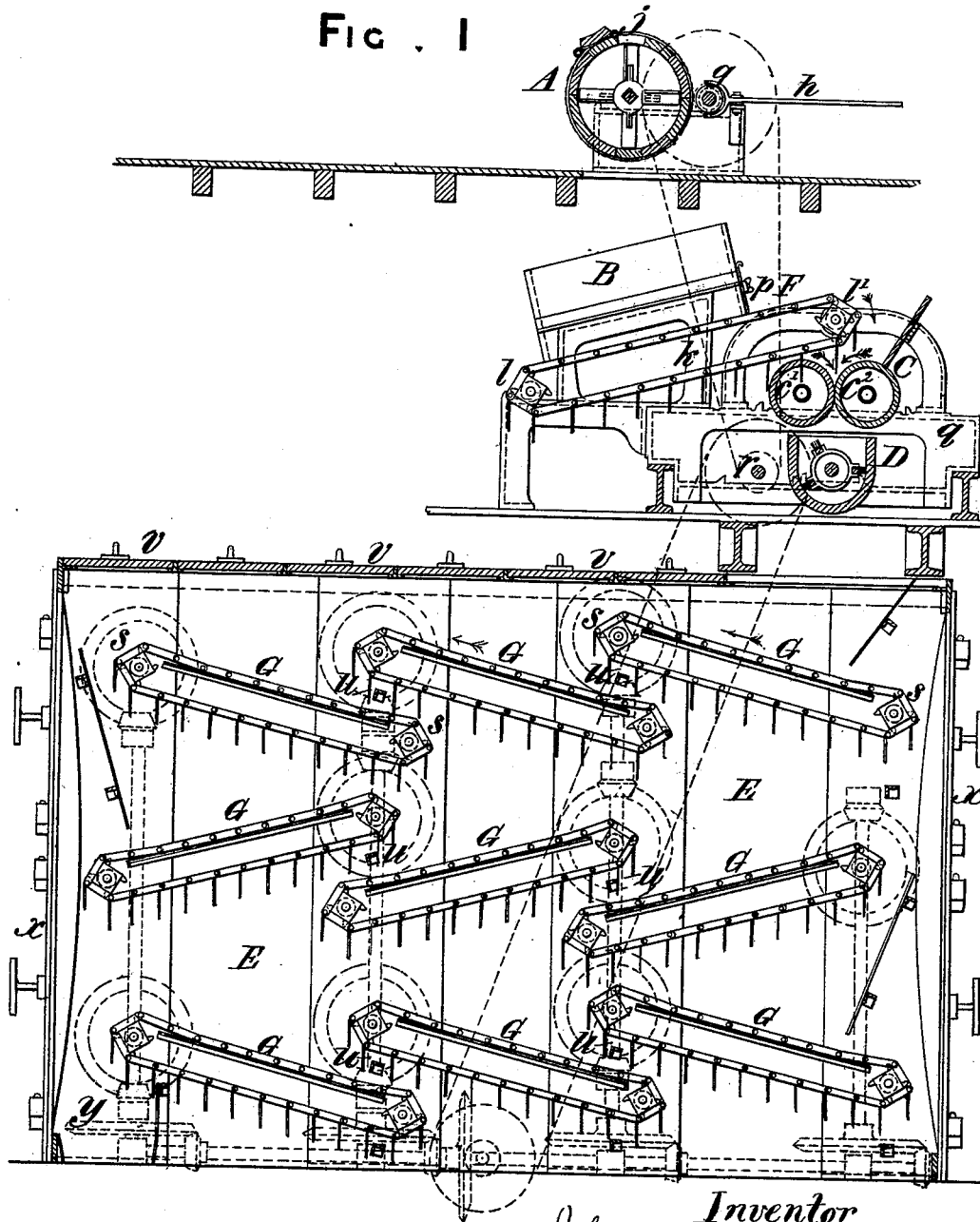


J. N. FLEMING.  
Apparatus for Mixing, Crushing, and Drying  
Granular Materials.  
No. 221,543. Patented Nov. 11, 1879.

FIG. 1



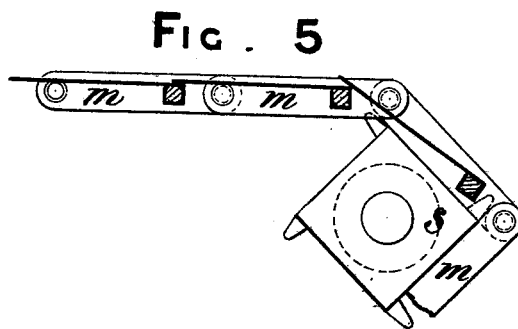
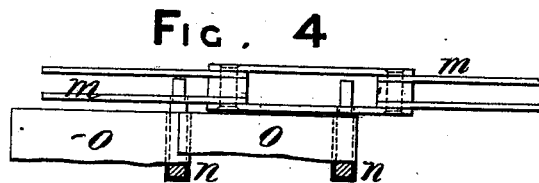
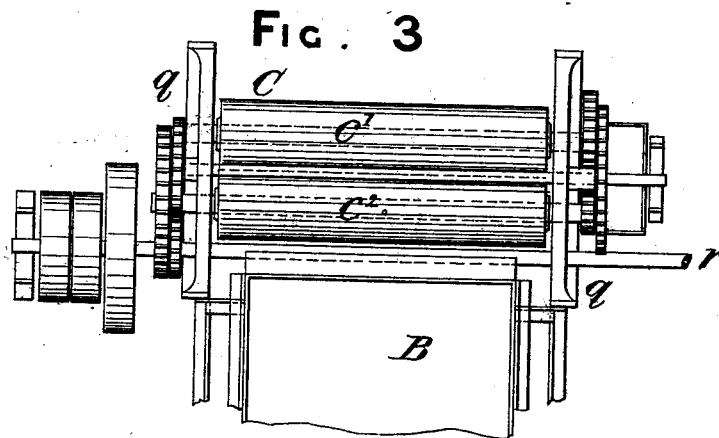
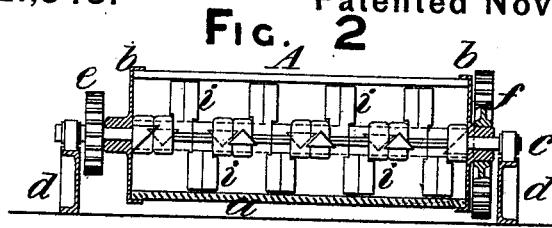
Inventor  
John Nicholson Fleming  
by his Attorneys  
Hawson & Son

Witnesses  
Henry Howson Jr.  
Harry Smith

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Harry Smith Witnesses

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# UNITED STATES PATENT OFFICE.

JOHN N. FLEMING, OF NEWCASTLE, COUNTY OF NORTHUMBERLAND,  
GREAT BRITAIN.

## IMPROVEMENT IN APPARATUS FOR MIXING, CRUSHING, AND DRYING GRANULAR MATERIALS.

Specification forming part of Letters Patent No. **221,543**, dated November 11, 1879; application filed May 2, 1879; patented in England, February 22, 1878.

*To all whom it may concern:*

Be it known that I, JOHN NICHOLSON FLEMING, of Newcastle, in the county of Northumberland, in the Kingdom of Great Britain, have invented Improved Apparatus for Mixing, Crushing, and Drying Granular Materials, of which the following is a specification.

My invention, for which British Letters Patent No. 4,270, November 15, 1877, sealed February 22, 1878, have been granted to me, relates to apparatus adapted for use in the manufacture of fruit-salt.

The ingredients are introduced into a mixing-drum, which is arranged to be revolved, and is provided internally with a shaft fitted with stirrers. The ingredients, when mixed, are discharged through a door into a hopper provided with a moving bottom, which gradually feeds forward the ingredients to a set of crushing-rollers. The ingredients, on leaving the crushing-rollers, fall into a sieve having a semi-cylindrical bottom and a revolving brush. The sifted ingredients fall onto the first of a series of endless aprons arranged within a drying-stove, and are passed from one apron to another until they are discharged in condition ready to be packed.

