J. W. BROWN.

ELECTRIC FURNACE.

APPLICATION FILED JAN. 8, 1912.

1,177,680.

Patented Apr. 4, 1916.

4 SHEETS—SHEET 1.

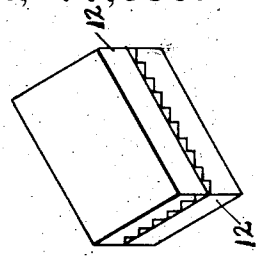

Fig 3.

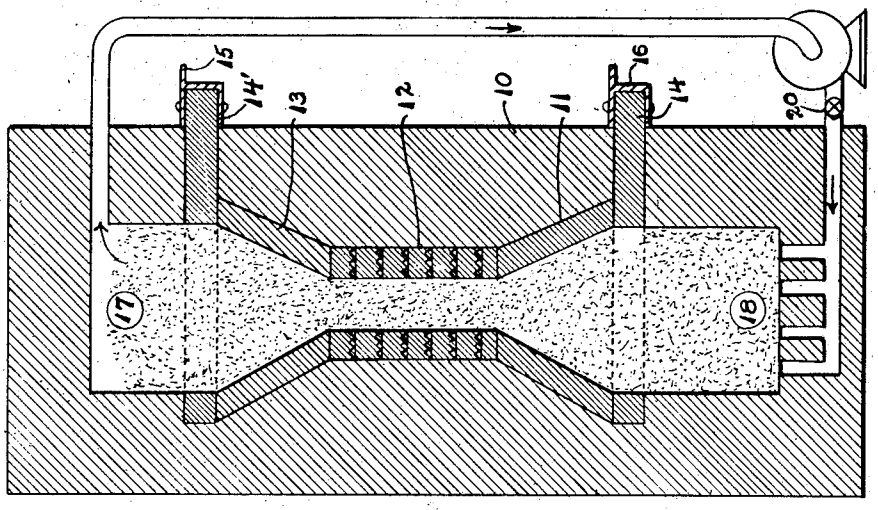

Fig 2.

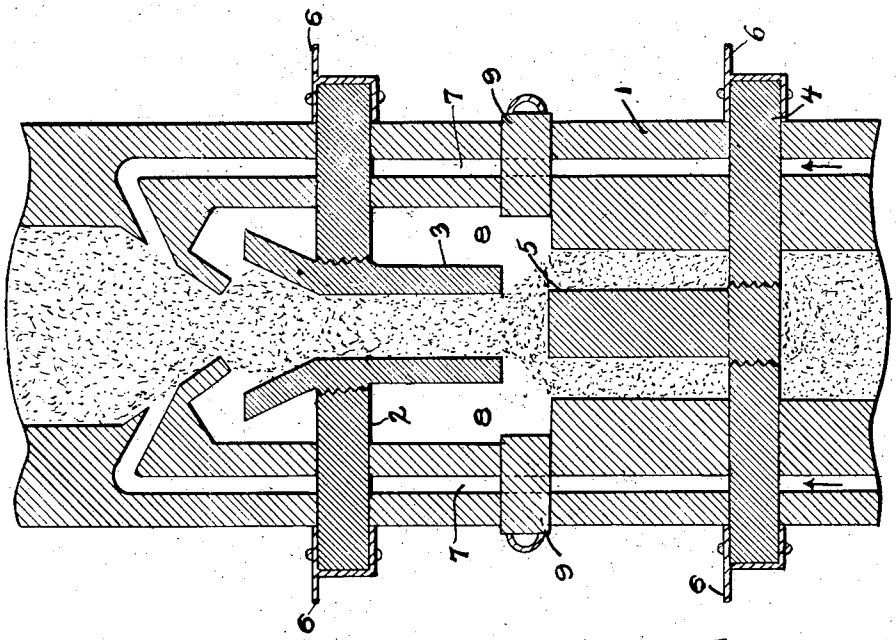

Fig 1.

