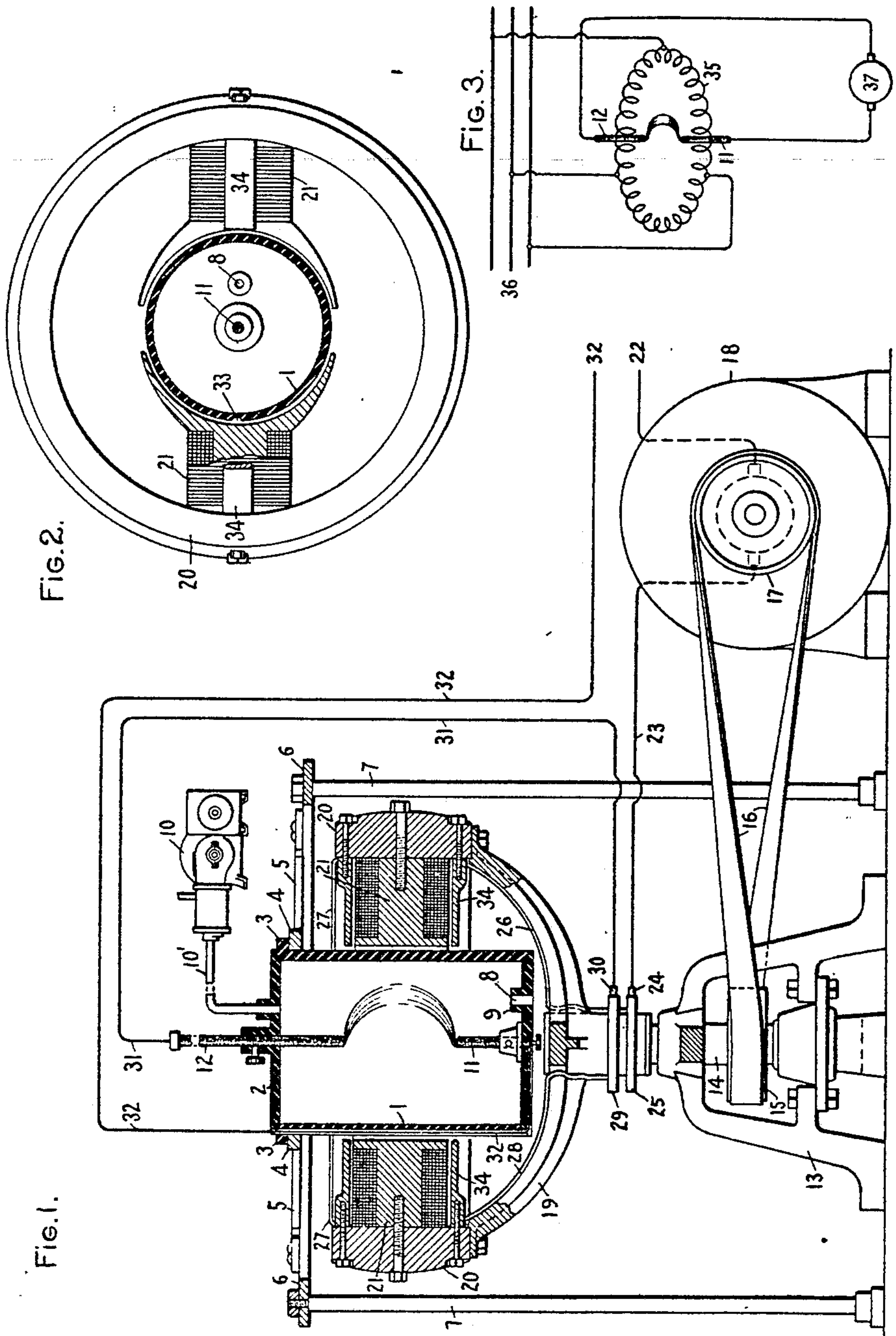


No. 865,618.

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G. P. STEINMETZ.
PRODUCTION OF NITROUS COMPOUNDS.
APPLICATION FILED APR. 20, 1907.



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UNITED STATES PATENT OFFICE

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PRODUCTION OF NITROUS COMPOUNDS.

No. 865,618.

Specification of Letters Patent.

Patented Sept.

Application filed April 20, 1907. Serial No. 369,263.

To all whom it may concern:

Be it known that I, CHARLES P. STEINMETZ, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Production of Nitrous Compounds, of which the following is a specification.

My invention has reference to a process of and apparatus for manufacturing nitrous compounds from atmospheric air by exposing the air to the action of an electric arc of minimum volume and greatest practicable length.

