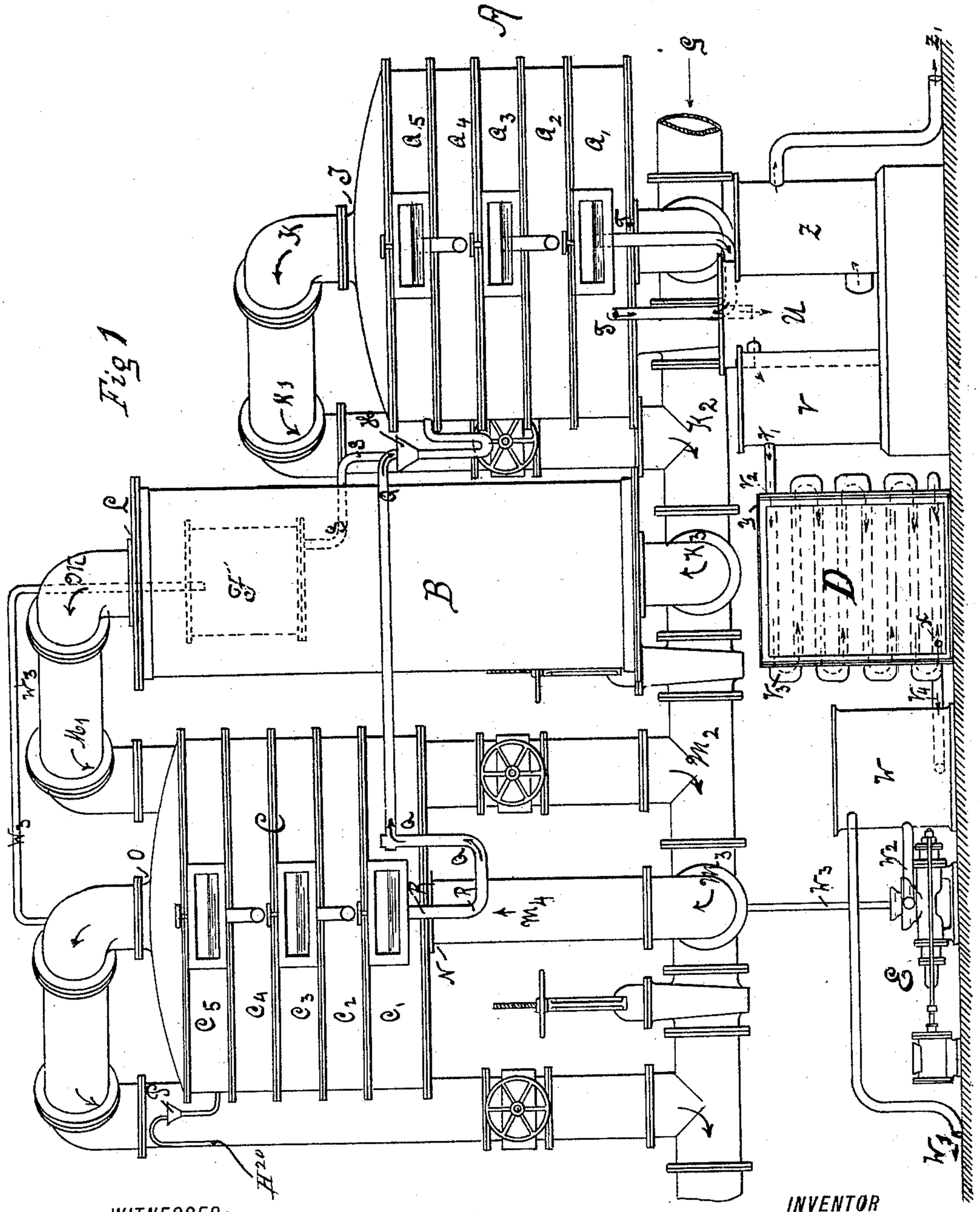
(No Model.) 2 Sheets—Sheet 1.

F. BREDEL.

PROCESS OF AND APPARATUS FOR PURIFYING GAS.

No. 467,605. Patented Jan. 26, 1892.

