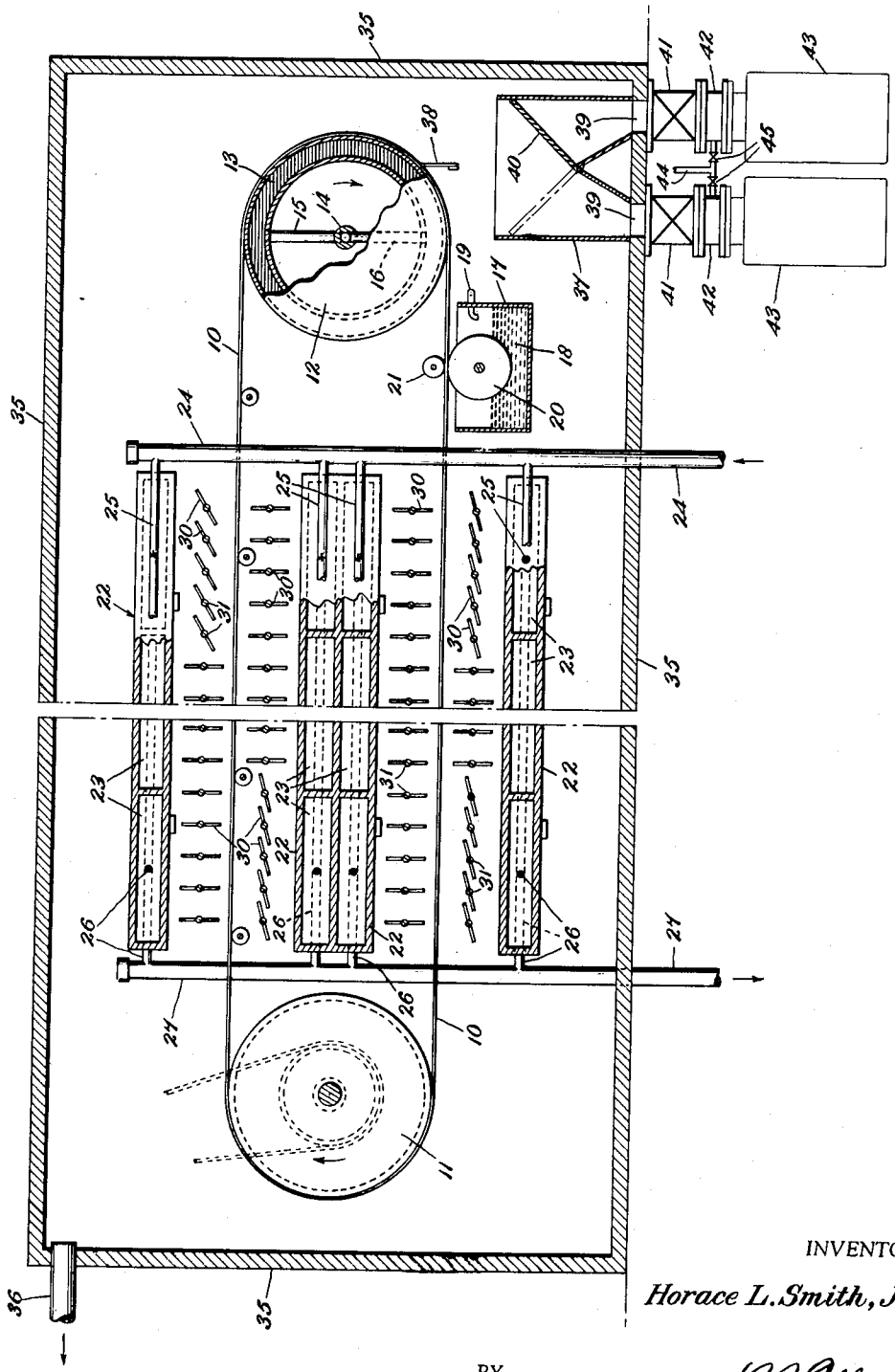
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APPARATUS FOR DRYING CULTURE MEDIA AND ANALOGOUS MATERIALS

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APPARATUS FOR DRYING CULTURE MEDIA AND ANALOGOUS MATERIALS

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This invention relates to the drying of culture media, pharmaceutical materials, heat-sensitive food products, and other similar semi-liquid substances, and has for its principal object the provision of an improved apparatus for effecting continuous dehydration of such materials in a more facile and efficient manner than has been heretofore proposed.

Essentially, this is accomplished by subjecting a thin stratum or film of the material adherent to one face of an endless traveling metallic belt to the action of radiant heat directed toward both faces of such belt, with means being provided whereby the quantity of heat reaching each face of the belt, and preferably different portions of each such face, may be easily, quickly and efficiently varied at will as conditions may require. The belt and other elements appurtenant thereto preferably are enclosed in a housing from which the air is evacuated, and which is provided with means whereby the dried product may be removed as desired without loss of vacuum. The water vapors resulting from the drying may be removed from the enclosure by any of several conventional methods, e. g., by the employment of steam jets; through absorption by a dried dessicant such as silica gel; by collection on refrigerated surfaces upon which they will freeze; or by condensation by sprays of refrigerated lithium chloride or other low vapor pressure condensing liquid.

