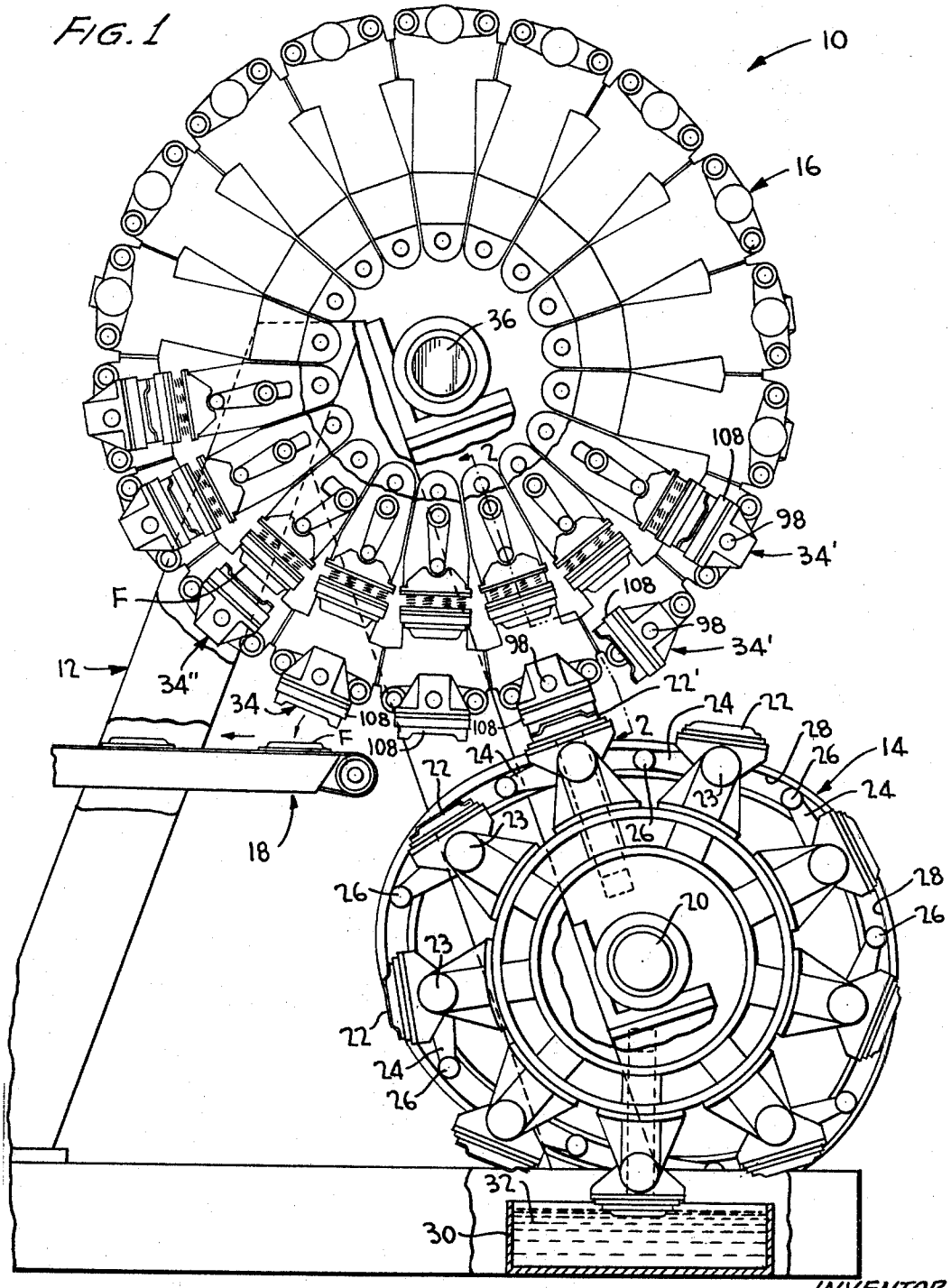
Nov. 11, 1969 D. T. DANIELE 3,477,908

COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

Filed Jan. 4, 1967 7 Sheets-Sheet 1

FIG. 1



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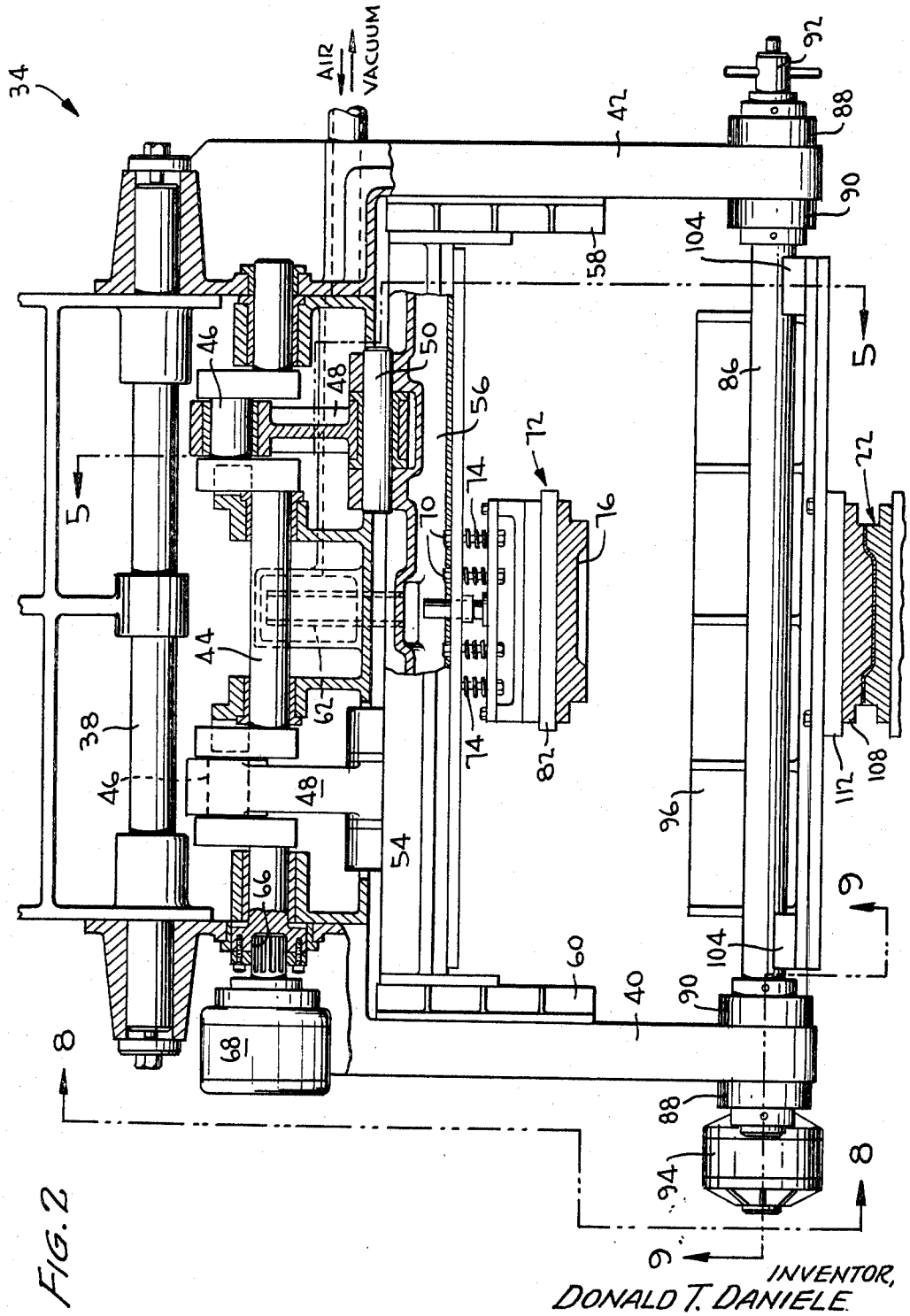

