July 30, 1968 W. M. ROLL 3,394,664

WAFERING MACHINE HAVING OVERLAPPING PRESS WHEELS

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FIG. 1

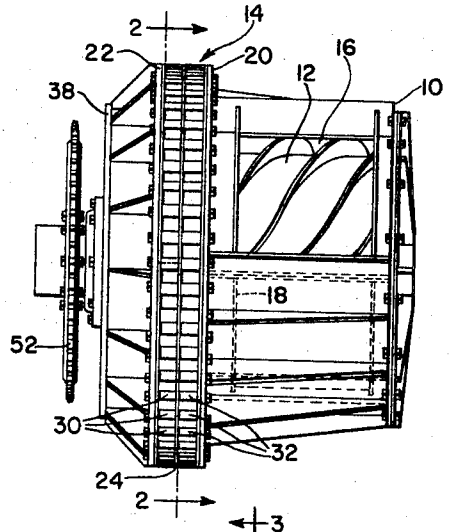
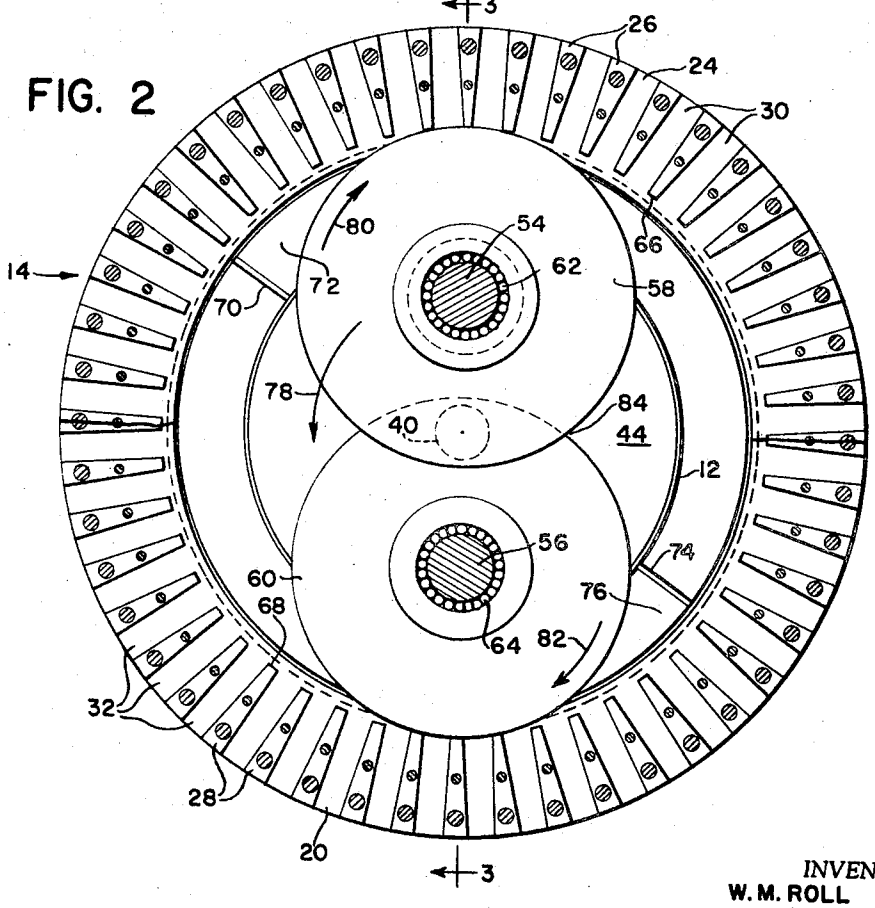


