(No Model.)

2 Sheets—Sheet 1.

E. LUHMANN.

APPARATUS FOR MAKING CARBON DIOXID.

No. 507,143. Patented Oct. 24, 1893.

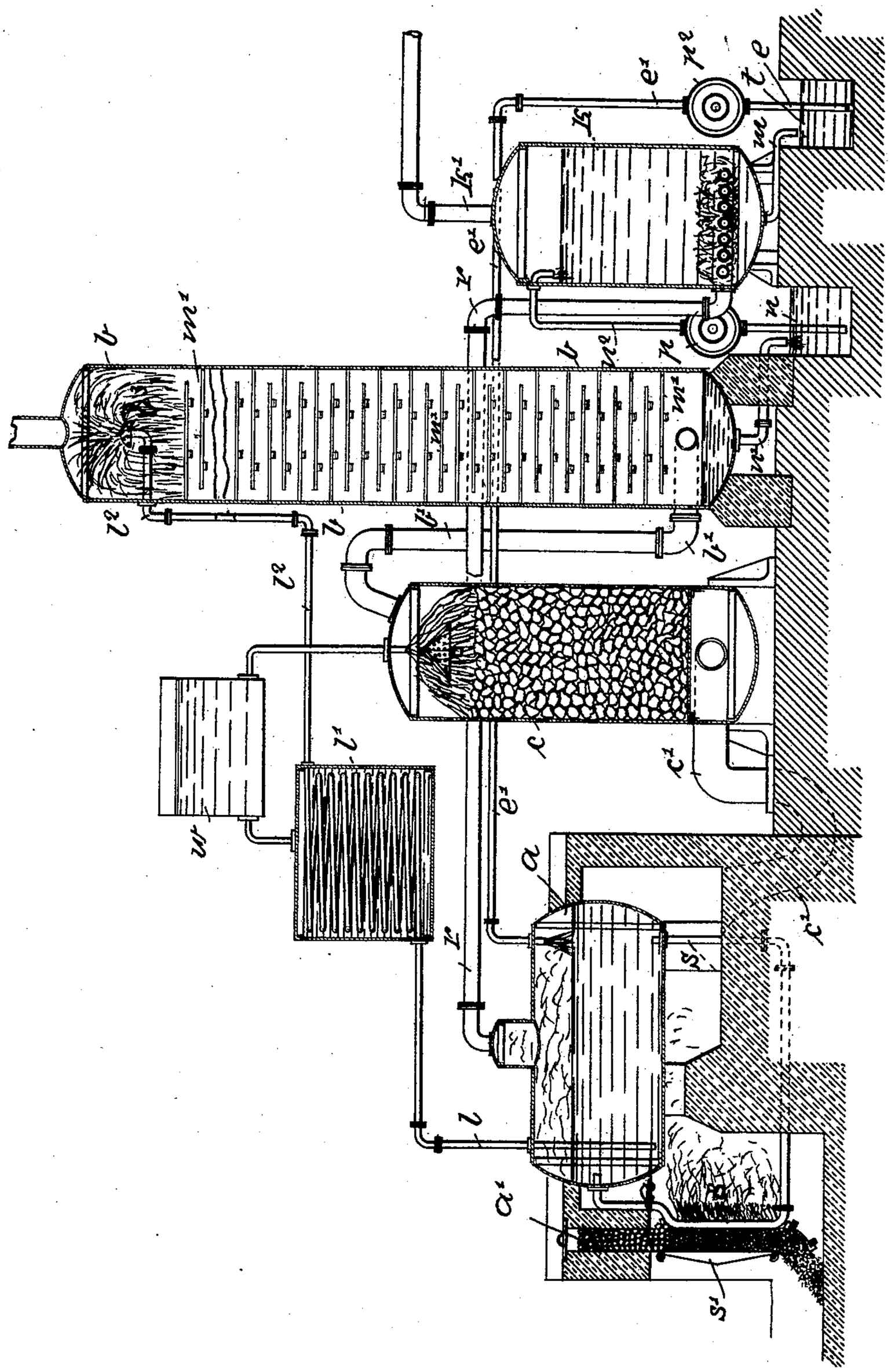

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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APPARATUS FOR MAKING CARBON DIOXID.