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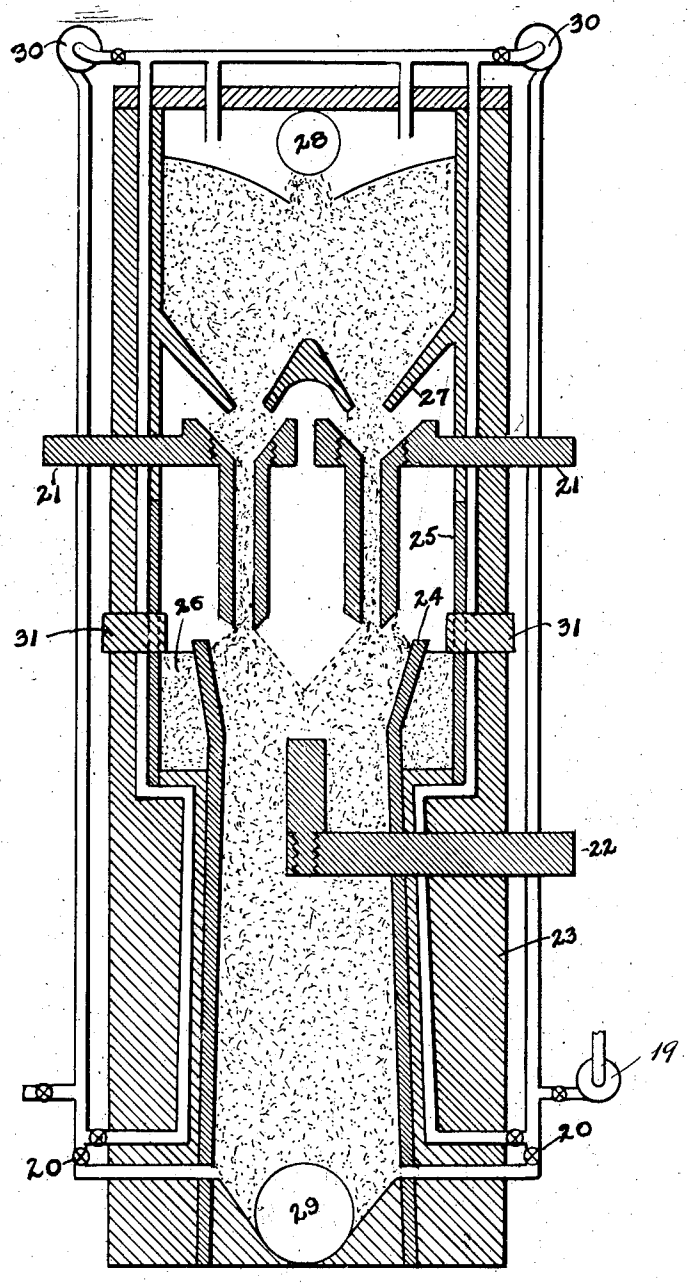

Fig. 4

WITNESSES

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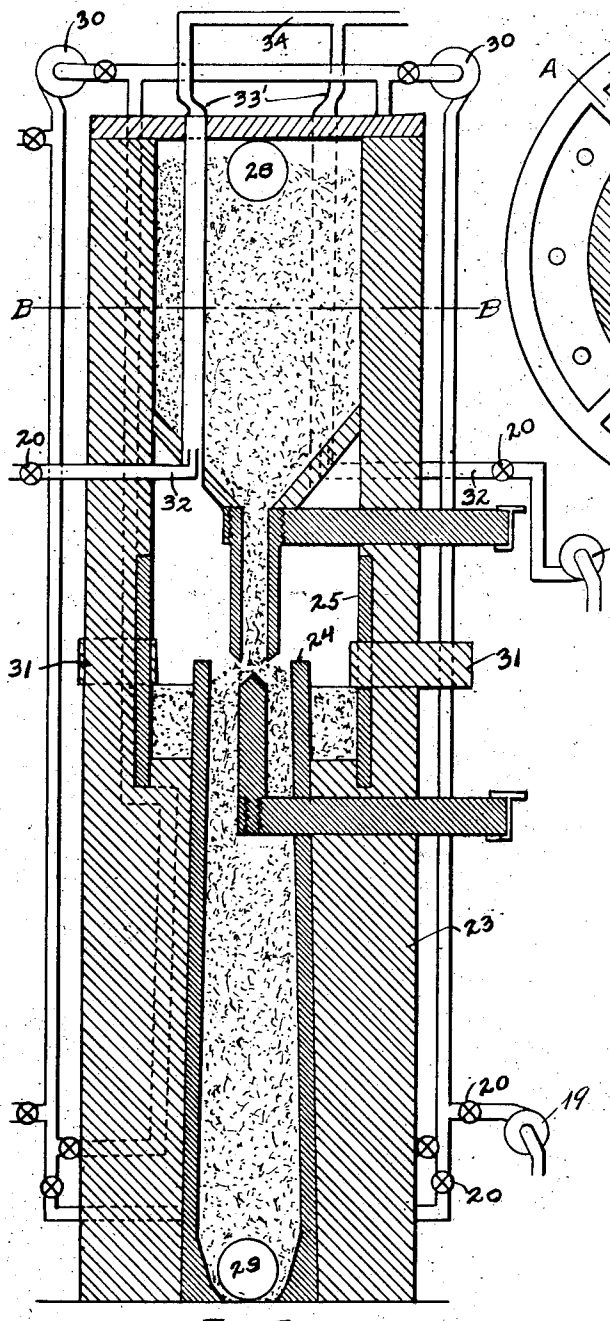