FIG. 2

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COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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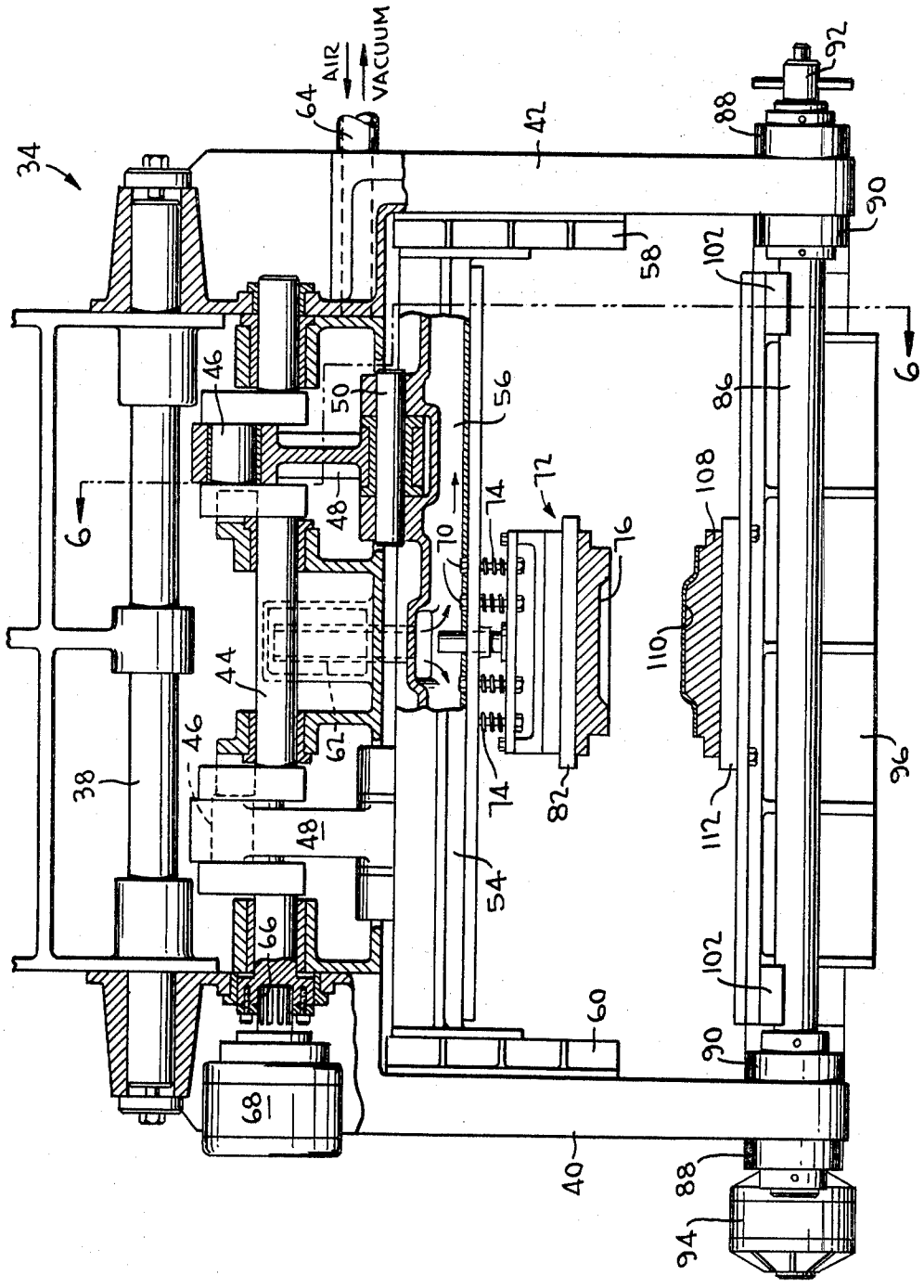

