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Patented Jan. 17, 1899.

J. SENIOR, R. BURY & H. M. WALKER.  
APPARATUS FOR DRYING GRAIN.

(Application filed Dec. 24, 1897.)

(No Model.)

2 Sheets—Sheet 1.

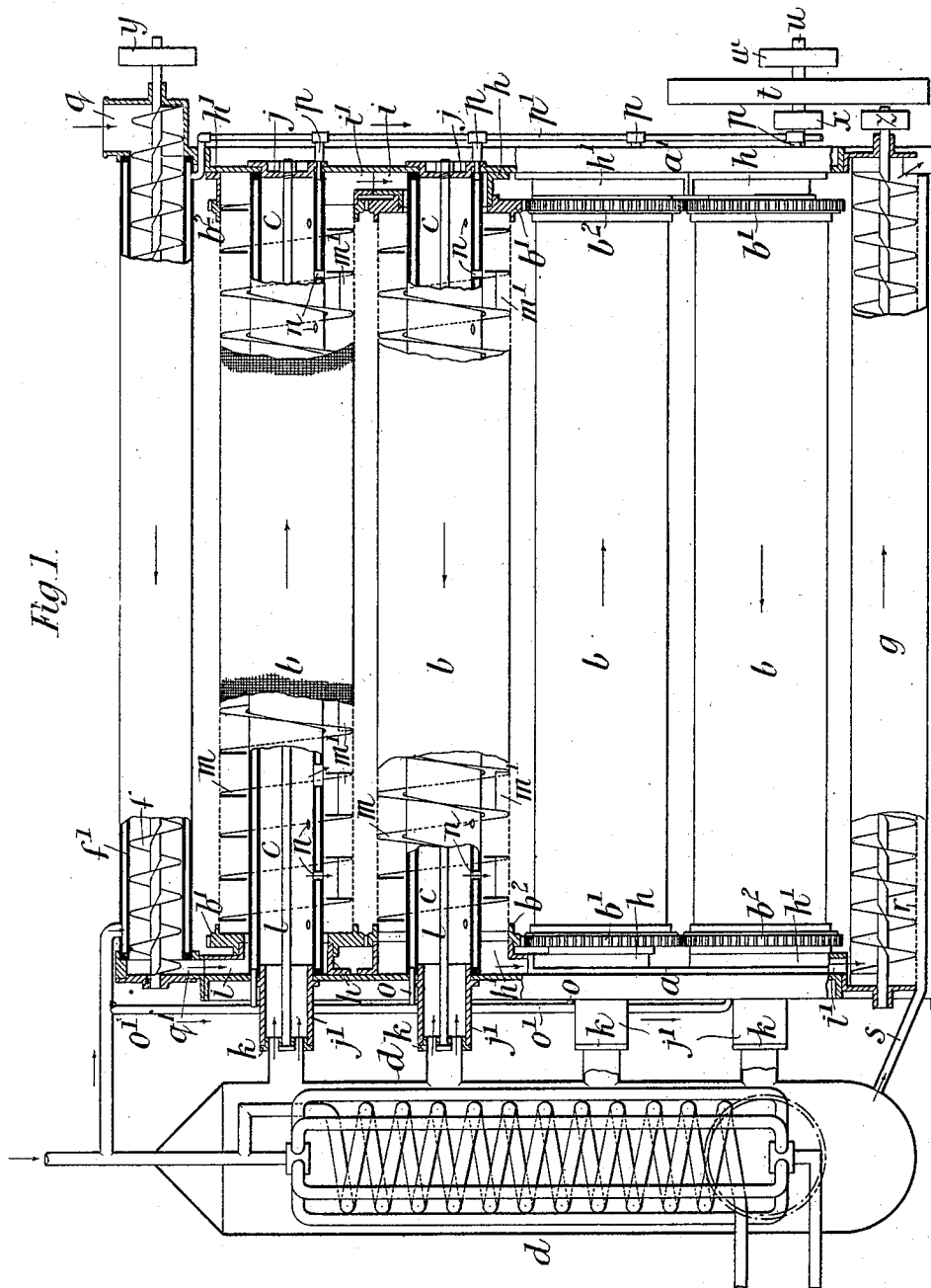


Fig. 1.

