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MOISTURE TESTING APPARATUS

Filed Jan. 13, 1951

Fig-1

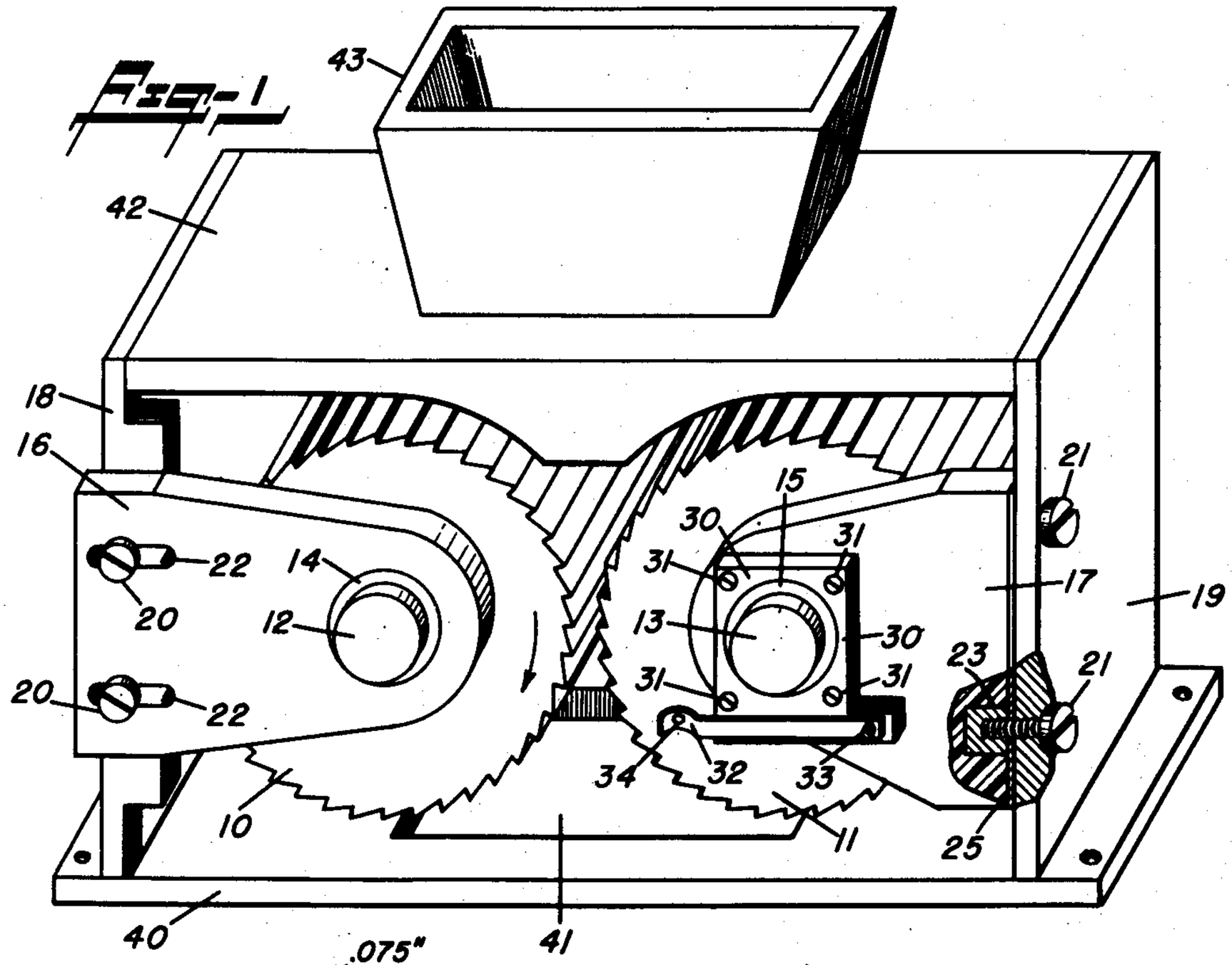