FIG. 3

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COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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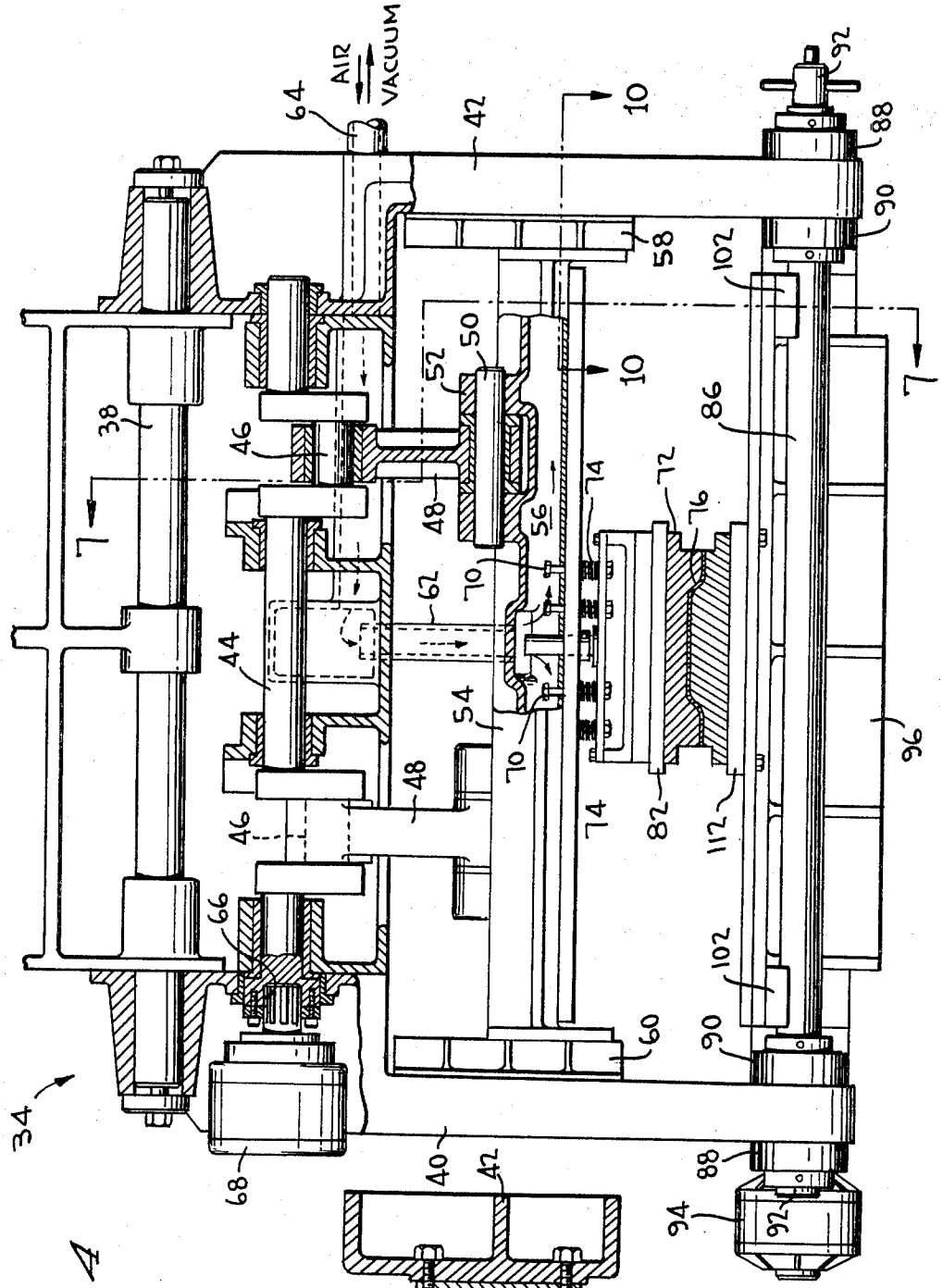

FIG. 4

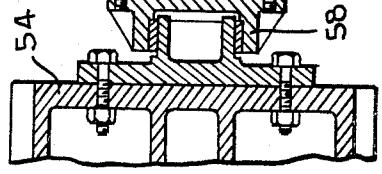

FIG. 10

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COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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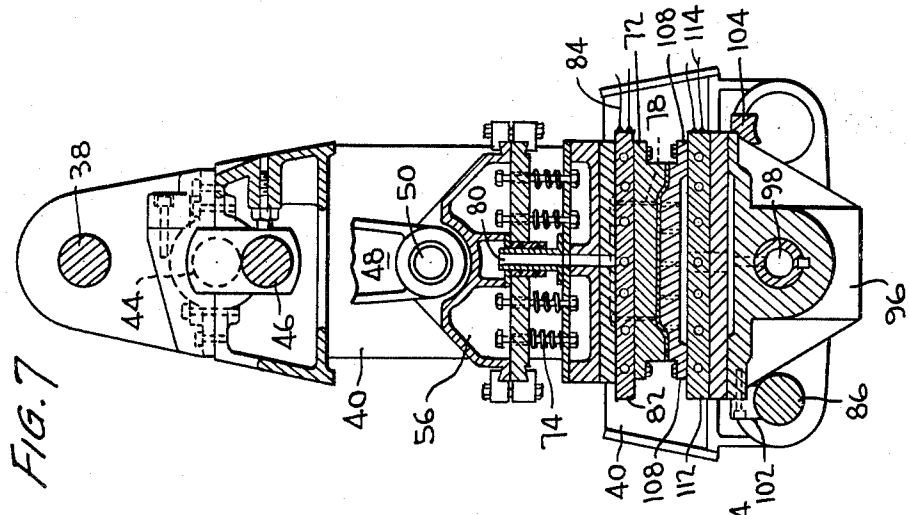