Witnesses  
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Fig. 2.

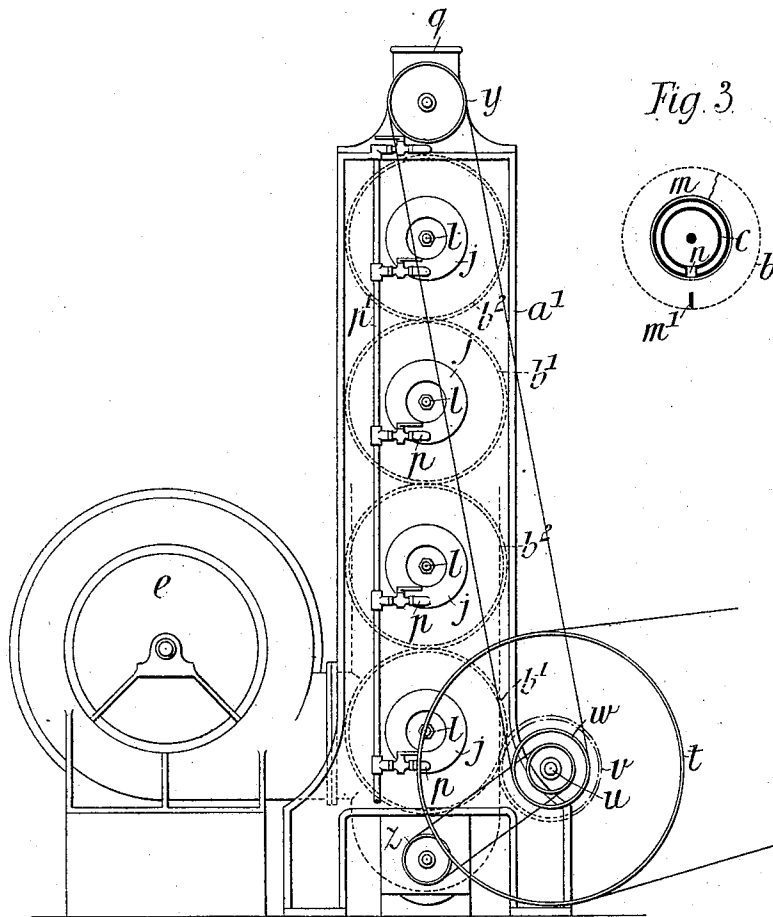


Fig. 3.

Witnesses.

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# UNITED STATES PATENT OFFICE.

JOSEPH SENIOR, OF WAKEFIELD, AND REGINALD BURY AND HENRY MILNES WALKER, OF BARNSELY, ENGLAND; SAID SENIOR ASSIGNOR TO SAID BURY AND WALKER.

## APPARATUS FOR DRYING GRAIN.

SPECIFICATION forming part of Letters Patent No. 617,816, dated January 17, 1899.

Application filed December 24, 1897. Serial No. 663,413. (No model.)

*To all whom it may concern:*

Be it known that we, JOSEPH SENIOR, residing at Wakefield, and REGINALD BURY and HENRY MILNES WALKER, residing at Barnsley, England, subjects of the Queen of Great Britain, have invented new and useful Improvements in Apparatus for Drying Grain and other Granular Substances, (for which patents have been obtained in Great Britain, No. 11,930, dated June 20, 1894; in France, No. 243,862, dated December 22, 1894, and in Germany, No. 85,100, dated January 4, 1895,) of which the following is a specification.

This invention relates to apparatus for drying grain and other granular substances by means of hot air more rapidly than heretofore.

