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(12) # EUROPEAN PATENT APPLICATION

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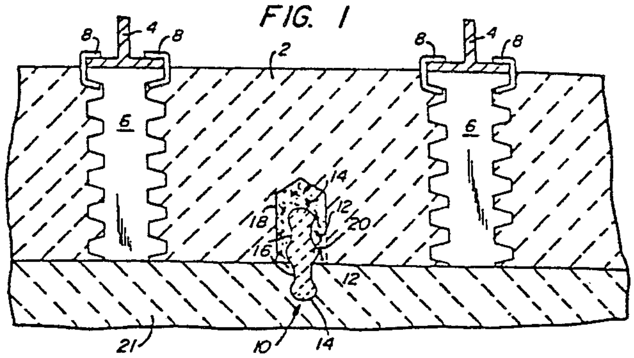
(54) **Anchoring refractory materials to a refractory lining.**

(57) Refractory anchoring for a layer (21) of refractory material to a refractory furnace lining (2) has a number of generally cylindrical refractory anchors (10) with a concave locking surface (16) on each end. Each anchor has one end cemented into a hole (18) in the lining and the other end covered with a cementitious refractory material (21). A plunger tool is used for inserting the anchor (10) and cement (20) into the hole (18) in the lining.

FIG. 1



EP 0 061 263 A1

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ANCHORING REFRACTORY MATERIALS TO A REFRACTORY LINING

This invention relates to the anchoring of refractory materials to a refractory lining of a furnace.

Furnaces for reheating of steel preparatory to rolling are constructed with dense (greater than 100 pounds per cubic foot) refractory roof and walls. The refractories are preferably shaped in place to make a monolithic lining, but construction requirements may include some segments. The dense refractories have a tendency to spall and the operating conditions create thermal stresses in the refractory lining which increases the tendency of the dense lining to develop cracks and chips.

The conventional method of repairing the refractory lining is by the hydraulic gun palcement of a refractory cement coating or veneer over the worn or damaged portions of the lining. The refractory cement coating may be lightweight, under 100 pounds per cubic foot, or dense, over 100 pounds per cubic foot, and when applied to roof or wall surfaces may spall as a result of poor adhesion of the coating to the lining surfaces, as a result of shrinkage or fracture of the coating itself, or as a result of excessive temperature gradient across the thickness of the coating. Load factors create high-stress area, a peeling stress, to pull the coating off the lining. This occurs on the furnace roof and to a lesser extent on the lining of the furnace side walls, and requires anchoring to prolong the life of the lining and /or coating.

There are a number of metallic anchoring devices to anchor a refractory coating to a furnace lining, but such anchors are not available for hot-face temperatures exceeding 2000°F. There is no high-temperature refractory anchor available that is easily installed on the hot face of an existing furnace roof.

The heat loss in a reheating furnace can be substantially reduced by covering the dense refractory lining with a layer of refractory insulation. In new furnace construction, it is appropriate to place the insulating layer on the cold side of the furnace lining.

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This is not possible on existing furnaces, so the insulating layer is placed on the hot side of the lining. This requires anchoring the gunned coating in the same manner for essentially the same reasons as just described.

According to the present invention, there is provided a method of anchoring a refractory material to a refractory lining of a furnace comprising making a hole in the refractory lining, inserting a refractory anchor into the hole with a first concave locking section of the anchor inside the hole and a second concave locking section of the anchor outside the hole, filling the hole with a refractory cement, and applying a layer of cementitious refractory material to the lining over the second concave locking section of the anchor.

The invention also provides a refractory covering for a furnace, comprising a refractory lining, a pluarality of spaced apart refractory anchors, each refractory anchor having a first concave locking section cemented into a hole in the lining and a second concave locking section projecting outward from the lining, and a layer of cementitious refractory material covering the lining and the projecting anchor sections.

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refractory cement and a portion of a refractory anchor, a plunger tube adapted to fit inside the charging tube for pressing the cement and the anchor out of the charging tube and into a hole in the lining, and a gasket fitted inside the charging tube and over the end of the plunger tube for holding the cement and the anchor in place while pressing the cement and the anchor into the hole.

The invention is further described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a cross-section through a furnace roof showing an installed anchor supporting an insulating layer,

Fig. 2 is a side view of the anchor,

Fig. 3 is an end view of the anchor,

Fig. 4 is a cross-section showing the anchor, anchor cement, and a plunger prior to insertion of the anchor into the lining, and

Fig. 5 is a cross-section showing the anchor, anchor cement, and plunger after insertion of the anchor.

Referring now to Figure 1, reference numeral 2 designates a thick layer of dense refractory material which constitutes the refractory lining of a reheating furnace roof. Lining 2 is secured to structural I-beams

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4 (partially shown) by means of dense fireclay or high-alumina anchors 6 attached to the I-beams 4 by metal hangers 8. This is a typical reheating furnace roof installation; the sidewall linings are connected to a furnace structural frame or continuous steel plate (not shown) in a similar manner.

A refractory anchor 10 has a center bulge section 12, a bulbous section 14 on each end and a concave locking section 16 between center bulge section 12 and each bulbous end section 14. As shown in Fig. 1, the anchor 10 is inserted in a hole 18 in the lining 2 and one end is held in place by a quantity of light weight fine grained calcium-aluminate cement 20 in refractory lining 2 and the other end is anchored in an insulating refractory coating 21.

Referring now to Figs. 4 and 5, reference numeral 22 designates a charging tube, and reference numeral 24 designates a plunger tube which fits inside the charging tube 22. An outer gasket 26 fits around the upper end of the charging tube 22. A gasket 28 fits inside charging tube 22, rests on top of plunger tube 24, and has a hole 30 slightly smaller than the center bulge section 12 of anchor 10.

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To install the anchor 10, a hole 18 is drilled into lining 2. Hole 18 does not need to pass through lining 2, but assuming a lining 9 to 13 inches thick, and an anchor 10 about 4 inches long with the central bulge about 1-3/8 inches in diameter, hole 18 would be preferably 1-1/2 inches in diameter and about three inches deep. A rotary hammer drill, or impact drill with a carbide tipped bit is a satisfactory tool for drilling the hole, but any method is satisfactory to provide a receptacle for anchor 10 and cement 20.

The anchor 10, gasket 28 and tubes 22 and 24 are assembled as shown in Fig. 4. The inner diamter of tube 22 is preferably just slightly larger than that of the hole 18. Tube 24 fits inside tube 22, and gasket 28 is placed on the end of tube 24. Gasket 28 is preferably of waxed cardboard and may be split for easy removal. Anchor 10 is placed in hole 18 which is slightly smaller than center bulge section 12. Outer gasket 26, of any convenient resilient material, is placed over the end of tube 22. The cavity in tube 22 is then filled with a light weight fine-grained fireclay castable 20, such as a calcium-aluminate cement. The assembly is then positioned over hole 18 and plunger tube 24 moved in the direction of arrow 32 which places the anchor and cement

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in the position shown in Fig. 5. Gasket 26 prevents leakage as plunger tube 24' and gasket 28 press the castable 20 into hole 18.

Cement 20 should be viscous enough to support the anchor 10 when the anchor is inserted into hole 18. The porosity of lining 2 creates capillary action, drawing water out of cement 20 to improve its staying power while the cement hardens. Pre-wetting the hole may be necessary if the refractory 2 is too porous. When the cement has set, gasket 28 is removed and discarded.

The description and drawing have shown the placement of a single anchor in a furnace roof. However, if a large roof area, or the entire roof area is to be covered, a plurality of anchors is used, generally 12 to 18 inches apart. Furnace sidewalls, except portions of high walls, rarely require anchoring. When anchors are required on the side walls, they are inserted in the same manner and spaced apart about the same as described for the furnace roof.

Before any anchors are set in place or any coating is applied to the furnace lining, the lining should be cleaned and any deposits or loose crumbly materials removed. Since gunning light weight material (for example a calcium-aluminate cement with coarse aggregate weighing 60 pounds per cubic foot) requires

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a careful water mix, it is important that the surface porosity be considered in attempting to make a maximum bond. If a group of similar anchors is inserted into the lining to equal depths, they provide an excellent measure of the coating thickness as the material is applied.

Anchor 10 is composed of a refractory material having suitable hot strength. Generally, a fine-grained, high-alumina or mullite composition is preferred, from 40% to 95% alumina and the balance silica. It may be cast or pressed to shape and is prefired. The bulbous ends minimize unequal stresses in the anchor, the concave surfaces lock the anchor to the coating and to the original furnace lining and the bulging center section, while completing the concave sections, holds the cement 20 in place during insertion of the anchor and setting of the cement.

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CLAIMS:

1. A method of anchoring a refractory material to a refractory lining, characterized by

making a hole (18) in the refractory lining (2),

inserting a refractory anchor (10) into the hole (18) with a first concave locking section (10) of the anchor (10) inside the hole (18) and a second concave locking section (16) of the anchor (10) outside the hole (18),

filling the hole (18) with a refractory cement (20), and

applying a layer of cementitious refractory material (21) to the lining (2) over the second concave locking section (16) of the anchor (10).

2. A method according to claim 1, characterized by wetting the hole (18) prior to filling the hole (18) with cement (20).

3. A refractory covering for a furnace, characterized by

a refractory lining (2),

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a plurality of spaced apart refractory anchors (10),

each refractory anchor (10) having a first concave locking section (16) cemented into a hole (18) in the lining (2) and a second concave locking section (16) projecting outward from the lining (2) and

a layer of cementitious refractory material (21) covering the lining (2) and the projecting anchor sections (16).

4. Apparatus for placing a refractory anchor in a refractory lining, characterized by

a charging tube (22) for holding a quantity of refractory cement (2) and a portion (14, 16) of a refractory anchor (10),

a plunger tube (24) adapted to fit inside the charging tube (22) for pressing the cement (20) and the anchor (10) out of the charging tube (22) and into a hole (18) in the lining (2), and

a gasket (28) fitted inside the charging tube (22) and over the end of the plunger tube (24) for holding the cement (20) and the anchor (14) into the hole (18).

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5. Apparatus according to claim 4, characterized by an outer gasket (26) surrounding the charging tube (22) so as to contact the lining (2) for confining the cement (2) to the charging tube (22) and hole (18) when pressing the cement (2) and the anchor (10) into the hole (18).