FIG. 7

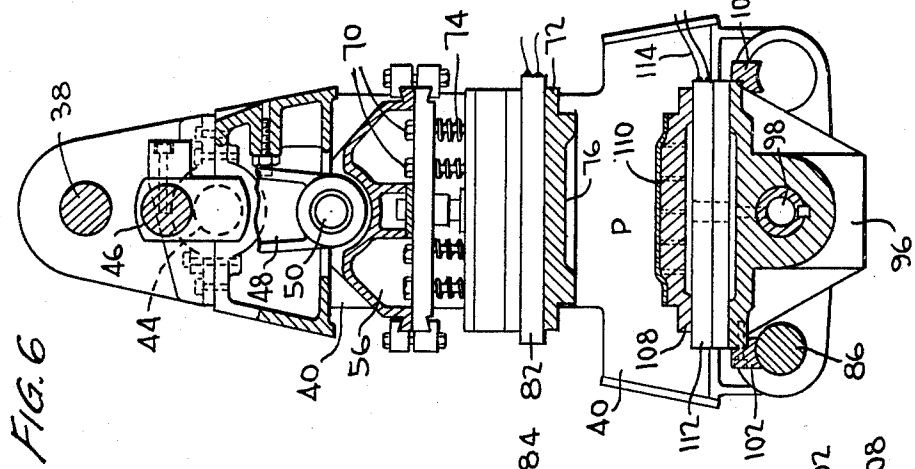

FIG. 6

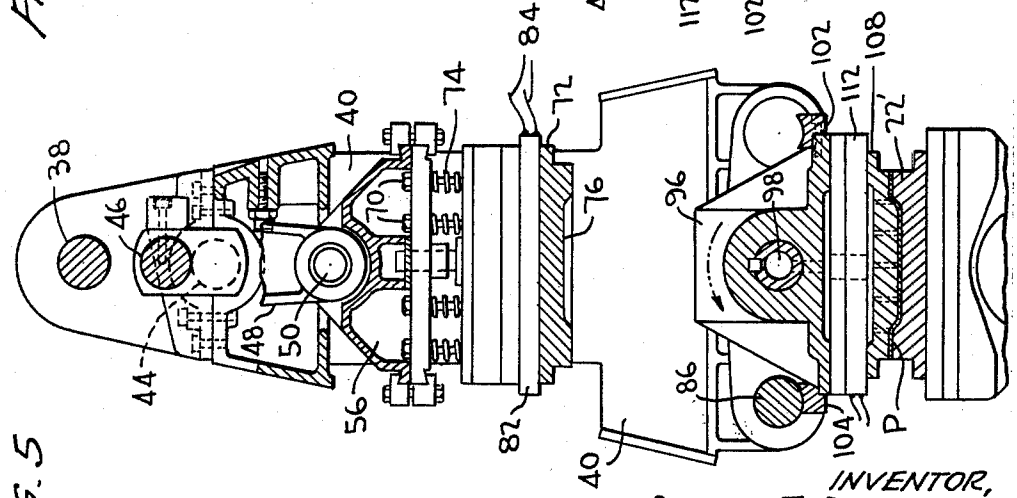

FIG. 5

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COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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FIG. 8