Fig 1



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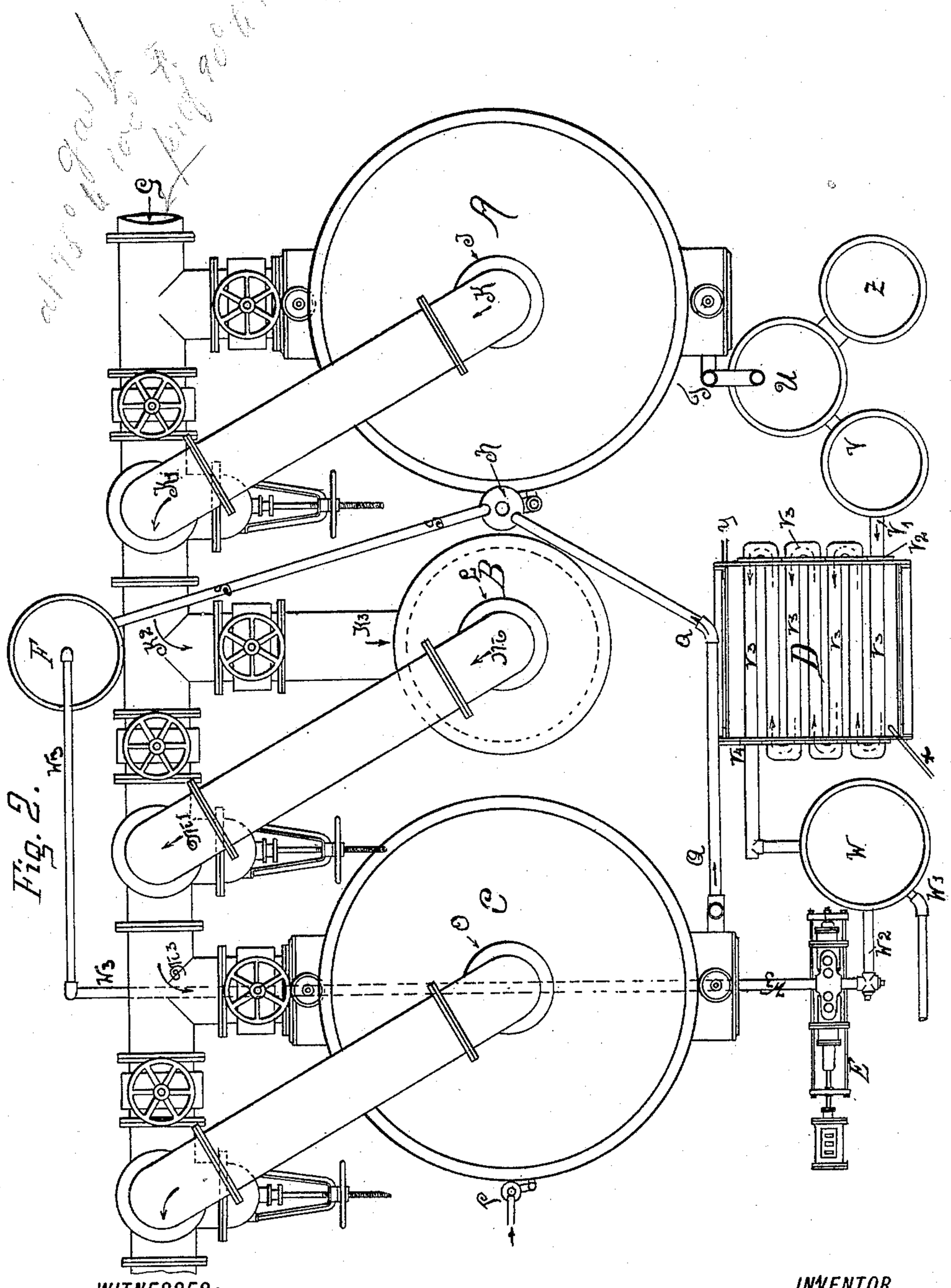

Fig. 2.

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UNITED STATES PATENT OFFICE.

FREDERICK BREDEL, OF MILWAUKEE, WISCONSIN.

PROCESS OF AND APPARATUS FOR PURIFYING GAS.

SPECIFICATION forming part of Letters Patent No. 467,605, dated January 26, 1892.

Application filed July 25, 1891. Serial No. 400,726. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK BREDEL, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Cooling and Purifying Illuminating-Gas; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improved method of eliminating the impurities of the gas in such a way and at such a time of the process that the heavier illuminants cannot be absorbed by tar. These impurities are tar, carbonic acid, sulphureted hydrogen, bisulphide of carbon, ammonia, and other sulphur compounds. The illuminants are propene or propylene, butene or butylene, &c., and benzol and naphthaline vapors, which latter give the gas a great illuminating power, but which are readily absorbed by tar as soon as the temperature of the tar falls below 95° Fahrenheit. This new process and apparatus removes the tar in such a way that the gases cannot come in contact with the tar-wetted surfaces when the cooling and purifying process proper begins.

Having now given a general outline of the process, I will now commence to describe same.

On the annexed sheets of drawings the apparatuses are shown in different sections. Figure 1 is a side view, and Fig. 2 a plan, of the apparatus.

Same figures always have reference to the same apparatus or part of apparatus.