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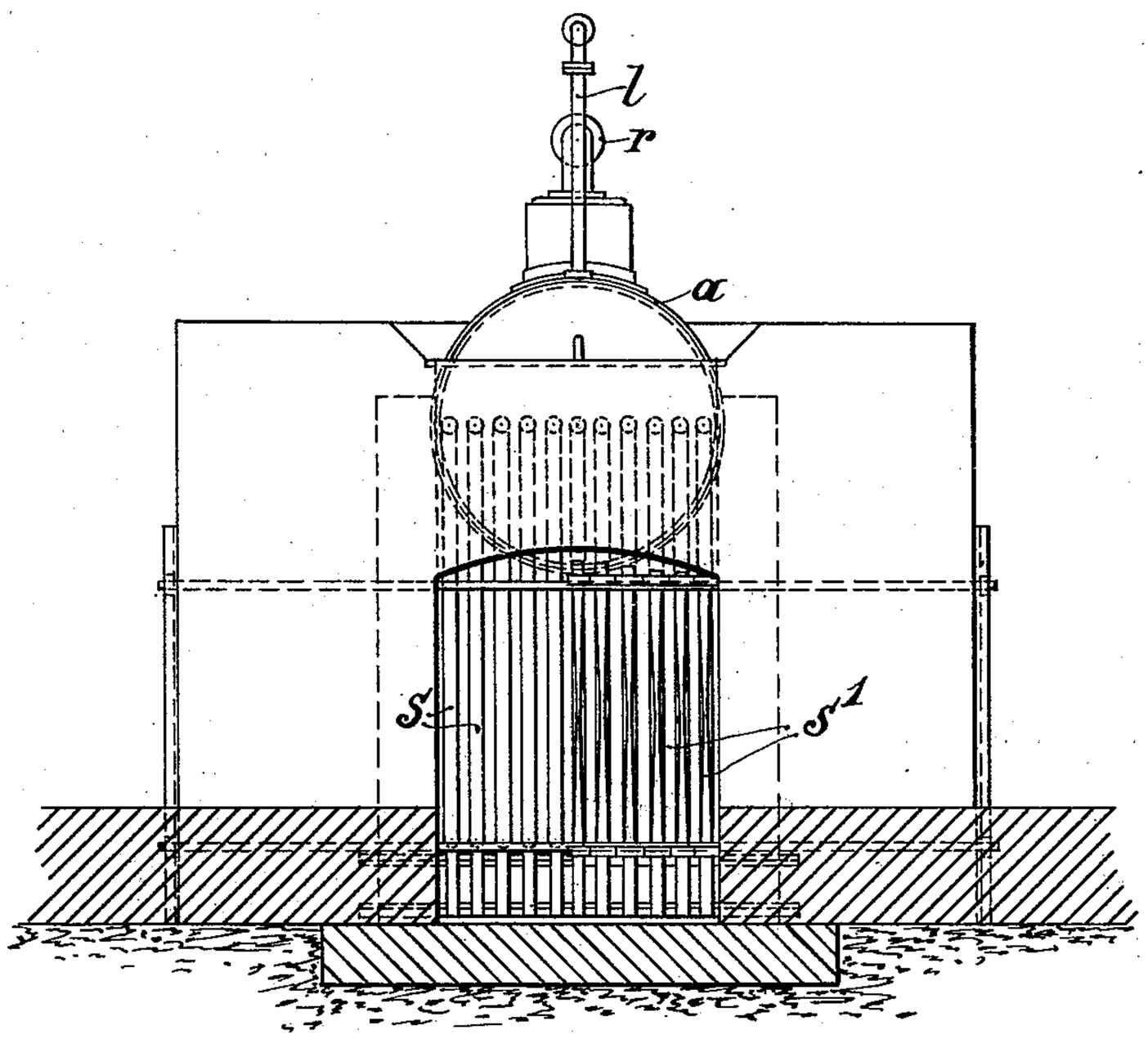
Fig: 2.



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UNITED STATES PATENT OFFICE.

EDUARD LUHMANN, OF ANDERNACH, GERMANY.

APPARATUS FOR MAKING CARBON DIOXIDE.