FIG. 2



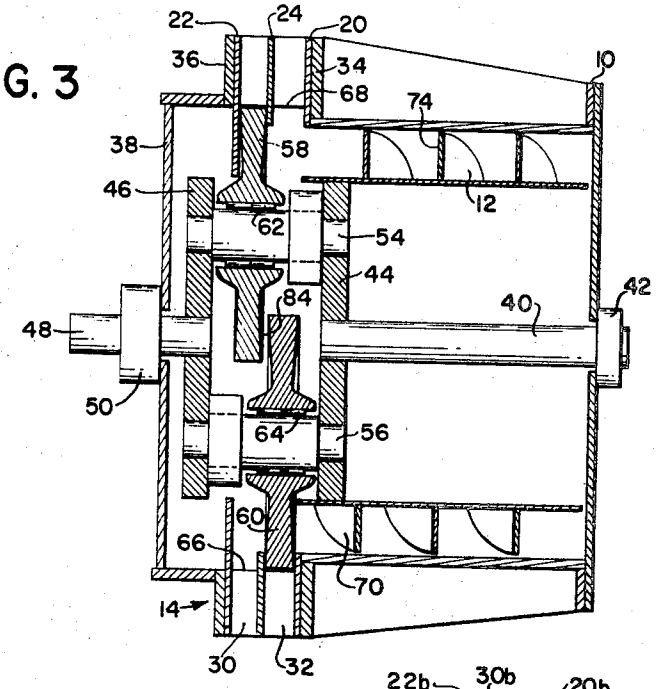
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FIG. 3



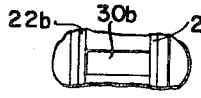
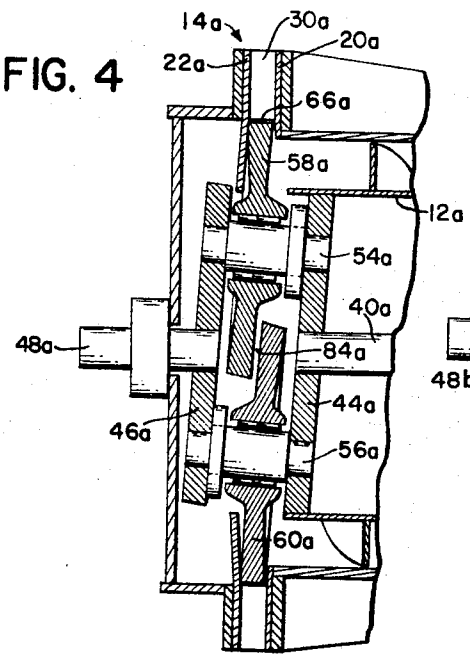


FIG. 6

FIG. 4



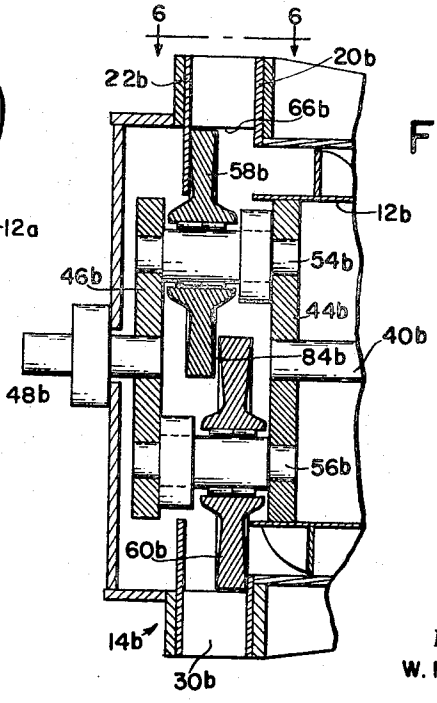


FIG. 5

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WAFERING MACHINE HAVING OVERLAPPING PRESS WHEELS

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2 Claims. (Cl. 107—14)

This invention relates to a wafering machine for wafering forage crops such as hay and the like and has for its principal object the provision of improvements in the die structure, featuring overlapping press wheels.

