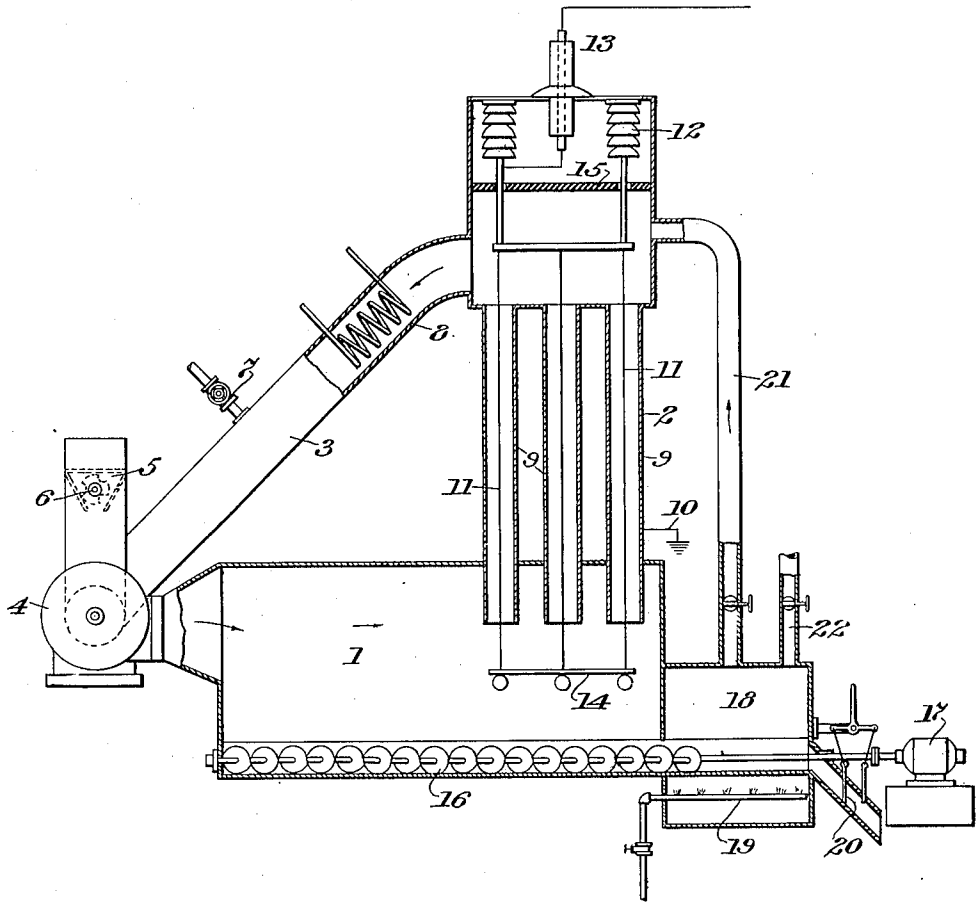
L. BRADLEY.

PROCESS AND APPARATUS FOR EFFECTING GAS REACTIONS.

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1,291,745. Patented Jan. 21, 1919.



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PROCESS AND APPARATUS FOR EFFECTING GAS REACTIONS.

1,291,745. Specification of Letters Patent. Patented Jan. 21, 1919.

Application filed April 30, 1918. Serial No. 231,712.

To all whom it may concern:

Be it known that I, LINN BRADLEY, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Processes and Apparatus for Effecting Gas Reactions, of which the following is a specification.

This invention relates to that class of chemical reactions in which one at least of the reacting bodies is a gas, and comprises a process of carrying out such reactions in a highly efficient, economical and rapid manner. The invention comprises also an apparatus useful in the performance of said process. An important characteristic of my process is that the gaseous reagent may, without waste or loss, be maintained in any desired excess of the reacting proportions, whereby the acceleration of the reaction due to mass may be availed of. Furthermore, the gaseous reagent is or may be kept in continuous movement at any desired velocity, whereby certain important functions are accomplished, including the mixing of the reacting bodies, the conveying of reacting bodies or reaction products, and the like.

For a full understanding of my invention reference is made to the accompanying drawings, wherein the figure is a view in vertical section of a closed conduit-system embodying my invention.

In the particular embodiment of my invention chosen for illustration the closed conduit-system is arranged in the general form of a triangle of which the reaction- or fume-chamber 1 forms the horizontal leg or member; the electrical precipitator 2, the vertical member; and the return-flow conduit 3, the inclined member. Obviously, this particular arrangement may be varied as desired. 4 is a blower, receiving the gas from the conduit 3 and impelling it as a current or stream of controllable velocity through the reaction chamber 1 and the precipitator 2. The material upon which the gas is to react or with which it is to unite is conveniently introduced into the system at the blower 4, for example by means of a hopper 5, which may be provided with a feed-wheel 6 of any appropriate construction. 7 represents a valved gas-inlet through which additional quantities of the reactive gas may be introduced to compensate for the absorption and to maintain any desired pressure, whether atmospheric, or above or below atmospheric. In regard to regulation of pressure, of temperature, and of gas-velocities, this closed conduit-system affords the widest latitude. Heating or cooling means may be provided at any desired point or points in the circuit, as exemplified for instance by the coil 8 in the conduit 3.