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FIG. 1

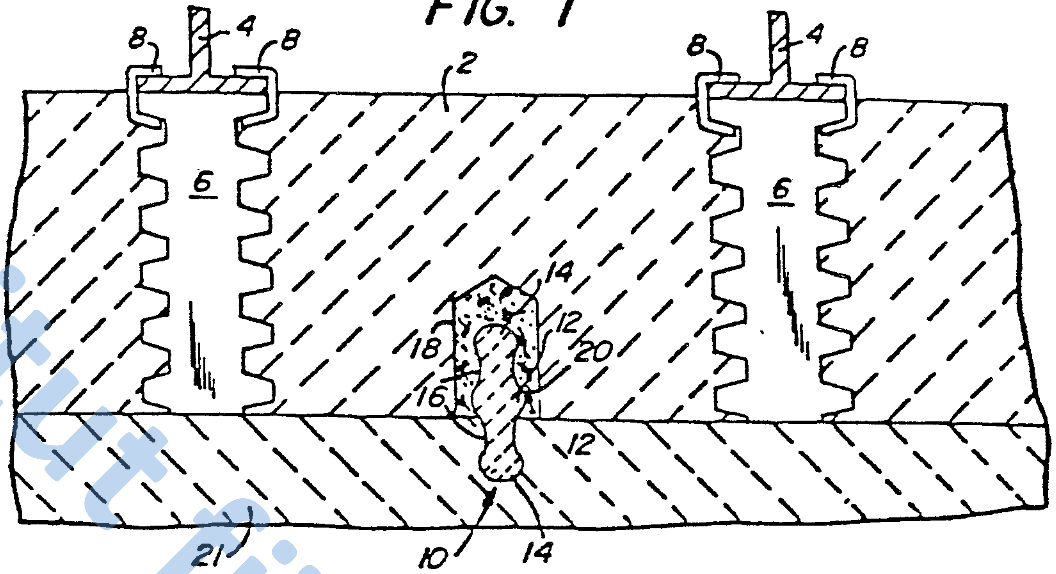


FIG. 2

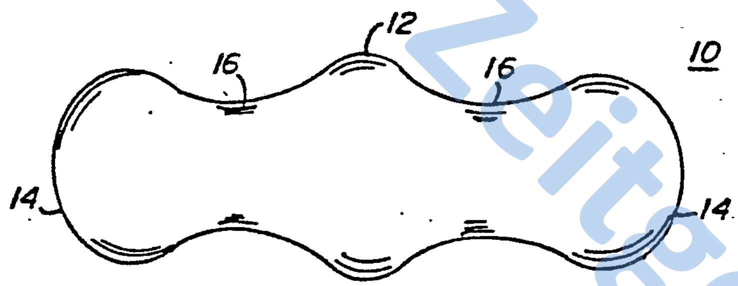


FIG. 3

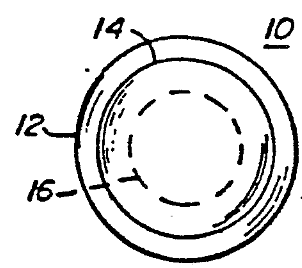


FIG. 4

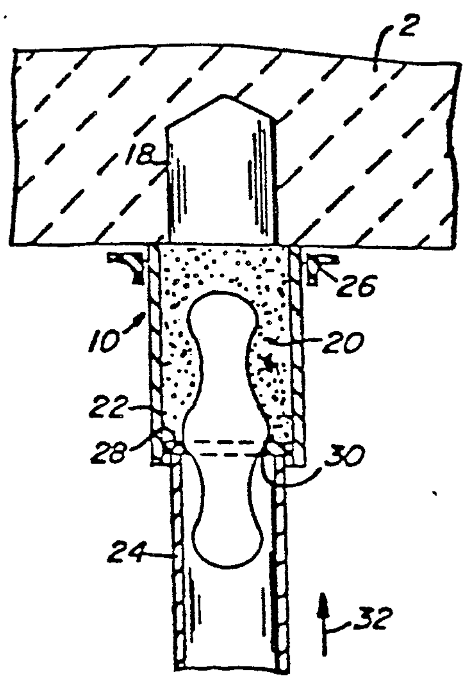
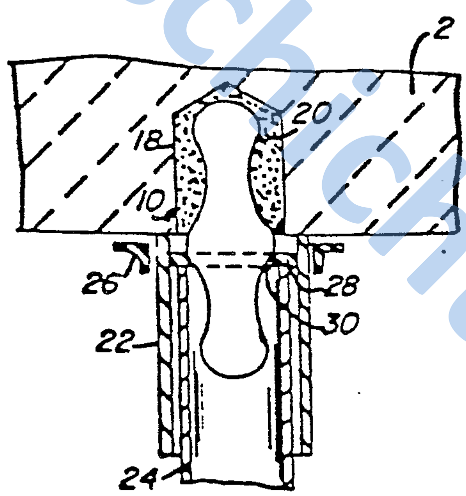


FIG. 5



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European Patent Office

EUROPEAN SEARCH REPORT

0061263

Application number

EP 82 30 1255

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. ³)
Y	FR-A-2 328 173 (CREUSOT-LOIRE) *Claim 1; figures 1,2*	1	F 27 D 1/00 E 04 F 13/04 F 27 D 1/10

Y	FR-A-2 116 721 (ENTREPRISE HARTMANN PERE & FILS) *Page 2; figures*	1	

Y	US-A-2 061 822 (BANKERT) *Page 2, figures 4 to 6*	1	

A	US-A-2 021 610 (QUINT)		

A	DE-C- 432 483 (KARL PRINZ)		
	-----		**TECHNICAL FIELDS SEARCHED (Int. Cl. ³)**
			F 27 D E 04 F F 23 M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18-06-1982	COULOMB J.C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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EPO Form 1503. 03.82

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KARL PRINZ ZU LÖWENSTEIN.
CASING FOR DOWN DRAFT FURNACES.
APPLICATION FILED JULY 18, 1913.

1,140,908. Patented May 25, 1915.

Fig.1.

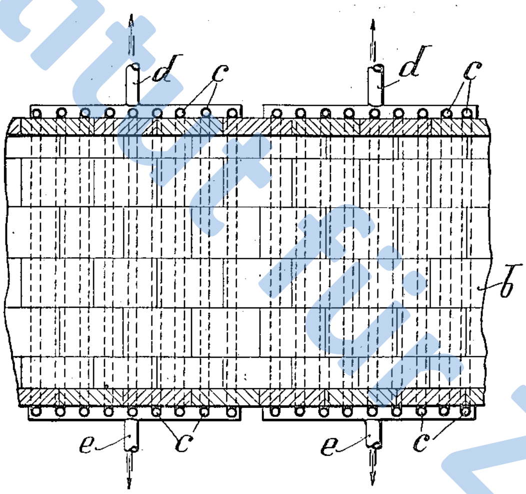


Fig.2.

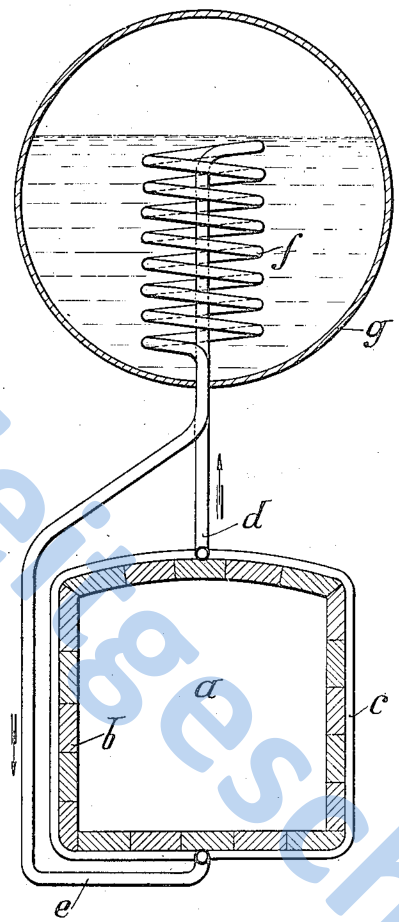
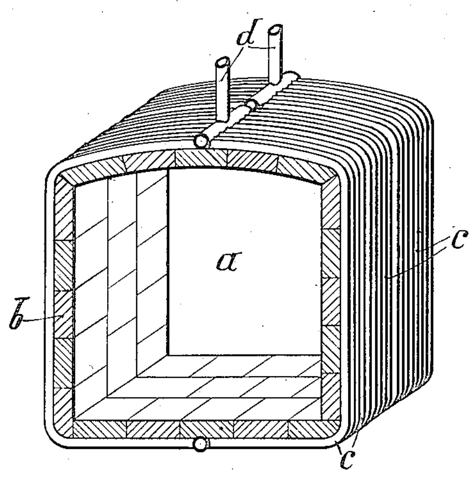


Fig.3.



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KARL PRINZ ZU LÖWENSTEIN
BY Otto H. Berrigan
ATTORNEY

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UNITED STATES PATENT OFFICE.

KARL PRINZ zu LÖWENSTEIN, OF NECKARGEMÜND, GERMANY.

CASING FOR DOWNDRAFT-FURNACES.

1,140,908. Specification of Letters Patent. Patented May 25, 1915.

Application filed July 18, 1913. Serial No. 779,824.

To all whom it may concern:

Be it known that I, KARL PRINZ ZU LÖWENSTEIN, a citizen of the German Empire, residing at Neckargemünd, in the Grand Dukedom of Baden, Germany, have invented certain new and useful Improvements in Casings for Downdraft-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 has for its object a frame or casing for the firebrick masonry of the combustion chambers of furnaces with a bottom flue. The casing enables very thin masonry to be employed in order to reduce as far as possible the weight of the apparatus.

The furnace shell must, in order to avoid too rapid a destruction of the thin firebrick lining, prevent the masonry becoming too highly heated, that is to say, must cool it, utilizing the heat withdrawn. Further, the casing must also be able to absorb the heat flowing through the masonry, in order that loss of heat may not take place. The casing itself must also be of rigid construction, and afford the masonry built in it a secure hold and a good anchorage, and it must also be simple in construction, cheaply made, and quite safe, so that on any portion of the casing becoming defective no danger is involved in working the apparatus. Finally, the casing must be durable in working, that is to say it must not become stopped with boiler scale in a short time, which would prevent a circulation of the cooling fluid.

The tubular frame or casing according to this invention entirely fulfils the above-mentioned requirements, and for this purpose consists of a number of continuous pipes arranged close together, in which pipes the same liquid constantly circulates.

The pipes may be combined into groups composed of any suitable number of pipes, each tubular element being connected by an up and down pipe with a cooling coil or the like which is located in a steam-boiler or other cooling vessel and by means of which the heat absorbed from the pipes of the casing or frame is transmitted to the cooling vessel and made available in the latter.

The invention will now be more particularly described with reference to the accompanying drawings in which one form of construction is illustrated as an example.

Figure 1 is a longitudinal section of a furnace flue provided with the improved casing or shell, a number of the pipes being combined into one tubular element; Fig. 2 is a cross section of the furnace flue; while Fig. 3 is a perspective view of the arrangement of the shell.

The furnace flue *a* is lined with a thin layer of fire brick masonry *b*, and this masonry, according to this invention, is surrounded by a casing or frame consisting of a number of continuous pipes *c* lying closely together. The separate pipes may be combined in any suitable number to form tubular elements in which the same cooling liquid constantly circulates. This absorbs the heat passing through the masonry *b* and thus cools the latter. The heated liquid rises through the pipe *d* and flows through a cooling coil *f* placed in a steam boiler *g* or the like, to the water of which it imparts its heat.

The cooled liquid flows back again to the same tubular element through the down pipe *e* in order to re-commence the same circulation. The combination of a number of pipes into a tubular element has the advantage of a considerable saving of weight and a cheaper construction of the cooling portion of the tubular element, and further a considerable stiffening of the element itself is obtained, whereby the firebrick masonry built therein obtains a secure hold.

The way in which the pipes are combined with one another to form tubular elements and also the particular construction of the cooling arrangement is immaterial as regards the essential feature of the invention.

I declare that what I claim is:—

1. In a water-cooled furnace, the combination of a thin lining of refractory brick masonry; a plurality of closely spaced pipes surrounding said lining in contact therewith; upper and lower conduits above and below said lining and connecting the pipes in groups; a circulation pipe connecting each upper conduit with the corresponding lower conduit; and a heat exchange device associated with the circulation pipe.

2. In a water-cooled casing for refractory masonry for furnaces, the combination of a plurality of groups of pipes lying close together; conduits connecting one group of

pipes with another; and a heat exchange device in the conduits.

3. In a water-cooled furnace, the combination of a thin lining of refractory material; a plurality of closely spaced water conducting pipes surrounding said lining in contact therewith and a heat exchange device connected with said pipes.

4. In a water-cooled furnace, the combination of a thin lining of refractory material; and a plurality of closely spaced water conducting pipes surrounding said lining in contact therewith, said pipes and device forming a closed system through which the same water circulates repeatedly.

In testimony whereof I affix my signature, in presence of two witnesses.

KARL PRINZ zu LÖWENSTEIN.

Witnesses:
WALTER SCHWARBACH,
PAULINE MÜLLER.

