No. 704,649. Patented July 15, 1902.

H. MAXIM.

ELECTRICAL FURNACE FOR TREATING HIGHLY REFRACTORY SUBSTANCES.

(Application filed Oct. 30, 1901.)

(No Model.)

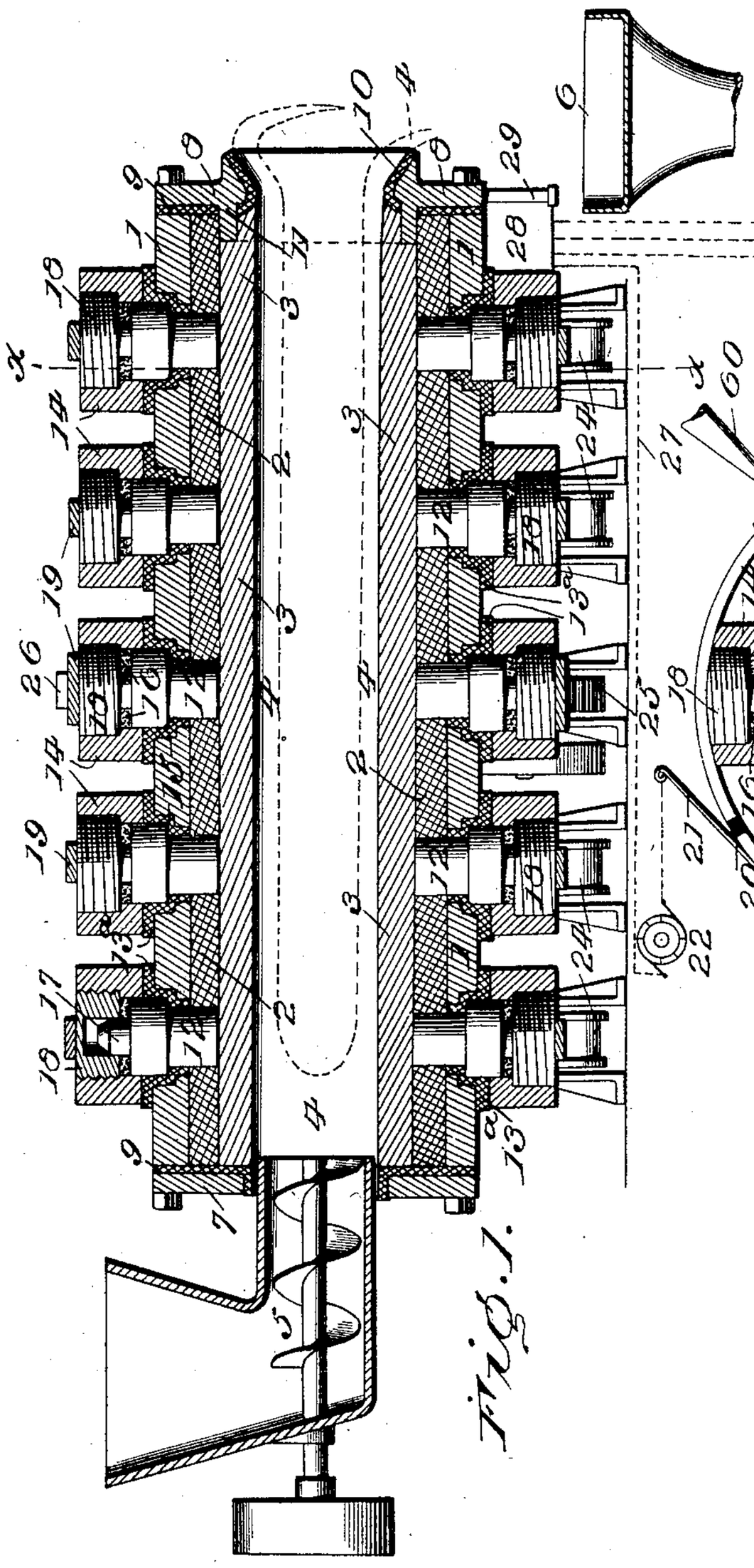

Fig. 1.