Fig-2

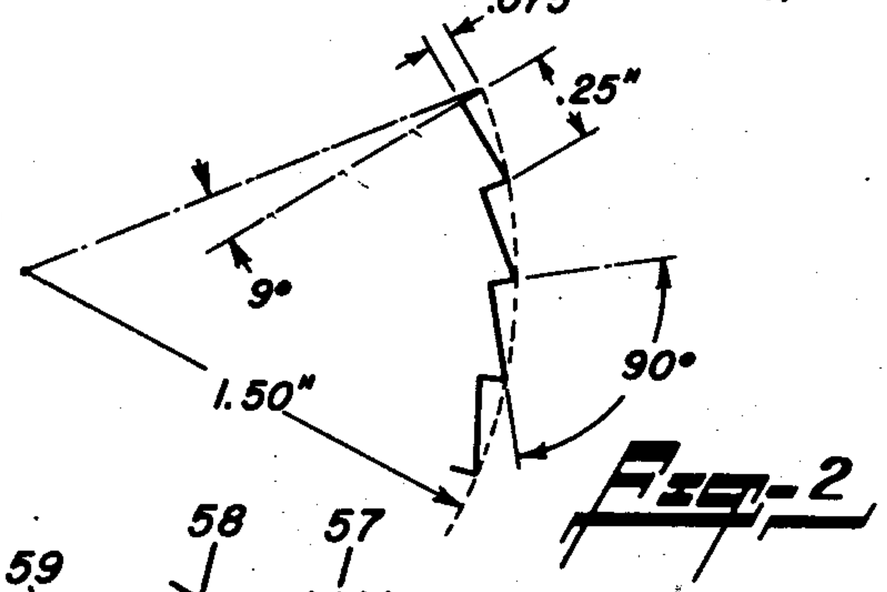


Fig-3

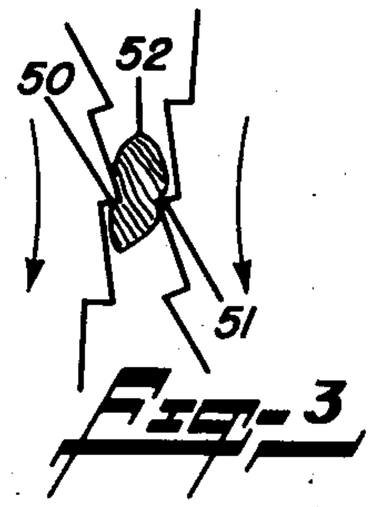
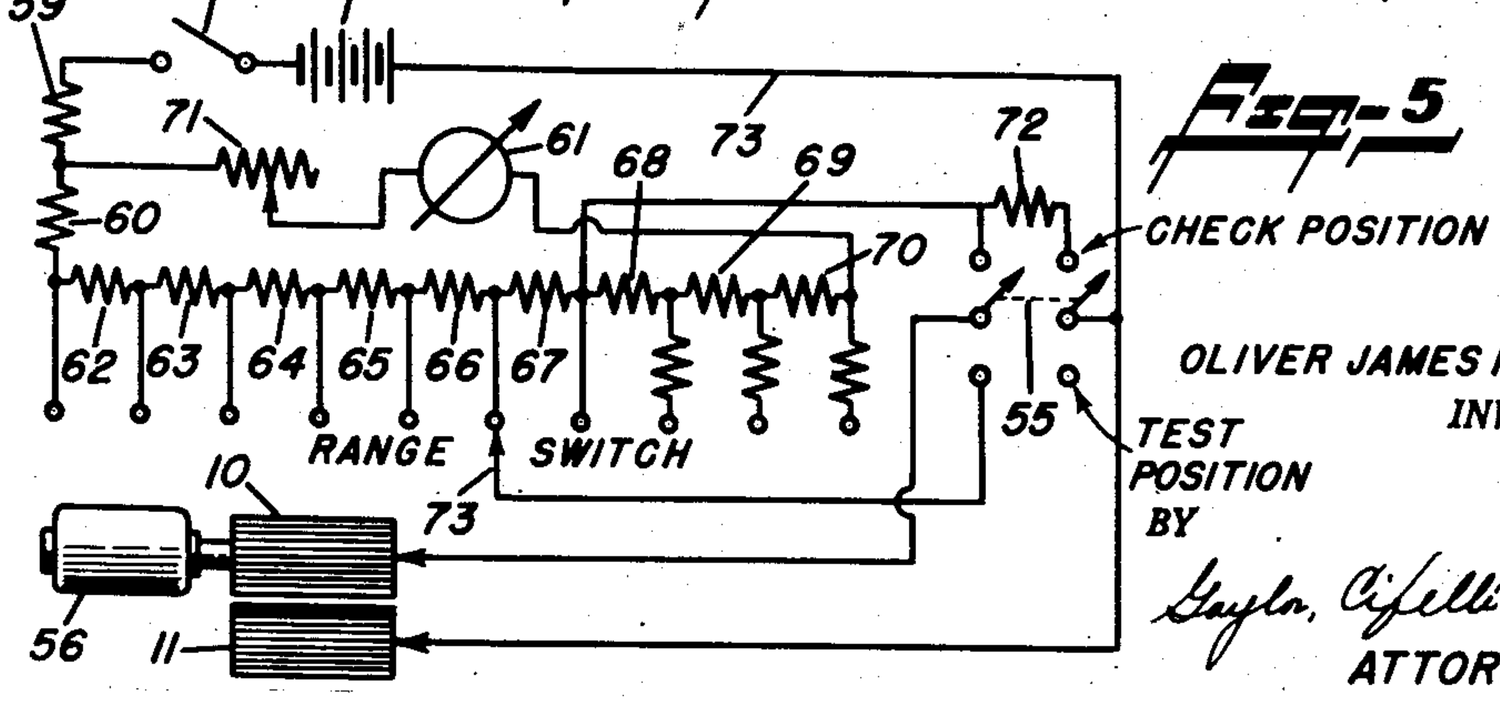