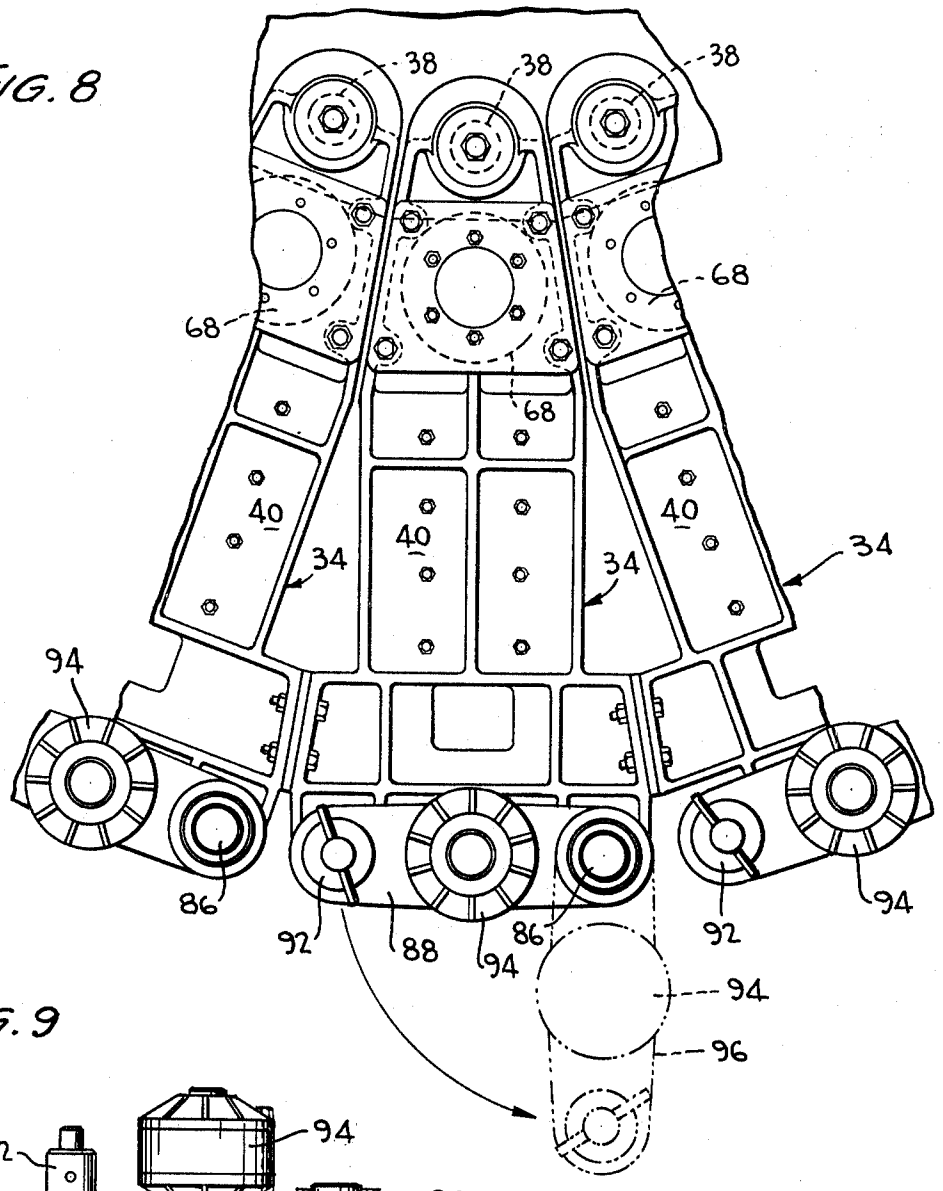
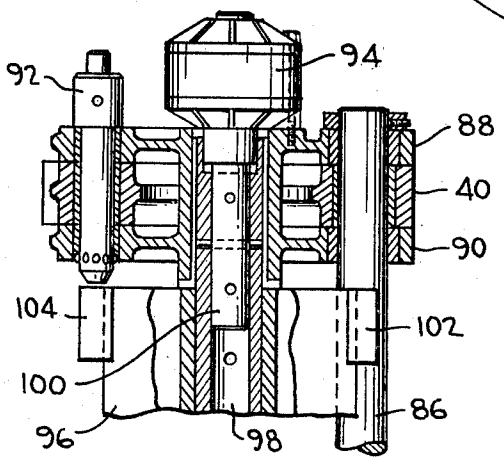


FIG. 9



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COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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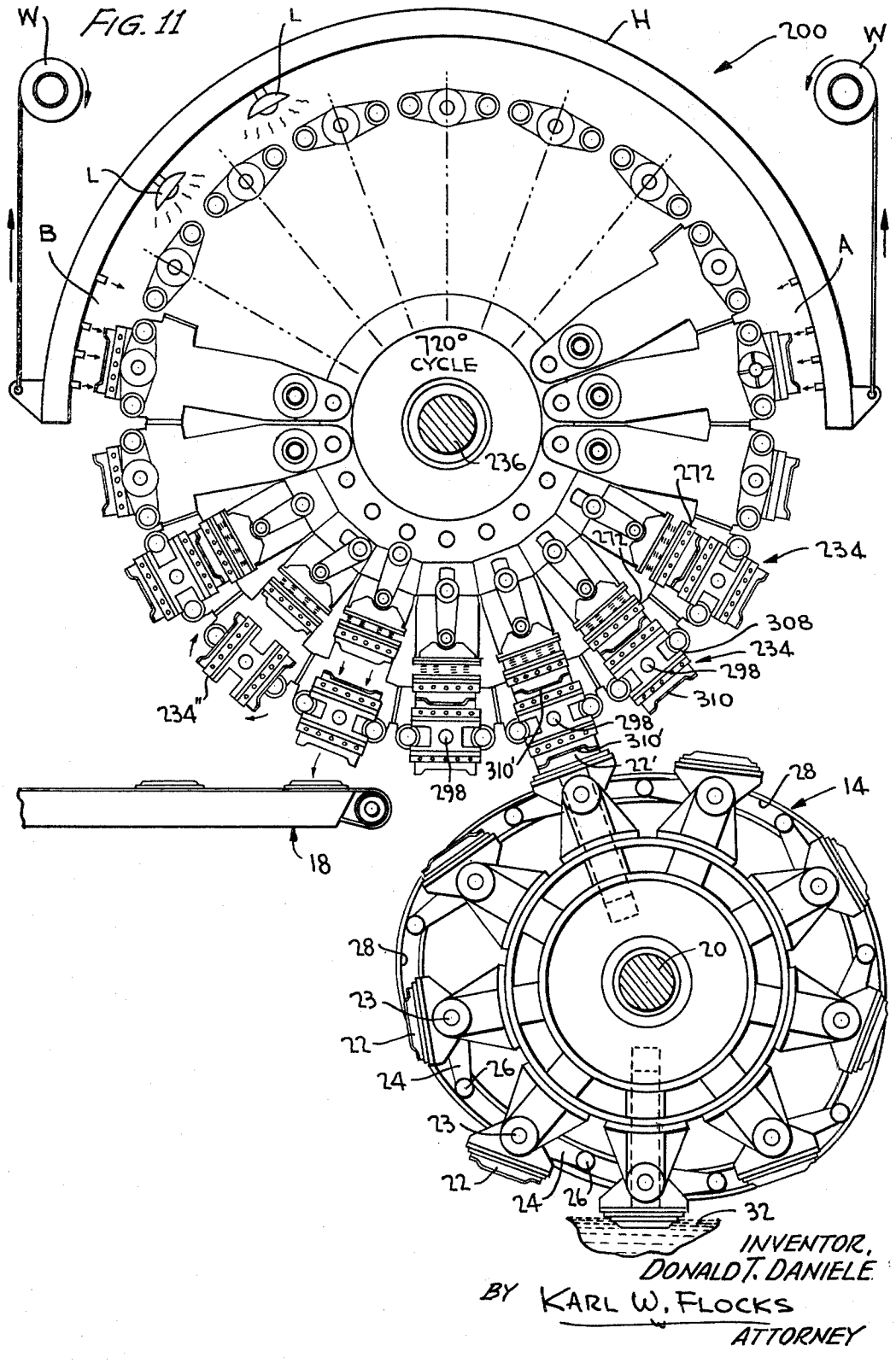
FIG. 11



