Oct. 25, 1949. F. W. KOSTER ET AL 2,485,609

DRYING APPARATUS

Filed April 19, 1945 3 Sheets-Sheet 1

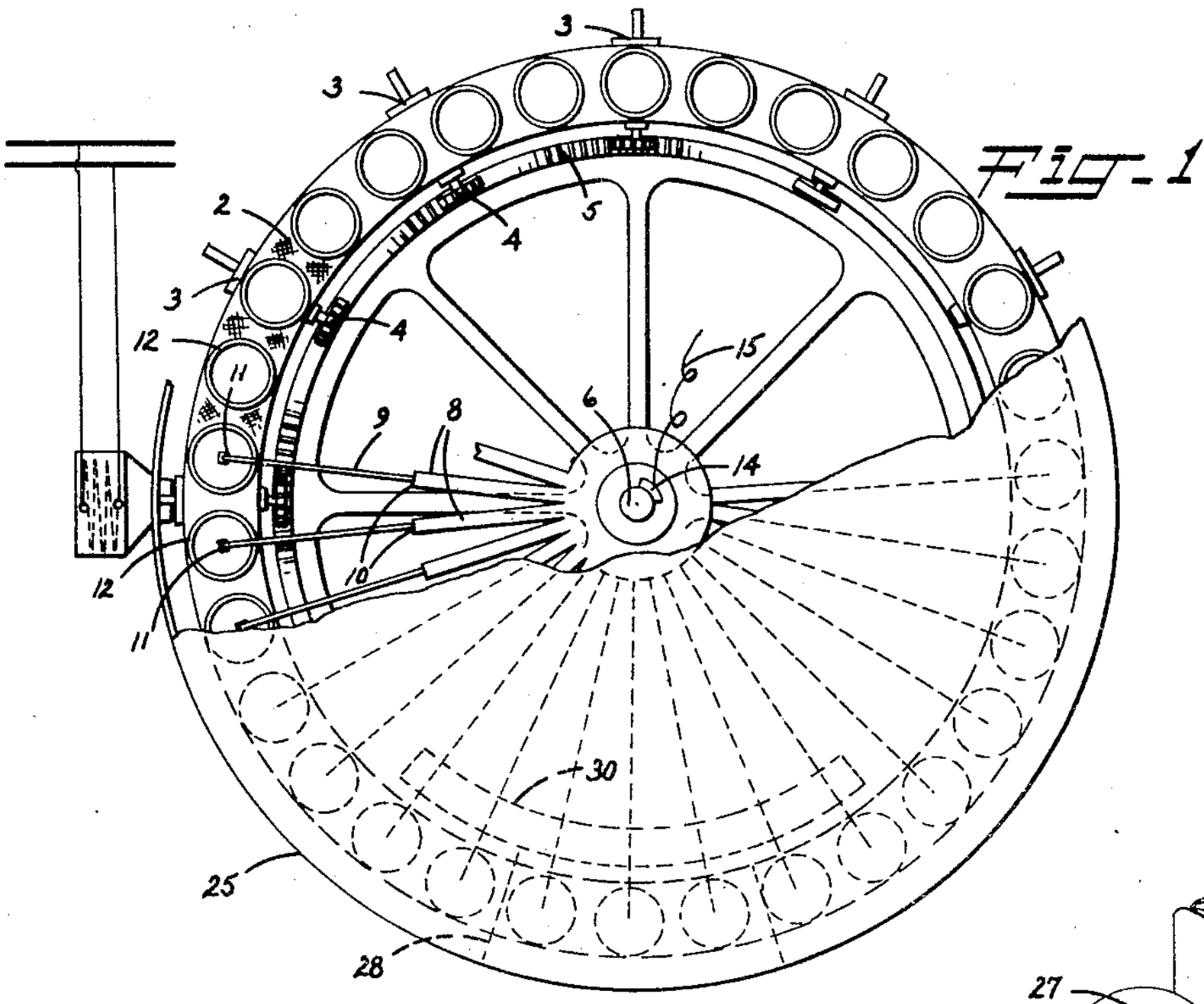