Fig-4

Fig-5



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MOISTURE TESTING APPARATUS

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This invention relates to apparatus useful for determining the moisture content of materials and more particularly to a set of rollers of novel construction and adapted to establish electrical contact with shelled, or unshelled, nuts passing therebetween, whereby the moisture content of such nuts may be established by changes in the electrical conductivity.

At present there is no really satisfactory method for determining the moisture content of nuts. It has been proposed to employ the dielectric method for such purposes but this is not satisfactory as the random packing of the nuts, either whole or chopped, between the two plates of the dielectric apparatus results in great variations of reading accuracy. Attempts have also been made to measure such moisture content by the electrical conductivity method but thus far this has proven to be impractical because of the irregular packing of the kernels and, more importantly, because such kernels are encased within an outer skin or husk. Inasmuch as nuts have a high percentage of oil content it is important that the apparatus employed involves a minimum crushing action if any practicable degree of actual moisture content is to be obtained.

This invention contemplates the provision of a set of rolls having splined surfaces of specific contour, thereby providing sharp cutting edges that cut into the nuts without crushing them and which make it possible to test unshelled, as well as shelled, nuts with equal facility and accuracy.

An object of this invention is the provision of a set of non-clogging rolls suitable for use in testing shelled or unshelled nuts for moisture content with a minimum crushing action.

An object of this invention is the provision of a set of spaced rolls for use with moisture testing apparatus, said rolls having splined surfaces terminating in aligned, sharp edges adapted to cut into nuts without crushing them.

An object of this invention is the provision of a set of spaced rolls having longitudinally-extending knife edges capable of cutting through the shell and into the kernel of a nut passing therebetween to permit establishment of electrical contact on opposite surfaces of the nut.

An object of this invention is the provision of a moisture tester for nuts comprising a pair of spaced rolls having knife edge surfaces, power means for rotating one of the rolls, means electrically insulating the rolls from each other, a hopper for storing and directing nuts between

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the rolls, an electrical system connected to each of the rolls, and means indicating the magnitude of the current flow through the nuts contacted by the knife edge surfaces of the rolls.

These and other objects and advantages will be apparent from the following description when taken with the accompanying drawings. The drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purpose to the appended claims.

In the drawings wherein like reference characters denote like parts in the several views:

Figure 1 is an isometric view of apparatus made in accordance with this invention;

Figure 2 is a fragmentary, transverse sectional view of a roll showing the formation of the teeth in the roll surface;

Figure 3 is a fragmentary, transverse section showing the teeth of the rolls cutting into a peanut kernel;

Figure 4 is similar to Figure 3 and showing the action of the teeth on an unshelled peanut; and

Figure 5 illustrates an electrical circuit of the type suitable for determining the moisture content of nuts.

Referring now to Figure 1, the metallic roll **10** is carried by a shaft **12** journaled for rotation in a pair of sleeve bearings carried by metallic mounting brackets, one such bearing **14** and bracket **16** being shown in the isometric view. These brackets are secured rigidly, but adjustably, to a frame **18** by screws **20** passing through the slots **22**. A second roll **11** is carried by its shaft **13** that is journaled for rotation in sleeve bearings **15**, which bearings, however, are carried by mounting brackets **17**, made of insulating material, secured to the frame **19** by screws **21** passing through the frame into inserts **23** molded in the brackets. The positioning of the roll **11** may be accomplished by placing insulator shims **25** of the proper thickness, between the mounting brackets and the frame. Alternatively, the adjustable mounting of the follower roll may be accomplished in any suitable manner. It will be apparent the roll **11** is electrically insulated from the frame and the roll **10**.