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3,477,908

COMBINED DRY AND FINISHING APPARATUS FOR MOLDED PULP ARTICLES

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Int. Cl. D21j 3/00
U.S. Cl. 162—392 13 Claims

ABSTRACT OF THE DISCLOSURE

A compound transfer pressing-heating die apparatus whereby wet pulp preforms are removed from a forming die, are both dried and finished into a condition for immediate use upon removal from the compound transfer pressing-heating die.

Apparatus for producing molded pulp articles with a smooth finish, in the past have required a great deal of space to accommodate the forming, transfer, finishing and after-former presses, printers, etc. Since the initial deposited pulp has an extremely large water content and complex molded shapes involve variable shrinkage and different product control problems, there has always been a demand for a single apparataus which would not only rapidly eliminate the residual moisture in the wet preform but would then immediately finish the articles (with distinctive marks, colors, etc.) so that the articles are immediately in a condition for consumer use at maximum production rates.

Primary objects of the present invention comprise a novel compound transfer die for wet molded pulp preforms in which the wet preform is simultaneously dried and finished for immediate use; in which a plurality of compound transfer dies are movable in an orbital path for removing wet pulp preforms from molding apparatus, and are molded in a sub-orbital path in which cooperating portions of the compound die both dry and finish the articles for immediate use by the consumer; in which the compound dies can be readily interchanged to provide ready conversion of the apparatus for use in the production of different articles; and in which the apparatus substantially eliminates most problems of production control including warpage, shrinkage and yet attains a high rate of production.

These together with other and more specific objects and advantages will become apparent from the following description when taken in conjunction with the drawing forming a part hereof, in which:

FIG. 1 is a diagrammatic side elevational view showing a molding wheel in relation to a transfer apparatus incorporating a plurality of the compound transfer-drying-finishing dies of the invention;

FIG. 2 is an enlarged, fragmentary sectional view taken substantially on the plane of line 2—2 of FIG. 1 with portions broken away;

FIG. 3 is a view similar to FIG. 2 showing the transfer portion of the compound die reoriented for mating engagement with its cooperating pressing die;

FIG. 4 is a view similar to FIGS. 2 and 3 showing the transfer and pressing dies in mated relation;

FIGS. 5, 6 and 7 are sectional views taken on lines 5—5, 6—6 and 7—7 of FIGS. 2, 3 and 4, respectively;

FIG. 8 is a side elevational view taken substantially on the plane of line 8—8 of FIG. 2, and showing by phantom lines how a portion of the compound die can be displaced for removal and/or replacement;

FIG. 9 is a fragmentary sectional view taken on the plane of line 9—9 of FIG. 2;

FIG. 10 is an enlarged section taken substantially on the plane of line 10—10 of FIG. 4 and

FIG. 11 is a diagrammatic view similar to FIG. 1 showing a modified embodiment of the compound transfer-heating-pressing dies.

Referring to the drawing in detail and first considering FIG. 1, apparatus for producing completely finished articles is indicated generally at 10 and comprises suitable support structure 12 upon which is mounted a molding wheel assembly 14, an article finishing assembly 16, and article conveyor means 18.

The molding wheel assembly is generally conventional, and comprises a suitably journaled central shaft 20 upon which is mounted a plurality of radially disposed suction dies 22 journaled at 23 on the support structure. The suction dies will include a plurality of foraminous dies in a row extending the width of the wheel and suitable means (not shown) for communicating fluid pressure and/or vacuum thereto will be provided. Each row of suction dies 22 will include an orienting arm 24 having a terminal cam follower 26 receiving a suitably conformed cam truck 28.

A slurry container 30 is disposed beneath the wheel 14 and each row of dies 22 will be immersed in the slurry solution 32 in container 30 as the dies are rotated with the wheel 14. The cam track 28 will orient the row of dies 22 at a take-off station 22' where a wet pulp preform, or vacuum deposed layer of pulp, will be removed by the article finishing assembly 16.

Means for synchronizing operation of the suction wheel assembly and/or finishing assembly and/or supplying vacuum and/or pressurized air to the forming-pressing and finishing dies are generally conventional and specific details thereof will not be illustrated in this application.

The article finishing assembly 16 comprises a plurality of compound transfer-pressing and finishing dies indicated generally at 34 and corresponding to the number of forming dies 22. In a sense, each row of compound dies 34 is separate and distinct from the other. In its broadest context, the invention comprises a single compound die functioning in the manner to subsequently be described.

The assembly 16 includes a suitably journaled support shaft 36 and the compound dies 34 are circumferentially spaced thereabout in radially extending relation.

As seen in FIG. 2, each of the compound dies 34 includes a support shaft 38 having depending from opposite ends thereof support members 40 and 42. Disposed outwardly of the shaft 38 and journaled at opposite ends and intermediate portions thereof, is a crank shaft 44 having intermediate, offset, throw portions 46.