Fig. 1

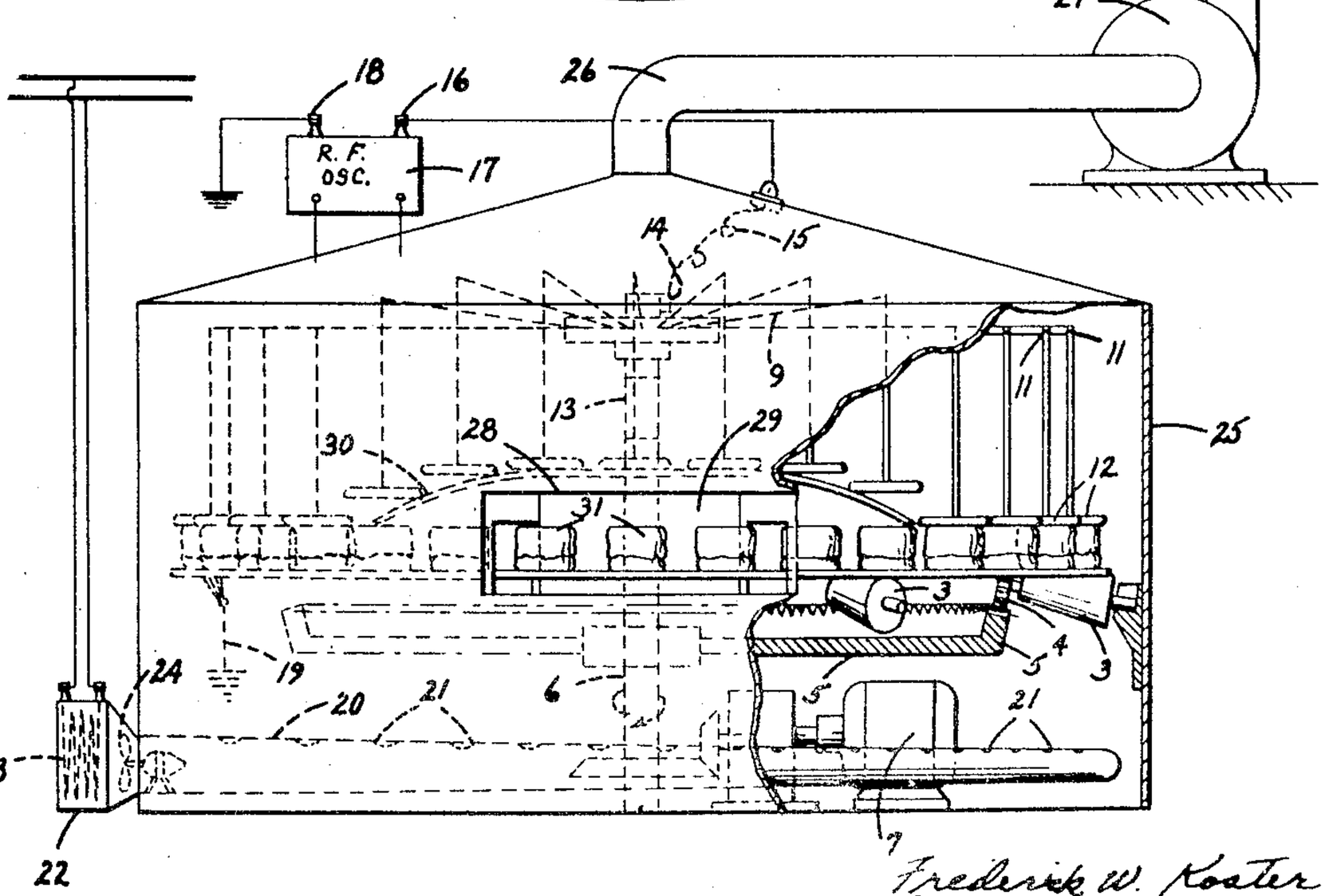

Fig. 2

Frederick W. Koster
Louis A. Oberly
INVENTORS.
by Carl A. Castellan
atty.