Secured to the insulator mounting brackets **17** is a metal plate **30** by means of the screws **31**. Sliding electrical contact with the roll **11** is achieved by the contact blade **32** secured to the metal plate **30** by the screw **33**. The contact blade **32** is made of spring material, such as Phosphor bronze, and such blade may be provided with a silver button **34** to establish and

maintain good electrical contact with the roll. It may here be pointed out that the roll 11 may be connected to the electrical circuit by securing a wire under the screw 33 or by soldering such wire directly to the blade 32. On the other hand, the roll 10 may be connected into the circuit by attaching a wire to any portion of the frame. Alternatively, such later contact may be made directly with the roll 10 by a contact blade, similar to the blade 32 but carried by the mounting bracket 16.

The two frame members 18, 19 are suitably, and rigidly, secured to a base 40 having an opening 41 therein, and such frame members support the top 42 carrying the hopper 43. It is apparent that nuts placed into the hopper will be directed to the space between the two rolls which have splined surfaces of identical and specific contour.

Reference is now made to Figure 2 which is a fragmentary, transverse view of the roll 10 showing the construction of the teeth. The dimensions given are for a roll having a diameter of approximately 3 inches. It will be noted that the root of the individual teeth has an angle of 90° and that the side wall of each tooth inclines at an angle of 9° from the radial line. When two rolls, having such identical teeth formations, are spaced apart (see Figure 1) the adjacent teeth are oppositely disposed and there is thus provided substantially aligned knife edges running longitudinally the length of the rolls.

As stated hereinabove, the roll 10 is power driven, preferably by an electric motor. The precise positioning of the roll 10 is set at the factory and, normally, no further adjustment thereof need be made by the user. However, the actual spacing between the two rolls is set by the user in accordance with the specific grade and specie of nuts to be tested. Such spacing is accomplished by inserting shims of the proper thickness under the mounting brackets associated with the roll 11. A set of shims is furnished by the manufacturer, each shim having a precise thickness and appropriately marked so that the user will know which shim, or shims, to insert for each product specie and grade. When the spacing between the two rolls is so set, nuts of that particular grade and specie can pass between the rolls only when the sharp, longitudinally-extending knife edges of the roll surfaces cut partially into the nuts.

The cutting action of the rolls is illustrated in the fragmentary view of Figure 3 which illustrates the opposed teeth 50, 51 cutting into the peanut kernel 52. It is understood that when the rolls have an axial length of, say, four inches, and the hopper opening, longitudinally relative to the rolls, is somewhat shorter, say, three inches, a plurality of kernels will be engaged by the opposed knife edges. Thus, the electrical circuit between the insulated rolls is bridged, or closed, by such kernels as are cut into by the knife edges of the teeth. If the rolls are connected to an electrical circuit a current will flow and such current may be translated into moisture content of the nuts grasped between the two rolls. Further, although the single roll 10 is power driven, the roll 11 will rotate as the kernels are grasped between the knife edges. It should be noted that the teeth are so disposed relative to the roll rotation that the cutting action into the kernel and, likewise, rotation of the idler roll 11, are facilitated. Specifically, the radially-extending wall of the tooth 50, on the

power-driven roll, forces the nut against the radially-extending wall of the tooth 51 of the idler roll. Inasmuch as these walls of the teeth are oppositely disposed, relative to the downward movement of the nut therebetween, a positive "biting" action takes place.

Figure 4 is similar to Figure 3 but showing an unshelled peanut passing between the rolls. If such unshelled peanuts are of the same grade and species as that of the kernel shown in Figure 3, the spacing between the rolls remains unchanged. Consequently, the shell is crushed but the kernel remains whole, except for the cuts made by the knife edges. In either case, the depth of penetration of the roll teeth into the kernel is substantially less than the transverse diameter of the kernel, whereby the kernel remains whole and there is no oil diffusion and no crushed nut meat to clog the rolls.

Figure 5 illustrates an electrical circuit suitable for use with my novel rolls to determine the moisture content of the nuts passing therebetween. The rolls 10, 11 are connected to the center blades of a double pole-double throw switch 55, the roll 10 being driven by the motor 56. Electrical energy is supplied by a suitable constant source, such as the battery 57 connected into the circuit through a switch 58 and the current-limiting resistors 59, 60. The indicating instrument 61, which may have a scale calibrated directly in terms of moisture content, is connected across a series of fixed range-adjusting resistors 62 to 70, inclusive, through the adjustable resistor 71. One side of the switch 55 is shunted by a calibrated resistor 72 connected to a predetermined point on the series of resistors 62 to 70. When the switch 55 is thrown to the upper position current flows from the battery through the lead 73, the calibrated resistor 72, the series resistors 68, 69, 70, the instrument, adjustable resistor 71, resistor 59 and switch 58. Under this condition the resistor 71 is adjusted to provide top scale deflection of the instrument pointer. The switch 55 is then thrown to the lower position, whereby the rolls 10, 11 are substituted into the circuit for the calibrated resistor 72 and the circuit to the indicating instrument is completed by the resistance of the nuts grasped between the two rolls, and, consequently, the instrument pointer will deflect to some position determined by the electrical conductivity of the nuts. By properly calibrating the instrument scale, the pointer indication can be made to read per cent moisture content directly. Alternatively, the instrument scale may be calibrated in terms of current or conductance, which factors may be converted to per cent moisture content by reference to a suitable tabulation as is well known in this art. The switch 73 manually settable to a selected point along the series of resistors 62—70 serves to change the range of indicating instrument.