The electrical precipitator 2 may be of any desired type, that illustrated comprising multiple vertical tubes 9 grounded at 10 and constituting the collecting electrodes; the discharge electrodes comprising vertical, axial wires or rods 11 carried by an insulated frame 12 and connected through the insulated conductor 13 with a source of high tension current. I prefer to use a direct current of which the discharge electrodes constitute the negative pole. 14 indicates a weight or other suitable tensioning device for the wires 11. 15 is an insulating plate or diaphragm serving to protect the insulators from dust and conductive deposits. 16 is a screw conveyer operated by a motor 17 and serving to withdraw the deposited matter from the bottom of the reaction chamber 1, as well as from beneath the precipitator 2.

The apparatus may be operated without adjuncts other than those described above, and is useful for a wide variety of reactions involving a gas. As one example of such a reaction I will mention the following:—

Sulfur dioxid is precipitated from smelter fumes by injecting into the fume minimum quantities of ammonia. For the sake of economizing ammonia and reducing losses it is desirable to use in this operation only sufficient ammonia to yield, with the sulfur dioxid of the smelter fume, the bisulfite, NH_4HSO_3. This bisulfite, which may be recovered from the flue gases by electrical precipitation in the form of a solid, is thereafter converted successively into normal ammonium sulfite by reaction with ammonia in excess; and into sulfate by atmospheric oxidization of the normal sulfite. The apparatus described is applicable for carrying out both of these latter reactions. For instance an atmosphere of ammonia is maintained in circulation throughout the system, while powdered ammonium bisulfite is fed in through the blower 4. The excess of ammonia quickly transforms the bisulfite to the normal salt, which is completely removed

from the gas-stream by the action of the precipitator 2. The after-transformation of the normal sulfite into sulfate may be similarly accomplished in the same or similar apparatus by means of a circulating stream of air or oxygen at the appropriate temperature.

In certain cases, notably in the formation of normal ammonium sulfite as described above, some excess of ammonia is absorbed by the salt; and this excess is desirably returned to the circulating stream. I accomplish this in the present instance by the provision of a heating chamber 18 in which the recovered salt is warmed, for example by a burner 19, while being conveyed to the sealed discharge chute 20. The excess of ammonia is thereby expelled from the salt, and is returned to the system, for example through the valved conduit 21. 22 indicates a valved connection to the heating chamber, which may serve at will for exhausting or filling the apparatus.

It will be understood that the treatment of ammonium bisulfite is only one of many possible applications of the apparatus. For example it is useful for the treatment of the potash-containing dust recovered from cement kilns or blast furnaces for the purpose of converting the potash-content thereof into the form of chlorid by charging the dust into a flowing stream of hydrochloric acid. Similarly the apparatus may be used for chloridizing ores.

It will also be understood that the material introduced into the gas-stream for the purpose of reacting therewith may be either a solid, a liquid, or a gas, provided only the reaction product is non-gaseous and therefore susceptible of being precipitated by the high-tension electrical apparatus. For example ammonium bromid may be formed and recovered by introducing bromin vapors into a circulating atmosphere containing ammonia.

The value of this closed conduit-system in the accomplishment of gas reactions will be appreciated from the foregoing. The system permits the gaseous reagent to be maintained at all times at any desired concentration, and used in any desired volume (mass), and under any desired condition of temperature and pressure. It avoids loss of the gaseous reagent, and lends itself readily to the use of dangerous or otherwise objectionable gases. It also affords the mechanical and chemical advantages which may be secured by a thorough and rapid intermingling of the reacting bodies, the intermixing being secured not only in the reaction chamber proper, but also under the very intense mixing action of the electrical precipitator.

I claim:—

1. A closed-cycle apparatus for gas-reactions, comprising a closed conduit-system, means for supplying a gas to said system and circulating it therethrough, means for introducing into the gas-stream a substance yielding therewith a non-gaseous reaction product, and an electrical precipitator arranged in the line of gas-flow for collecting said reaction product.

2. A closed-cycle apparatus for gas-reactions, comprising a closed conduit-system, means for supplying a gas to said system and circulating it therethrough, means for introducing into the gas-stream a substance yielding therewith a non-gaseous reaction product, an electrical precipitator arranged in the line of gas-flow for collecting said reaction product, means for expelling an excess of the reagent from the reaction product, and means for returning the expelled excess to the conduit-system.

3. A process of effecting gas-reactions, comprising maintaining a reactive gas in movement through a closed circuit, introducing into the gas-stream a substance yielding therewith a non-gaseous reaction product, and electrically precipitating said reaction product from the gas-stream at another point in the line of flow thereof.

In testimony whereof, I affix my signature.

LINN BRADLEY.