Oct. 25, 1949. F. W. KOSTER ET AL 2,485,609

DRYING APPARATUS

Filed April 19, 1945 3 Sheets-Sheet 2

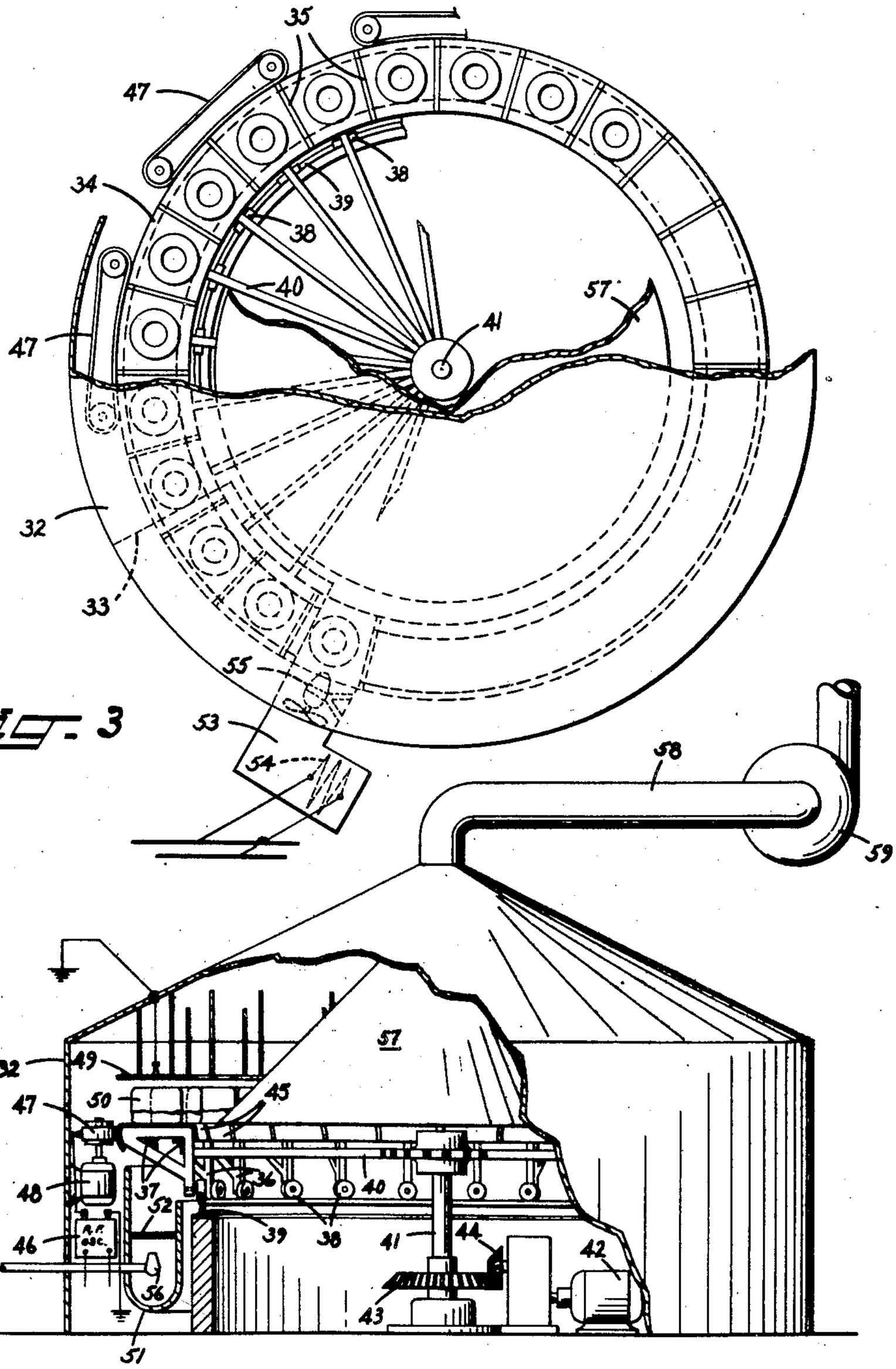

FIG. 3

FIG. 4

Frederick W. Koster
Louis A. Oberly
INVENTORS.
by Carl A. Castellan
atty.