In a machine of the character described, as distinguished from well-known pelleting mills which handle relatively dry, granular material, it is conventional practice to utilize a die in the form of an annulus, together with one or more press wheels for extruding the forage crops either radially inwardly or radially outwardly through the die. Among the problems encountered in machines of this type are those created by differences in the material handled, such differences residing in moisture content, density, particle size of the material etc. It is common practice to feed the materials in the first instance into the die structure by an auger or other means, whereby the material enters the interior of the die (by way of example) in the "crescent" formed ahead of the point of tangency between a press wheel and the interior track from which the die openings radiate. Press wheels of varying diameter will of course cause variations in the crescent and these in turn produce different results, according to the material being handled, the problem becoming worsened when the material is higher in moisture content. Experience has shown that relatively large press wheels are desirable so as to reduce the size of the crescent. This however creates a conflict between the use of a large press wheel and the use of several press wheels, because the inside diameter of the annulus formed by the die track will not normally permit more than one wheel of acceptable size. However, this problem is overcome according to the present invention by the use of press wheels of appropriate diameters but arranged in axially offset relationship so that they can travel about the die to accomplish desirable results on the basis of overlapping the wheels radially at their peripheries in the area of the axis of the carrier on which they are mounted for orbiting about or relative to the track. It is a further object of the invention to exploit the overlapping press wheels in a die structure in which the annular track is made up of as many rows of die cells as there are press wheels. A still further object is to utilize a single relatively wide track in conjunction with a plurality of overlapping press wheels. A still further variation of the invention uti'izes specially constructed overlapping press wheels with a relatively narrow die track so that the outer peripheries of the wheels track each other in the track whereas their inner peripheral portions in the area of the carrier axis are in overlapped relation.

The foregoing and other important objects and desirable features inherent in and encompassed by the invention will become apparent as preferred embodiments thereof are disclosed, by way of example, in the ensuing description and accompanying sheets of drawings, the figures of which are described below.

FIG. 1 is an elevation of a typical wafering machine, at least to the extent that it shows the feed housing and die means.

FIG. 2 is an enlarged staggered section on the line 2—2 of FIG. 1.

FIG. 3 is a reduced section on the line 3—3 of FIG. 2.

FIG. 4 is a sectional similar to FIG. 3 but showing a modified form of the invention.

FIG. 5 is a view similar to FIGS. 3 and 4 but showing a third modification of the invention.

FIG. 6 is a fragmentary plan of the structure shown in FIG. 5, as seen generally along the line 6—6 of FIG. 5.

FIG. 1 will first be referred to for explaining the general characteristics of the wafering machine.

In that figure, the numeral **10** designates an auger housing or feed chamber in which a feed means, here a double-flight auger **12**, operates to move material from right to left as seen in the drawings for extrusion through the die means, designated generally by the numeral **14**, as wafers, typically in the form of products in the order of 2 x 2 inches in random lengths from 1 to 6 inches; although, different sizes in this general order can be formed. In FIG. 1, a portion of the housing **10** has been omitted to expose an inspection opening **16** so that the double-flighted auger can be more readily visualized. Substantially diametrically opposed to the opening **16** is a feed opening **18** by means of which the forage crops and like material are introduced in the first instance to the feed auger.

The die means, as shown particularly in FIG. 2, is in the form of an annular structure, in this case being made up of a pair of outer rings **20** and **22**, an inner or divider ring **24** and a plurality of spacer blocks, there being one annular set of blocks **26** between the outer ring **22** and divider ring **24** and another annular set of blocks **28** between the divider ring **24** and the opposite plate **20**. The section in FIG. 2 has been taken so as to show one-half of the annular set of blocks **26** in the upper portion of the figure and the opposite half of the set of blocks **28** in the lower portion of the figure. The blocks are uniformly circumferentially spaced in each set so as to provide in one set a plurality of generally radial die cells **30** in one set and a corresponding plurality of similar die cells **32** in the opposite set.

The above will be evident from FIG. 3, as will additional structure which rigidifies the annular die means **14**, such structure in the present case including an annular flange on the housing **10** and an annular flange **36** on cover or supporting structure **38** at the left-hand end of the structure. It will be understood that the housing and its related components generally provide support means for the die means **14** and other structure to be described.