The throw portions 46 have journaled thereon connecting rods 48. The connecting rods are journaled by rods 50 to bracket portions 52 of a manifold member 54. The support members 40 and 42 include guideway-bearings 58 and 60 respectively, reciprocably supporting complementary ends of the manifold member 54; see FIG. 10. The hollow chamber 56 is connected by suitable conduits 62 and 64 to a source of vacuum and/or air, controlled in any suitable manner in relation to heat and pressure communicated to a pulp article being finished.

The crank shaft incorporates an axial, keyed recess 66 mating with the drive shaft of a suitable indexing drive means 68 comprising a reversible motor of any suitable character; one of which for example, being known in the trade as a "Houdaille Hydroac" component produced by Houdaille Industries, Inc. of 537 Delevan Ave., Buffalo, N.Y. When the indexing drive means is actuated the crank shaft 44 rotates 180 degrees, the manifold member 54 will be reciprocated radially with respect to shaft 38.

Secured to the member 54 by bolts 70 is a pressing die half 72 which is normally urged outwardly by springs 74 circumposed bolts 70 and disposed between member 54 and the die half. The die half 72 includes an article re-

ceiving recess **76** conforming to the finished shape of one side of a wet preform to be finished. The recess **76** communicates with internal ducting **78**; see FIG. 7, communicating with a pipe **80** communicating with chamber **56**. Additionally, the die half will incorporate suitable heating means such as a resistance heater plate **82** connected to leads **84** connected to a suitable electrical supply source. The temperature of plate **82** will be thermostatically controlled in any suitable manner. Accordingly, when a wet preform is subjected to both heat and pressure, as will be described, steam and water will be evacuated or exhausted to dry the article as the finishing assembly **16** rotates.

A transfer die support shaft **86** extends between members **40** and **42** and has pivotally supported at opposite ends thereof a transfer die-half support casting including portions **88** and **90** flanking opposite sides of the outer end of supports **40** and **42**; see FIG. 9, for example. Spaced from the shaft **86** and formed in portions **88**, and members **40** and **42**, are alignable apertures receiving therethrough a removable coupling pin **92**. The casting portions **88** and **90** have fixed thereto a reversible indexing drive means **94** operated in any suitable manner and adjusted to reversibly rotate a transfer die carrier **96** one hundred and eighty degrees. The transfer die carrier **96** is fixedly keyed on a hollow shaft **98** having a terminal, axial bore keyed to the drive shaft **100** of the indexing drive means **94**. The transfer die carrier includes at opposite sides thereof abutment elements **102** and **104** projecting radially from the shaft **98**. The elements **102** and **104** have an arcuate surface complementary to the outer surface of shaft **86**, and when the indexing drive means **94** is actuated, the transfer die carrier **96** will be repositioned from the position shown in FIG. 5; where a wet preform is received thereon, to the position shown in FIG. 6, where the wet preform is disposed in opposing confronting relation with respect to the finishing die **72**.

The transfer die carrier **96** is connected to the hollow shaft **98** and to suitable conduits and ports **106** (not shown) for communicating with a transfer die half **108** which is ported and has an article receiving surface **110** complementary to the recess **76**. The transfer die includes a thermostatically controlled heater plate **112** connected to a suitable source of electrical energy by leads **114**.

Considering FIGS. 5–7, a still wet pulp preform P is formed on the suction or forming dies **22** and is indexed at position **22'**. At this time, through the medium of reversing vacuum and air pressure in the die **22**, the wet preform will be transferred. At the same time, the transfer die **108** will be disposed in engaged relation on the exposed surface of the preform. The indexing drive means **94** will be actuated, and at the same time vacuum is communicated to the transfer die half **108**. The preform is then oriented to the position shown in FIG. 6. The vacuum applied to the die half **108** will not only serve to retain the preform P thereon, but will also serve to remove steam and residual moisture from the still-damp preform.

Next the indexing drive unit **68** will be actuated whereby the crankshaft **44** will be rotated 180 degrees causing mating of the die halves **72** and **108**, as seen in FIG. 7. It will be noted that after a predetermined pressure exists between the dies, the springs **74** will be compressed to prevent damage between the engaged dies.

The heater plates **82** and **112** of the respective dies will cause the residual moisture to become vapor and communication of vacuum to the respective dies will remove steam and water vapor from the articles being finished. The finishing die recess **76** may be so conformed to a shape for the purpose of "reforming" the shape of the preform P, i.e., incorporating indicia, unusual flanges, recesses, etc. Further, the application of both heat and pressure on the wet preform results in "ironing" or calendering the article to finish with a smooth and soft finish resulting from reorienting to loosely interdigitated fibers of the preform initially deposited on the suction dies **22**.

Each of the compound dies **34**; see FIGS. 1 and 8, for example, occupy a segment of a primary orbit about the shaft **36**. While the transfer die halves **108** are moved through a suborbital path from station **22'** to that of **34'**; see FIG. 1, the die halves **72** and **108** remain in engagement a sufficient period of time to completely finish the preform P for immediate use by the consumer. As shown at **34''**, after the preform is completely finished as article F, the indexing drive means **68** and **94** are once more actuated, i.e., reversed, the die halves separate, and through the medium of suitable air pressure control valves, the finished articles F are deposited onto the conveyor means **18**. The die half **108** will now be in a position to receive another wet preform thereon at station **22'**.

Referring to FIG. 11, a modified finishing assembly is shown diagrammatically at **200**. Similar reference numerals will be used to identify previously described structure, and such structure will not be further described with reference to FIG. 11. The molding wheel assembly **14** and conveyor means **18** are similar to those previously described and are generally conventional.