A is a washer, which will hereinafter be called the "cooling-washer;" B, the compensator; C, the ammonia-extractor; D, the cooler; E, the pump, and F the storage-tank. The cooling-washer A and ammonia-extractor C are apparatuses of the style known as "immersion-washers," and similar to the one on which Letters Patent were granted, under No. 380,040, to Mr. Aug. Kloenne, of Dortmund, Germany, under date of March 27, 1888. The compensator is similar to an apparatus known as a "gas-condenser and tar-separator," for which Letters Patent were granted to me, No. 388,474, dated August 28, 1888. The cooler D is a surface condenser—an apparatus similar to one for cooling and condensing anhydrous ammonia-vapors used in ice and cold-storage factories. Pump E is a pump specially constructed for pumping ammoniacal liquor or gas-water. Storage-tank F is an ordinary storage-tank, into which the cool ammoniacal liquor is pumped. All the pipes and valves shown on the different plans are so arranged that the gas and ammoniacal liquor can be conveyed from one apparatus to the other with the necessary amount of by-pass valves to enable the by-passing and cleaning of one apparatus while the others are in use, and which will readily be understood by anybody familiar with the manufacture of gas.

I will now commence to describe the process. The gas, after it has been manufactured in the retorts or producer and having passed the exhausters, passes a friction or air or water surface condenser, or both or all three apparatuses, which are not shown in this plan; but it is not absolutely necessary to use one of these latter three apparatuses as long as the gas reaches the inlet G at a temperature of from 75° to 100° Fahrenheit, preferably at from 90° to 100° Fahrenheit, and as long as the mechanical impurities—such as coke-dust, heavy pitch, &c.—have been removed, which can be done by either one of the aforesaid condensers or by the necessary length of gas-mains, as the gas will deposit all these impurities in a very short time by passing through conduits. From G the gas enters into the cooling-washer A in its bottom section A′, where it immediately has to plunge through ammoniacal liquor, whereby part of the tar drops into the liquor without having a chance to absorb any of the heavy hydrocarbons mentioned in my general explanation. The temperature of the gas is thereby lowered also. The gas then passes consecutively into the sections A^2 A^3 A^4 A^5, where it loses all its tar, and, as said before, all the carbonic acid and as much sulphur as the ammoniacal liquor, which enters at H and which contains a great amount of caustic am-

monia, is able to absorb and transform into carbonates and bicarbonates of ammonium and sulphates and bisulphites of ammonium. The gas in the meantime has given up part of its heat to the ammoniacal liquor and leaves the cooling-washer at I at a temperature of from 60° to 70°, and is absolutely free of tar, which it generally is already after passing section A^2 or A^3. The sections in the cooling-washer are not limited to five, but can be more or less. The gas passes from I through the pipes, following direction of arrows K K′ K^2 K^3, and enters the compensator B. The gas there is kept at an even temperature of 60° Fahrenheit, and this compensator has only the duty to fulfill of keeping the gas as near as possible to a steady temperature of 60°, which otherwise would not be possible, as the flow of ammoniacal liquor which enters at H is nearly constant, while the quantity of gas manufactured at different periods during a twenty-four-hours run is always variable. For economy's sake this compensator might be omitted, but it is advisable not to. The gas leaves the compensator at L, follows the direction of arrows M M′ M^2 M^3 M^4, and enters the ammonia-extractor at N and passes the different sections C′ C^2 C^3 C^4 C^5 of said ammonia-extractor C, consecutively, and leaves the extractor at O free of ammonia. This apparatus is also not limited to five compartments, but might consist of more or less.

To extract the ammonia, clear water, as free as possible of lime, is admitted at P. This water flows from section to section in the way described in the aforesaid patent, No. 380,040, till it leaves the ammonia-extractor C at R. It is then thoroughly charged with the ammonia originally contained in the gas, and partly with sulphates of ammonium. From R it flows in the direction of arrow Q and enters the cooling-washer A at H, together with other ammoniacal liquor, coming from storage-tank F through pipes S. It goes then from section to section, as described in Patent No. 380,040, till it leaves the first section A′ of cooling-washer A at T. The water has naturally taken up part of the heat originally contained in the gas. At T it goes into a tar and light-oil separator U, where the tar and light oil are separated from the liquor and flow through Z and Z′ to the tar-well, while the ammoniacal liquor leaves the separator U and goes through V and pipe V′ and enters the cooler D at V^2, and passing through the pipes V^3, which are continually cooled by cold water, it is cooled down to between 60° and 65° Fahrenheit. After the ammoniacal liquor leaves the cooler at V^4 it goes into distributing-tank W, where a quantity of ammoniacal liquor equal to a quantity of clear water admitted at P is discharged at W′ into the ammonia-well, and the balance passes through pipe W^2 into pump E, and is then forced through pipe W^3 into storage-tank F and repeats the process. The position of pump E may be at option either ahead of or after cooler D. Also tank W may be ahead of cooler D, at option.