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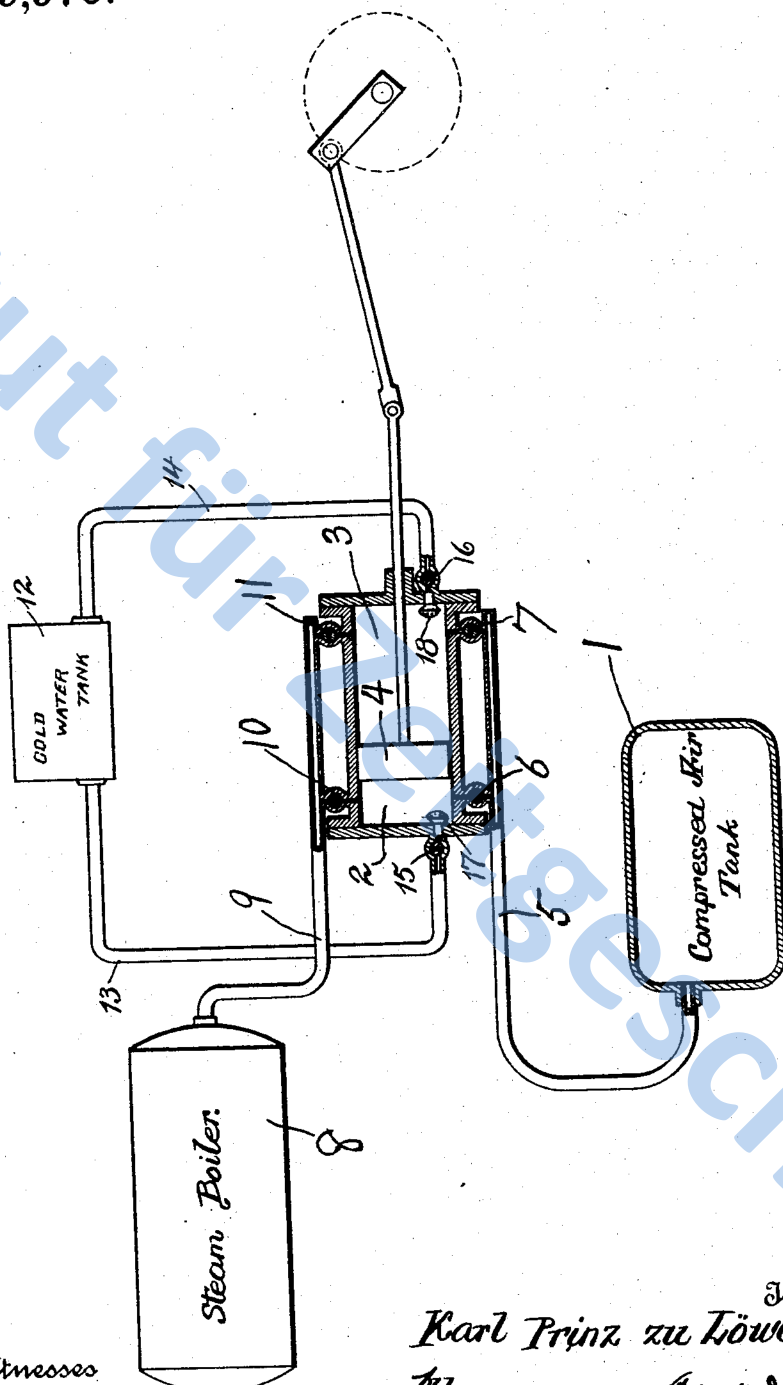
KARL PRINZ ZU LOWENSTEIN.

PROCESS FOR CONVERTING STEAM HEAT OF A LIQUID INTO MOTIVE FORCE.

APPLICATION FILED JULY 11, 1916.

1,219,970. Patented Mar. 20, 1917.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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UNITED STATES PATENT OFFICE.

KARL PRINZ zu LÖWENSTEIN, OF KLEINGEMÜND, NEAR NECKARGEMÜND, GERMANY.

PROCESS FOR CONVERTING STEAM HEAT OF A LIQUID INTO MOTIVE FORCE.

1,219,970. Specification of Letters Patent. **Patented Mar. 20, 1917.**

Application filed July 11, 1916. Serial No. 108,738.

To all whom it may concern:

Be it known that I, KARL PRINZ ZU LÖWENSTEIN, a subject of the German Emperor, and resident of Kleingemünd, near Neckargemünd, Germany, have invented new and useful Processes for Converting Steam Heat of a Liquid into Motive Force, of which the following is a specification.

The object of the invention is to convert the steam heat present in a liquid including the socalled latent heat into motive force. This is achieved by allowing the steam to work as usual but particularly using it more as a heat carrier, causing the steam to impart its heat to a gaseous elastic body such as a gas or steam, preferably a high compressed gas, during confined or checked expansion. This gas the pressure of which has been increased by the heat admitted, is caused to do work in the working cylinder of a motor, thereby converting the heat of the gas into work.

If atmospheric air, or, for practical reasons, preferably high compressed air from a compressed air container is admitted into the cylinder of a motor, say for instance up to about a quarter of the piston stroke and if then the supply is cut off and steam introduced to such an amount that the temperature of the gas in the cylinder increases, say to a temperature of about 100 degrees higher than that existing in the compressed air container, the mixture of air and steam will have a pressure of about 40% higher than that in the compressed air container. If this mixture of air and steam is caused to expand and to do work, all the steam of the mixture will be condensed in consequence of the conversion of the steam into work. The heat of the steam and also the latent heat as well as a part of the heat of the condensed liquid will thereby be transferred to the compressed air and will in this manner be converted into motive force.

In practice the process may be carried out with advantage if the same compressed air is used again and again. For instance, compressed air of about 12 atmospheres is kept in a container. Of this air an amount is admitted into the cylinder which will fill the latter to about a quarter of its contents; then the supply is cut off and steam is introduced to such an extent, that the mixture will have a temperature of about 100 degrees or more higher than that of the air contained in the compressed air container. The mixture of air and steam in the cylinder is then caused to expand and do work. The steam admitted must have a pressure at least as high as that present in the compressed air container. At the end of the stroke the temperature will be much lower, because heat has been consumed while performing work. The final temperature in the most favorable case will again be equal to that existing in the compressed air container.

The compressed air charge is not allowed to exhaust but the same cycle is repeated at the opposite side of the piston. The expanded gas charge is thereby compressed by the returning piston and in order not to increase its heat by the compression, cooling water is injected. After the air has been compressed in the very quarter of the cylinder which it filled originally it is released to flow to the compressed air container. The charges 1 and 2 of the compressed air absolutely counter-balance each other and the work performed with one charge is used for expelling the preceding charge and pressing it to the compressed air container. Practically the compression may take place in a second cylinder coupled with the first cylinder.

Instead of using steam high heated water may be injected directly into the compressed air charge. A part of this injected liquid will during expansion be converted into steam and then again condensed, but otherwise the liquid acts as steam.

In the drawing forming part of this specification, the figure is a diagrammatic view, partly in elevation and partly in section, of an apparatus for carrying out the above process.

Referring more particularly to this drawing, 1 designates a compressed air tank communicating with the chambers 2 and 3 to opposite sides of the piston 4 by a pipe 5. Passage of the compressed air to the chambers 2 and 3 is under the control of valves 6 and 7 respectively, operated by any suitable means.

At 8 is indicated a steam boiler or source of hot water supply, and which is in connection through a pipe 9 with the chambers 2 and 3; passage through such pipe 9 being under the control of valves 10 and 11.

Cold water from a tank 12 is admitted to the chambers 2 and 3 through pipes 13 and

14, under the control of valves 15 and 16, and sprayed thereinto in fine jets through nozzles 17 and 18. The other engine parts necessary to an understanding of the present invention are indicated diagrammatically in the drawings, and will be clear to those skilled in this art.

In the drawings, the piston 4 has been shown as advanced substantially a fourth of its stroke in the chamber 2, and the valve 6 indicated as closed. Compressed air from the tank 1 and through the pipe 5 having been admitted to the chamber 2 during the initial travel of the piston 4, the valve 6 has now been closed and the valve 10 opened to permit steam or other carrier of heat to issue through the pipe 9 and into the chamber 2, so that it will be compressed together with the air therein upon the further travel of the piston 4; the transfer of heat thereupon taking place and the expansion of the fluids developing power all in the manner as above fully described.

On the reverse movement of the piston 4 the same action takes place in the chamber 3, the valves 7 and 11 being actuated to open and close at the same period.

As described in lines 69 to 86 page 1 of this specification, the expanded charge is not exhausted but is compressed in the respective chambers on the return motion of the piston 4, and, in order to prevent raising the temperature of such charge by compressing, the valves 15 and 16 will be so timed as to permit the entrance of water from the tank 12, which will be sprayed through the nozzles 17 and 18 in fine jets and absorb the heat of compression. After the charge has been compressed sufficiently, the valves 6 and 7 will be opened to permit the same to be forced back through the pipe 5 into the tank 1, where it will be stored for further utilization.

I claim:—

1. The process substantially as described, which consists in supplying a compressed fluid to an engine, admitting a heat carrier to said engine, allowing the fluid and heat carrier to expand, causing the fluid to absorb the heat of said carrier, and finally recompressing the fluid and returning it to its source of supply.

2. The herein described process for developing motive power, consisting in supplying a compressed fluid and a heat carrier to an engine, allowing the fluid and heat carrier to expand and develop power, re-compressing the fluid after expansion, supplying a cooling agent during the recompression, and returning the re-compressed fluid to its source of supply, substantially as described.

3. A process for converting the steam heat of a liquid into motive force, consisting in admitting compressed gas into a working space, cutting off the gas supply, admitting steam to the gas confined in the working space, allowing the steam to condense, using the latent heat of said steam to increase the heat of the compressed gas, causing the gas to perform work and escape to the gas supply.

4. A process for converting the steam heat of a liquid into motive force, consisting in admitting compressed gas into a working space, cutting off the gas supply, admitting steam to the gas confined in the working space, allowing the steam to condense, using the latent heat of said steam to increase the heat of the compressed gas, causing the gas to perform work, and using said charge of gas to expel the preceding charge out of the working space and press it to the gas supply again.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this twenty-eighth day of February 1916.

KARL PRINZ zu LÖWENSTEIN.

Witnesses:
HENRY HASPER,
ALLEN F. JENNINGS.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

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June 26, 1923. **1,460,024**

KARL PRINZ ZU LÖWENSTEIN

APPARATUS FOR THE SEMICOKING OF COAL, SLATE, OR OTHER BITUMINOUS SUBSTANCES

Filed Aug. 22, 1921

Fig.1.

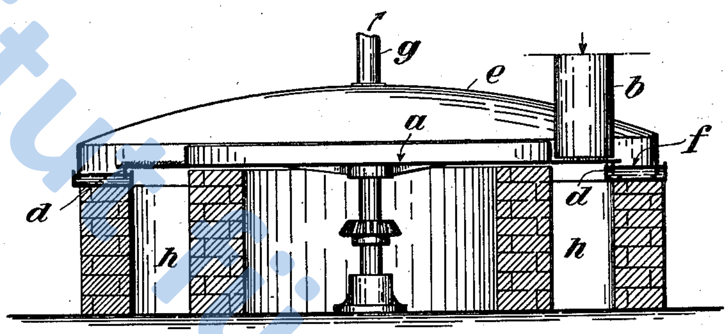
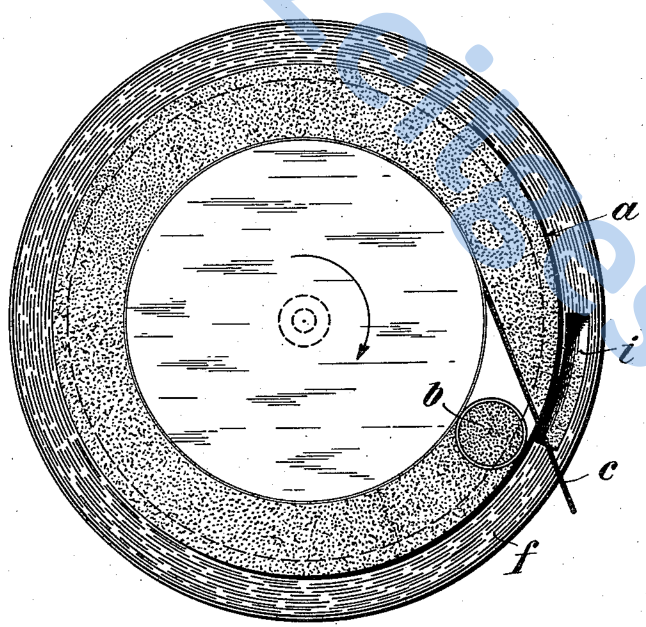


Fig.2.



INVENTOR.

Karl Prinz zu Löwenstein

By *William C. Linton*
Atty.

Institut für Zeitgeschichte

Patented June 26, 1923. 1,460,024

UNITED STATES PATENT OFFICE.

KARL PRINZ ZU LÖWENSTEIN, OF BERLIN, GERMANY.

APPARATUS FOR THE SEMICOKING OF COAL, SLATE, OR OTHER BITUMINOUS SUBSTANCES.

Application filed August 22, 1921. Serial No. 494,213.

To all whom it may concern:

Be it known that I, Karl Prinz Zu Löwenstein, citizen of the German Republic, and residing at No. 11 Lutzow-Ufer, in the city of Berlin, in the Republic of Germany, have invented certain new and useful Improvements in Apparatus for the Semicoking of Coal, Slate, or Other Bituminous Substances, of which the following is a specification.

This invention relates to the semi-coking of coal, slate, and other bituminous substances and consists chiefly in the combination of a horizontal rotary disk with a hood arranged above it, heating-means provided below it, and a scraper arranged within the hood and upon the disk. The substance to be coked is conducted to and upon the disk in such a manner that it forms an annular layer which is rotated by means of, and together with, the rotating disk, the speed of which is such that the material carried round is semi-coked during one revolution, the semi-coking being completed when the material arrives at the scraper in order to be conducted off the disk and out of the apparatus. The substance to be treated forms a thin layer upon the rotary disk, and the rim of this latter which carries that layer is heated from below, as is more fully described hereinafter in connection with the drawing.