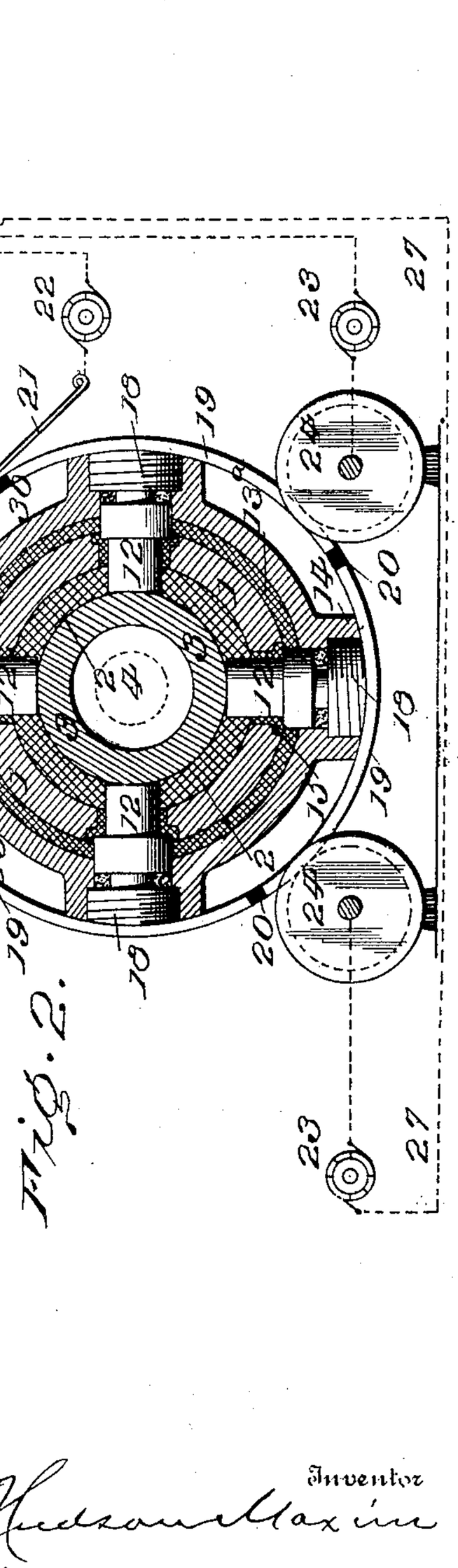

Fig. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

HUDSON MAXIM, OF BROOKLYN, NEW YORK.

ELECTRICAL FURNACE FOR TREATING HIGHLY-REFRACTORY SUBSTANCES.

SPECIFICATION forming part of Letters Patent No. 704,649, dated July 15, 1902.

Original application filed June 25, 1895, Serial No. 553,952. Divided and this application filed October 30, 1901. Serial No. 80,532. (No model.)

To all whom it may concern:

Be it known that I, HUDSON MAXIM, a resident of Brooklyn, New York, have invented a new and useful Improvement in Electrical Furnaces for Treating Highly-Refractory Substances, which invention is fully set forth in the following specification.

In my application, Serial No. 553,952, filed June 25, 1895, of which the present application is a division, I have described and claimed a process of making calcium carbid.

The present invention relates to electrical furnaces, and has for its object to provide a furnace of this class adapted to successfully and continuously treat highly-refractory substances requiring for their treatment a constant very high temperature—as, for example, lime and carbon in the manufacture of calcium carbid. In the treatment of such materials the constant very high temperature required results in destructive wear and tear on the furnace; and one of the objects of this invention is to obviate such destructive action, as well as provide against injury to the materials under treatment.

