C. CONOVER.

APPARATUS FOR BRINGING ABOUT AND CONTROLLING REACTIONS BETWEEN GASES.

APPLICATION FILED APR. 30, 1919.

1,363,955. **Patented Dec. 28, 1920.**

2 SHEETS—SHEET 1.

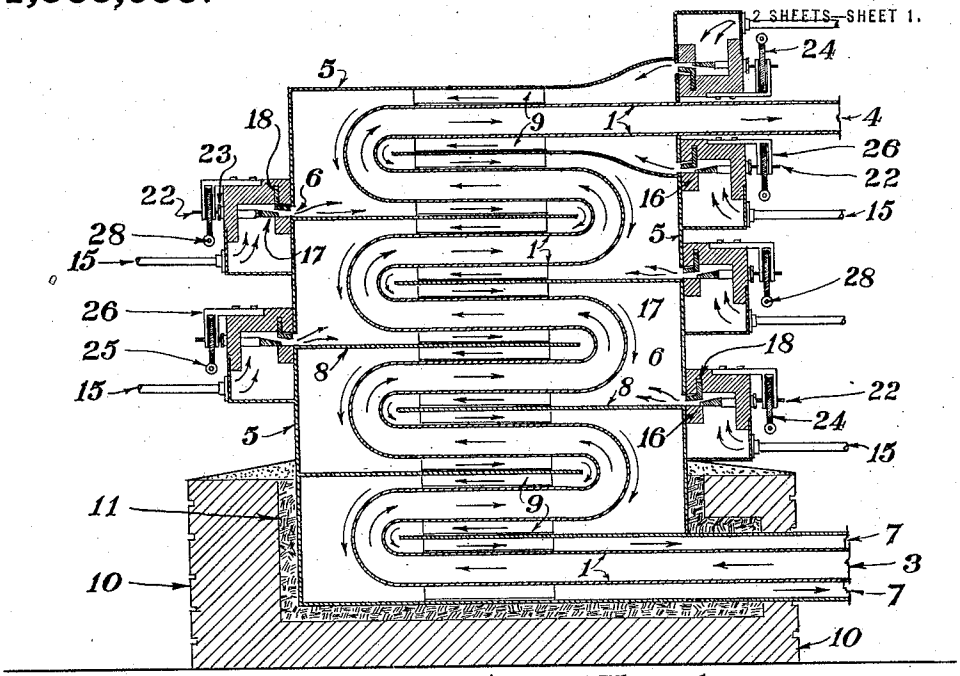


Fig. 1

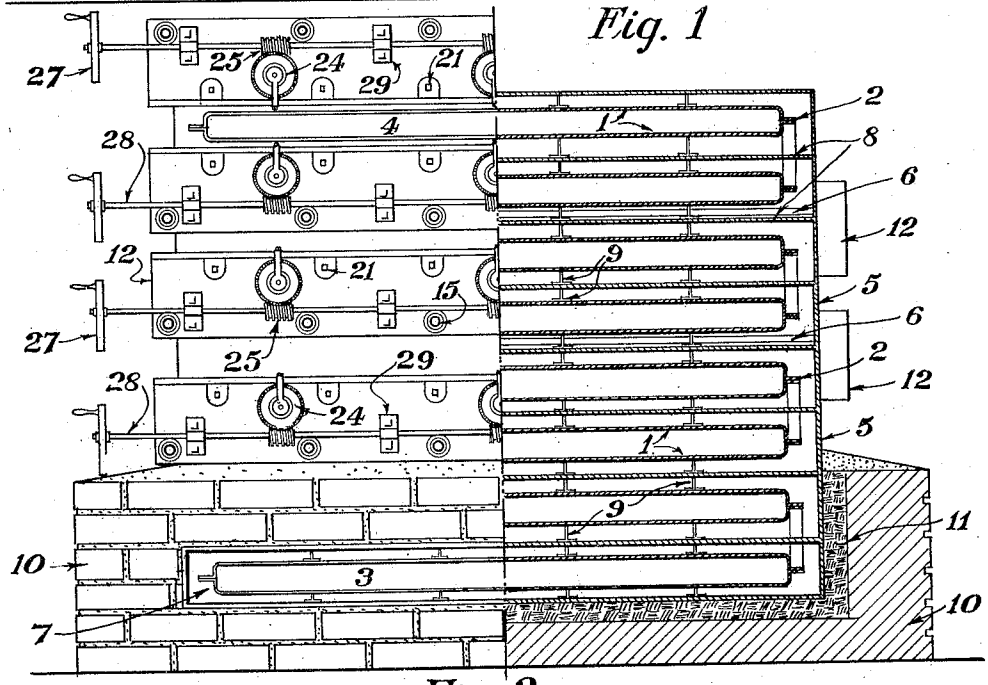


Fig. 2

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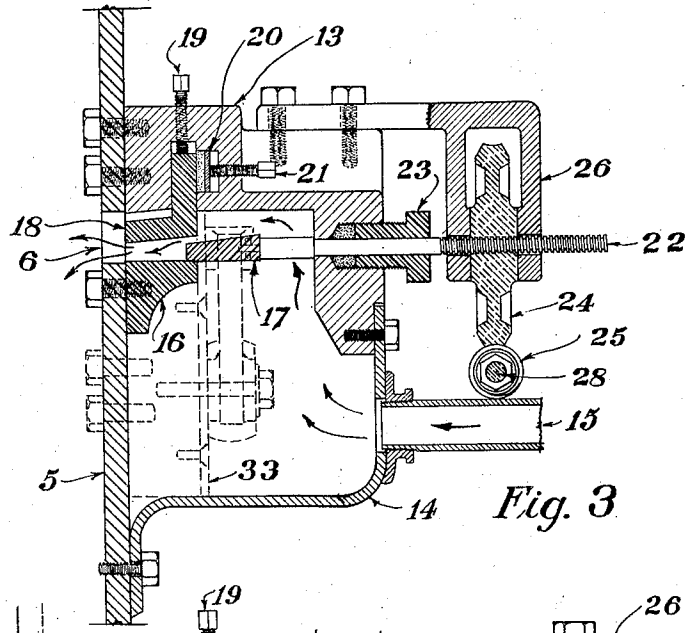


Fig. 3

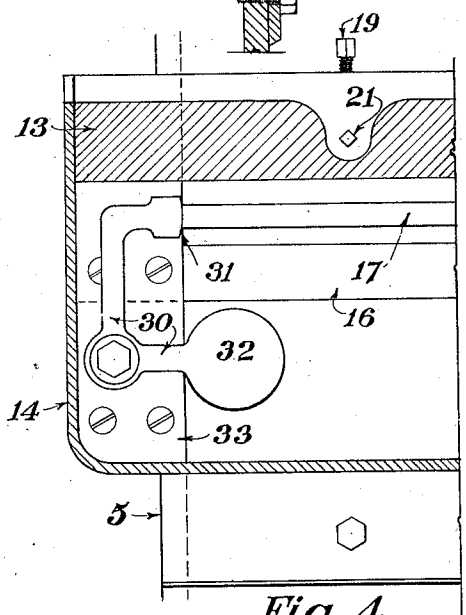