The novel construction of the apparatus for semi-coking coal etc. and the novel manner of working made possible by it, offer several advantages. First of all, the material to be semi-coked does not stick fast to the heated surface and does not agglomerate in itself, so that no interruption of the procedure by reason of such occurrences takes place and consequently, a continuous service is warranted. The expenditure of power is very small, the wear and tear of the working parts is diminished to a minimum, and no dust is produced because the coal or other substance under treatment is at rest whilst being carried round over the furnace or other heating means. Also the saving of time resulting from the novel construction and manner of working is valuable, furthermore the smallness of the space required, the more, as a plurality of the rotary disks may be arranged one above the other or others.

In order to make my invention more clear, I refer to the accompanying drawing which shows by way of example a form of construction of the apparatus having but one rotary disk and a furnace below it, and in which Figure 1 is a vertical section through this apparatus and Figure 2 is a plan of the parts visible after the hood has been removed.

The rotary disk *a* is affixed to the upper end of a vertical shaft arranged below its centre and driven by any suitable means with such a speed as appropriate to the purpose. Above the disk *a* is a hood carrying a shaft-like tube serving for conducting the material to be treated to the disk. The lower end of the shaft or tube terminates shortly above the upper surface of said disk so that the material carried away upon the disk forms a thin annular layer, the thickness of which depends upon the distance of the lower edge of the shaft or tube from the disk.

Below the disk *a* is, in the example shown, a furnace, preferably of circular or annular shape, having an annular heating channel *h* located below the rim of the disk *a*. The hot gases coming from any source are led through the channel so as to heat especially the rim of the disk *a*.

The space above the disk is closed by a liquid metal-seal formed by an annular basin supported by the outer part of the furnace and containing a suitable metal such as tin or lead when in their molten state. The rim of the hood *e* dips into the metal *f*, as does also a flange *d* attached to the lower surface of the disk *a*. The annular basin is not completely closed, but interrupted by a passage *i* through which the material treated is led out of the apparatus. The passage *i* lies close to the shaft or tube *b*, in front of it with respect to the direction of rotation of the disk, and radially inwards from it is a scraper *c*, the lower edge of which is in contact with the upper surface of the disk and scrapes the material treated off the disk and conducts it to and through the passage *i* before the fresh material is fed upon the disk through the shaft or tube *b*.

The vapors or gases arising during the coking operation are collected in the hood *e* and sucked off in known manner and by known means through the pipe *g*.

Having now described my invention, what I desire to secure by a Patent of the United States is:

1. An apparatus of the character de-

scribed comprising in combination a horizontally arranged disk, means for housing said disk, means for rotating said disk, an annular heating channel arranged below said disk whereby heat may be applied directly to the lower face of said disk and a feeding tube arranged above said disk substantially as and for the purpose specified.

2. An apparatus for semi-coking coal, slate and other bituminous substances, comprising in combination a rotary disk, a hood for completely housing the upper face of said disk, means for supplying heat directly to the lower face of said disk, a feeding tube extending through said hood and terminating in spaced relation to the upper face of said disk, and an outlet leading from the central portion of the hood, substantially as and for the purpose specified.

3. An apparatus for semi-coking coal, slate and other bituminous substances, comprising, in combination, a rotary disk, a hood for completely housing the upper face of said disk, a furnace arranged below said disk, an annular heating channel communicating with said furnace whereby the heat arising therein will be directed to the lower face of said disk, a feeding tube arranged adjacent the periphery of said disk and a scraper arranged adjacent said feeding tube and adapted to rest upon the upper face of said disk substantially as and for the purpose specified.

4. An apparatus for semi-coking coal, slate and other bituminous substances, comprising, in combination, a furnace, an annular heating channel arranged in said furnace, a horizontally arranged disk positioned above said furnace whereby the outer periphery thereof will extend above said annular heating channel, an annular basin arranged above said furnace containing a molten metal, a flange formed with said disk and adapted to extend within the molten metal in said basin, a hood extending over said disk, a rim formed with said hood and adapted to extend within the metal arranged in said basin, a feeding tube extending through said hood and terminating adjacent the upper face of said disk, and a scraper arranged upon the upper face of said disk substantially as and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

KARL PRINZ ZU LÖWENSTEIN.

Witnesses:
EMIL STEIN,
A. POHL.

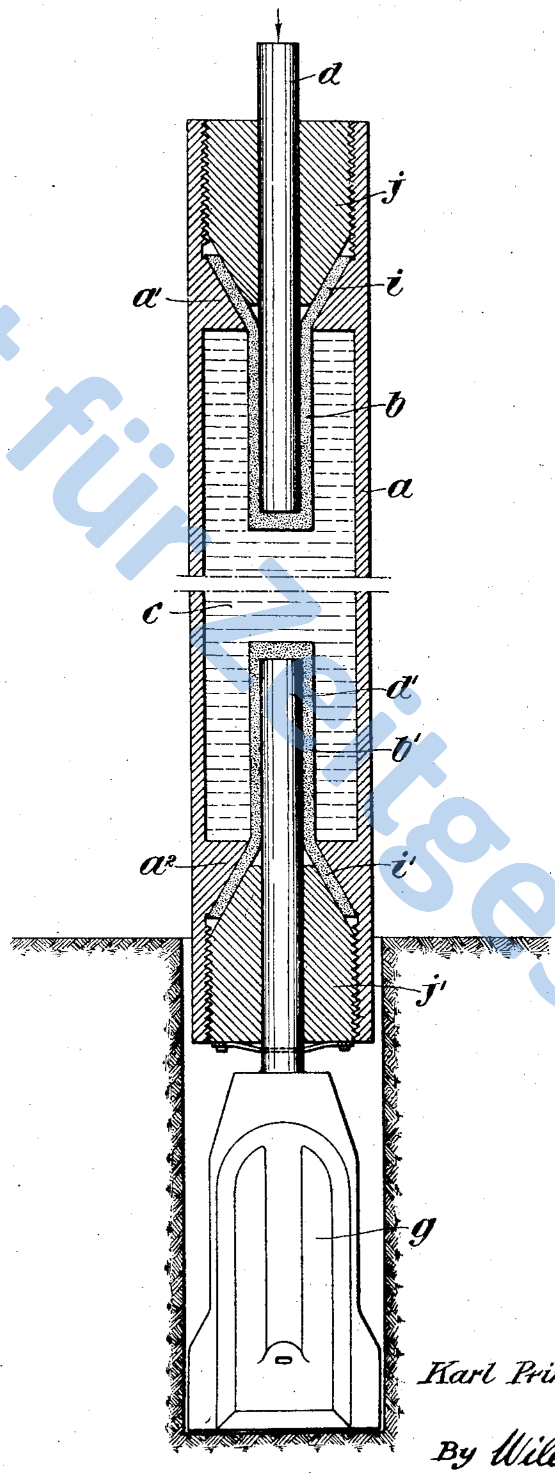
Institut für Zeitgeschichte

March 29, 1927. 1,622,896

K. P. ZU LÖWENSTEIN

DEVICE FOR DRILLING OR CHISELING AWAY ROCK

Filed Oct. 17, 1925



Inventor,
Karl Prinz zu Löwenstein.

By William E. Linton,
Attorney.

Institut für Zeitgeschichte

Patented Mar. 29, 1927. 1,622,896

UNITED STATES PATENT OFFICE.

KARL PRINZ zu LÖWENSTEIN, OF BERLIN, GERMANY.

DEVICE FOR DRILLING OR CHISELING AWAY ROCK.

Application filed October 17, 1925. Serial No. 63,104.

This invention relates to a device for drilling rock or for chiseling it away. In this device a liquid, generally water, is enclosed in a tube which is closed and packed at both ends and into which extend from both ends, through the packings, pistons, of which one receives the outer blows and transmits them to said liquid which then transmits the blows to the other piston and to the drill or chisel attached thereto. The object of the invention is to render the latter blows as hard as possible in order to increase the effect of the drill or chisel, and the invention consists in certain means provided for this purpose.

Now to attain the effect in view, the two pistons extend freely into the chamber filled with liquid, and the projecting part of each piston is enclosed in an elastic bag closed at its inner end where it covers the respective piston, and consisting of rubber or the like, so as to be extensible, and being secured at its other end firmly between the cylinder wall or, more precisely, an internal annular shoulder thereof and a guide-member for the respective piston. The inwardly projecting part of each tubular bag is surrounded with the liquid enclosed in the cylinder and cannot, therefore, give way laterally, or bend in any way, so that the blows are transmitted without any decrease of strength.

My invention is illustrated diagrammatically and by way of example in the accompanying drawing in which the improved device is shown in vertical section. It is constructed as follows:

The metallic cylinder or tube *a* is closed at its ends by metallic plugs *j j′*, the inner ends of which are conical, as shown. The tube *a* is provided with internal annular shoulders a' a^2, each of which is so shaped as to correspond to the conicalness of said shoulders. The pistons *d* and *d′*, of which *d* receives the blows at its outer end, whereas *d′* receives them at its inner end by the intermediary of the liquid *c* which fills up completely the interior of the tube *a*, extend axially through the plugs *j j′* and terminate at some distance from one another, as shown. The pistons *d d′* are enclosed in bags *b b′* of rubber or the like, and the open ends of the bags are enlarged conically in such a manner as to fit accurately between the plugs and the shoulders described. *i* and *i′* denote these enlarged parts of the bags; these parts form at the same time packings for the tube or cylinder and the pistons. It is obvious that the bags cannot give way laterally, in consequence whereof the transmitted blows are harder than otherwise.

I claim:

A device for drilling or chiseling away rock, comprising, in combination, a tube having a chamber formed therein, packed stoppers each having a bore therein arranged within the opposite ends of said tube, pistons extending through the bores of said stoppers into the chamber formed within said tube, the tube adapted to be filled completely with a liquid; and elastic bags enclosing the inwardly projecting parts of said pistons and being fastened at their other ends, substantially as set forth.

In witness whereof I have hereunto set my hand.

KARL PRINZ zu LÖWENSTEIN.

Institut für Realgeschichte

Patented Mar. 1, 1932 **1,847,617**

UNITED STATES PATENT OFFICE

KARL PRINZ zu LÖWENSTEIN AND WILHELM MÜLLER, OF BERLIN, GERMANY; OLGA PRINZESSIN ZUR LIPPE, EXECUTRIX OF SAID KARL PRINZ zu LÖWENSTEIN, DECEASED; ASSIGNORS TO HIRSCH, KUPFER UND MESSINGWERKE AKTIENGESELLSCHAFT, OF FINOW (MARK), GERMANY

HARD ALLOY

No Drawing. Application filed December 11, 1928, Serial No. 325,404, and in Germany February 11, 1928.

In the last decades a number of alloys of iron with carbon, tungsten and molybdenum distinguished by their unusual hardness and heat stableness has become known. These alloys represent, therefore, an excellent starting material for tools and working implements of all kinds especially drawing stones. But the resistance of these hard metals to chemical influences is comparatively slight, which renders them unsuited for the working of such materials that when being clamped in for being worked affect the tool chemically, especially if the temperature arising during the working procedure has become high by reason of the high working speed. Materials acting in this way are hard rubber, vulcanized fibre, glazed cardboard, pertinax, certain sorts of paper, and similar materials having organic components. To give an example also for an inorganic substance we mention the anhydrous sulphate of calcium ($CaSO_4$) which, as it seems, impairs the cutting capacity of the drilling and cutting tools by its radical.

Now, the present invention relates to an iron alloy which, on the one hand, is, as regards hardness, not inferior to the above-mentioned hard alloys owing to its contents in heavy metals in connection with carbon, and which, on the other hand, represents a chemically nearly unaffectable tool substance for the working of materials of the above-stated kinds by reason of an addition of chromium and cobalt, the amount of which depends upon, and stands in a certain relation to, the amount of the heavy metal.

A proportion which is characteristic for the present invention and is, probably the cause of its chemical stableness is this: tungsten:chromium:cobalt=about 8:2:1 (per cent by weight).

Anyhow, the amount of iron should not surpass 55 per cent by weight of the total amount of the alloy. Deviations of the numbers of the proportion stated should, preferably, not exceed 10%.

According to the desired hardness and to the admissible brittleness the proportion of the components tungsten, chromium and cobalt with respect to the amount of the iron, as well as to the amount of the carbon, (this latter being kept between 1 and 4 per cent) varies. A typical analysis of a tough material of medium hardness is, for instance:

55 per cent of iron,
32 per cent of tungsten,
8 per cent of chromium,
4 per cent of cobalt,
1 per cent of carbon.

