said rabble arm and having cooling passages communicating with both passages in said arm, and baffle means within said arm for directing flow of cooling medium to said teeth.

21. In a rabble structure, the combination, with a rabble arm comprising separable units having a longitudinal cooling passage therein, of hollow rabble teeth supported by said arm, and baffle means in said cooling passage for directing flow of cooling medium to said teeth.

22. In a rabble structure, the combination, with a rabble arm having a longitudinal cooling passage therein open at one end of the arm, of hollow rabble teeth supported by said arm, and baffle means in said passage arranged to divert to the other end of said passage a portion of cooling medium supplied to the open end and thereby to favor uniform distribution of cooling medium to said teeth.

23. In a rabble structure, a tooth-supporting device comprising an elongated webbed member forming a skeleton supporting member unenclosed for the major part of its length and having an extremity enclosed to form a tubular socket end interiorly divided into cooling passages.

24. In a rabble structure, a tooth-supporting device comprising an elongated member formed by intersecting webs of which one terminates short of the other at both ends, said member having one extremity enclosed to form a tubular socket end interiorly divided into cooling passages.

25. A rabble device comprising a tooth and a tubular hub integral therewith and provided with a longitudinal key way on its inner surface.

26. A rabble device comprising a tooth and a supporting hub integral therewith, said tooth having a cooling medium passage opening into said hub.

27. In a rabble structure, the combination, with a rabble arm comprising separable units and an internal supporting member provided with inflow and outflow cooling passages, of hollow rabble tooth means mounted thereon and affording communication between said passages.

28. In a rabble structure, the combination, with a hollow rabble arm having a partition formed to provide separate continuous inflow and outflow cooling passages, of hollow rabble tooth means mounted thereon and affording the sole communication between said passages.

29. In a rabble structure, the combination, with a hollow rabble arm having a partition formed to provide separate inflow and outflow cooling passages, of hollow rabble tooth means mounted thereon and affording communication in parallel between said passages.

30. A rabble structure comprising a rabble arm composed of separable units and an internal supporting member and teeth interiorly formed to provide passages for conducting a cooling medium into said arm, through said teeth and out again through said arm.

In testimony whereof I hereunto affix my signature.

LEWIS BAILEY SKINNER.