SPECIFICATION forming part of Letters Patent No. 507,143, dated October 24, 1893.

Application filed July 11, 1891. Serial No. 399,252. (No model.)

To all whom it may concern:

Be it known that I, EDUARD LUHMANN, a subject of the King of Prussia, German Emperor, and a resident of Andernach, in the Province of the Rhine, Kingdom of Prussia, Empire of Germany, have invented a new and useful Apparatus for Producing Carbonic Acid from Bicarbonate of Soda, of which the following is a full, clear, and exact specification.

My invention relates to an apparatus for rationally performing the processes for the production of carbonic acid as described in my applications filed July 11, 1891, Serial Nos. 399,250 and 399,251. These processes consist in decomposing solutions of bicarbonate alkalies in two stages, and in continuously regenerating the decomposed liquid by causing it to absorb carbonic acid gas.

My improved apparatus as described further on is constructed more especially for performing the process as described in my application filed July 11, 1891, Serial No. 399,251, that is to say, the decomposed liquid is caused to absorb the combustion gases proceding from the coke furnace heating the boiler, which contain of course carbonic acid gas.

In the annexed drawings Figure 1 is a longitudinal sectional elevation of my improved apparatus; Fig. 2 a detail cross-sectional view of the coke furnace.

Similar letters denote similar parts throughout both views.

The closed boiler *a* is placed within a furnace of any suitable construction, from which the gases of combustion are conducted by means of a pipe *c'* into a washing and cooling apparatus *c* filled with fragments of marble. A pipe *l* is passed through a suitable hole in the shell of the boiler, at or near the top of the same, and reaches down almost to the bottom of the same. The pipe *l* leads into a cooling tank or cooler *l'*, in which it forms a coil, and leaves the same by means of the pipe l^2, which is connected with the absorption tower *b* and provided at its extremity, in the upper part of the said tower *b*, with a rose b^3 directed upward. This absorption tower *b* is provided with a large number of parallel disks *m'* preferably horizontal, and placed after the fashion of alternately overlapping steps, so as to produce a zig-zag path. A pipe *n'* leads from the bottom of the mentioned absorption tower *b* to the collecting vessel or tank *n* in the lower part of the absorption tower *b*, below the undermost of the disks *m'*.

I provide another pipe *b'* which communicates with the top of the washing and cooling apparatus *c*, and in which I may insert a fan or blower (not shown on the drawings). Above the said washing and cooling apparatus *c* and the cooler *l'*, I place a reservoir *w*, from the lower part of which one pipe leads into the cooler *l'*, and another pipe, terminating with a rose, into the washing and cooling apparatus *c*. The latter is hermetically closed. Above the collecting tank *n* there is provided a forcing pump *p*, from which a pipe descends into said tank *n*, while another pipe n^2 leads up from the pump *p* into the upper part of a boiling vat *k*. In the lower part of the latter I arrange several perforated tubes, which are all in communication with the pipe *r* coming from the dome at the top of boiler *a*. At the top of the boiling vat *k* I provide a pipe *k'* communicating with a cooler and with a condensing trap, from which the water is discharged into the tank *t;* the pipe *k'* also connects with a gasometer. The cooler, condensing trap, and gasometer are not shown on the drawings, being of usual construction. Into the tank *t* are also led the pipes *m* and *e*, the former being in communication with the lower part of the boiling vat *k*, and the latter with a forcing pump p^2, from which a pipe *e'* leads into the boiler *a*. In front of the latter I have provided an upright tray-shaped coke furnace *a'*, the front part of which is formed by fire bars *s'* of usual construction, while the rear part is constituted by a series of tubes *s* communicating by one end with the front part of the boiler *a*, and by the other end with the bottom of the same.

My improved apparatus is employed as follows: The boiling vat *k* is filled with a bicarbonate of soda solution of 10° Baumé (or a bicarbonate of potash solution of 17° Baumé). The reservoir *w* and the cooler *l'* are filled with water. Boiler *a* is likewise partly filled with a weak lye of carbonate of soda (or of potash respectively). The boiler *a* is then heated by means of the coke furnace *a'*, till the lye boils

thoroughly and the steam evolved escapes through the pipe *r* into the boiling vat *k*, carrying along with it a small proportion of carbonate of soda. As the boiler *a* is closed, the lye to be boiled therein may be exposed to a pressure, of from two to two and a half atmospheres which is requisite and advantageous for expelling perfectly the carbonic acid from the lye. It will be obvious that the circulation of the brine also facilitates and accelerates its heating.