In the accompanying drawings corresponding letters of reference indicate the same parts in the various figures.

Figure 1 represents a vertical elevation, partly in section, of the complete apparatus. A is the mixer. B is the hopper. C is the set of crushing-rollers. D is the sieve, and E is the drying apparatus.

Fig. 2 is a vertical section of the mixer, taken at right angles to the section in Fig. 1. Fig. 3 is a plan of the crushing-rollers and of part of the hopper. Figs. 4 and 5 illustrate the construction of the endless aprons.

In the said mixer, A is a cylinder or drum, which, in the example, is formed of wood lags *a*, bolted to cast-metal ends *b*. A boss upon each of the said ends is bored to fit upon a shaft, *c*, which is fitted to revolve in bearings in the standards *d*. A spur-wheel, *e*, is fixed upon the said shaft, and a second spur-wheel, *f*, is fixed upon one of the ends *d*. A

driving-shaft, *g*, is fitted to revolve in bearings, and is driven by means of suitable strap-pulleys. Upon this shaft two pinions are mounted, one pinion gearing with an intermediate wheel, which gears with the wheel *e*, and the other pinion gearing with the wheel *f*. Each pinion is formed as a clutch, the sleeve part of the clutch being fitted to slide upon the shaft upon a fast key in the ordinary manner.

Each clutch can be disengaged by means of a hand-lever, *h*. When both of the clutches are in gear the shaft *c* will be caused to revolve, and at the same time the drum A will revolve, but at a slower speed and in the contrary direction.

The part of the shaft *c* extending between the ends *b* is square in section, and upon this part are fixed arms *i i*. These arms are prismoidal in form, and are each cast or formed in two parts, which are bolted together so as to gripe the shaft; but this construction may be varied.

The drum is formed with a long opening, *j*, which is provided with a hinged door, which, when shut, is secured by means of a sliding bolt or by other suitable means.

In the example the mixer A is situated on a floor above the hopper B. The said hopper consists of a rectangular frame, B, which is secured to standards *k*.

An endless apron, E, is mounted upon two chain-rollers, *l l'*. The construction of the said apron is illustrated by Figs. 4 and 5. Two endless chains, formed of links *m*, are mounted upon the two chain-rollers. The said links are perforated to receive the ends of cross-bars *n*, upon which are fixed flaps of sheet metal *o*. The free end of each flap rests upon the next flap at the point of attachment to the cross-bar, the series of flaps thus forming a surface capable of holding any matters which it may receive. The said surface constitutes the bottom of the hopper. The front of the hopper is provided with a sliding shutter, *p*, which can be adjusted nearer to or farther from the apron.

A revolving motion is imparted to the roller *l* by suitable gearing, whereby the apron is

caused to travel in the direction indicated by the arrow.

The crushing-rollers C, formed of steel, cast-iron, chilled iron, or other suitable material, are turned to a cylindrical form, or are grooved, or partly smooth and partly grooved. The axes of the rollers revolve in suitable plumb-er-blocks or bearings, fixed to strong frames g, which rest upon beams, as indicated, or are otherwise suitably sustained.

A pinion on the driving-shaft r gears with a wheel on the roller c', and imparts to it a revolving motion in the direction indicated. The two rollers are connected together by spur-wheels, having the proportions of about two to one, so that the roller c' is also caused to revolve in the direction indicated, but at a slower speed than the roller c'.

The arrangement of gearing may be varied as considered or found to be most suitable—as, for example, the roller c' may revolve in the same direction as the roller c', but at a much slower speed; or both rollers may revolve in the directions indicated in the drawings, and at the same speed; or the relative speeds may be different from the speeds herein indicated. Also, more than two rollers may be combined together, so as to act in concert.

