Feb. 27, 1968 F. H. JOHANNSEN 3,371,136

DETERGENT TABLET FORMING MACHINE

Filed July 28, 1965 4 Sheets-Sheet 1

FIG. 1.

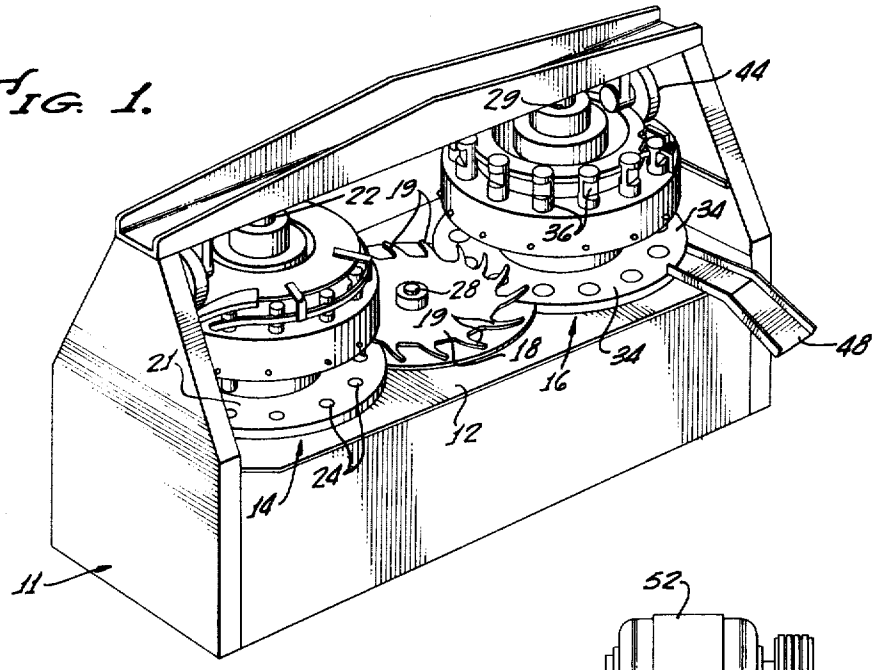
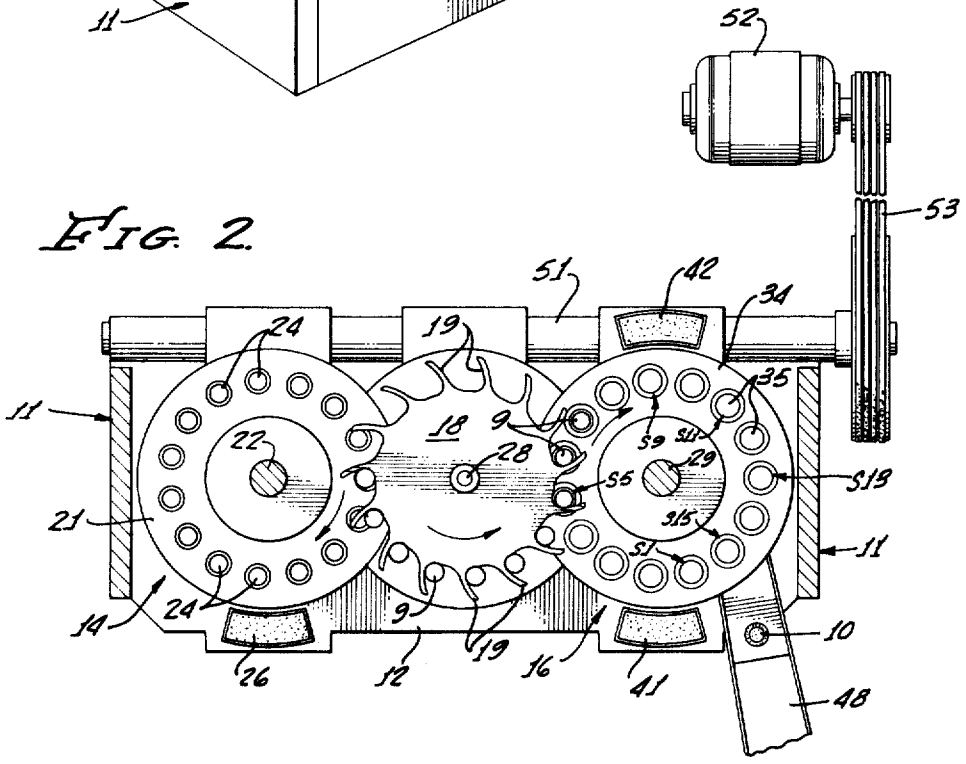


FIG. 2.