Oct. 25, 1949. F. W. KOSTER ET AL 2,485,609

DRYING APPARATUS

Filed April 19, 1945 3 Sheets-Sheet 3

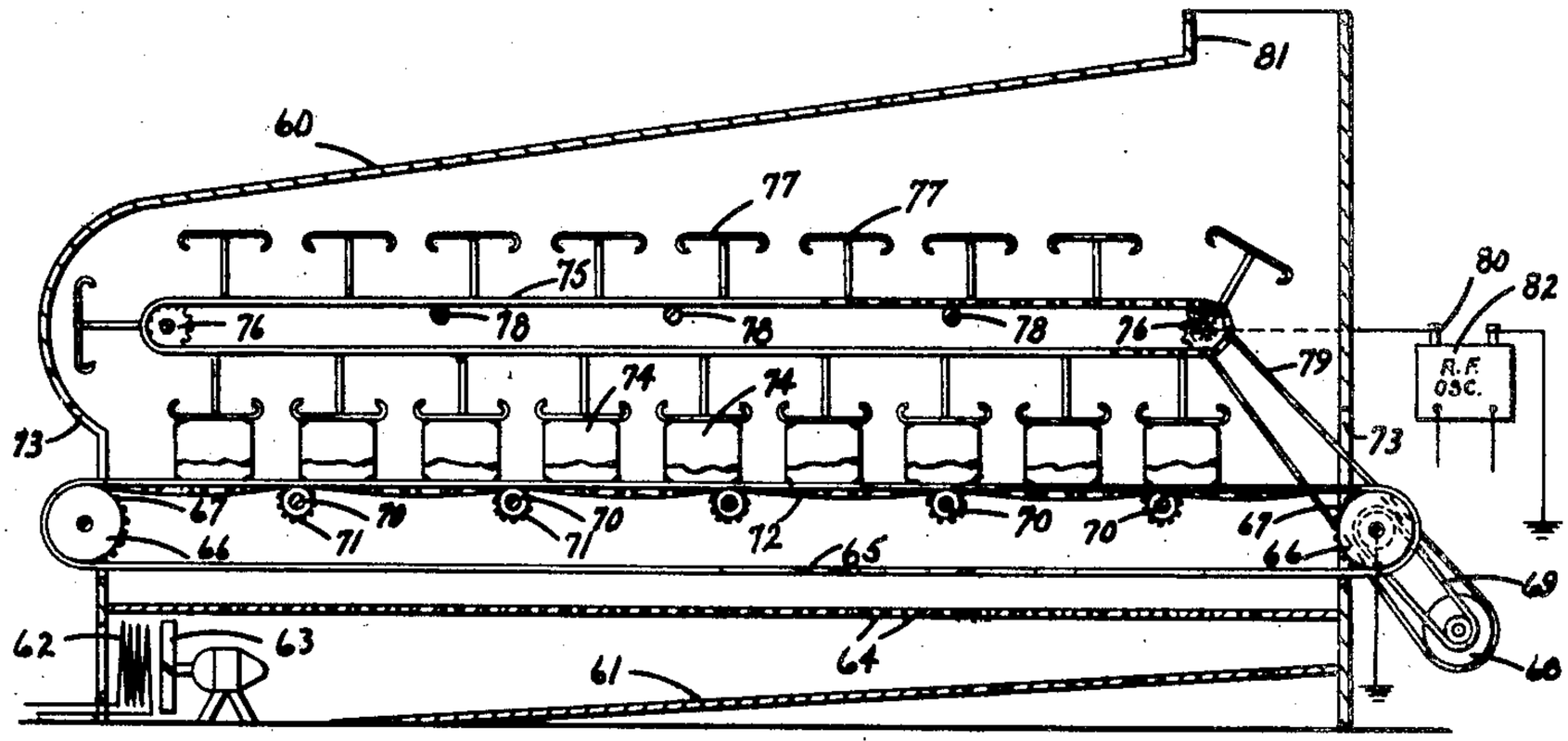

Fig. 5

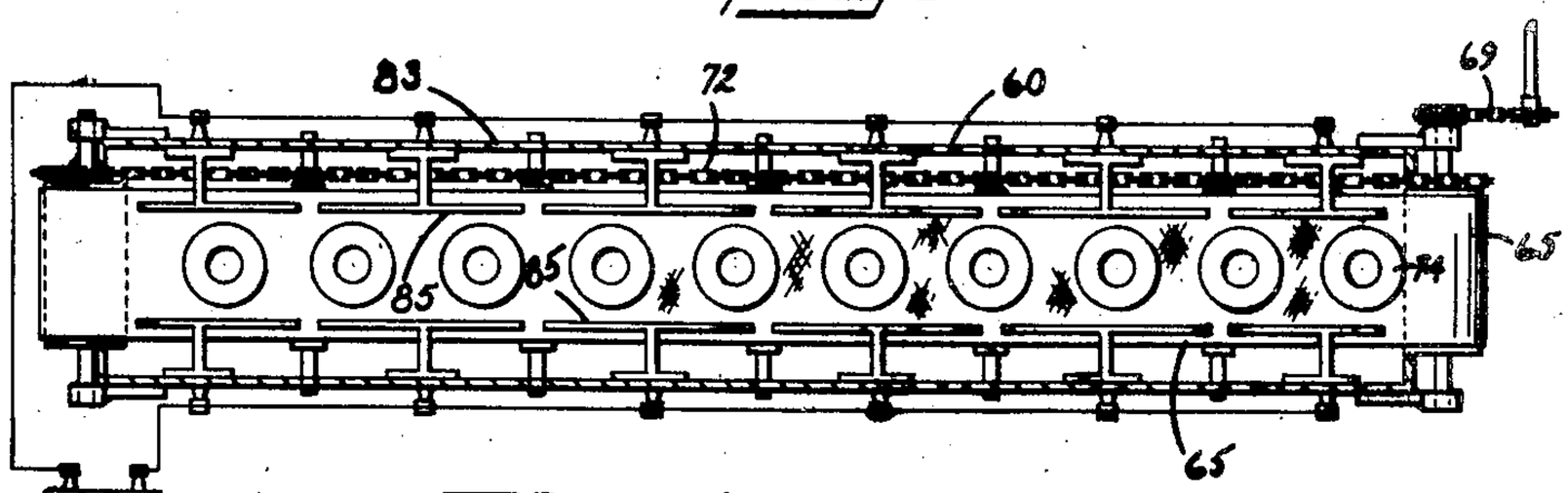

Fig. 6

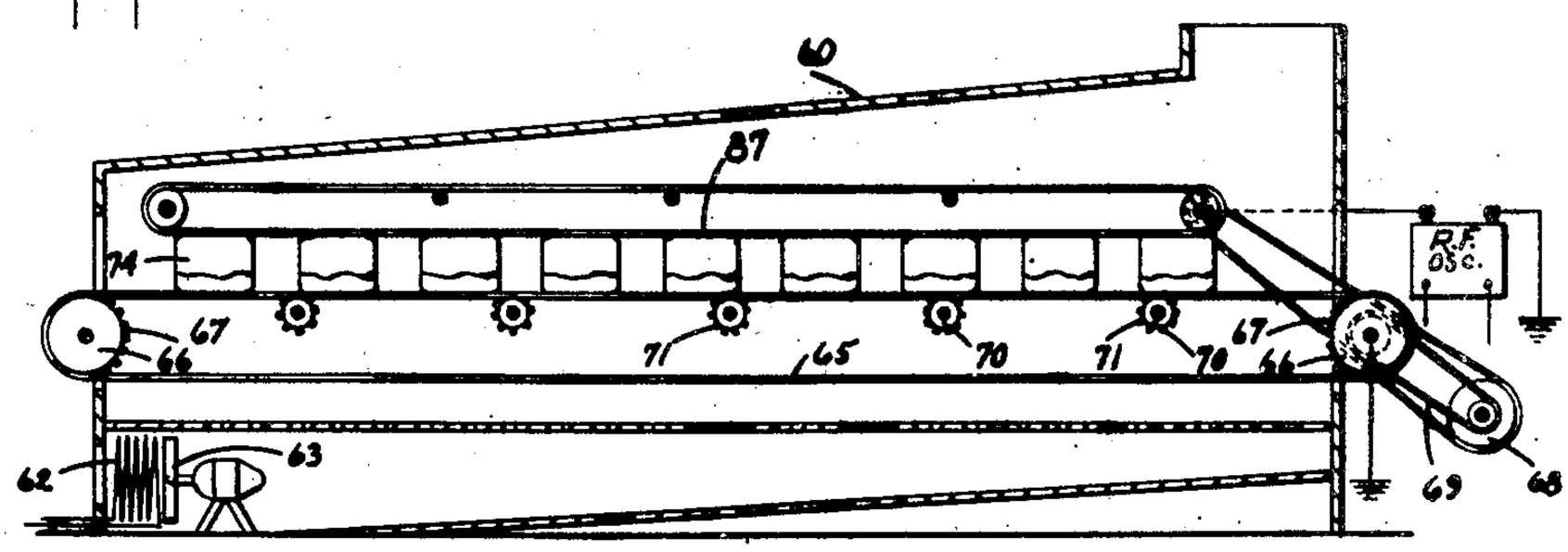

Fig. 7

Frederick W. Koster
Louis A. Oberly
INVENTORS.

BY Carl A. Castellan
atty.

Patented Oct. 25, 1949 2,485,609

UNITED STATES PATENT OFFICE

2,485,609

DRYING APPARATUS

Frederick W. Koster, Wallingford, and Louis A. Oberly, Swarthmore, Pa., assignors to American Viscose Corporation, Wilmington, Del., a corporation of Delaware

Application April 19, 1945, Serial No. 589,200

4 Claims. (Cl. 34—1)

1

This invention relates to apparatus for drying parcels of filamentary material and the like, such as wound packages of rayon.

It is an object of the present invention to provide an improved drying apparatus utilizing the dielectric characteristics of the materials to be dried for developing the heat internally thereof in which the parcels to be dried are carried by a foraminous support which is moved in a cyclical path along a portion of which a high frequency electric field is developed and maintained, while at the same time passing a current of heated gaseous medium, such as air, upwardly through the foraminous support and above the parcels being dried to facilitate the removal of moisture vaporized by the dielectric heating and to prevent condensation of the vaporized moisture on adjacent surfaces of the apparatus, such as the electrodes, their supports, and the housing through which the foraminous support moves. Other objects and advantages of the invention will be apparent from the drawing and the description thereof hereinafter.

In the drawing illustrative of the invention,

Figure 1 is a plan view, with part of the housing removed of one embodiment of the invention;

Figure 2 is an elevation of the embodiment of Figure 1;

Figure 3 is a plan view, with part of the housing removed, of a modification;

Figure 4 is a cross-sectional elevation of the embodiment of Figure 3;

Figure 5 is a cross-sectional elevation of another modification;

Figure 6 is a plan view of a modification with the roof of the housing removed; and

Figure 7 is a cross-sectional elevation of a modification of Figure 5.