In contradistinction to this composition, a very hard material which is sufficiently tough to be used for the manufacture of cellulose threads is composed as follows:

10 per cent of iron,
65 per cent of tungsten,
16 per cent of chromium,
7 per cent of cobalt,
2 per cent of carbon.

It is known that in many hard alloys molybdenum can be substituted for the tungsten either totally or to a very large proportion. With alloys according to the present invention such substitution is possible only in a certain measure, viz. at the highest up to 25% of the contents of tungsten; the most favorable percentage in relation to the tungsten is about 12.

For the purpose of increasing the chemical stableness nickel which is, as is known, kindred to cobalt can be substituted for this latter metal up to one half of the amount thereof. But in this respect attention must be paid to the point that in the majority of cases the toughness of the alloy is diminished by said substitution, but its hardness is not increased.

Substituting for the iron another metal which is kindred to it has up to now not proved favorable. This fact is not disproved by the other fact that a small addition of manganese improves the texture of the alloy. Probably manganese acts in this instance merely as a reducing agent.

In order to increase the hardness still more, one or more other known hardening substances, viz. silicium, boron, zirconium, titanium, nitrogen, vanadium, beryllium, cerium, and so on, can be added to the alloy, but the per cent thereof should, at the highest,

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be 4 per cent, as otherwise the alloy becomes too brittle.

The hard metal alloy described is particularly suitable for the production of projectiles for rifles and other fire-arms, and for the manufacture of projectile casings (shells), also for the points of projectiles of large and small calibers as well as for mines, torpedoes and the like.

We claim:

1. A hard alloy having a high mechanical strength and chemical stableness, suitable for tools and working implements, consisting of from 10 to 33 per cent of iron, 1 to 4 per cent of carbon, 64 to 46 percent of tungsten, 16 to 11.5 per cent of chromium and 8 to 5.5 per cent of cobalt, said three last named substances having among themselves the proportions of 8:2:1, all by weight.

2. A hard alloy having a high mechanical strength and chemical stableness, suitable for tools and working implements, consisting of from 10 to 33 per cent of iron, 1 to 4 per cent of carbon, 48 to 35 per cent of tungsten, 16 to 11 per cent of molybdenum, 16 to 15.5 per cent of chromium and 8 to 5.5 per cent of cobalt, the ratio of the total percentage of tungsten and molybdenum to that of chromium and that of cobalt being 8:2:1.

3. A hard alloy having a high mechanical strength and chemical stableness, suitable for tools and working implements consisting of from 10 to 33 per cent of iron, 1 to 4 per cent of carbon, 64 to 46 per cent of tungsten, 16 to 11.5 per cent of chromium, 4 to 3 per cent of cobalt and 4 to 3 per cent of nickel, the ratio of the total percentage of tungsten to that of chromium and that of cobalt and nickel being 8:2:1.

4. A hard alloy having a high mechanical strength and chemical stableness, suitable for tools and working implements consisting of 10 to 33 per cent of iron, 1 to 4 per cent of carbon, 48 to 35 per cent of tungsten, 16 to 11 per cent of molybdenum, 16 to 5.5 per cent of chromium, 4 to 3 per cent of cobalt and 4 to 3 per cent of nickel, the ratio of the total percentage of tungsten and molybdenum to that of chromium and to that of cobalt and nickel being 8:2:1.

In testimony whereof we affix our signatures.

KARL PRINZ zu LÖWENSTEIN.
WILHELM MÜLLER.

Institut für Zeitgeschichte

United States Patent [19] Abom

[11] 4,196,594

[45] Apr. 8, 1980

[54] **PROCESS FOR THE RECOVERY OF MECHANICAL WORK IN A HEAT ENGINE AND ENGINE FOR CARRYING OUT THE PROCESS**

[76] Inventor: **Jan V. Åbom,** 12 Popplegatan, Västra Frölunda, Sweden, S-421 74

[21] Appl. No.: **851,560**

[22] Filed: **Nov. 14, 1977**

[51] **Int. Cl.**[2] **F01K 21/04;** F01K 25/06

[52] **U.S. Cl.** **60/649;** 60/509; 60/673

[58] **Field of Search** 60/649, 673, 674, 509

[56] **References Cited**

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Primary Examiner—Allen M. Ostrager

Attorney, Agent, or Firm—Karl W. Flocks

[57] **ABSTRACT**

In a process for recovering mechanical work in a heat engine there is used as a working medium in the heat engine a gas to which vapor is added having a H-value lower than the H-value of the gas, the gas being caused to absorb the condensation heat from the vapor by condensation of the vapor under essentially isothermal expansion. A heat engine for carrying out the process comprises; an isothermal compressor to which a liquid injection mechanism is connected; an isentropic compressor; an expansion machine to which a vapor generator is connected; and at least one additional expansion machine with liquid separator; said compressors and expansion machines being included in a closed circulation system for the gas serving as a working medium.

9 Claims, 2 Drawing Figures

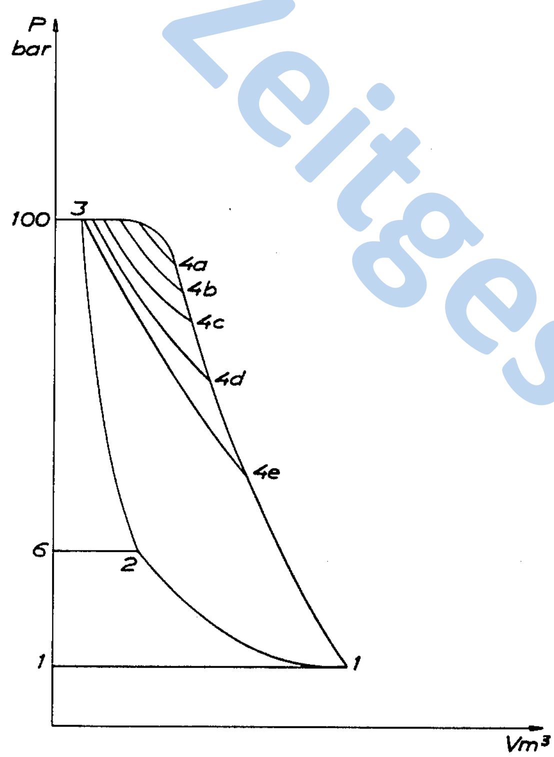

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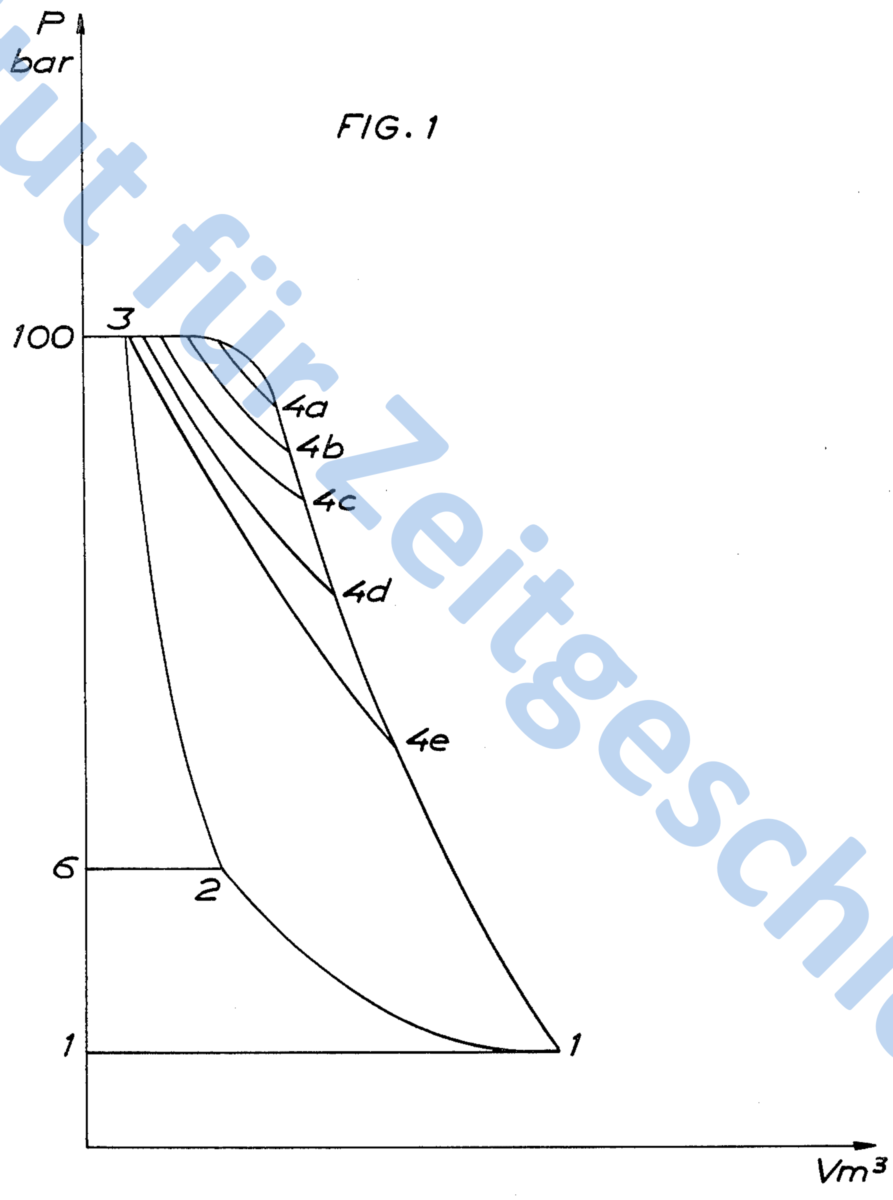
FIG. 1



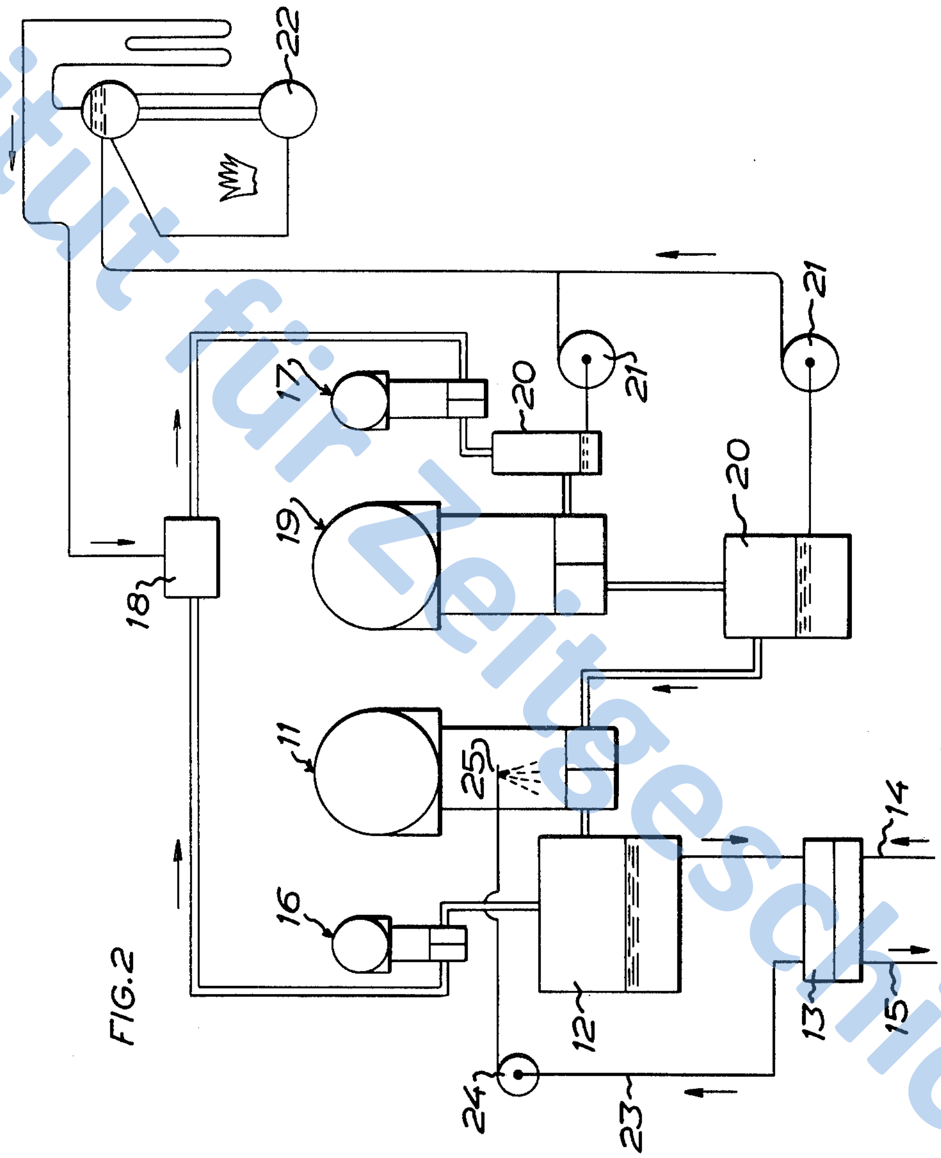


FIG. 2

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PROCESS FOR THE RECOVERY OF MECHANICAL WORK IN A HEAT ENGINE AND ENGINE FOR CARRYING OUT THE PROCESS

The present invention relates to a process for the recovery of mechanical work in a heat engine. The new and characteristic feature of the process is that the working medium used in the heat engine is a gas to which vapour is added having a H-value lower than the H-value of the gas, said gas being caused to absorb the condensation heat from the vapour by condensation of the vapour under essentially isothermal expansion. In this connection, H is $=Cp/Cv$, where Cp is the specific heat at constant pressure and Cv is the specific value at constant volume. As a working medium in the heat engine use is advantageously made of rare gas (monatomic), such as argon or helium $H \approx 1.66$, while the vapour may be aqueous steam with $H \approx 1.30$. The vapour may also advantageously be zinc vapour or cadmium vapour. This will give a still better result because $H \approx 1$ and the boiling-point is higher, which results in the total pressure of the process being low.