The auger includes a central core which is hollow and which is supported on a central auger shaft **40** which at one end is appropriately journaled in a bearing **42** in an end wall of the housing **10** and which at its other end is rigidly secured to what may be regarded as a crankshaft cheek **44**, parallel to which and leftwardly spaced therefrom is a second crankshaft cheek **46**, having rigidly and coaxially connected thereto a stub shaft **48** which finds a journal at **50** in a bearing attached to the supporting wall **38**. As shown in FIG. 1, the stub shaft **48** may have keyed thereto an input sprocket **52** by means of which rotation is imparted to the auger **12** and carrier structure made up by the crankshaft cheeks **44** and **46**, together with a pair of press wheel shafts **54** and **56**. As will be seen, each of the shafts **54** and **56** is appropriately shouldered so as to space the crankshaft cheeks **44** and **46** axially apart, it being clear that the shafts **54** and **56** provide, in conjunction with the cheeks **44** and **46**, a double crankshaft, the shaft **54** journaling a press wheel **58** and the shaft **56** journaling a press wheel **60**. The shafts **54** and **56** may be rigidly secured to the cheeks **44** and **46**, the press wheels being respectively journaled on the shafts as at **62** and **64**.

In the present case, the divider means or ring **24** divides the total width of the die structure into the pair of annular rows of die cells and blocks. In each case,

the inner portions of the blocks have their terminal ends lying on a circle which may be regarded as track means, the track means for the set of cells **30** being designated by the numeral **66** and that for the other set of die cells **32** being designated by the numeral **68**. Since the total track means **66–68** is divided in two, there are in this case the two press wheels **60** and **62**. Because of the two press wheels, there are two flights on the auger **12**, one flight as at **70** delivering to a "crescent area" **72** ahead of the press wheel **58** and the other flight at **74** delivering to a crescent area **76** immediately ahead of the other press wheel **60**. The arrow **78** in FIG. 2 indicates the rotation of the auger and carrier **44–46**, and the arrows **80** and **82** designate the respective directions of rotation of the press wheels **58** and **60**. Regarding now the rotation of the auger and press wheel assembly as represented by the arrow **78**, it will be seen that this direction is counterclockwise. Accordingly, the shafts **54** and **56** move in a circle in the same direction, carrying the respective press wheels therewith so that the peripheries of the press wheels roll respectively in the tracks **66** and **68**. Since the auger flights **70** and **74** deliver material respectively to the crescent areas **72** and **76**, this material will be literally run over by the press wheels as the press wheel and auger assembly rotates. In instances in which the press wheel assembly is held and the die structure **14** rotated, generally the same result will obtain. Broadly, the two variations on which element rotates and which is held may be regarded as equivalents.

As already noted, there are the two tracks **66** and **68** and the two press wheels **58** and **60** running respectively in these tracks. On this basis, then, the axial width of each of the press wheels at its outer periphery is generally one-half the total width of the track means **66–68**, subtracting of course, the relatively narrow axial width of the divider or partition means **24**. This is by way of illustration only, since other combinations of press wheels and tracks could be used. Because of this relationship, the two wheels are axially offset so that the peripheral portions thereof in the area of the axis of the track means and press wheel assembly, as at **84**, are in radially overlapped relation. This enables the use of relatively large press wheels, permitting the exploitation of appropriate crescent areas as at **72** and **76**. It further permits the use of the double die means having the two rows of cells **30–32**, which thus affects the capacity of the machine. For example, the total axial width of the die means could be two inches, with the divider and double press wheel arrangement resulting in a division of this into two rows of cells each less than 1 inch in width. Or, a pair of two-inch rows of cells could be used, giving the overall width of the die means a dimension of 4 inches, plus the intervening divider. Other variations will readily occur to those versed in the art.

FIG. 4 illustrates a variation on the above structure in which a die means **14*a*** has a single track **66*a*** afforded by a plurality of die cells **30*a*** arranged in an annular row just as would be the case if only one-half of the die structure of FIG. 3 is regarded. In this case, a double-flight auger at **12*a*** is mounted on a shaft **40*a*** together with a press-wheel assembly made up of a pair of cheeks **44*a***, **46*a*** a pair of shafts **54*a*** and **56*a*** and a pair of press wheels **58*a*** and **60*a***, the press wheel and auger assembly being driven through a coaxial stub shaft as at **48*a***.