As shown in Figures 1 and 2, an annular foraminous belt or platform 2, such as of open-mesh metallic screen material is rotated about its axis by the supporting conical rolls 3 which are driven by the pinions 4 arranged inside the annular belt which mesh with the annular gear 5 carried by the central shaft 6 mounted for rotation by means of a motor 7 therebelow. The shaft carries in spider-like arrangement a plurality of outwardly extending arms 8 which have projections 9 thereof hinged at points 10 and 11. Individual electrodes 12, preferably of foraminous material, such as metallic screening, are suspended pivotally from the outer ends of the respective projections from the arms of the spider, so that the electrodes are arranged above the annular foraminous belt 2. The upper portion of

2

the shaft 6 carrying the spider 5 is of metal but is insulated by an intermediate section 13 from the lower portion of the shaft extending to the motor 7. A brush 14 bears against the upper metallic portion of the shaft and is connected by a lead 15 to one pole 16 of a high frequency oscillator 17, such as a radio frequency oscillator. The arms, projections and suspensions to the individual electrodes are all of metallic construction, so that the brush serves to connect each of such electrodes with the same pole of the oscillator. The other pole 18 of the oscillator is preferably grounded and the annular foraminous belt is also grounded at 19 so it will constitute a cooperating electrode with respect to the upper individual electrodes. Beneath the annular belt 2 there is arranged a duct 20, preferably of annular shape having discharge openings 21 in the upper surface thereof. One end of the duct is connected to a chamber 22 adapted to receive a heating element 23, such as a steam coil, electric coil or the like, so that air entering the duct is heated thereby. A fan 24 may be provided in the chamber to force the air into the duct. A housing 25 is provided about the assembly and the roof may slope upwardly to the center thereof to which the discharge duct 26 may be connected to a fan 27 for inducing a draft therethrough. The housing is provided with an opening 28 in the peripheral wall, so that the annular belt is accessible to an operator for introducing and removing the parcels of material to be dried. Preferably the opening is of such height as to allow plenty of room for the size of the parcels 31 to be handled and it is provided with a back wall 29 just behind the annular belt which may be supported by a bottom and ceiling walls extending inwardly from the lower and upper edges of the opening. A stationary cam 30 is arranged above the charging opening in the path of the hinged projections 9 from which the electrodes 12 are pivotally suspended so that as they are brought into proximity to the opening, the upper electrodes are lifted from the parcels 31 and proceed over the ceiling of the opening and then descend into contact with the parcels beyond the charging opening. In this fashion, the operator is protected from any substantial influence of the high frequency electric field.

In operation of the embodiment of Figures 1 and 2, the motor rotates the shaft which effects travel of the annular foraminous belt and the electrodes at the same speed in a cyclical path, part of which extends through the charging opening. As the annular foraminous support

passes through the charging opening, the parcels of material to be dried may be placed upon the support either mechanically or manually and similarly those parcels which have passed through the housing may be discharged from the support either manually or mechanically. The characteristics of the oscillator may be adjusted to give any desired heating effect internally of the parcels depending upon the particular nature thereof. The temperature of the air which is forced upwardly through the foraminous support is also controlled in accordance with the material under consideration. For example, where wound packages, such as cakes of regenerated cellulose filaments, such as those obtained from viscose, are being dried, the temperature of the air may be from about 140° to 170° F., whereas the temperature developed internally of the cake by the electric field may be about the same as that of the air or higher, such as up to substantially 212° F. The passage of the heated air through the housing, which may be insulated advantageously, serves to prevent condensation on the walls thereof and on the upper electrodes and the suspensions thereof, thereby preventing drippings back upon the parcel being dried, conserving heat and increasing the uniformity of drying effect.

As shown in Figures 3 and 4, a similar housing 32 having a similar charging opening 33 is provided but the foraminous belt 34 is divided into sections which are connected together by insulating transverse ribs 35. As shown more particularly in Figure 4, the annular carriage is comprised of a plurality of supporting brackets 36 connected together by annular angle bars 37 and provided with rollers 38 operating upon an annular track 39. A spider 40 carried by a shaft 41 driven by the motor 42 with bevel gears 43 and 44 is secured to the annular carriage for rotating it about its axis. The carriage may be composed entirely of insulating materials, or at least sufficient to provide for the electrical separation or insulation of the several sections of metallic screen 45 or equivalent foraminous web, which, as shown, is wrapped about the inner and outer peripheries of the upper surface of the carriage. The lower insulated segments or sections of the foraminous supporting web constitute lower electrodes and a plurality of oscillators 46 may be arranged about the periphery of the annular carriage except for the vicinity of the charging opening of the housing. Metallic belts 47 are connected to one pole of a corresponding oscillator and driven by small motors 48 serve to connect the foraminous supporting web adjacent the respective portions of the periphery of the annulus to distinct oscillators. The other pole of the several oscillators may be grounded. An upper foraminous web 49 is suspended from the roof of the housing 32 a sufficient distance above the carriage to allow ample room for passage of the parcel 50 that is grounded. The section of this upper foraminous electrode adjacent the charging opening 33 may be and is preferably omitted. An annular duct 51 is arranged below the carriage and has openings 52 in its upper surface to discharge upwardly. As in the first embodiment, a chamber 53 is provided adjacent the entrance to the duct and contains a heating coil 54 and a fan 55 or blower to force air into the duct. At one or more points about the annular duct, humidifiers 56 are arranged therein. These humidifiers may be controlled to impart a predetermined relative humidity to the air that is circulated past the parcels to be dried. An internal cone 57 is formed within the housing to provide a more or less flaring annulus for discharging the air and the evaporated moisture contained therein through a central discharge duct 58 which may again be provided with a suction fan or blower 59.