Fig 5

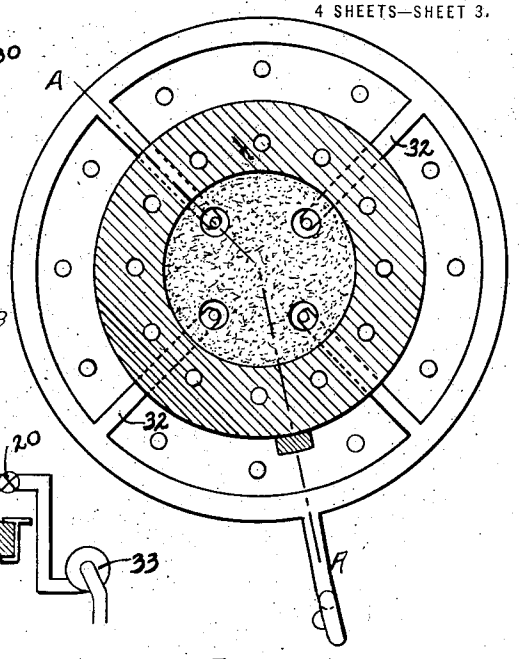

Fig 6.

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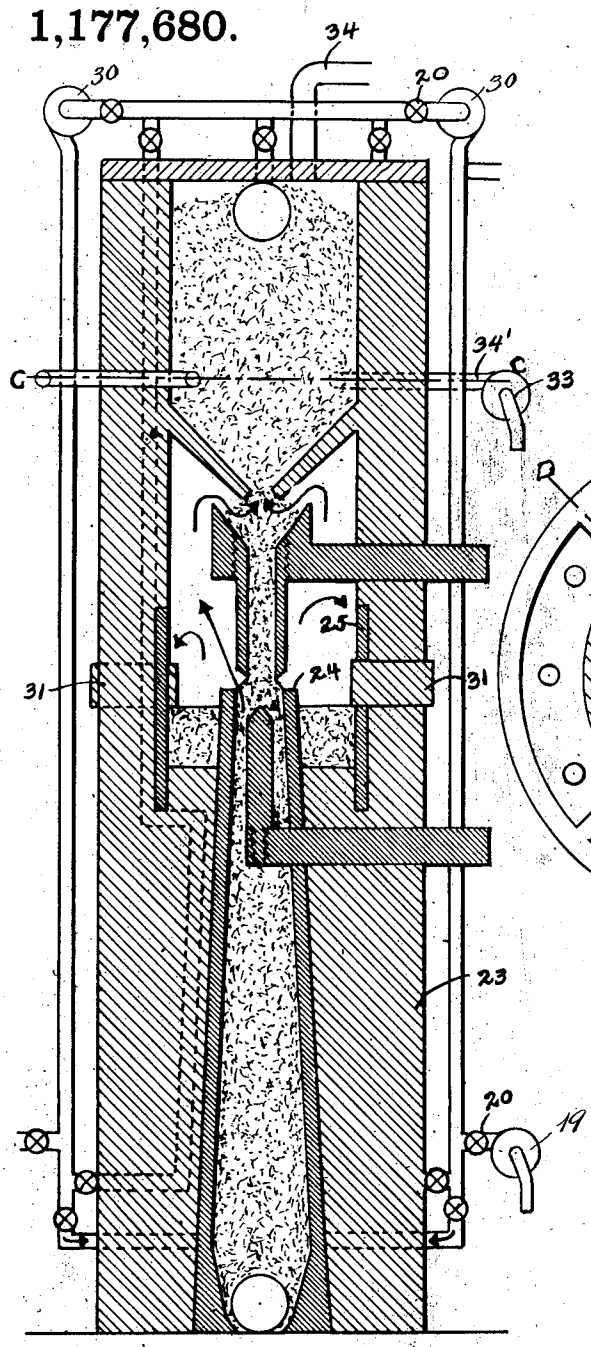