Fig. 4

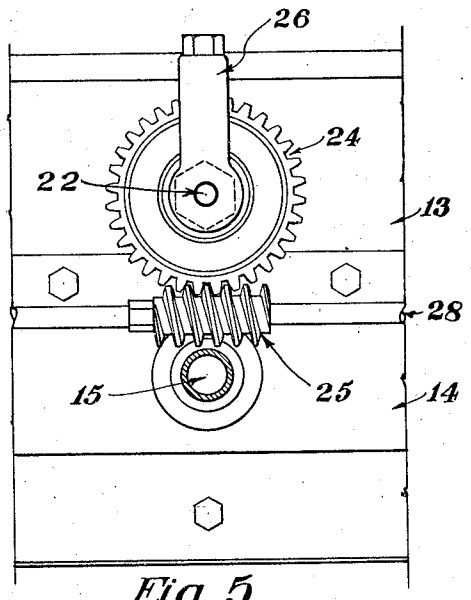


Fig. 5

Courtney Conover, Inventor

UNITED STATES PATENT OFFICE.

COURTNEY CONOVER, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR BRINGING ABOUT AND CONTROLLING REACTIONS BETWEEN GASES.

1,363,955. Specification of Letters Patent. Patented Dec. 28, 1920.

Application filed April 30, 1919. Serial No. 293,787.

(FILED UNDER THE ACT OF MARCH 3, 1883, 22 STAT. L., 625.)