In carrying out our invention we provide a series of superposed drying-cylinders, through which the grain or other material to be dried is caused to pass successively, each of the said cylinders, which is composed of wire-gauze and adapted to be rotated, having within it a spiral conveyer blade or web. Through the center of each cylinder extends a distributing-tube, preferably steam-jacketed, into the interior of which hot air is blown from a heater by means of a fan, the said hot-air-distributing tube having through it holes or openings for allowing the hot air to pass into contact with the material in the drying-cylinders. The tubes are held in position by being clamped between side frames, which also carry flanged castings, upon which the drying cylinders rotate. At the top of the apparatus is a steam-jacketed conveyer, through which the material to be dried is introduced, and at the bottom of the apparatus is another conveyer, through which the dried material is discharged, the latter conveyer being provided with a perforated bottom for permitting cold air to be blown through the dried material in order to cool it, if necessary.

To enable our invention to be fully understood, we will describe the same by reference to the accompanying drawings, in which—

Figure 1 is a sectional elevation of our improved apparatus, and Fig. 2 is an end ele-

vation. Fig. 3 is a transverse section illustrating the construction of the cylinders.

$a a'$  are the side frames of our improved drying apparatus, and  $b b'$  are the wire-gauze drying-cylinders.

$c c$  are the jacketed tubes passing through the cylinders.

$d$  is the chamber in which the air is heated, and  $e$  is the blast-fan, by means of which the current of air is produced.

$f$  is the conveyer at the top of the apparatus for introducing the material to be treated, and  $g$  is the discharge-conveyer.

Each of the cylinders  $b$  has fixed to each end a ring of gear-teeth, as indicated at  $b' b^2$ , the ring  $b'$  at the inlet end having a central aperture of such size as to leave a space between itself and the jacketed central tube through which the material to be dried can pass into the cylinder, while the ring  $b^2$  at the discharge end has an internal diameter equal to the internal diameter of the cylinder, so that it will offer no obstruction to the flow of material therefrom. These rings  $b' b^2$  work upon the flanged castings  $h h'$ , respectively, the castings  $h$  having formed at their upper parts passages  $i$ , through which the material to be dried can flow into the cylinders, and the castings  $h'$  having discharge passages  $i'$  at the lower part, through which the material discharged from the cylinder can flow and escape. It will be understood by referring to the drawings that the castings  $h h'$  of one cylinder are arranged at opposite positions to those of the adjacent cylinder or cylinders, so that the discharge-passage  $i'$  of one casting shall coincide with the inlet-passage  $i$  of the next cylinder.

The heat-distributing tubes  $c$  are arranged between the said frames, each being at one end supported upon the boss or central portion of a plate  $j$  and at the other end upon the end of a bush or tube  $j'$ , through which the warm air is introduced. The said tube  $j'$  has at its outer end a flanged grid  $k$ , through the center of which a bolt  $l$  is passed, the said bolt being also passed through the center of the plate  $j$  and secured by a nut in order to clamp the tubes  $c$  and  $j'$  and frames  $a a'$  in position.

*m m* are the conveyer-blades fixed within the gauze cylinders *b b*, the said blades being so arranged that they will move freely with the cylinders around the distributing-tubes *c c*.

*n n* are the holes formed at the lower part of each distributing-tube, through which the hot air escapes into the cylinders *b b*.

*m' m'* are plates fixed between adjacent convolutions of the conveyers *m m*, so as to lift the grain and allow it to fall upon the heated tubes *c c*.

The heater *d*, which may be of any suitable shape, is connected to the bush *j'* of each cylinder *b*, so that the hot air from the said heater may flow into the several distributing-tubes *c* independently and thence escape into the respective cylinders *b* through the holes *n n*, so as to come into contact with the material to be dried. As shown, the heater *d* is provided with an internal heating-coil and with a series of vertical pipes, through all of which steam is caused to circulate. The fan is connected to the heater at the lower part and serves to force the air through the heater into the several cylinders. When jacketed heat-distributing tubes *c c* are used, steam is introduced into the jacket of each one, for which purpose an inlet-pipe *o*, communicating with a steam-flow pipe *o'*, is connected with each jacket at one end and a discharge-pipe *p* connected with the common discharge-pipe *p'*, arranged at the other end, so that there will be a constant flow of steam through each jacket, any water of condensation also passing away through the said pipes *p p'*. The holes *n n* are formed in the jacketed tubes by passing short pipes or nipples through the two walls of the jacket and tube, as shown in Fig. 3.