Fig. 7.

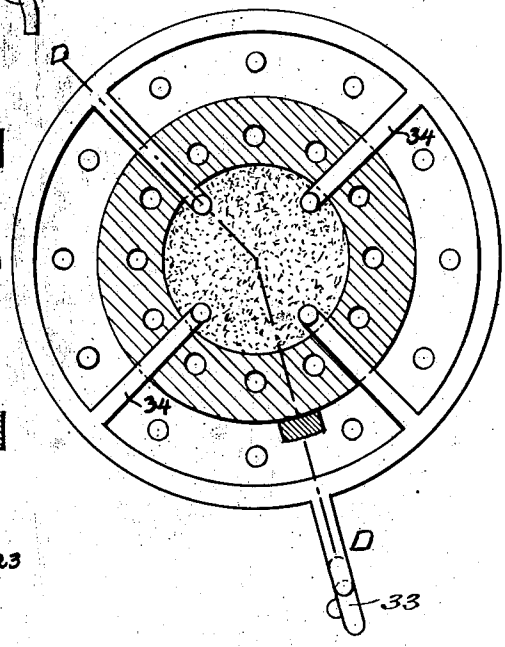

Fig. 8.

WITNESSES

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UNITED STATES PATENT OFFICE.

JOHN W. BROWN, OF LAKEWOOD, OHIO, ASSIGNOR TO NATIONAL CARBON COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF NEW JERSEY.

ELECTRIC FURNACE.

1,177,680. Specification of Letters Patent. Patented Apr. 4, 1916.

Application filed January 8, 1912. Serial No. 670,071.

To all whom it may concern:

Be it known that I, JOHN W. BROWN, a resident of Lakewood, in the county of Cuyahoga, in the State of Ohio, have invented new and useful Improvements in Electric Furnaces, of which the following is a clear and exact description.

This improvement relates to electric furnaces, and more specifically to that type in which the charge is a conductor of electricity and is continually fed through the furnace.

It is particularly adapted to the manufacture of graphite and to the baking of cokes.

In the electric furnaces as usually constructed there is a large waste of heat due in part to the imperfect heat insulating medium and to the large amount of heat contained in the treated charge when it leaves the heating zone. In order to continuously move the charge through the furnace it has heretofore been found necessary to cool it to a temperature that would admit of its being conveyed out into the open air. The cooling has been done by forcing water through pipes in the lower part of the furnace. The heat absorbed by the water is all wasted and one of the objects of my invention is to save this heat.

Another object of my invention is to preheat the charge so that it will not be necessary to use so much electric energy.

Further objects will appear in the description of my invention, particular reference being had to the drawings in which;

Figure 1 represents the heating zone of a continuous furnace in which the charge is preheated by the combustion of part of the charge itself. Fig. 2 is another type of continous furnace in which the charge is preheated by inert gases passed therethrough. Fig. 3 is a detail of the form of carbon brick used in the furnace of Fig. 2. Fig. 4 is a sectional elevation of a type of furnace in which the charge is preheated by gases passing upward through the charge and also upward through the walls of the furnace. Fig. 5 is another modification in which the charge is preheated by burning hot gases in the upper region of the furnace. The figure is a section on A—A of Fig. 6. Fig. 6 is a section on B—B of Fig. 5. Fig. 7 is another modification in which the charge is preheated by the combustion of both the charge itself and the hot gases. This figure is a section on D—D of Fig. 8. Fig. 8 is a section on C—C of Fig. 7.