The essential elements of a typical example of the present apparatus are illustrated in the accompanying drawing forming a part of this specification, in which the figure is a longitudinal vertical sectional view, partly in elevation and to some extent diagrammatic.

Referring to said drawing in greater detail, a thin endless stainless-steel or similar metal belt **10** is trained about a pair of spaced rotatably mounted pulleys **11** and **12**, the former of which may be driven in the direction indicated by the arrow by any appropriate source of power (not shown), and the latter of which is provided with a peripheral compartment **13** through which cold water or other cooling medium may be circulated by means of the hollow shaft **14** and the induction and eduction pipes **15** and **16**, whereby the temperature of the dried product may be suitably reduced prior to discharge from the drier. A receptacle **17** is disposed below the starting end of the lower run of the belt **10** adjacent the pulley **12**, to which receptacle the culture medium or other substance to be dried is supplied through a pipe **19**. A roll **20** rotatably mounted in said receptacle dips into the medium **18** and its peripheral face engages the under surface of the belt **10** whereby it may transfer a thin layer or film of the medium to such surface. A presser roll **21** is provided above the belt to insure continuous contact of the belt with the transfer roll **20**, as will be readily understood from the drawing.

A chambered radiating element **22** is mounted in spaced parallel relation to each face of each run of the belt **10**, such elements being of a width to span the belt transversely and of a length to extend throughout a major portion of the distance between the pulleys **11** and **12**. A

heating medium such as steam, or preferably a heat-transfer liquid of the chlorinated bi-phenyl type, is circulated through the chambers **23** of said elements by means of suitable supply pipes **24** and **25** and return pipes **26** and **27**.

Interposed between each radiator element **22** and that face of the belt adjacent thereto is a series of adjustable heat-reflecting members **30**, each of which comprises a transversely extending metal slat carried by an oscillatably mounted rod or shaft **31**. These members are volitionally adjustable between the vertical position in which some of them are shown and the inclined positions in which others are illustrated, and in the former position they interpose substantially no interference to the flow of heat from their associated radiating element **22** to the adjacent belt face, while in the latter position they intercept and reflect such heat away from such face to a degree dependent upon their inclination from the vertical. These reflectors thus provide a simple and effective means for controlling the heat being received by each face of the belt from the several radiator elements, and of quickly varying the amount of such heat as conditions may require.

The reflecting members **30** may be individually adjustable if desired but preferably they are interconnected in sets of two or more for unitary adjustment. That surface of each member which faces toward its associated radiating element **22** when the member is inclined, preferably is highly polished whereby to have a maximum reflecting power.

The parts thus far described are enclosed in a housing **35** from which the air may be evacuated through a pipe **36** connected to any suitable vacuum pump. A hopper **37** is provided within said housing beneath the cooling pulley **12** for receiving the dried material, which is scraped from the belt **10** as it passes about such pulley by a doctor blade **38**. The hopper communicates with a pair of discharge passages **39** in the bottom wall of the housing **35**, and is provided with a swingable vane **40**, shifting of which causes the material to be directed to one passage or the other as desired. Each passage **39** is controlled by a valve **41**, normally closed to preserve the vacuum within the housing, and below each valve there is a fitting **42** to which may be attached a bottle or other receptacle **43** for receiving the product. Piping **44**, controlled by valves **45**, is adapted to supply nitrogen or similar inert gas to the fittings **42** whereby to break the vacuum below the valves **41** after a container **43** has been filled and the valve therefor closed.

What is claimed is:

1. Apparatus for drying culture media and analogous semi-liquid materials, comprising an endless metal belt traversably mounted upon a pair of spaced pulleys; means for continuously applying a film of the material to be dried to the outward face of said belt; a chambered radiating element mounted in spaced parallel relation to each face of the belt intermediate said pulleys; means for circulating a heating fluid through the chambers of said elements, whereby they may emit radiant heat toward each of said belt faces; a plurality of adjustably mounted heat-reflecting members disposed between each of said radiating elements and the adjacent face of the belt, said members being severally adjustable to control the heat reaching various areas of the belt from said radiating elements; and means for removing the dried material from the belt.

2. Apparatus for drying culture media and analogous semi-liquid materials, comprising an endless metallic belt traversably mounted upon a pair of spaced pulleys; means for continuously supplying the material to be dried to the outward face of said belt; a chambered radiating element mounted in spaced parallel relation to each face of the belt intermediate said pulleys; means for circulating a

heated fluid through the chambers of said elements, whereby they may emit radiant heat toward each of said belt faces; a series of oscillatably mounted parallel metallic slats extending transversely of the belt intermediate each of said radiating elements and the belt face adjacent thereto, said slats having heat-reflecting surfaces and being arranged in sets each of which is volitionally adjustable whereby to vary the amount of heat reaching various longitudinal areas of the belt from said elements; and means for removing the dried material from the belt.