This embodiment of the invention has the advantage of providing for independent control of the various stages of drying. Thus, at the first stage of drying, the relative humidity of the heated air forced past the parcel being dried and the electrical characteristics of the oscillator may be preselected independently of those provided in successive stages of the drying path or cycle. Thus, the drying may be started while in the presence of high humidity heated air and at successive stages, the relative humidity may be progressively lower. At the same time, the electrical characteristics of the oscillators may be progressively changed to effect a higher heating rate in successive stages of the cycle until a predetermined moisture content of the parcels is obtained, after which the heating effect may be progressively decreased. If desired, instead of providing a single air inlet and heating chamber for the entire duct, a plurality of such may be arranged thereabout, a separate heater and fan serving to supply the heated air adjacent each distinct portion of the cycle. Thus, the temperature as well as the relative humidity and the dielectric heating effect at any given stage can be controlled independently of those characteristics at succeeding stages of the drying cycle.

Figure 5 shows a modification in which a longitudinal housing 60 is provided having a duct 61 at the bottom for receiving air which is heated by a coil 62 and blown by the fan 63 set in a chamber to one side of the apparatus and communicating with one end, the charge end, of the duct. The duct is provided with openings 64 in its upper surface to allow the air to flow upwardly. A foraminous metallic belt 65 is driven by rolls 66 which may be provided with sprockets 67 and is in turn driven by the motor 68 and interconnecting chain 69. The foraminous belt system is grounded to serve as one electrode in the high frequency system and suitable rolls 70 having sprockets 71 at their ends serve to support the upper course of the foraminous belt as it travels from one end to the other of the housing. The chains 72 operated by the end sprockets 67 engage the sprockets at the end of the small supporting rolls and serve to drive them at substantially the same linear speed as the foraminous belt. The width of the belt 65 is approximately the width of the housing but extends outwardly therefrom at each end and the housing has an opening 73 at each end above the belt to allow the entrance and discharge of the parcels 74 to be dried. A metallic chain 75 is driven by end sprockets 76 and carries individual electrodes 77 at spaced intervals therealong. Guide rollers 78 may be provided to support the upper source of the chain and the chain may be driven from the same motor as the foraminous belt by means of the chain 79 so that both the electrode-carrying chain and the foraminous belt travel at the same speed. One pole 80 of the radio frequency oscillator 82 is electrically connected to the electrode-carrying chain and the other may be grounded. The roof of the housing 60 may be sloped upwardly toward the discharge end of the apparatus and a duct 81 may be connected to the highest portion thereof and may be pro-

vided with a fan for withdrawing air and moisture therefrom.

In operation of this embodiment, the upper electrodes are brought into contact with the parcels which may be fed to the foraminous belt by hand or mechanically at definite intervals shortly after the parcels enter the housing, and these upper electrodes rest thereon until a point adjacent the discharge opening of the housing, at which instant, they are swung upwardly around the chain and out of contact.

Figure 6 shows a modification in which a housing 83 provided with a duct for introducing heated air along the bottom thereof as in Figure 5 is provided with an endless belt 84 of foraminous character as in Figure 5 for supporting the parcels to be dried. The supporting foraminous belt 84 is driven but is not intended in this embodiment to form a pole for the high frequency current. Instead, the upper electrodes and driving structure are omitted and electrodes 85 are disposed substantially vertically at opposite sides of the path of the parcels within the housing 83. The electrodes on one side may be connected to one pole of an oscillator 86, while those of the other side are connected to the opposite pole. Alternatively, a separate oscillator may be provided for each pair of electrodes and alternate oscillators are disposed on opposite sides of the housing, so that the electrode of each pair which has the shortest lead to its oscillator is positioned alternately on opposite sides of the series of pairs.

Figure 7 shows a modification of Figure 5, in which the upper individual electrodes are replaced by an endless foraminous belt 87 similar to that constituting the lower electrode. The lower course of the upper belt may be allowed to droop into contact with the parcels, so that it rests thereon as they proceed through the housing.

The present invention is adaptable to the drying of parcels of filamentary material which merely contain moisture and also to such parcels as may have been treated with other conditioning agents whether in the presence of water as a solvent or in the presence of an organic solvent of volatile character. For example, the apparatus may be used to dry rayon to which a soap solution has been applied, with the object of leaving a small amount of soap upon the fibers as a conditioning agent. Again, an aqueous emulsion or a solution in an organic solvent of oils, soaps, fats, dyes, pigments or waxes may have been applied. Again, the conditioning medium may be one which undergoes condensation or curing to a final insoluble condition, examples of such being urea formaldehyde, resins, melamine resins, or rubber and synthetic rubber dispersions.