Referring to Fig. 1 of the drawings. 1 represents the outer walls of the heating zone of the furnace made of some heat insulating material well known in the art. 2 is the upper carbon electrode supporting a funnel shaped part 3. 4 is the lower electrode supporting the carbon electrode end 5. The electrode ends 3 and 5 are preferably screwed into the members 2 and 4. The electrical terminals are represented by 6. This furnace is adapted for using either direct or alternating current. 7 represents air pipes for conveying air under pressure to the upper part of the charge.

Granular coke is fed into the upper part of the furnace and removed from the lower part by screw conveyers. Since Fig. 1 illustrates only the heating zone of the furnace these conveyers are not illustrated. The granular charge will pass into the funnel shaped electrode 3 and out therefrom in the shape of a cone as clearly shown in the drawing.

The current enters the two upper connections 6 and passing through the carbon electrodes 2 and 3 till it comes to the end of the electrode, then it enters the granular charge and passes therethrough to the lower electrode end 5, electrode 4 and lower connections 6. It will be understood that the two upper connections 6 are connected to one bus bar and the two lower connections 6 are connected to the other bus bar.

The granular charge emerges from the electrode end 3 in the shape of a frustum of a cone and the upper end of the cone can be made very restricted in cross section so that in this region it will become intensely hot in a very short time. After the furnace has been in operation for a short time the upper part of the charge becomes heated by conduction, and air is then blown into pipes 7 by any device (not shown). The air absorbs heat from the walls and enters the upper part of the furnace. Here it causes part of the hot carbon charge to burn and the remainder is raised to a high temperature. The amount of air in the pipes 7 can be regulated so that the operator can control the amount of the charge that is to burn. This preheating will amount to a great saving as the charge can be heated to

a moderate temperature more cheaply by combustion than by electrical energy. However, the heat of combustion is not sufficient to graphitize the carbon. The electric current is employed to raise the temperature to the graphitizing point. It will thus be seen that my furnace can be operated at reduced expense.

The carbon charge always contains some ash and volatile matter. In the electric heating region these will volatilize and will pass out into the open spaces 8 where they will condense on the cooler walls. The condensed material can be removed by pulling out the block 9. This is an important matter. If no condensing chamber were provided the volatile matter would pass up through the down-coming charge, and would condense thereon. It will thus be seen that the ash material would steadily increase if the condenser were not used, preventing the continuous operation of the furnace.

In Fig. 2 the outer walls 10 are made as usual of some heat insulating material that is a non-conductor of electricity. The walls are lined with a carbon section 11 in the shape of a frustum of a cone, a built-up section 12 made of corrugated carbon blocks shown in detail in Fig. 3, and an insulating section 13 in the shape of an inverted frustum of a cone. The lower electrode 14 is placed beneath and in contact with the member 11. The upper electrode 14′ is placed on top of the member 13. With the construction thus disclosed the current will flow from the upper electrode 14′ through the upper part of the charge until the built-up section 12 is reached. Here the greater part of the current will pass down through the constricted portion of the charge which is surrounded by the section 12, and a small part of it will flow through the section 12. When the section 11 is reached the current again will divide, most of it flowing through the carbon section 11 directly to the lower electrode 14. A small part of the current, however, will flow through the lower part of the charge to the lower electrode. The corrugated surface on the sections 12 increases the resistance to such an extent that only a small part of the current passes therethrough. However, the carbon blocks will be heated by this current and will aid in heating the constricted portion of the charge. It will thus be seen that the charge surrounded by the built-up section 12 can be quickly heated to a very high temperature. The charge is fed into the furnace by the screw conveyer 17 and removed therefrom by the screw conveyer 18. The fan 19 forces an inert gas into the bottom of the furnace and withdraws it from the top. The gas absorbs the heat from the heated charge in the lower part of the furnace and cools it so that it can be removed into the air by the conveyer. The hot gas in passing through the upper part of the furnace delivers up the heat to the untreated charge and preheats it. Fig. 2 is shown greatly reduced in height as compared with its width, but this is for the purpose of illustration. In practice the furnace would be 20 or 30 feet high and the space above and below the heating zone would be great enough for the gas to absorb the heat from the lower part of the furnace and deliver substantially all of it up to the upper part so that it would emerge therefrom in a practically cool state. The valve 20 is for regulating the supply of gas.