To all whom it may concern:

Be it known that I, COURTNEY CONOVER, a citizen of the United States of America, and an employee of the Department of Agriculture, residing in the city of Philadelphia, county of Philadelphia, State of Pennsylvania, whose post-office address is Department of Agriculture, Washington, D. C., have invented a new and useful Apparatus for Bringing About and Controlling Reactions Between Gases, of which the following is a specification.

This application is made under the Act of March 3, 1883, Chapter 143 (22 Stat., 625), and the invention herein described and claimed may be used by the Government of the United States or any of its officers or employees in the prosecution of work for the Government, and any person in the United States, without payment to me of any royalty thereon.

This invention relates to apparatus in which reactions between gases may be brought about, especially those reactions which are induced by catalysts and in which heat is generated.

The object of this invention is to provide an apparatus which shall be an improvement over existing forms of apparatus in the following respects:

(*a*). The chamber in which reaction takes place is a sinuous duct of uniform cross section having no pockets or recesses through which portions of the gas stream would tend to move more slowly than the rest of the stream. This is an advantage since in some reactions it has been found that when the movement of gases is delayed in parts of the reaction chamber destruction of valuable material takes place.

(*b*). Provision is made for cooling different parts of the reaction chamber in different degrees so that the cooling may be greatest where the most heat is liberated.

(*c*). Provision is made for applying cooling air uniformly across the breadth of the reaction chamber.

(*d*). Provision is made for utilizing the heat formed in the reaction for heating the incoming gases sufficiently to start reaction.

(*e*). The apparatus may be so constructed that the inside of the reaction chamber is easily accessible.

One form of the apparatus is shown in the accompanying drawings.

Figure 1 is a cross section of the apparatus; Fig. 2 a half elevation and half longitudinal section; Fig. 3 a cross section of an air distributing chamber; Fig. 4 a longitudinal section of the end of an air distributing chamber; Fig. 5 an elevation of the valve-operating mechanism.

The parts of the apparatus which come in contact with the reacting gases are made of a metal which is not quickly corroded by the gases and which does not exert an injurious effect on the course of the reaction or which can be coated with a material which does not have such an injurious effect.

The reaction chamber (1, Fig. 1) is a duct of uniform cross section folded backward and forward upon itself so as to mix the gases passing through it. Its two walls are supported separately from the shelves, 8. They are joined (2, Fig. 2) at the ends of the apparatus.

Preferably these walls should extend to the casing, 5, and should be joined by a partition set a short distance from the casing, 5, so as to form a separate duct next to the casing through which a separate stream of cooling air could be passed. The partition would form the end of the reaction chamber.

This reaction chamber contains a catalyst which may lie upon the bottom surfaces of the chamber or preferably is attached to the walls in the form of an adherent coating.

The shelves, 8, support the walls of the reaction chamber by means of T bar supports, 9, or by other suitable means and may themselves be supported by brackets (not shown in the drawings) from the main frame work of the apparatus. Their main function is to force air, blown in for cooling purposes, to follow the walls of the reaction chamber 1.

The casing, 5, of the apparatus is supported on a frame work not shown in the drawings.

The lower part of the apparatus is surrounded by heat insulating material, 10 and 11.

In the operation of the apparatus it is essential that cooling air should be forced to flow downward along the outside of the reaction chamber and should be introduced at different levels in the upper and middle

portions of the apparatus. The incoming streams should be spread evenly across the entire breadth of the reaction chamber. This could be approximately accomplished in several ways but I prefer the use of the devices and mechanism described as follows:

Longitudinal slits such as 6 are cut in the casing, 5. They extend the entire length of the apparatus. Outside of the slits, 6, air distributing chambers (12, Fig. 2) are fastened to the casing, 5. To these air is supplied under pressure. The flow of the air through the slits, 6, is regulated by the mechanism shown in detail in Fig. 3.

The upper portions of the reservoirs, 12, are formed by pieces of metal, 13, which are rigid enough to resist distortion by the pressure of the air in the reservoir and strong enough to form firm supports for the mechanism of the valves.

A valve extends the entire length of the apparatus. It is essentially a tapered slot which may be closed by a wedge. The slot is formed by the jaws, 16 and 18. The jaw 16 is bolted to the casing, 5, the holes in the casing being slightly elongated horizontally so as to allow for differences of expansion with heat if different metals are used. The jaw, 18, may be adjusted vertically by being forced down by several screws, 19, against the wedge 17. When adjusted it is held in place by the packing, 20, compressed by the screws, 21. This packing also prevents the escape of air around the jaw. The valve is closed or opened by the wedge, 17, being forced into or drawn out of the slot. The wedge 17, is preferably level on its under side and tapered only on top so that its weight rests mainly on the jaw, 16, at all times.