In practicing the process in question, attention should be paid to the fact, that the combustion-gases arising from the coke-furnace contain the greatest quantity of carbonic acid gas, and, at the same time, the purest carbonic acid gas (with regard to the absence of carbonic oxide) when the fire is kept at a dull red heat. The lye, which is thus brought to boil, rises in pipe *l* and flows through the serpentine coil placed in the cooler *l'*, where it is brought to the temperature which will enable it to absorb the maximum amount of carbonic acid. Hereafter the lye proceeds through the connecting pipe l^2 to the absorption tower *b* and issues in the top of the same through the rose b^3 provided at the end of the pipe. At the same time the combustion gases from the coke furnace *a'* heating the boiler *a*, which gases contain of course carbonic acid, kept pure as described, enter the washing cylinder *c* at the lower part of the same by the pipe *c'*. The fragments of marble with which this cylinder is filled are continuously kept moist by a fine shower of water coming from the reservoir *w*. The carbonate of soda solution as it runs over the numerous disks *m'*, which provide large surfaces, is brought into close contact with the carbonic acid coming from the opposite direction, and which in this state has great absorbent power, so that the solution reaches the lower part of the absorption apparatus fully saturated with the carbonic acid gas. The rose b^3 is arranged in such a way as to allow fine jets of the solution emanating from same, to be still further brought into contact and to absorb any carbonic acid which might remain free after having passed the absorption apparatus, thus avoiding all waste of carbonic acid. The bicarbonate of soda solution thus obtained leaves the absorption tower *b* by the pipe *n'* and flows into the collecting vessel or tank *n*, whence it is conveyed into the boiling vat *k* by means of the pump *p* and through the pipe n^2. The boiling vat *k* is heated by means of the steam emanating from the boiler *a* and entering the same through the perforated pipes located at the bottom. The steam then heats and decomposes the brine to such an extent that it gives off most of the available carbonic acid which it contains, which becomes mixed with that carried away with the steam from boiler *a*. The carbonic acid which is thus freed passes through pipe *k'* into a cooler supplied with water from a suitable reservoir and thence into the condensing trap, from which the condensation water is discharged into the tank *t;* the carbonic acid gas is conducted to the gasometer. By discharging the condensation water into tank *t* a uniform concentration of the brine is maintained. This is absolutely necessary, as otherwise the lye would become so dense, as to be unable to retain the salt in solution, but would throw it off and clog the pipes. The hot lye coming from the boiling vat K, and which runs out of same into the vessel *t* through the pipe *m*, is not yet freed of all the bicarbonate of soda which it holds in solution. It is still to a certain extent undecomposed and would not only, if used again in that state, hamper the production of carbonic acid gas to a great extent, but it would be very difficult to regenerate this mixture of normal and acid carbonate into bicarbonate or sesquicarbonate of soda, that is to say, that this solution of small absorption would greatly impede the further processes. To avoid this the said mixture is taken up by the pump p^2 by means of pipes *e e'* and pumped into boiler *a*.

It will be understood that the process is a continuous one, and therefore may be kept up for any length of time, but it is preferable for practical reasons that the boiling should be continued for one hour at least.

Having thus fully described the nature and manner of performing my said invention, I declare that what I claim, and desire to secure by Letters Patent of the United States, is—

In an apparatus for the production of carbonic acid gas: the combination with the closed boiler *a*, heated by a coke furnace *a'*, the boiling vessel *k*, connected with the boiler *a* by the pipe *r*, of a cooling-and washing-apparatus *c*, fed by the gases of the furnace *a'*, and a cascade-like absorption-tower *b*, having an outlet pipe and being connected on one side with the boiler *a* by the pipe l^2, having at its end a rose b^3, and on the other with the cooling-apparatus *c* by the pipe *b'*, substantially as and for the purpose described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EDUARD LUHMANN.

Witnesses:
OTTO BRAEGER,
WILLIAM OELRICHS.