Through the process of the present invention the engine can give a thermal efficiency of about 75%, at moderate pressures, i.e. approximately $\frac{3}{4}$ of the heat supplied will be theoretically transformed into mechanical work. This is to be compared with the Stirling, Diesel and vapour processes which will give a thermal efficiency of approximately 37% when applying the Carnot process.

The process of the invention is primarily intended to be carried out in a compression and expansion engine in which the vapour is supplied after the compression phase but before or during the expansion phase. The compression of the gas in the engine is performed in at least two steps, the first step being essentially isothermal and the latter step being essentially isentropic. The expansion of the gas in the engine is also carried out in at least two steps, the first step being essentially isothermal and the latter essentially isentropic.

The invention also relates to an engine for carrying out the process stated above, said engine being characterized in that it comprises; an isothermal compressor to which there is connected a liquid injection mechanism or the like; an isentropic compressor; an expansion machine to which there is connected a vapour generator; and at least one additional expansion machine with liquid separator for the condensed vapour; said compressors and expansion machines being included in a closed circulation system for the gas.

The invention will be described more in detail hereinafter with reference to the accompanying drawings, in which:

FIG. 1 represents the thermodynamic process and

FIG. 2 shows schematically the engine for carrying out the process of the invention.

In the process illustrated in FIG. 1 use is made of a rare gas e.g. argon, as a working medium in the heat engine, the H-value of the rare gas being approximately equal to 1.66. To the rare gas there is added aqueous steam having a H-value approximately equal to the 1.30. As the aqueous steam thus has a H-value lower than that of the rare gas, the rare gas will obtain the condensation heat, which correponds to the steam forming heat, from the aqueous steam during the expansion of the rare gas.

Isothermal compression of the rare gas takes place between 1–2. The isothermal compression is brought about by injection of liquid which is allowed to carry off heat. Isentropic (adiabatic) compression of the rare gas takes place between 2–3. Injection of aqueous steam into the rare gas takes place between 3–4. The supply of heat thus starts here at the same time as the expansion. Between 4–1 the expansion continues at the same time as the aqueous steam condenses, and practically all the steam should have condensed into liquid at point **1**. Thus, one should not supply more aqueous steam than what is condensed during the expansion. In connection with the condensation of the aqueous steam, the rare gas receives the condensation heat.

The zone represented by surface **3**, **4***a*, **4***b*, **4***c*, **4***d* and **4***e* constitutes the control zone at constant vapour pressure.

In the example shown the pressure at the point designated 1 is 1 bar, at the point designated **2** it is 6 bar and at the point designated **3** it is 100 bar.

The vapour, which is supplied at 100 bar, should preferably be superheated at about 800° C., the thermal efficiency being about 75%.

It would also be possible to carry out the process by using air or nitrogen as a working medium which has a H-value approximately equal to 1.40. The heat, however, which in this connection passes from the condensed aqueous steam, will be very insignificant, and therefore the process can hardly be considered economically practicable, at least not under present conditions.

The engine schematically illustrated in FIG. **2** is provided with an isothermal compressor **11** into which liquid is injected during the compression. Heat will thereby be carried off. The gas from the isothermal compressor **11** is to pass a liquid separator **12** in which the gas will be freed from liquid drops. In a counter-current type heat exchanger, designated **13**, the heat received from the isothermal compression is transferred to the ambient air or water, e.g. through the radiator of an automobile or boat. The inlet conduit of the heat exchanger **13** is designated **14** and the outlet conduit **15**.

The gas thus freed from liquid drops is transferred to the isentropic compressor **16** which may be a piston, lamella or turbo type compressor.

Interposed between the isentropic compressor **16** and the expansion machine **17**, which may be a piston, lamella or turbine type machine, is a gas-vapour mixer **18**. Alternatively, the vapour may be mixed with the gas within the expansion machine **17**.

The second step of the expansion machine is designated **19**. Additional steps may of course also be provided. The expansion machine **19** is connected to a liquid separator **20** for the condensate which is to be pumped by the condensate pump **21** to the steam-boiler **22** with superheater. Also between the expansion machines **17** and **19** there should be a drop or liquid separator **20** with a pump **21** for pumping the condensate to the steam-boiler **22**. Operation with solar energy and nuclear force is possible in connection with the steam-boiler **22**.

A liquid conduit **23** to the isothermal compressor **11** is provided with a liquid injection pump **24** and terminates in a liquid injection nozzle **25** for the liquid. The nozzle **25** is preferably engaged in the downwardly directed piston of the compressor **11**, said piston being positioned under the crankshaft to make it easy for the liquid to leave the compressor.

In case the condensate is not completely separated from the gas in the separator **20** it is separated from the gas in the isothermal compressor **11**.

The step between 1–2 in FIG. **1** is taken in the isothermal compressor **11**, the step between 2–3 is taken in the isentropic compressor **16**, the step between 3–4 is taken in the expansion machine **17** and the step between 4–1 is taken in the expansion machine **19**.

The installation described above may also be used for desalting of sea water. In that case the steam-boiler **22** is fed with salt water. The fresh water is taken out at the water separator **20**, while the rare gas, preferably argon, must be recovered from the fresh water. The pressure in the boiler **22** should be kept relatively low in the preparation of fresh water because otherwise there will be a hard scale in the boiler.

According to a modified embodiment the isothermal compressor **11** may be replaced by several common compressors of the piston, lamella or turbo type with intermediate coolers. This, however, reduces the efficiency.

The invention is not restricted to that which is described above and shown in the drawings but may be modified within the scope of the appended claims.

I claim and desire to secure by Letters Patent is:

1. A process for the recovery of mechanical work in a heat engine, comprising using as a working medium in the heat engine a gas to which vapour is added having a H-value lower than the value of the gas, the gas being caused to absorb the condensation heat from the vapour by condensation of the vapour under essentially isothermal expansion wherein rare gas, from the group including argon and helium, is used as a working medium in the heat engine.

2. A process as claimed in claim **1**, wherein the vapour supplied is aqueous steam which is superheated.

3. A process as claimed in claim **1**, which is carried out in a compression and expansion engine, the vapour being added at least during the expansion phase.

4. A process as claimed in claim **3**, wherein substantially all the vapour is condensed into liquid during the expansion phase.

5. A process as claimed in claim **3**, wherein the compression of the gas in the engine is carried out in at least two steps, the first step being essentially isothermal and the latter step essentially isentropic, and the expansion of the gas in the engine is also carried out in at least two steps, the first step being essentially isothermal and the latter step essentially isentropic.

6. A process as claimed in claim **5**, wherein liquid is injected into the gas during the compression at the first step for carrying off heat.

7. An engine for carrying out the process of claim **5**, in which the compression of the gas in the engine is performed in at least two steps, the first step being essentially isothermal and the latter essentially isentropic, and in which the expansion of the gas in the engine is also carried out in at least two steps, the first step being essentially isothermal and the latter essentially isentropic, wherein said engine comprises; an isothermal compressor to which a liquid injection mechanism or the like is connected; an isentropic compressor; an expansion machine to which a vapour generator is connected; and at least one additional expansion machine with liquid separator for the condensed vapour; said compressors and expansion machines being included in a closed circulation system for the gas.

8. A process for the recovery of mechanical work in a heat engine, comprising using as a working medium in the heat engine a gas to which zinc vapour is added having a H-value lower than the value of the gas, the gas being caused to absorb the condensation heat from the zinc vapour by condensation of the zinc vapour under essentially isothermal expansion.

9. A process for the recovery of mechanical work in a heat engine, comprising using as a working medium in the heat engine a gas to which cadmium vapour is added having a H-value lower than the value of the gas, the gas being caused to absorb the condensation heat from the cadmium vapour by condensation of the cadmium vapour under essentially isothermal expansion.

* * * * *

Institut für Zeitgeschichte

United States Patent [19]

Moffett

[11] **4,438,755**

[45] **Mar. 27, 1984**

[54] **WOOD BURNING STOVE HAVING WATER HEATER**

[76] Inventor: **Daniel J. Moffett,** Route 2, Box 99B, Osceola, Wis. 54020

[21] Appl. No.: **446,043**

[22] Filed: **Jan. 31, 1983**

[51] **Int. Cl.**³ **F24C 13/00**

[52] **U.S. Cl.** **126/34;** 122/9; 126/132

[58] **Field of Search** 126/31, 34, 35, 132, 126/344; 122/9, 17

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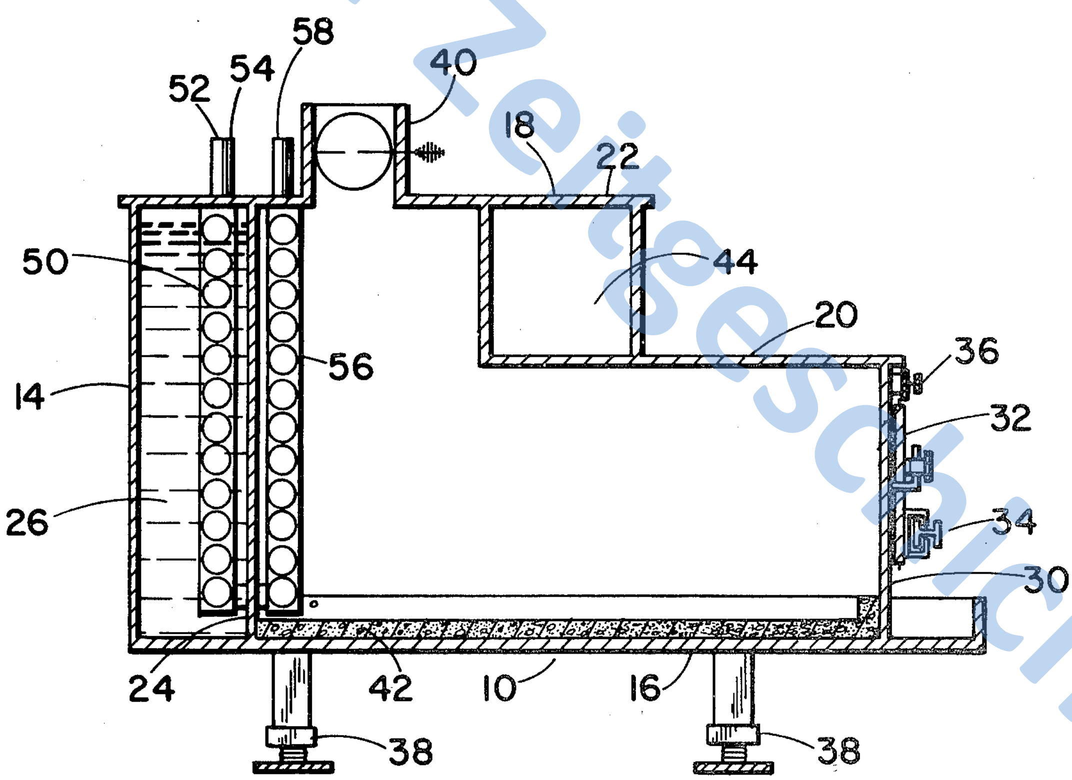
Primary Examiner—Daniel J. O'Connor

[57] **ABSTRACT**

A solid fuel burning stove having a hot water heating means. A water containing chamber open at the top for communication with room air serves the dual purpose of providing a heat sink for preheating water while at the same time providing a means for humidifying the room air. Domestic water heating coils are positioned so that cold water flows first through coils located at the water containing reservoir where it is preheated and then passes into the combustion chamber where it is heated to a high temperature before flowing into a hot water tank. The stove is preferably also provided with a small baking oven.