In the drawings the conveyer *f* is represented as arranged within a jacketed tube *f'*, provided at one end with an opening or hopper *q*, through which the material to be dried is introduced into the conveyer, and at the other end with a discharge-opening *q'*, coinciding with the inlet-passage *i* of the uppermost bearing-casting *h*, steam being allowed to flow through the conveyer-jacket in the same manner as through the jackets of the jacketed tubes *c c*.

*r* is the wire-gauze placed beneath the bottom of the discharge-conveyer *g*, a space being left beneath the wire-gauze into which cold air, flowing directly from the fan *e*, may enter through a tube *s*.

Motion is communicated to the drying-cylinders and the several conveyers by any suitable means. As shown, a belt-pulley *t* is mounted on a driving-shaft *u*, the said driving-shaft having upon it a gear-wheel *v*, which engages with one of the gear-rings of the lowermost cylinder *b*, or, the shaft being of sufficient length, two gear-wheels may be employed, gearing with the gear-ring on the cylinder. On the said shaft *u* are also mounted pulleys *w x*, the former of which serves to communicate motion by means of a belt to a pulley *y* on the

shaft of the conveyer *f* and the latter to a pulley *z* on the shaft of the conveyer *g*.

The operation of the apparatus hereinbefore described is as follows: Steam being admitted into the heating-coil and pipes of the heater *d* and also to the jackets of the jacketed distributing-tubes *c, c,* and *f'*, air is forced into the said heater by the fan *e* and flows into the said distributing-tubes, whence it escapes into the cylinders *b b* through the gauze of the said cylinders, the said material being introduced into the conveyer *f* through the aperture *q* and conveyed to the passage *q'*, whence it flows through the passage *i* into the uppermost cylinder *b*. After passing through this cylinder it escapes through the passage *i'* into the passage *i* of the next cylinder, through which it is conveyed, whence it escapes in a similar manner into the third cylinder and into the fourth, being finally delivered into the conveyer *g*. After being subjected to the action of cold air, as hereinbefore described, it is discharged. The arrows in the passages *i i'* and on the cylinders *b b* indicate the direction in which the grain passes.

It is to be understood that although we have shown our apparatus as being provided with four drying-cylinders a greater or less number may be employed.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is—

1. A drying apparatus having a series of superposed drying-cylinders made of wire-gauze or like material, the several cylinders being in communication and each having an internal tube through which hot air is forced and distributed into contact with the material in the drying-cylinders, each of said cylinders having an internal conveyer adapted to move freely with it and around its internal tube, to cause the traverse of the material, all substantially as set forth.

2. In an apparatus for drying grain and granular substances, having a series of superposed, parallel wire-gauze or equivalent cylinders, located in vertical series one above the other, the combination therewith of a hot-air-distributing tube passing through each cylinder, and a jacket on each of said tubes, the distributing-tubes having holes or openings therein to allow the hot air to pass into contact with the material in the drying-cylinders.

3. In combination with the series of superposed cylinders *b*, the hot-air-distributing tubes *c*, the steam-flow pipe *o'*, and its several pipes *o*, connecting with the jackets of said tubes, and the discharging-pipes *p p'*, the combination permitting a constant flow of steam through each jacket, and the discharge of water of condensation.

4. In combination with the described series of superposed perforate drying-cylinders, of

5 a heater having a direct pipe connection severally with each one of said cylinders, and a fan serving to cause a current of hot air to be blown from the heater through distributing-tubes and into contact with the material in the drying-cylinders.

10 5. In a drying apparatus, the combination with a series of drying-cylinders, of a heater having steam-pipes inclosed therein which serve to heat the air within such heater, delivery-pipes from the heater to supply the hot air to the cylinders, and steam-pipes for supplying steam to the annular spaces within the cylinders, as described.

6. In combination with a drying apparatus 15 having a series of superposed and connecting wire-gauze cylinders, of a conveyer into which the dried material is delivered, said conveyer having a perforated bottom for admitting cold air to it, all substantially as set 20 forth.

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