Instead of using only one cooling-washer A, it might under certain conditions be advisable to use two, either together or consecutively. It is not necessary to use a cooling-washer A or ammonia-extractor C of the construction shown and described in Letters Patent No. 380,040, for any good plunger or immersion washer might be substituted for either of them, and if a rotating washer should be available such a one may be substituted for ammonia-extractor C. For compensator B any multitubular condenser having sufficient water capacity might be substituted. For cooler A any water-cooler might be substituted. If it is deemed advisable to remove all the sulphur impurities out of the gas with this purifying-machine, it is necessary that there should be enough ammonia in the gas to chemically bind all the carbonic-acid and sulphur compounds contained in the gas. This condition is scarcely ever fulfilled. To increase the capacity of this purifying-machine it is necessary to make more caustic ammonia available to do this work. This is done by letting all the ammoniacal liquor which comes from the hydraulic main and condensation ahead of this machine, which liquor contains a large amount of caustic ammonia, enter either by gravity or by pumping it into any of the compartments of the washers A or C, preferably in compartments C^2 C′ or A^5. It naturally must not be introduced in C^4 or C^5. This introduction can be done in any way which might suggest itself, or as shown on plan 1 at P and H; but this amount of caustic ammonia will generally not be sufficient to free the gas of all its impurities, as it forms carbon and sulphur compounds of ammonia. If, therefore, the complete purification of the gas by this apparatus is deemed necessary and advisable, instead of, as it is now generally done, passing the gas through iron-oxide or lime purifiers after leaving this apparatus, an additional quantity of caustic ammonia in the shape of either aqua-ammonia in its crude or purified state or in the shape of anhydrous ammonia, the latter preferable in gas form, has to be procured.

As there are different processes well known to everybody conversed in the art, I will not try to explain the processes of manufacturing either aqua or anhydrous ammonia here, but only the way they have to be used. If aqua-ammonia is used, it is preferable to use a weak solution not containing more than from ten to eighteen per cent. of ammonia, (NH_3,) as otherwise the loss by evaporation would be too great. This solution could best be introduced in the necessary quantities at either C′, A^5, or A^4. If anhydrous or an ammonia gas is used, then it should best be mixed with the gas before it enters the cooling-washer A. The quantity of ammonia required for the complete purification of the gas

would differ according to the impurities originally contained in the gas manufactured, as all the time sufficient ammonia has to be present to absorb by neutralization or chemical combination the impurities of the crude gas.

I am perfectly aware that plunger-washers have been used before, but do not know, to my best knowledge and belief, that they have ever been used for cooling the gas, by which is meant to bring the gas from a high temperature to such a temperature where the rational elimination of ammonia is possible. This work has up to now been done by what is known as "air" or "water" condensers, which offered the passing gas large tar-wetted surfaces, which tar being at a lower temperature than the passing gas readily absorbs the heaviest of the olefiant gases and the benzol and naphthaline vapors, which latter are the best illuminants. Furthermore, by so chilling the gas in the presence of tar the condensation into and formation of naphthaline crystals, commonly known as "naphthaline," is made possible, while, as is done in my apparatus and process, the formation of such naphthaline crystals by cooling the gas through the medium of direct contact with more or less caustic ammoniacal liquor becomes impossible, and the naphthaline or benzol vapors remain as a more or less permanent vapor in the gas.

In the following claims the cooling of the gas is always understood to be the process of bringing the gas safely over its critical cooling moments, which lie for the formation of naphthaline crystals below 95° Fahrenheit in the presence of tar, and which formation is impossible when all the tar is removed by immersion of the gas in more or less caustic ammoniacal liquor before it reaches the temperature of 74° Fahrenheit.

Having thus described the process and different apparatuses used, I claim as new and as my invention—

1. The process of cooling and completely or partly purifying coal or carbureted water-gas, which consists in passing the gas through an immersion or plunger washer while it is yet at a temperature which would prevent the partial condensation of benzol and naphthaline vapors or the absorption of same by tar, cooling the gas gradually by immersion in and passing through ammoniacal liquor, and then passing it through an ammonia-extractor of any form, substantially as and for the purpose specified.

2. The combination of a cooling-washer A, a compensator B, an ammonia-extractor C, cooler D, pump E, with storage-tank F, substantially as and for the purpose specified.

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

FREDERICK BREDEL.

Witnesses:

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FRANK M. HOYT.