The wedge, 17, is moved by means of spindles, 22, which are attached to it by joints which will allow lengthwise expansion of the wedge. The spindles pass through stuffing boxes, 23, in the walls of the reservoir. They are forced forward or backward by the wheels, 24, which can revolve only in one plane, being held between the jaws of the guide bracket, 26.

The wheels, 24, are worm gear wheels meshing into the worms, 25, several of which are operated on one shaft, 28. The shaft is rotated by means of the hand wheel, 27, Fig. 2. The worms, 25, are fastened to the shaft, 28, by set screws and may be released and operated independently for purposes of adjustment.

In order that the wedge, 17, may not meet resistance at the end of the slot, the slot is made somewhat longer than the wedge and is covered at the end by an expansion gate, 30. This is mounted on a plate guide, 33, and is held against the wedge by means of the weight, 32. The gate is fitted to the wedge with a ground joint 31.

The operation of the apparatus is as follows: The lower half of the apparatus is heated by any suitable means; *e. g.*, by blowing hot air into the reaction chamber, 1, at 3 and into the space outside the reaction chamber from the distributing chambers, 12. When a temperature is reached at which the gases which are to be introduced will react, the hot air is shut off. The slots in the distributing chambers are all closed, and cool air under pressure is admitted to the chambers through the tubes, 15.

The gases which are to react are introduced at 3. When they strike the hot catalyst in the reaction chamber reaction takes place and heat is generated. As reaction proceeds some part of the reaction chamber where the reaction is most rapid may become heated to a point which is considered unsafe or otherwise undesirable; also the lower part of the reaction chamber may be cooled to such an extent by the cool incoming gases that the zone of reaction will rise progressively higher in the apparatus. In either case certain of the valves are opened by means of the hand wheels 27. Since the openings in the valves are very narrow slits the pressure in the reservoirs can be kept high and nearly constant and the flow of air through the narrow openings will not be appreciably affected by slight differences of resistance inside the apparatus or by currents in the air in the distributing chambers. Hence the volume of air flowing through any portion of a slit will be equal to that flowing through any other equal portion of the same slit.

The cool air flowing along the outside of the reaction chamber absorbs heat from the hotter portions and becoming heated itself conveys heat to the lower part of the apparatus and serves to heat the incoming gases.

Temperatures in the apparatus are determined by means of thermocouples inserted at various points.

Having thus described my invention I claim:

1. In an apparatus for bringing about and controlling reactions between gases, the combination of a sinuous reaction chamber with a casing surrounding it to which are attached shelves which act as baffles and force air introduced within the casing to follow the sinuosity of the reaction chamber.

2. In an apparatus for bringing about and controlling reactions between gases, the combination of a sinuous reaction chamber with channels for the passage of air along the walls of such reaction chamber, which channels have openings at different levels for the admission of air.

3. An apparatus for bringing about and controlling reactions between gases in which apparatus streams of air are caused

to flow along the walls of a reaction chamber absorbing heat from the hotter portions of the reaction chamber and conveying this heat to the cooler portions of the reaction chamber.

4. In an apparatus for bringing about and controlling reactions between gases, a device for distributing air uniformly across the breadth of a reaction chamber, consisting of a reservoir for air communicating with the interior of a casing surrounding the reaction chamber through a narrow slit, the width of which may be adjusted.

5. In an apparatus for bringing about and controlling reactions between gases, a device for distributing air uniformly across the breadth of a reaction chamber, consisting of a reservoir for air, communicating with the interior of a casing surrounding the reaction chamber, through a valve having two jaws (one of which is adjustable in relation to the other) so placed as to form a slot, a wedge which may be moved into or out of the slot, and expansion gates at each end of the wedge, the valve being operated by means of spindles attached to the back of the wedge and passing to the outside of the reservoir where by means of screw threads on the spindles, gear wheels on these screws, held by bracket clutches and rotated by worms on a common shaft, the spindles may be moved in or out, the whole device being substantially as described.

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

COURTNEY CONOVER.

Witnesses:
H. D. GIBBS,
L. A. SKINNER.