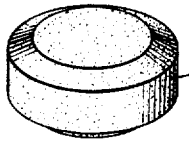


FIG. 3.

INVENTOR.
FLOYD H. JOHANNSEN

BY FOWLER, KNOBBE & GAMBRELL

ATTORNEYS

Feb. 27, 1968 F. H. JOHANNSEN 3,371,136

DETERGENT TABLET FORMING MACHINE

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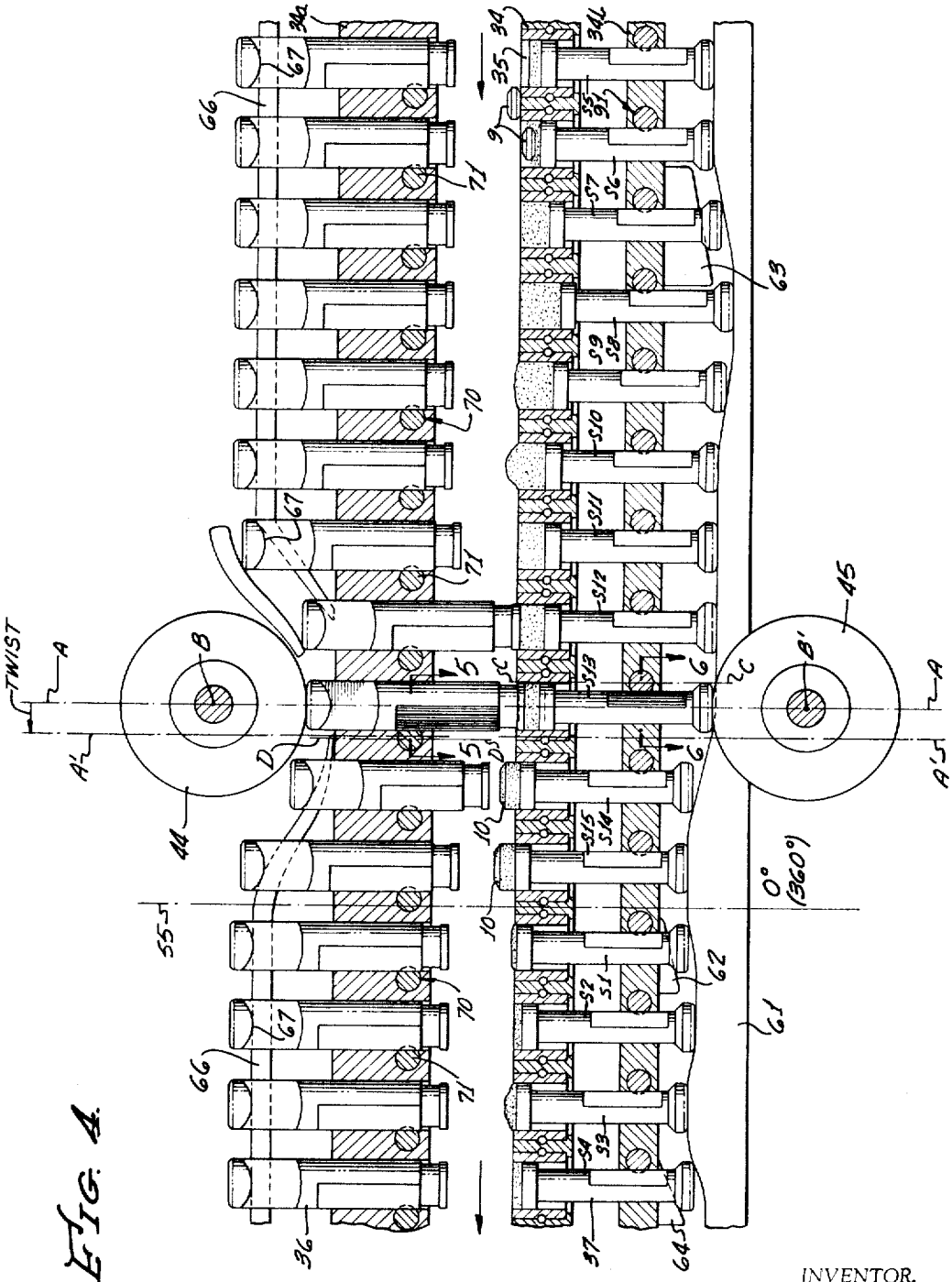