In Fig. 4 two sets of upper electrodes 21 are shown, each being similar to the one shown in Fig. 1. Only one lower electrode 22 is used. The three terminals can be connected to a polyphase circuit or if a single phase circuit is used the two upper electrodes would be connected to the same terminal. The outer wall 23 is lined with carbon material 24 to resist the high heat which is necessary to graphitize the charge. The condensing chamber is also lined with carbon 25. The space 26 is filled with the granular material to act as a heat insulating medium. The funnel shaped part 27 can be supported at various places, but such is not shown as such details are in the province of the mechanic and need not be shown. 28 and 29 are conveyers for feeding and removing the charge. In this figure gas is circulated through the charge itself as in Fig. 2, and also through the walls 23. In both the gas absorbs heat in the lower part of the furnace, and gives it out to the charge in the upper part. The fans 30 are for circulating the gas. The condensed material can be removed by pulling out the blocks 31.

Fig. 5 shows in addition to the preheating system of Fig. 4 a heating zone due to the combustion of the gases. For this purpose air is blown in through pipes 32 by fan 33. On account of the combustion of the gas the pipes 33′ open into the flue 43. The burnt gas ascends through the pipes 33′ and does not go through the charge itself. The features of this furnace that are similar to those of Fig. 4 will not be further described.

Fig. 7 differs from Fig. 5 in the provision for the combustion of the gas. The air is blown directly into the charge through pipes 34′ as in Fig. 2. The gas as well as part of the charge is thereby consumed. The gaseous products of combustion pass out into the flue 34. Features similar to those of Fig. 4 have not been described as further description is unnecessary.

In the various figures valves 20 are shown whereby the supply of gas and air can be

controlled. This also enables me to use any of the preheating schemes as desired.

I do not limit my invention to the use of gases as a preheating medium when circulated through the furnace walls. Water or any other liquid such as molten alloys could also be used. By closing the appropriate valves 20 the fans or pumps 30 could circulate the liquid.

Having described my invention, what I claim is:

1. In an electric furnace for treating granular material, means for admitting an electric current to heat the material, a chamber for the untreated material, a second chamber for the treated material, means for forcing a combustible gas through the material in the second mentioned chamber whereby heat is absorbed therefrom, and admitting it to the first mentioned chamber, and means for forcing air into the first chamber to burn the heated combustible gases so as to preheat the charge.

2. In an electric furnace, electrodes for heating the charge, means for forcing a combustible gas through the treated charge to absorb the heat therefrom and means for forcing air into the furnace to burn the heated gas forced in by said first mentioned means.

3. In an electric furnace, electrodes for heating the charge, means for forcing a combustible gas through the treated charge to cool the same and means for delivering air into the upper part of the furnace to cause the combustion of the charge and the combustible gas whereby it is preheated.

4. In an electric furnace, an upper electrode, a lower electrode, a chamber above the first mentioned electrode, a chamber below the second mentioned electrode, a conveyer for feeding the charge into the upper chamber, means for delivering a combustible gas to the lower chamber, means for delivering air to the upper chamber whereby the gas cools the treated charge and is burned in the upper chamber to preheat the untreated charge and means whereby the treated charge is removed from the lower chamber.

5. In an electric furnace, an upper electrode, a lower electrode, a chamber above the first mentioned electrode, a chamber below the second mentioned electrode, means for delivering a combustible gas to the lower chamber, means for delivering air to the upper chamber whereby the treated charge in the lower chamber is cooled and the gas and part of the charge is burned in the upper chamber, and means whereby the treated charge may be removed from the lower chamber.

6. In an electrical furnace, inclosing walls, an upper chamber therein for the untreated material, a lower chamber for the treated material, a hollow upper electrode adapted to permit the passage of material therethrough from said upper chamber to said lower chamber and a lower electrode in the lower chamber.

7. In an electric furnace, inclosing walls, an upper chamber therein having an opening in the bottom, a vertically arranged hollow electrode having a hopper beneath said opening, a chamber beneath said electrode and a second electrode therein.

In testimony whereof I have hereunto signed my name.

JOHN W. BROWN.

Witnesses:
F. D. LAWRENCE,
A. H. AVERY.