3. Apparatus for drying culture media and analogous semi-liquid materials, comprising an endless metallic belt; a pair of spaced pulleys about which the belt is trained, one of said pulleys having a peripheral compartment; means for circulating a cooling fluid through said pulley compartment; means for driving one of said pulleys; means adjacent said compartmented pulley for depositing a film of the material to be dried upon the outward face of said belt; chambered heat radiating elements disposed in spaced parallel relation to each face of the belt intermediate said pulleys; means for circulating a heating medium through the chambers of said radiating elements; means disposed between the radiating elements and the belt for controlling at will the amount of heat received by various longitudinally adjacent areas of the belt and the material thereon from such elements; and means adjacent said chambered pulley for removing the dried material from the belt.

4. Apparatus for drying culture media and analogous semi-liquid materials, comprising a housing providing a closed chamber; means for evacuating the air from said chamber; an endless metallic belt mounted upon a pair of spaced pulleys within the chamber to provide spaced upper and lower belt runs, one of said pulleys having a peripheral compartment; means for circulating a cooling fluid through said pulley compartment; means for driving said pulleys and belt; means adjacent the starting end of said lower belt run for continuously depositing a film of the material to be dried upon the outward face of said belt; heat radiating means extending in spaced parallel relation to each face of each run of the belt between the pulleys; means disposed between the belt and each of said radiating means for volitionally varying the amount of heat reaching various longitudinal areas of the belt and material thereon from such radiating means; means for removing the dried material from the belt; a hopper within said chamber for receiving the material from said removing means, said hopper communicating with discharge passages in a wall of the chamber; and valve means controlling said passages.

5. Apparatus for drying culture media and analogous semi-liquid materials, comprising an endless metallic belt trained about a pair of spaced pulleys to provide elongated spaced upper and lower belt runs; means for driving one of said pulleys to continuously traverse said belt runs between them; means adjacent the beginning of said lower belt run for continuously applying a thin coating of the material to be dried to the under surface of such run; a chambered radiating element fixedly mounted in spaced relation to each face of each of said belt runs and extending parallel thereto throughout substantially the length of such runs; means for circulating a heating fluid through the chambers of said elements whereby the elements may emit radiant heat toward each of said belt faces; a series of adjustably mounted heat-reflecting members disposed between each of said radiating elements and the face of the belt run adjacent thereto, the various members of each such series being

volitionally adjustable to intercept or pass heat from said elements to selected longitudinal areas of their associated belt runs whereby to control the drying of the material; and means adjacent the final end of the upper belt run for removing the dried material from the belt.

6. Apparatus for drying culture media and analogous semi-liquid materials, comprising a pair of spaced pulleys having an imperforate endless metal belt trained about and extending between them in elongated substantially paralllel upper and lower runs; means for driving one of said pulleys to continuously move said belt about them; means adjacent the point of departure of the lower run of the belt from one of the pulleys for continuously applying a thin layer of the material to be dried to the under surface of said lower belt run; a chambered radiating element fixedly mounted adjacent each face of each of said belt runs and extending in spaced parallel relation to the respective faces throughout a major portion of the length thereof; means for circulating a heating fluid through the chambers of said elements whereby they may emit radiant heat toward each of said belt faces; means for volitionally varying the heat reaching longitudinally contiguous areas of the respective belt runs whereby to control the drying of the material, such means comprising a series of adjacent adjustably mounted heat-reflecting members disposed between each of said radiating elements and the face of the belt adjacent thereto, which members are adjustable to intercept or pass heat from the radiating elements to said belt faces, and the members of each series being arranged in independently adjustable longitudinally adjacent sets, each of which comprises a plurality of the members interconnected for simultaneous adjustment; and means adjacent the last mentioned pulley for removing the dried material from the belt.

7. In apparatus for the vacuum drying of heat-sensitive, biologically-active substances (and analogous liquid and semi-liquid substances) of the type including a vacuum chamber, a continuously movable endless belt for carrying the substance to be dried during the drying operation, means for heating the substance on said belt, means for applying the undried substance to said belt while maintaining said belt in motion and holding a vacuum in said chamber, and means for removing the dried substance from said belt while maintaining said belt in motion and holding a vacuum in said chamber, the improvement including, in combination, at least two means for supporting said belt during motion thereof spaced apart and providing a run for said belt between them, at least one hollow radiator means disposed to radiate heat onto said run, means for circulating a fluid heat transfer medium through said radiator, and variable radiation interceptor means disposed between said run and said radiator.

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