5 Claims, 2 Drawing Figures



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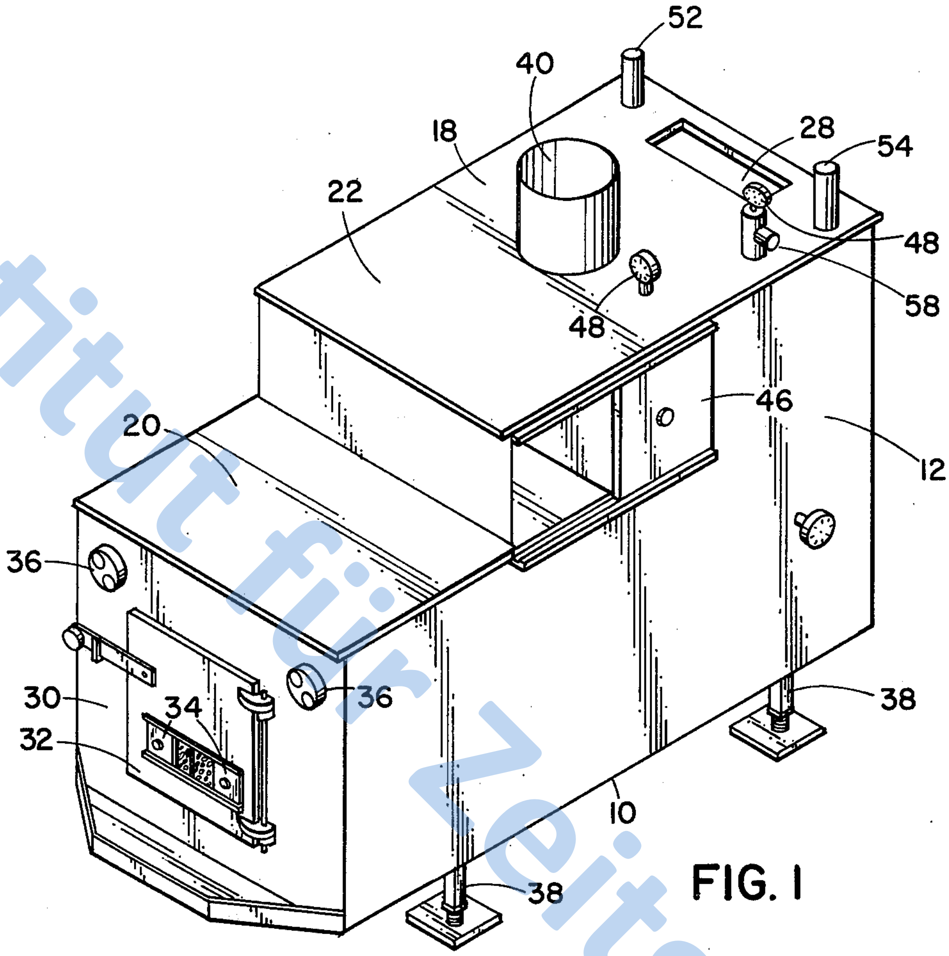

FIG. 1

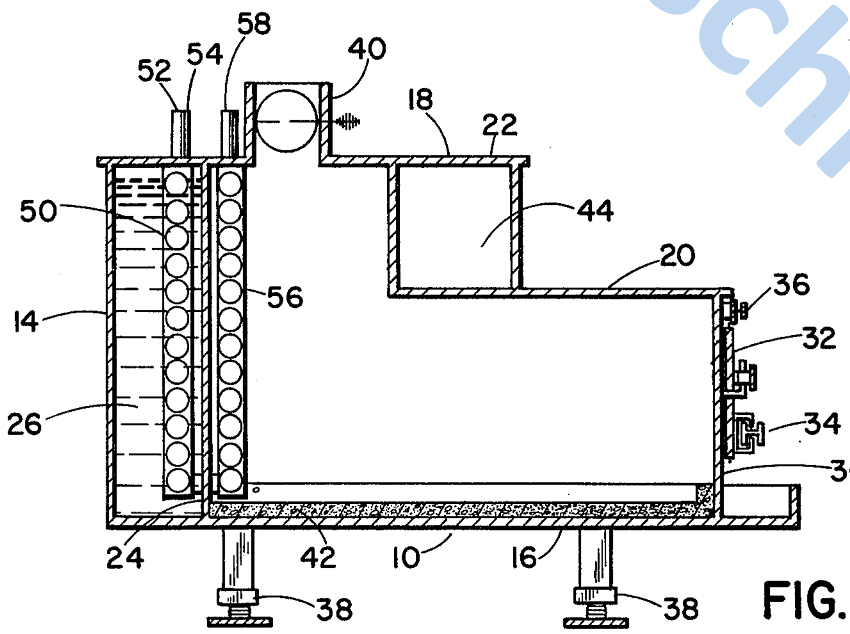

FIG. 2

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WOOD BURNING STOVE HAVING WATER HEATER

BACKGROUND OF THE INVENTION

Stoves which burn solid fuels such as wood, coal and briquettes have previously had incorporated into them heat exchange tubes for heating water. See, for example, U.S. Pat. No. 2,521,142. Such stove and heating devices afford a means for conserving fuel oil, gas or electricity by substituting less expensive or more plentiful fuels such as wood or coal.

The present invention provides an improvement for such stoves. In the preferred embodiment the present invention involves a stove suitable for home use as a supplementary heating means capable, if desired, of use for some cooking and baking chores while at the same time providing an inexpensive means for heating of domestic hot water.

The stove according to the present invention includes a conventional fire chamber confined within metal walls having conventional fuel loading doors, dampers and exhaust flues. The stove utilizes a hot water heat sink which is in open 20 communication with the room air, thus supplying humidity into the air when the stove is in use. The present invention further contemplates the use of such water reservoir as a heat sink for preheating domestic water by passage of said water through a heat exchanger located in the water reservoir prior to passage through further heat exchangers located within the fire chamber. Such water reservoir further provides moderate heating of the water even when the fire has burned down by extracting.

It is the primary object of the present invention to provide an improved wood or coal burning stove which is of a relatively inexpensive and practical design suitable for use in the average home. This and other objects of the invention will become clear from an inspection of the detailed description of the invention, and from the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an exemplary stove according to the present invention;

FIG. 2 is a cross-sectional side view of the stove in FIG. 1;

DETAILED DESCRIPTION OF THE INVENTION

A wood or coal burning stove according to the present invention as shown generally at **10** in FIG. **1** and FIG. **2**. This stove includes side walls **12**, a back wall **14**, a bottom wall **16** and a top wall **18** with cooking surfaces **20** and **22** disposed at different levels. Interior wall **24** is provided so as to form a water containing chamber for heat sink **26** at the rear of the stove. An opening **28** is formed in top wall **18** to permit filling of the heat sink **26** and transmission of water vapors to the atmosphere.

Front wall of the stove **30** is provided with a conventional door **32** which is provided with primary air intake openings which are preferrably adjustable. Conventional grate openings below the door may also be employed as an alternative. The front wall may also be provided with secondary air intake openings **36** if desired.

Stove **10** may also be provided with supporting legs **38** of conventional design. Conventional exhaust flue **40** is also provided for conveying the smoke and other exhaust gasses to a chimney. A conventional damper of the butter-fly type may be provided in the exhaust flue. As seen in FIG. **2** the bottom of the stove may be provided with fire brick **42**. In the preferred embodiment a small oven **44** having an opening door **46** at the end thereof is provided so that the stove may be used for baking small amounts of bread or rolls or other food preparation. The stepped top surfaces of the stove **20** and **22** provide cooking surfaces of differing temperatures, particularly in view of the fact that oven **44** somewhat separates surface **22** from the direct action of the fire. The stove is preferrably provided with temperature gauges **48** of conventional design.

Located within heat sink **26** is a first set of heat exchange coils **50**. An intake pipe **52** is provided to conduct the flow of cold water into coil **50**. Intake pipe **52** would normally be connected to a domestic cold water supply. An outflow pipe **54** is also connected to coil **50** and provides for the outflow of water which has been preheated in coil **50** into a second coil **56** which is located within the firebox. While pipe **54** is shown for purposes of illustration as passing above the top surface of the stove, it may readily be located beneath the surface to provide a stove design of cleaner appearing design.

In operation, the usual water pressure differentials occurring when a faucet is opened causes water to flow through intake pipe **52** into the preheating coil **50** where a heat exchange from heat sink **26** occurs. The preheated water is then caused to flow through pipe **54** into heat exchanger **56**. The burning of a fire in the fire chamber of the stove causes heating of water in the heat sink **26**. A portion of this stored up heat is extracted by the heat exchange coil **50**. The preheated water flowing out of the coil **50** is then readily heated to the desired hot water temperature when it flows through heat exchange coils **56**. The intensity of the fire in the firebox can be adjusted by adjustment of the air intake control **34** and **36**. Constant evaporation of some of the water in the heat sink **26** occurs through opening **28** providing needed humidity to the room air. It has been found that with a stove of the type illustrated, passage of the water through the heat sink reservoir causes a 30° to 40° F. rise in temperature. Without this preheating, it is difficult for such a stove to provide hot water of a temperature sufficient to satisfy formal domestic needs.

The hot water emerging from the combustion chamber is discharged through outlet pipe **58** to conventional water pipes leading to a conventional domestic hot water heater. It is desirable to maintain continuous circulation of the water from the stove of this invention through the hot water heater either by means of thermosyphoning or by means of pump (not shown). Such pump could be activated by a temperature controlled switch so that circulation occurs only when the stove is hot. It has been found that a slow flow of water is desirable. This permits the flowing water to extract as much heat as is being provided by the stove without unduly cooling down the stove.

While the preferred embodiment comprises a small free standing stove, it will be understood that a preheat sink of the design of this invention may be used in connection with a hot-water boiler, a wood or coal furnace, a cook stove of conventional design, or even a trash burner.

In a further embodiment the heat exchange system using the preheat sink may be employed to heat water for heating purposes rather than for domestic hot water. The use of such system enables heating of more than one room with a free standing wood stove by provision of heating radiators to which the stove is connected.

Other modifications and further embodiments will be apparent to those skilled in the art.

What is claimed is:

1. A solid fuel burning stove comprising

(a) a combustion chamber having openings for introduction of fuel, intake of air and exhaust of smoke;

(b) a tank adjacent said combustion chamber having the top thereof open to the atmosphere;

(c) a heat exchange device positioned in said tank adapted to cause preheating of water circulated therethrough;

(d) a second heat exchange device located in the combustion chamber adapted to heat said preheated water to an elevated temperature, and

(e) suitable conduit means for carrying a flow of water into said first heat exchange device, from said first heat exchange device to said second heat exchange device and therefrom to a hot water distribution system.

2. A stove according to claim 1 which comprises a free standing stove having cooking surfaces at the top thereof and an oven therein for food preparation.

3. A free standing wood-burning stove suitable for residential use for home heating and domestic hot water heating comprising

(a) a combustion chamber having adjustable air intake openings and an exhaust flue suitable for connection to a chimney;

(b) a tank for containing water adjacent to said combustion chamber having the top thereof in communication with the atmosphere;

(c) a heat exchange coil positioned in said tank having an intake means connected to the domestic cold water supply and an outflow pipe leading to;

(d) a second heat exchange means located in the combustion chamber adapted to cause the fire within said chamber to heat water in said heat exchanger to an elevated temperature, and

(e) discharge pipe for carrying a flow of hot water from said stove to a hot water distribution system.