Heretofore it has been deemed necessary for the practical and efficient production of nitrous compounds from atmospheric air to employ a large number of arcs simultaneously which were established without actual initial contact. These arcs, therefore, when first established, were of short length and were then drawn out to their maximum length until they broke. This establishing, lengthening and breaking of the arcs was repeated in rapid recurrent successions, while the air from which the compounds were to be produced was drawn to and past the arcs in a continuous stream, which carried off the nitrous compounds that had been produced, so that they were not acted upon again to any appreciable extent by the arcs. This old process, requiring as it does the use of a great number of electric arcs and of high tension currents, is expensive and troublesome, and the apparatus employed is liable to get out of order, and, owing to the multiplicity of the arcs employed, the readjustments or repairs are exceedingly troublesome and time-consuming, since ordinarily, the whole apparatus has to be taken to pieces for this purpose. By my invention, these difficulties are overcome by the employment of a single electric arc maintained by direct current, and which arc is deflected or drawn out laterally, magnetically, to a distance within which it can be safely maintained, and it is also magnetically rotated within its sphere of action, so that it sweeps through the air which is to be converted into nitrous compounds.

In the accompanying drawing, which forms a part of this specification, the apparatus adapted for the practice of the process is illustrated as follows:—

Figure 1 represents an elevation of the apparatus as a whole, showing the converting chamber and its appurtenances in vertical section; Fig. 2 is a horizontal section of the converting chamber and its appurtenances; and Fig. 3 is a diagram of another form of apparatus that may be employed.

Like numerals of reference indicate like parts throughout the drawing.

Referring to Figs. 1 and 2, the cylindrical air chamber 1 of insulating material, such as glass or porcelain,

is provided with a removable cover 2 and 3 by which the chamber is supported and held by radial arms 5, the outer ends of which are secured to an annulus 6 which is supported by arms 7. Any other mode of supporting the chamber may be used.

In the bottom of the chamber there is surmounted by a short, inwardly projecting flange 8, there may be a number of such openings for the admission of air, which is drawn into the chamber through these openings by a suitable pump 9, which is connected with a tube 10 which passes through the chamber. The suction pump and the means for disposing of the mixture of air and nitrous compounds which is drawn from the chamber form a part of my invention, and the pump is therefore not specifically indicated.

In the center of the bottom of the air chamber is formed a suitable opening for the insertion of the electrode 11, and a similar opening is provided in the cover 2 for the insertion of the other electrode 12, and the usual means are provided for holding the electrodes in position. These electrodes may be of any suitable material for establishing and maintaining an electric arc between them, such as carbon, but other materials are available.

Below the chamber 1 is mounted a frame 13 having suitable bearings for a vertical shaft 14 which carries a pulley 15 driven by a belt 16 from a motor 17. Any other means for driving the shaft 14 by the electric motor may be employed. To the upper free end of the shaft 14 is secured a ring or cage formed with four upwardly and outwardly curved arms 19, upon the free ends of which is secured the ring yoke 20 of the electromagnet, the legs of which project inwardly toward the chamber so that the magnetic flux passes substantially at right angles to the axis of the arc. The electromagnet largely surrounds the air chamber, substantially in the manner in which the field poles of an electric motor surround the armature.

The circuit connections in this apparatus are as follows:—The current, from any suitable source, enters the motor by the conductor 21, passes by conductor 23 and brush 24, collector 25, and conductor 26, to the winding of one leg of the electromagnet, and by conductor 27 to the winding of the other leg of the electromagnet; then by conductor 28 to the collector ring 29, and by brush 30 and conductor 31 to the electrode 12, through the arc to the electrode 11, and by conductor 32 back to the generator. It is noticed that part of the conductor 32 passes along the outer face of the air chamber which, for convenience, may have a longitudinal groove formed

in Fig. 2, at 33. The conductor 32 is lodged in roove, so that it will not project beyond the outer f the air chamber.

ill be seen that by the construction described, the ator (not shown), the motor, the electromagnets e electrodes between which the arc is established in series. The consequence of this arrangement the resistance of the arc largely controls the speed motor. The rotating electromagnets have the e function of deflecting the arc as shown in the ig, and of rotating the arc about the common axis two electrodes, so that this arc sweeps through the l part of the space of the air chamber and acts he air to produce a chemical combination be- the nitrogen and oxygen to produce mostly gas- nitrous compounds, which are drawn off by the l. If any small quantities of liquid nitrogen com- should form, which may sometimes happen, the ill accumulate at the bottom of the air chamber y be drawn off, at long intervals, in any desired r. The inwardly projecting short tube 9 at the g 8 in the bottom of the air chamber is provided vent the untimely discharge of liquid nitrogen inds which, coming in contact with the metallic s of the apparatus, might injure the same.