The present invention lends itself readily to procedures in which the removal of solvent and/or reaction between components of the conditioning medium or between one or more components of the conditioning medium and a textile material is effected in separate stages of a multiple-stage process. For example, for many purposes it may be desirable to effect merely a removal of solvent at a relatively low temperature until a definite solvent content is obtained and then finish the removal of solvent and simultaneous reaction at a high temperature for a short time. This procedure, in which a negligible amount of reaction is effected during the preliminary stage and the reaction and final drying are both accomplished in a short time in the final stage is particularly advantageous when the

conditioning medium contains one or more components which, during the treatment with heat, undergo a change to an insoluble condition such that removal of the balance of the solvent by diffusion through the insoluble product is greatly hindered or almost completely prevented.

While preferred embodiments have been described, it is to be understood that they are merely illustrative of the invention, and that changes and variations may be made herein without departing from the spirit and scope as defined by the appended claims.

We claim:

1. Apparatus for drying parcels of filamentary material and the like comprising a foraminous belt electrode for supporting the parcel to be dried, means for moving the electrode through a cyclical path, a housing substantially enclosing the electrode except for openings provided therein adjacent the positions for charging and discharging the parcels to be dried, a plurality of electrodes arranged above the path, means for moving the latter electrodes along a portion of the path with the first electrode at substantially the same speed, means for lowering the upper electrodes as they pass beyond the charging position, means for elevating the upper electrodes in advance of the discharge position, and means for forming a high frequency electrostatic field between the lower and upper electrodes respectively.

2. Apparatus for drying parcels of filamentary material and the like comprising a foraminous belt electrode for supporting the parcel to be dried, means for moving the electrode through a cyclical path, a housing substantially enclosing the electrode except for openings provided therein adjacent the positions for charging and discharging the parcel to be dried, means arranged beneath at least a portion of the path for directing a gaseous medium upwardly therethrough, a plurality of electrodes arranged above the path, means for moving the latter electrodes along a portion of the path with the first electrode at substantially the same speed, means for lowering the upper electrodes as they pass beyond the charging position, means for elevating the upper electrodes in advance of the discharge position, and means for forming a high frequency electrostatic field between the lower and upper electrodes respectively.

3. Apparatus for drying parcels of filamentary material and the like comprising an annular foraminous electrode for supporting the parcel to be dried, means for rotating the electrode about its axis through a cyclical path, a housing substantially enclosing the electrode except for openings provided therein adjacent the positions for charging and discharging the parcels to be dried, means arranged beneath at least a portion of the path for directing a gaseous medium upwardly therethrough, a plurality of electrodes arranged annularly above the path, means for moving the latter electrodes along a portion of the path with the first electrode at substantially the same speed, means for lowering the upper electrodes as they pass beyond the charging position, means for elevating the upper electrodes in advance of the discharge position, and means for forming a high frequency electrostatic field between the lower and upper electrodes respectively.

4. Apparatus for drying parcels of filamentary material and the like comprising an annular foraminous electrode for supporting the parcel to be dried, means for rotating the electrode about its axis through a cyclical path, a housing sub-

stantially enclosing the electrode except for openings provided therein adjacent the positions for charging and discharging the parcels to be dried, said openings being opposed to each other and a shielding arrangement comprising a bottom wall, back wall, and ceiling provided between the two openings, means arranged beneath at least a portion of the path for directing a gaseous medium upwardly therethrough, a plurality of electrodes arranged annularly above the path, means for moving the latter electrodes along a portion of the path with the first electrode at substantially the same speed, means for lowering the upper electrodes as they pass beyond the charging position, means for elevating the upper electrodes in advance of the discharge position, and means for forming a high frequency electrostatic field between the lower and upper electrodes respectively, means for impressing a high frequency electrostatic field across the belts, and means for directing a gaseous medium upwardly through the belts.

LOUIS A. OBERLY.
FREDERICK W. KOSTER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
327,198	Sargent	Sept. 29, 1885
811,306	Lorimer	Jan. 30, 1906
1,476,424	Sargent	Dec. 4, 1923
1,626,766	Tompkins	May 3, 1927
2,042,145	Darrah	May 26, 1936
2,231,457	Stephen	Feb. 11, 1941
2,263,681	Hart, Jr.	Nov. 25, 1941
2,275,431	Hart, Jr., et al.	Mar. 10, 1942
2,291,807	Hart, Jr.	Aug. 4, 1942
2,325,652	Bierwirth	Aug. 3, 1943
2,390,572	Brabander	Dec. 11, 1945
2,403,800	Hoyler	July 9, 1946
2,408,434	Mann et al.	Oct. 1, 1946
2,428,615	Brown	Oct. 7, 1947