4. A stove according to claim 3 wherein cooking surfaces of different elevations are provided at the top of said stove.

5. Device according to claim 3 wherein a small oven is provided at the top of said stove.

* * * * *

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carbid trägt. Der Ofen wird elektrisch beheizt. Der Stickstoff strömt kontinuierlich der sich drehenden Ringscheibe entgegen, von welcher das fertig azotierte Produkt mittels eines mechanisch bewegten Messers abgenommen wird. *M. Novak* (D. R. P. 305 061, 305 532) führt Azotiergefäße mit elektrischer Innenheizung auf Transportwägelchen durch einen Kanalofen hindurch, so daß seine Konstruktion gewissermaßen eine Kombination zwischen dem *Frank-Caro*- und dem *Polzenius*-System darstellt. Im D. R. P. 312 934 des Elektrizitätswerks *Lonza* in Basel bzw. Gampel ist ein Drehrohrofen gezeichnet, bei dem der überschüssige Stickstoff im Kreislauf durch außerhalb des Ofens liegende Heiz- bzw. Kühlvorrichtungen wieder in den Ofen zurückkehrt. Dadurch wird die Reaktionstemperatur desselben dauernd auf der geeigneten Höhe gehalten und die Wärmewirtschaft ist eine sehr gute. Die Lonzawerke sollen mit diesem oder einem ähnlichen Ofen befriedigend arbeiten.

Den Gedanken von *Tofani* (D. R. P. 246 077) nehmen *Det Norske Aktieselskab for Elektrokemisk Industri* und *Norsk Industri-Hypotekbank* in Kristiania im D. R. P. 314 363 wieder auf, indem sie vorschlagen, das staubförmige Carbid durch ein Stickstoffgebläse in geeigneter Weise in einen Ofen einzuführen, dessen erste Beheizung durch Flammenbögen erfolgt. *Karl, Prinz zu Löwenstein*, und *F. Hauff* zerlegen nach ihrem D. R. P. 318 286 zunächst Methan durch Erhitzen usw. in Wasserstoff und Kohlenstoff. Den Wasserstoff verbrennen sie mit Luft und gewinnen dabei Stickstoff, während sich der Kohlenstoff nach ihren Angaben außerordentlich gut zur Herstellung von Stickstoffbindungsgemischen aus Bariumcarbonat oder aus Kalk und Kohle eignet. Das Patent stellt somit einen Übergang zu den später zu besprechenden Cyanidverfahren dar. Die Reaktionsmassen werden brikettiert und im Revolverofen mit Stickstoff behandelt. Bei 1200 bis 1400° sollen sich Cyanide und Cyanamide bilden. *A. Lang* (D. R. P. 319 798) bläst wiederum Carbidstaub mittels Stickstoffs in den Reaktionsraum ein, der dieses Mal allerdings nicht beheizt ist. Die erforderliche Temperatur wird dadurch erzielt, daß der Stickstoff für sich hoch genug erhitzt wird. — Die Compagnie d'électricité industrielle errichtet übrigens in ihrem Marignacwerk einen kontinuierlichen Ofen mit 20 bis 30 t Kalkstickstoffleistung je Tag.[1]

J. H. Lidholm und die *Dettifoss Power Company, Ltd.* in London wollen so vorgehen, daß sie einem drehbaren Trommelofen[2] Stickstoff und Carbid im Gegenstrom zuführen, der einen guten gegenseitigen Wärmeaustausch gewährleistet. Charakteristisch ist bei ihrer Arbeitsmethode, daß sie den Stickstoff unter Druck[3] (5 bis 10 Atm.) einleiten und ihn gleichzeitig als Triebkraft für die Rotation ausnutzen (D. R. P. 321 618; Franz. Pat. 469045, 469 046). Um das Eintreten der Sinterung zu verhüten, wird von vornherein mit nur 55 bis 60 proz. Carbid gearbeitet oder es wird dem höher-

[1] Chem.-Ztg. 1921, S. 188.
[2] Siehe bei *C. Krauß*, a. a. O.
[3] Metallb. 1920, S. 1202.

(Bruno Waeser: Die Luftstickstoffindustrie. Mit besonderer Berücksichtigung der Gewinnung von Ammoniak und Salpetersäure, Springer Verlag: Berlin und Heidelberg 1922)

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Ausgangsmaterial	% C	Zusätze	Autor und Literatur
46 bis 64% W	1 bis 4	10 bis 33% Fe, 11.5 bis 16% Cr, 5.5 bis 8% Co, bis 4% Si, B, Zr, Ti, N, V, Be, Co. Bis 25% des W können durch Mo, Co durch Ni ersetzt sein	HIRSCH, KUPFER- und MESSINGWERKE A.-G., übertr. von KARL PRINZ ZU LÖWENSTEIN, W. MÜLLER (A. P. 1847617 [1928])
Wolframcarbid	—	Bis 25% Co, bis 3% Th	GENERAL ELECTRIC Co., übertr. von L. WYMAN (A. P. 1822720 [1929])
Wolframcarbid	—	Elektrolytisch abgeschiedenes Fe, Co, Ni, Cr	A. HASSELBACH (F. P. 701944 [1930])

Verfahren zur Formgebung von Hartmetallen.

Processes for Shaping Hard Metal Alloys

Über die Methth. zur Formgebung der Sinterlegg. s. K. BECKER (*Werkstattstechnik* **27** [1933] 175), über die Patentlage s. K. BECKER (*Metallwirtschaft* **12** [1933] 64, 77), über die techn. Anwendung s. K. BECKER (*Hochschmelzende Hartstoffe und ihre technische Anwendung, Berlin* 1933).

Verff. zur Herst. von Werkzeugen aus Hartmetallegg., wie Wolframcarbid und einem niedriger schmelzenden Bestandteil, wie Kobalt, in dem das gepreßte Gemisch bei einer Temp. von 700° bis 1100° vorgesintert und in diesem Zustand auf die endgültige Form bearbeitet wird. Darauf erfolgt eine Hochsinterung bei 1450°, F. KRUPP AKT.-GES., Erfinder K. SCHRÖTER (D. P. 481212 [1925]; Schwed. P. 65409 [1926]; Schwz. P. 120304 [1926]; Tschechosl. P. 24715 [1926]). Die Vorsinterung fällt weg, wenn das Hartmetallpulver unter hohem hydrostatischen Druck allseitig gepreßt wird, WOLFRAM UND MOLYBDÄN A. G. (Schwz. P. 159202 [1932]). — Hartmetallpulver wird mit Lsgg. von Paraffin, Schellack, Bakelit in einem organ. Lösungsm. zu einer Paste verrührt, diese in Formen gepreßt und nach dem Erstarren auf die endgültige Werkzeugform bearbeitet. Danach wird der Formkörper auf etwa 1450° hochgesintert, F. KRUPP AKT.-GES., Erfinder K. SCHRÖTER, H. WOLFF (Schwed. P. 70514 [1929]; Schwz. P. 139552 [1929]). — In einer Anzahl von Patenten sind Verff. zum Aufschmelzen von Hartmetall auf Wolframcarbidbasis auf Werkzeugkörper beschrieben, F. KRUPP AKT.-GES. (F. P. 706043 [1930]), W. I. RISKIN (Russ. P. 21443 [1930]), W. D. ROMANOW, W. I. RISKIN (Russ. P. 22985 [1930]), P. L. & M. Co., übertr. von H. J. MORGAN (E. P. 317361 [1929]). — Über Verff. zur Herst. von Hohlkörpern aus Hartmetallegg. mit einem Stahlkern s. F. KRUPP AKT.-GES. (F. P. 705132, 705134 [1930]) und mit einem Kohlekern, F. KRUPP AKT.-GES. (D. P. 549731 [1930]). — Um eine geeignete Korngröße und eine gute Durchmischung des Wolframcarbids und des Hilfsmetalls zu erzielen, werden beide Komponenten vor dem Pressen und Sintern unter Zusatz einer nicht oxydierenden und bei niedriger Temp. unzersetzt verdampfenden, organ. Fl. in Kugelmühlen vermahlen, F. KRUPP AKT.-GES., Erfinder K. SCHRÖTER, H. WOLFF (D. P. 531921 [1930]). — Zweckmäßig sollen die Ausgangsstoffe wie Wolframcarbid und Co eine Korngröße von weniger als 0.0001 mm haben, F. KRUPP AKT.-GES. (Schwz. P. 130203 [1927]); s. K. BECKER (*Koll. Z.* **63** [1933] 373).

Wolframcarbonyle.

Tungsten Carbonyls

CO von sehr niedrigem Druck reagiert mit Wolframdraht bei hohen Tempp. analog dem N unter Vereinigung des vom Faden abgegebenen einatomigen Wolframdampfes mit je einem Mol CO, wahrscheinlich unter Bildg. einer Verb. WCO; der Temperaturkoeff. der Rk. ist negativ, I. LANGMUIR (*J. chem. Soc.* **37** [1915] 1159). Auch das bei elektr. Entladungen beobachtete Verschwinden von CO an glühendem Wolframdraht (clean up) kann nach N. R. CAMPBELL, J. W. H. RYDE (*Phil. Mag.* [6] **40** [1920] 602, 607) möglicherweise zur Bildg. einer Verb. WCO führen. S. dagegen N. R. CAMPBELL (*Phil. Mag.* [6] **41** [1921] 688).

Über ein techn. Verf. zur Herst. von W-Carbonyl aus wolframhaltigen Ausgangsstoffen, die vor der Druckbehandlung mit CO einer reduzierenden Behandlung in Ggw. von Schwermetallen, wie Fe oder Cu, unterworfen werden, s. I. G. FARBENINDUSTRIE AKT.-GES. (F. P. 708260 [1930]; *C.* **1931** II 2041).

R. J. Meyer [Deutsche Chemische Gesellschaft] (Hg.): Gmelins Handbuch der anorganischen Chemie: Wolfram, 8. A. , Berlin Heidelberg 1933

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(S. 292)

Karl Prinz zu Löwenstein und *F. Hauff* schlagen im D. R. P. 318 286 vor, den Kohlenstoff, der durch Erhitzen aus Methan ausgeschieden wird, mit (z. B.) Bariumcarbonat zu mischen, dann zu brikettieren und diese Briketts in Revolveröfen bei 1200 bis 1400° mit Stickstoff zu behandeln. Die Spaltung des Methans liefert neben Kohlenstoff auch Wasserstoff, der, mit Luft verbrannt, sofort heißen Stickstoff erzeugt.

(S. 413: Die Cyanidverfahren)

Quelle: Bruno Waeser: Die Luftstickstoff-Industrie. Mit besonderer Berücksichtigung der Gewinnung von Ammoniak und Salpetersäure, Leipzig 1922

Vgl. Paul Askenasy/Frithjof Grude: Über die Einwirkung von Stickstoff auf die Gemenge aus Bariumoxyd und Kohle bei hoher Temperatur, in: Zeitschrift für Elektrochemie, Bd. 28 (1922), S. 130 ff.

Vgl. Sander: Polytechnische Schau, in: Polytechnisches Journal, Bd. 337 (1922), S. 239: „Ein beachtenswertes neues Verfahren zur Gewinnung von Zyanverbindungen aus dem Luftstickstoff unter Verwendung von Methan bezw. seiner Spaltprodukte beschreiben Prinz Karl zu Löwenstein und Dr. Fr. Hauff in dem DRP 318286. Methan wird bekanntlich bei Temperaturen von mehr als 1000° glatt in Wasserstoff und Kohlenstoff von hoher Reinheit gespalten. Wenn man den so gewonnenen Kohlenstoff nun mit Bariumkarbonat mischt oder aus diesem Gemisch Briketts formt und diese hierauf im Stickstoffstrom auf 1100–1300° erhitzt, so verbindet sich der Stickstoff, wie schon Margueritte und Sourdeval im Jahre 1862 fanden, mit dem Baryt und dem Kohlenstoff zu Bariumzyanid, aus dem durch Umsetzung mit Pottasche in guter Ausbeute Zyankalium gewonnen wird, wobei als Nebenprodukt wiederum Bariumkarbonat erhalten wird. Infolge der großen Reinheit des aus Methan abgeschiedenen Kohlenstoffs ist das Bariumkarbonat nicht wie sonst durch Schlacke verunreinigt und kann ohne weiteres wieder

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zur Bildung von Zyanid benutzt werden. Die für den Prozeß erforderliche Wärme liefert der gleichfalls aus dem Methan abgeschiedene Wasserstoff, bei dessen Verbrennung mit der genau berechneten Luftmenge ein Gemisch von Wasserdampf und Stickstoff entsteht. Durch Kühlung der Verbrennungsgase wird der Wasserdampf kondensiert und es bleibt reiner Stickstoff übrig, der seinerseits für die Gewinnung des Bariumzyanids Verwendung findet. Das neue Verfahren bietet somit durch die Reinheit des aus dem Methan abgeschiedenen Kohlenstoffs und Wasserstoffs sowie durch die Wiederverwendung sämtlicher Nebenprodukte gegenüber den bisher benutzten Verfahren große wirtschaftliche Vorteile und ermöglicht mit einfachen Mitteln die Schaffung einer Luftstickstoffindustrie in der Umgebung von Naturgasquellen.“

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