The finishing assembly **200** includes a plurality of compound dies **234**, and although the die halves **272** function in the same manner as die halves **72**, die halves **308** are of a different construction. The die halves are multiface, i.e., include at 180° about shaft **298** transfer and finishing recesses **310** and **310'**.

The wet preform is initially received in recess **310** and the articles are moved through a primary orbit of 720 degrees about shaft **236**. The first 360 degrees of rotation affords predrying of the preforms and spraying of waxes, dyes, etc. at stations A and B through the use of spray nozzles mounted on an arcuate adjustable hood H deposed about a substantial portion of the major orbit of the compound dies. The hood H can incorporate suitable auxiliary heating means L such as banks of heat lamps or the like, and the hood H can be adjusted in spaced relation from the exposed preforms by means of cable and winch assemblies W. Through the medium of the hood H predrying of the articles can be provided, coatings of waxes, dyes and/or other finishing materials can be applied to the exposed preforms.

During the next 360 degrees of rotation of the compound dies, the previously described indexing means, rotate recesses **310** and **310'** one hundred eighty degrees for cooperation with the finishing dies **272** whereafter the finished articles are deposited on conveyor means **18**.

The compound dies **72**, **108** and **272** and **308** can be readily removed and changed, i.e., for conversion and producing different articles, i.e., meat trays, egg cartons, etc. Due to space limitation change of the dies **72**, **272** and **108**, **308** would normally be extremely time consuming. Where the apparatus must be shut down for a relatively long period, production is lost and this results in expensive loses. However, in both types of apparatus disclosed, and as readily seen in FIGS. 8 and 9, for example, the pins **92** can be withdrawn from the aligned apertures in members **40**, **42** and casting portions **88**, **99** whereby the transfer die carrier **96** pivoted to the phantom line position shown, the dies can be removed, replaced and/or repaired and ready access is afforded to the inner finishing dies **72** for the same purposes.

It will be obvious to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown in the drawings and described in the specification.

What is claimed is:

1. In a molded pulp finishing assembly, means for supporting said assembly for rotation about an axis of rotation, said assembly comprising a plurality of compound finishing dies circumferentially spaced about said axis of rotation, said compound finishing dies comprising a transfer die half and a finishing die half, said die halves including complementary molding portions for sand-

wiched engagement on a pulp preform disposed therebetween, means supporting said finishing die half for movement toward and away from said transfer die half, and

means displaceably supporting said transfer die in an orbit of rotation of substantially 180° and spaced from said finishing die from a position for receiving a wet pulp preform to a position in direct opposed relation to said finishing die-half.

2. The structure as claimed in claim **1** in which at least one said die half includes means for heating the pulp preform being finished.

3. The structure as claimed in claim **2** in which at least one of said die halves includes means for exhausting water vapors away from dies when a preform is heated and passed therebetween.

4. The structure as claimed in claim **1** including independent indexing drive means operatively connected to said respective die halves.

5. A finishing assembly for use with apparatus for continuously forming pulp preforms comprising:

a plurality of compound dies disposed in radially extending relation about an axis of rotation defining a major axis of rotation,

said compound dies comprising a finishing die half and a transfer die half, said transfer die halves being disposed in radially spaced relation outwardly from a corresponding finishing die half,

means connected to said finishing die halves for moving said finishing die half into engagement with a corresponding transfer die half,

means on said transfer die half for moving said transfer die half in a sub-orbit defined by a pivot axis, disposed radially outwardly of said finishing die half,

said finishing die half including at least one surface positionable either radially outwardly for receiving a wet pulp preform, or radially inwardly for engagement with said finished die half for producing a finished article.

6. A finishing assembly as claimed in claim **5** in which at least one of said die halves includes heating means for drying pulp preforms.

7. A finishing assembly as claimed in claim **6** in which at least one of said die halves includes means for expressing steam and water vapor away from said compound dies.

8. A finishing assembly as claimed in claim **5** in which said finishing die half is spring mounted whereby only a predetermined pressure can be exerted between said complementary die halves.

9. A finishing assembly as claimed in claim **5** in which said transfer die half comprises a die carrier pivotally mounted at one edge, and lock pin means displaceably engaged with said carrier for permitting ready access to each of said finishing and transfer die halves.

10. A finishing assembly as claimed in claim **5** in which said transfer die half includes opposed transfer die portions disposed at 180 degree intervals, each of said transfer die portions being engageable with said finishing die half.

11. A finishing assembly as claimed in claim **10** including a hood over a portion of the major orbit of said compound dies, at least one of said transfer die portions being directed toward said hood during movement of said transfer dies in their major orbit, said hood including means for treating a preform during movement of said transfer dies thereby.

12. A finishing assembly as claimed in claim **5** in which each of said finishing dies includes a crank shaft and connecting rod, and an index drive means operatively connected to each of said respective crank shafts.

13. A finishing assembly as claimed in claim **5** in which each of said transfer dies includes an independent indexing drive means for orienting the transfer die half between a radially outward and radially inward position, said transfer die half including a transfer die carrier pivotally outwardly of a respective finishing die, said carrier including spaced abutment means extending radially from opposite sides of the pivot axis of the carrier at 180° intervals, and a support shaft disposed in the path of travel of said carrier abutment means for engagement with at least one of said abutment means.

References Cited

UNITED STATES PATENTS

2,746,358	5/1956	Emery	162—392
2,772,608	12/1956	Emery	162—392
3,132,991	5/1964	Hornbostel et al.	162—392

HOWARD R. CAINE, Primary Examiner

U.S. Cl. X.R.

162—223, 415