Below the rollers is arranged the sieve D, having a semicircular bottom. This sieve is formed with a suitable frame-work, covered with wire-gauze, or other suitable material. Within the said sieve a shaft is fitted to revolve, and on this shaft are fixed disks, to which are attached brushes, which extend from one end of the sieve to the other. Any suitable arrangement of brushes attached to the revolving shaft may be employed; or the shaft may be caused to rock or vibrate, if preferred. The sieve is, by preference, inclined from one end to the other, so that any matters not passing through the meshes may gradually travel toward the lower end and be discharged into a suitable receptacle, or be returned by means of a "Jacob's ladder" to the crushing-rollers.

Below the sieve is the drying apparatus E, consisting of a rectangular chamber, formed of T or angle iron framing, covered or lined with sheet-iron or with metal plates, or otherwise suitably formed. Within this chamber are arranged a series of nine endless traveling aprons, G G. Each apron is mounted upon two chain-barrels, s s, and is formed as hereinbefore indicated when referring to Figs. 3 and 4.

One of the axes of the chain-barrels of each apron passes through the wall of the chamber, and is connected by means of spur-gearing with an arrangement of driving and connecting shafts, (indicated by the dotted lines,) whereby all the aprons are caused to travel in unison in the direction indicated by the arrows.

Angle-irons u u are fixed to extend across the chambers in such positions as that the

hinged flaps which constitute the surface of each apron shall be drawn over the said angle-irons in succession, the said angle-irons or any other suitable parts substituted therefor acting as scrapers to remove any matters which might adhere to the surfaces of the said flaps.

The chamber E is heated by means of steam or hot-water pipes, or of flues, or of heated surfaces, or by means of currents of heated air, admitted, forced, or drawn into the chamber, or by any suitable means. The number of aprons in the series may be varied.

In the example the ceiling of the chamber consists of wooden panels v v, which fit between the T-iron cross-beams, and can be lifted out when necessary. Access to the interior of the chamber is also had through hinged doors at x.

The operation of the apparatus may be described as follows: A charge of the ingredients is introduced into the mixing-drum A, and the door thereof is closed. The drum and the inner shaft are then set in motion, and are kept in motion until it is considered that the mixing is completed. The movement of the drum or of both parts is then arrested, and the door is opened, so as to allow the ingredients to fall into the hopper B, from whence they are gradually fed forward by the apron F and delivered to the crushing-rollers C. The rate of delivery to the said rollers is regulated by raising or lowering the shutter p. The ingredients received by the rollers are crushed by the rollers, which have a triturating action, by reason of the difference in the surface velocity of the two rollers. The crushed and triturated ingredients fall into the sieve D, which separates any particles which have not been sufficiently crushed. The finely-divided ingredients passing through the sieve fall through an opening into the chamber E and onto the first of the series of aprons. The ingredients are carried forward and discharged from one apron onto another, the last apron in one row discharging onto the first apron in a lower row, the ingredients traveling in the direction indicated by the arrows until they are finally discharged into the space y, whence they may be raked out or removed at intervals, or be removed continuously by means of a creeper or worm or of a traveling apron.

The chamber E and the arrangement of apparatus, or a modification of the same, may be employed in the drying of other ingredients or matters than those herein indicated.

The frequent changing of the matters from one apron to another facilitates and expedites the drying operation, and tends to prevent agglomeration of the particles.

I claim—

1. The combination of the mixer A, the feeding-hoppers B, the crushing apparatus C, the sieve D, and the drying apparatus E, constructed substantially as and for the purposes set forth.

2. The combination of the revolving mixing-drum provided with an internal shaft having stirring-blades, the hopper B, provided with a traveling bottom or apron, F, the revolving crushing-rollers C, the partly-cylindrical sieve D, provided with the revolving brushes, and the traveling aprons G, provided with hinged

plates and mounted within a heated chamber, E, substantially as and for the purpose set forth.

JOHN NICHOLSON FLEMING.

Witnesses:

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WILLIAM WIXSTEAD.