However, in this case, the axes of the shafts **54*a*** and **56*a*** although parallel to each other, are inclined or non-parallel to the axis of the press wheel and auger assembly. Likewise, each of the press wheels **58*a*** and **60*a*** is of concavo-convex configuration, being dished as shown and arranged with their convex sides facing each other so as to achieve the overlap at **84*a*** while enabling the peripheries of the wheels to run in the single track **66*a***, here made up of rings **20*a*** and **22*a***, comparable respectively to those at **20** and **22**, but, of course, the divider being omitted. This construction enables the use of two overlapping press wheels in a single die track **66*a***.

A still further modification appears in FIG. 5, wherein a die assembly **14*b*** is made up of a pair of rings **20*b*** and **22*b*** to provide a single row of die cells **30*b***, this row having an axial width substantially equal to the combined widths of the double row of cells **30–32** in FIG. 3, taking into account, of course, the absence of the divider **24**. The auger tube **12*b*** is supported on a shaft **40*b*** which, together with cheeks **44*b*** and **46*b***, comprises the press wheel assembly including press wheels **58*b*** and **60*b***, mounted respectively on press wheel shafts **54*b*** and **56*b***. Here again, the auger will include two flights, in accordance with the structure shown at **70** and **74** in FIG. 3. Drive to the press wheel and auger assembly may be put into a stub shaft **48*b*** coaxial with the auger shaft **40*b***.

This arrangement provides a single relatively wide track **66*b***, which in this case is twice the axial width of the press wheel peripheries. Here, as suggested above, additional numerical values could be employed so that the multiple would be different. However, this will readily occur to those versed in the art. In this modification, each press wheel will introduce the material into substantially one-half of the associated row of die cells **30*b***, but the total extrusion will ultimately fill the total die cell area so as to produce satisfactory wafers. As in the cases of FIGS. 3 and 4, the press wheel overlap, here at **84*b***, accomplishes the desired objective.

As will be seen, the structures in FIGS. 4 and 5 are otherwise similar and detailed description is deemed to be unnecessary. Further, on the basis of the several modifications, others will readily occur to those versed in the art, all without departure from the spirit and scope of the invention.

What is claimed is:

1. In a machine for wafering forage materials such as hay and the like, the combination of: annular die structure having axially spaced apart opposite radial sides, an annular material-receiving track between said sides, an outer material-discharge peripheral portion in surrounding relation to the track, and a plurality of uniformly circumferentially spaced, generally radial, similar dies cells between said sides and opening at opposite ends respectively to the track and peripheral portion; press wheel means for extruding material radially outwardly through the cells from the track to said portion, comprising a carrier having a shaft coaxial with and extending toward said structure from one side thereof and having an inner end terminating at said one side, cheek means rigid on and radial to said shaft at said one side, a plurality of press wheel shafts carried by the cheek means on individual axes eccentric to the carrier shaft and extending toward the other side of said structure, and a like plurality of circular press wheels journaled respectively on the press wheel shafts within the track and disposed with their peripheries substantially tangent to the track, said wheels being so dimensioned and arranged that peripheral portions thereof are axially offset relative to each other and relative to said inner end of the carrier shaft and radially overlapped in the area of said inner end of the carrier shaft; support means; and means mounting the die structure and press wheel means on the support means for relative rotation about the track and carrier axis to cause the wheels and track to roll relatively with the wheel peripheries in substantial contact with the track.

2. The invention defined in claim **1**, including: second cheek means spaced axially from the first-mentioned cheek means and disposed at the other side of the structure and also carrying the press wheel shafts, and a second carrier shaft connected to the second cheek means coaxially with the first-mentioned carrier shaft and extending from an inner terminal end at said second cheek means and outwardly therefrom toward said other side

of the structure whereby the press wheels lie between the two cheek means and the terminal ends of the carrier shafts, and said support means also carries said second carrier shaft.

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