With these objects in view the invention consists in a revoluble electric furnace through which the material to be treated is advanced in a continuously-moving stream and subjected to a progressively-increasing temperature from the point of entrance to the furnace to its point of exit therefrom. As a preferred means of securing this result I provide the revoluble furnace with an interior electric conductor, which is adapted to receive independent electric currents from a series of outer electrodes disposed at successively-advancing points along the furnace, each successive and additional electric current reaching the interior conductor from the successive outer electrodes adding quantity to the current already flowing through the common interior conductor, thereby generating an intense heat, increasing in degree toward the place of discharge of the material to be treated.

In some cases, as in the manufacture of calcium carbid, the material under treatment may be of sufficient conductivity to serve as the interior conductor of the electric current employed.

The inventive idea involved may receive various mechanical expressions, and for the purpose of illustrating the invention I have shown one of these in the accompanying drawings; but it is to be understood that such drawings are for the purpose of illustration only, and not as confining the invention to the specific construction shown.

In said drawings, Figure 1 is a longitudinal sectional view of one style of horizontal furnace apparatus; and Fig. 2 is a transverse section thereof, taken on the line xx in Fig. 1.

The numeral 1 indicates the furnace body or shell, which is preferably made of steel and may have a fire-clay or other refractory electrically non-conductive lining 2, within which is a centrifugally-maintained auxiliary protective lining or bed 3, hereinafter more fully described. The material 4 under treatment is fed to the furnace in any suitable way, as from a hopper by a screw conveyer 5, and flows through or along on the bed 3 and discharges at the opposite end into a chute 6, which may convey the treated material to any suitable receiver. Opposite heads 7 8, with interposed insulation 9, of asbestos or other suitable material, are bolted to the ends of the furnace-body. The head 7 has an opening receiving the material feed-spout, and the head 8 has a central opening for discharge of the treated material and is preferably flared outward and faced by insulation 10, preferably magnesite. The head 8 also has a flange 11, which projects inward inside of the fire-clay lining 2 and into the auxiliary protective bed 3 to allow the electric current to be taken off from the bed through the head.

The electric appliances furnishing the progressively-increasing temperature in this apparatus comprise, in connection with the interior protective bed 3, a series of outer circumferential electrodes 12, preferably arranged in two opposing radial pairs or in series of four in the same transverse plane and projecting inward to the protective bed to transmit thereto electric current, which usually fuses the bed material to a fluid state, while it is maintained in tubular form by centrifugal force. For each transverse or circumferential series of electrodes 12, and preferably over an interposed encir-

cling asbestos packing 13ª, there is shrunk around the steel furnace-body a metal ring or band 13, which for each electrode has a cup-shaped radial projection 14. Inside of each cup 14 a shouldered insulation 15 is fitted to the furnace-body 1 and its lining 2. The electrode is passed into the cup 14 and rests by its shoulder on a shoulder of the insulation 15. A suitably-insulated annular packing 16 is placed on the outer end of the electrode, around its outwardly-projecting stem 17, which preferably enters an opening in a conductive plug 18, screwed into the cup 14 to retain the electrode. Centrifugal force developed by rotation of the furnace throws the electrode 12 outward and compresses the packing 16 between it and the plug to prevent leakage past the electrode of the fluid-bed 3 or the fused materials under treatment in the furnace.