By driving the roll 10 by means of an electrical motor a continuous moisture testing of nuts, placed into the hopper, may be had. In addition, a hand crank may be associated with one of the rolls, which crank will permit manual rotation of the roll a fixed distance to obtain a steady reading of the current flowing through such kernels as are engaged by the opposed knife-edges. This feature is of practical significance as it affords the operator a means of establishing the correct setting of the instrument range changing switch in accordance with the average moisture content of the particular batch of nuts being tested.

Having now described my invention, it will be apparent the opposed, sharp edges of the longitudinal splines on the rolls affords good electrical contact with the nuts passing between the rolls without crushing the nuts. Extensive tests have proven the suitability of such apparatus for testing peanuts, pecans, and almonds, either shelled or unshelled, and that the roll surfaces are sufficiently self cleaning to operate for long periods of time with no attention. While I have described my invention with specific reference to the testing of nuts, those skilled in this art will realize the apparatus is suitable for determining the moisture content of other products and/or materials having a finite shape such as coffee beans, seeds, etc.

I claim:

1. In moisture testing apparatus of the type comprising a pair of spaced rolls for establishing electrical contact with nuts passing therebetween, the improvement comprising discreet, longitudinally-extending, circumferentially-spaced, pointed teeth formed in the surface of each roll, the individual teeth in each roll having a triangular cross section defined by a relatively shallow wall extending radially of the roll and a relatively long wall extending peripherally of the roll, and the teeth of each roll being reversely disposed relative to each other in the space between the rolls.

2. The invention as recited in claim 1, wherein the radially-extending wall of each tooth forms an angle of approximately 9 degrees with the true radial line of the roll, and the root angle between such wall and the adjacent wall is approximately 90 degrees.

3. The invention as recited in claim 2, wherein the ratio between the peripheral length and the radial depth of each tooth is approximately 3.

4. In apparatus for establishing electrical contact with nuts for the purpose of determining the moisture content thereof the combination of a pair of spaced, rotatable rolls; longitudinally-extending, pointed teeth cut in the surface of each roll, the individual teeth in each roll having a triangular cross section defined by a relatively shallow wall extending radially of the roll and a relatively long wall extending peripherally of the roll and the teeth of the individual rolls being reversely disposed relative to each other in the space between the rolls; means electrically insulating the rolls from each other; manually-settable means to adjust the spacing between said rolls; a hopper directing the flow of nuts placed

therein to the space between the rolls; a contact blade in sliding contact with one of said rolls; and power means driving one of said rolls.

5. The invention as recited in claim 4, wherein the radial wall of the individual teeth forms an angle of approximately 9 degrees with the true radial plane of the roll, and such wall forms an angle of approximately 90 degrees with the other tooth wall.

6. The invention as recited in claim 4, wherein the ratio between the widths of the two walls defining the individual teeth is approximately 3.

7. Apparatus for determining the moisture content of nuts and the like comprising a supporting frame of metal; aligned metallic brackets adjustably secured to the frame; a first roll rotatably supported by said metallic brackets, said roll having a splined surface; aligned insulator brackets removably secured to the said frame; a second roll rotatably supported by said insulator brackets, said second roll having a splined surface identical to that of the first wall and spaced therefrom; a contact blade in slidable contact with the end of the second roll; power means for rotating the said first roll; a hopper carried by the frame, said hopper directing the flow of nuts placed therein to the space between the two rolls; an electrical network including a source of electrical energy and an indicating instrument calibrated in terms of moisture; a standardizing resistor selectively insertable into the electrical network to establish a predetermined indication of the instrument; and a double-pole, double-throw switch having one movable blade connected to the first roll and the other movable blade connected to the contact blade associated with the second roll.

8. The invention as recited in claim 7, wherein the splines on the individual rolls are oppositely disposed relative to each other at the adjacent roll surfaces.

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