re starting the apparatus, the upper electrode is act with the lower one. When the current is l to pass, the upper electrode 11 is slowly drawn stablish the arc of such length as is suited to the of the current employed, and the windings and ions of the magnets are so proportioned that the am practicable deflection of the arc is obtained. s been found that when an arc is laterally de- by a magnet, it displays a tendency to creep electrodes, above and below, respectively, the between which the arc is primarily established. ults in disfigurement of the electrodes by the f the arc. In order to prevent such disfigure- he electromagnets are formed with subsidiary ces 34, two for each main pole piece, and an opposite sides of the vertical diameter of the magnet cores, and outside of the winding of the These subsidiary pole pieces (which are, of magnetically connected with the yoke 20), the opposite polarity from that of the main ces, so that they act to repel the arc at the the electrodes when the main pole piece acts t the central portion of the arc, and vice [n this manner the arc, while being power- lged out in one direction, has no tendency to and down, respectively, on the body of the s. This refinement of construction is not ab- necessary, since it is quite practicable to do t.

tation of the deflected arc serves the double of extending the sphere of action of the arc and ig the time within which the arc acts upon any f the air which passes through the converting

If the arc were allowed to act upon the y of air for a longer time than is required to the chemical combination of nitrogen and t would cause a dissociation of the combina- ould to a considerable extent undo the work has done. This is the reason why, in the

former practices, the numerous arcs employed were 65 each maintained for a short period only, so as to allow the removal of the nitrous compounds from the sphere of action of the arcs during the intervals between the successive arcs. The same result is secured by the rotation of the deflected arc in accordance with my in- 70 vention, since thereby, the arc is continuously re- moved from the body of the air upon which it has once acted, and this with a practically uniform speed which is determined by the normal speed of the motor.

If for any reason the motor speed should increase, its 75 increased counter-electromotive force would weaken the deflecting magnet and reduce the deflection of the arc, so that its peripheral speed would remain practi- cally the same as before. If, on the other hand, the speed of the motor should, for any reason, momen- 80 tarily drop, the reduced counter-electromotive force would strengthen the magnet and increase the de- flection of the arc, so that its peripheral speed would again remain practically the same as before.

Instead of causing the deflection and rotation of the 85 arc by a rotary magnetic flux produced by mechan- ically rotated magnets, the same effect may be pro- duced by a rotary magnetic field produced by multi- phase currents, in the ordinary well known manner. This is diagrammatically indicated in Fig. 3, where 90 35 represents a rotary field winding energized by three-phase currents derived from the lines 36 in the usual manner. If this winding is substituted in the construction indicated in Fig. 1 for the rotating mag- nets there shown, the same result will be produced as 95 with the employment of mechanically rotated mag- nets. In this case, a separate source 37 of direct cur- rent must be employed for feeding the arc between the electrodes 11 and 12, so that while this modifica- tion of apparatus is simpler than the one represented 100 in Figs. 1 and 2, it requires two sources of current, one multiphase and the other direct, and for this reason the slightly more complex structure is the preferable one.

It will be understood that instead of using atmos- 105 pheric air for the production of the nitrous compounds, any other gas mixture containing nitrogen and oxygen in suitable quantities may be employed.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The process of producing nitrous compounds, which consists in rotating a deflected electric arc within a cur- rent of air.

2. The process of producing nitrous compounds, which consists in causing a current of atmospheric air and ro- 115 tating within the same a deflected electric arc.

3. The process of producing the chemical combination of nitrogen and oxygen, which consists in establishing an electric arc of minimum volume and maximum length, de- flecting and rotating the arc magnetically, and causing 120 a current of atmospheric air to pass through the space of rotation of the arc.

4. The process of producing the chemical combination of nitrogen and oxygen, which consists in establishing an electric arc, causing a rotating magnetic flux to pass 125 substantially at right angles to the axis of the arc, and passing a current of atmospheric air through or past the arc.

5. An apparatus for the manufacture of nitrous com- pounds, consisting of means for producing a current of air, 130 and means for rotating and deflecting an electric arc within the air current.

6. An apparatus for producing the chemical combination of nitrogen and oxygen, composed of means for establishing an electric arc of minimum volume and maximum length, means for deflecting and rotating the arc magnetically, and means for causing a current of atmospheric air to pass through the space of rotation of the arc.
- 5 7. An apparatus for producing the chemical combination of nitrogen and oxygen, composed of means for establishing an electric arc, means for passing a rotating

magnetic flux substantially at right angles to the axis of the arc, and means for passing a current of atmospheric air through and past the arc.

In witness whereof, I have hereunto set my hand and seal this 19th day of April, 1907.

CHARLES P. STEINMETZ

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.