The electrode-retaining plugs 18 of each circumferential series are each in contact with an independent conductive segment 19 of a ring which may have as many segments as there are electrodes in the series, the segments being preferably separated by end insulation 20, thus directing the current toward the electrodes in contact with the respective segments. The ring may be removed to allow the plugs to be taken out to give access to the electrodes and their packings. Each of the uppermost segments 19 in Fig. 2 is in circuit by a brush 21 with one pole of a dynamo 22, while the two lower segments receive current from separate dynamos 23 through wires leading to the axis of the antifriction-rollers 24, on which the furnace rests for rotation at any required speed by one or more pinions 25, meshing with a toothed gear 26 on the furnace-body. Wires 27 connect a conductive rod 28 with each of the dynamos 22 23 to receive the return current by means of a brush 29 on the rod bearing on the head 8 of the rotating furnace-body. There being four currents transmitted to each circumferential series of electrodes 12, the furnace shown in Figs. 1 and 2 and having five such series will have twenty independent electric currents supplied to it, and it may be by as many separate dynamos, to give their joint powerful heating effect on the material under treatment. It will be noticed that by providing the ring 13 with projecting cups 14 and fitting the conductive segments 19 outside of these cups or the plugs 18 in them considerable space is provided at 30 for circulation of air inside and quite around the parts 19 to prevent overheating of the exterior contacts by either the electric currents which they distribute to the furnace or the heat generated by said currents within the furnace and radiating through its body-wall.

The operation of this apparatus is as follows: Before feeding the material 4 to be treated into the furnace any suitable substance or compound having proper electrical resistance and a specific gravity higher than that of the material to be treated may be charged into the rotating furnace upon its lining 2 and be melted to form the auxiliary protective fluid bath or bed 3 by dynamos 22 23. The fused material of the bed 3 forms a common interior electrode, along which returns the constantly-increasing electric current derived from the successive circumferential series of electrodes 12, and whereby a very high temperature is obtained in the furnace, due mainly to the rapidly-increasing supply of electric current entering the fluid-bed toward the discharge end of the furnace and the resultant heating of the bed incidental to the resistance offered by the bed to the passage of the common return-current. The fluid-bed is maintained in tubular form against the furnace-lining 2 by centrifugal force, which also will maintain the lining 2 in tubular form against the furnace body or shell should this lining become softened or partly fused by the intense heat attained within the furnace. As the material 4 is fed into the furnace by the screw 5 or otherwise the centrifugal force causes the material to assume a tubular form and to float or drift forward easily along the tubular fluid-bed 3 while subjected to the intense heat of the electric current derived from the circumferential electrodes 12 and returning through the fluid-bed. The electrothermal treatment may continue for a longer or shorter time, as determined by the rapidity of feed of the material or the speed of rotation of the furnace or the nature of the material. The treated material discharges from the furnace into the receiver 6. In treating certain classes of materials the fluid-bed 3 serves a very important function by constituting a practically frictionless tubular bearing-surface, along and within which the treated materials are carried, floated, or drifted forward through the furnace by the developed centrifugal force aided by the natural tendency of the materials to seek their own level.

It will be understood that the fluid-bed 3 may be formed or built up from and be constantly renewed by a portion of the materials under treatment or from one of the products of the reaction effected in the furnace. One such material is calcium carbid, to produce which calcium oxid and carbon are fed into the furnace and subjected to its heat energy. As the reaction takes place and the carbid is formed it is carried by centrifugal force against the lining 2 of the furnace-body to form an incandescent auxiliary protective lining 3 therefor, and the surplus carbid will discharge from the furnace into the receiver 6, the fluid-bed or protective lining being constantly renewed by freshly-formed carbid on its way to the outlet.

At various stages of the operation water or other cooling fluid will be thrown over the exterior walls of the furnace from a series of

nozzles 60, Fig. 2, or equivalent cooling apparatus to prevent overheating of the furnace.

What is claimed is—

1. In an electrical apparatus for making calcium carbid, an electrical circuit, a carbid conductor included in said circuit, whereby said conductor is maintained incandescent, means delivering carbid-forming materials to the heating-field, and means uninterruptedly moving the calcium carbid from the heating-field as fast as formed.

2. In an electrical apparatus, for making calcium carbid, an electric circuit, a carbid conductor included in said circuit, whereby said conductor is maintained incandescent, and means moving the calcium carbid from the heating-field as fast as formed.

3. In an electrical apparatus for making calcium carbid, an electric circuit, a carbid conductor included in said circuit, whereby said conductor is maintained incandescent, and means continuously moving the calcium carbid from the heating-field as fast as formed.

4. In an electrical apparatus for making calcium carbid, an electric circuit, a carbid conductor included in said circuit, whereby said conductor is maintained incandescent, means moving the calcium carbid from the heating-field as fast as formed, and means supplying carbid-forming materials to the heating-field.

5. In an electrical apparatus for making calcium carbid, an electric circuit, a carbid conductor included between opposed electrodes in said circuit, whereby said conductor is maintained incandescent, and means moving the calcium carbid from the heating-field as fast as formed, thereby maintaining the electrical resistance between the electrodes approximately uniform.

6. An electrical apparatus for making calcium carbid provided with an inlet for the carbid-forming materials and an outlet for the calcium carbid when formed, an electric circuit, a carbid conductor included in said circuit, and means continuously moving the calcium carbid from the heating-field to the outlet as formed.

7. In a rotatable electrical apparatus for making calcium carbid, an electric circuit, a carbid conductor included in said circuit, and means rotating the apparatus and removing the calcium carbid as formed from the heating-field of the apparatus.

8. In a rotatable electrical apparatus for making calcium carbid, an electric circuit, a carbid conductor included in said circuit, and means continuously rotating the apparatus and thereby continuously removing the calcium carbid from the heating-field of the apparatus as formed.

9. In an electrical apparatus for making calcium carbid, a carbid conductor, a plurality of electric circuits in each of which said conductor enters as an element, and means for moving the calcium carbid from the furnace as formed.

10. Apparatus for electrothermally treating materials, comprising a revoluble structure having peripheral electrodes, retainers therefor, and packings interposed between the electrodes and retainers whereby the packings are tightened by centrifugal force and outward pressure.

11. In apparatus for electrothermally treating materials, the combination, with the furnace-body and its peripheral electrodes, of one or more rings encircling the body and having collars admitting the electrodes, insulation interposed between the furnace-body and rings, retainers for the electrodes at the ring-collars, and current-conveying devices in contact with said retainers.

12. In apparatus for electrothermally treating materials, the combination, with the recessed electric furnace-body, and its peripheral electrodes, of insulation in the body-recesses for the electrodes, one or more rings encircling the body and having collars admitting the electrodes, retainers for the electrodes at the collars, packings interposed between the electrodes and the retainers, and current-conveying devices in contact with said retainers.

13. Apparatus for electrothermally treating materials, comprising a revoluble furnace-body, a refractory lining therein, a tubular fluid-bed within said lining constituting a common return-electrode, and peripheral electrodes fitted in the body and lining and in contact with the fluid-bed, whereby said bed is electrically energized for treatment of material passing through it.

14. Apparatus for electrothermally treating materials, provided with outer electrodes, an inner common electrode in circuit therewith, an interior open-ended conduit of low electrical conductivity within the inner electrode, and a layer of carbon or equivalent material having relatively higher electrical conductivity within the interior conduit.

15. Apparatus for electrothermally treating materials, comprising a revoluble structure provided with outer peripheral electrodes, an inner common electrode in circuit therewith, an interior conduit of low electrical conductivity within the inner electrode and a layer of carbon or equivalent material having relatively higher conductivity within the interior conduit.

16. Apparatus for electrothermally treating materials, provided with outer electrodes, an inner common electrode in circuit therewith, and an interior open-ended conduit of low electrical conductivity within the inner electrode and out of contact with the outer electrodes.

17. Apparatus for electrothermally treating materials, provided with outer electrodes, an inner common electrode in circuit therewith,

an interior open-ended conduit of low electrical conductivity within the inner electrode and out of contact with the outer electrodes, and a layer of carbon or equivalent material having relatively higher conductivity within the interior conduit.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

HUDSON MAXIM.

Witnesses:
HENRY ASH,
OSCAR E. LANGER.