FIG. 4.

INVENTOR.
FLOYD H. JOHANNSEN

BY FOWLER, KNOBBE & GAMBRELL

ATTORNEYS.

Feb. 27, 1968 F. H. JOHANNSEN 3,371,136

DETERGENT TABLET FORMING MACHINE

Filed July 28, 1965 4 Sheets-Sheet 3

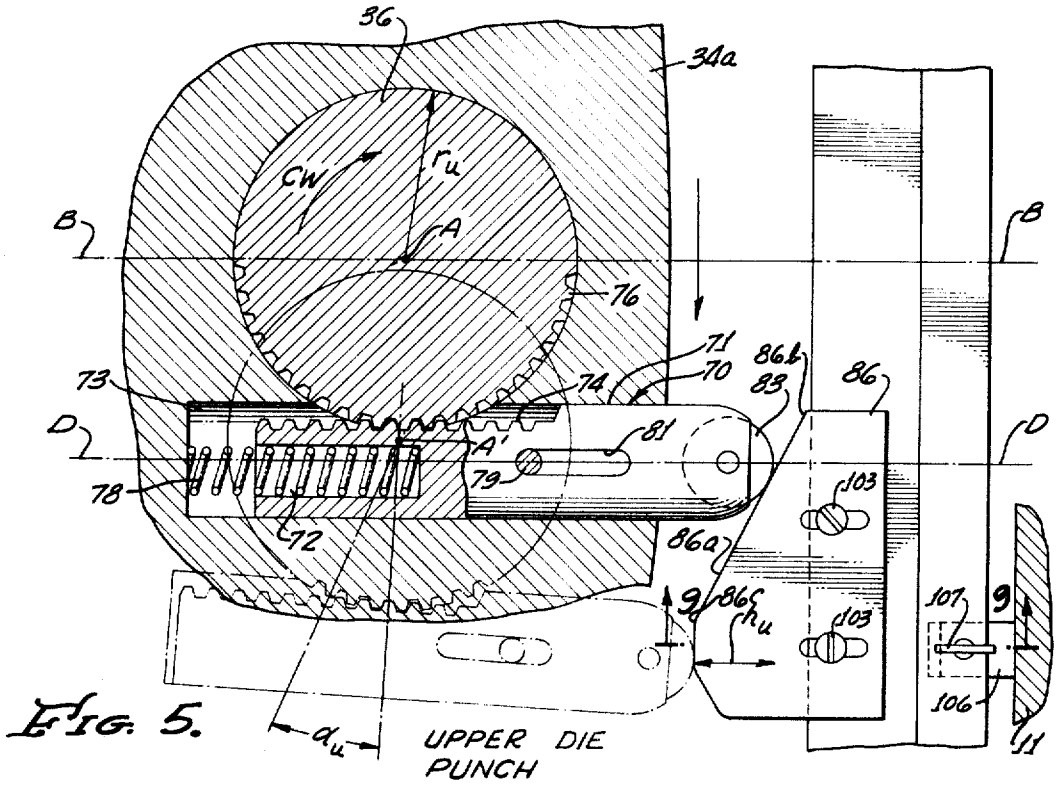


FIG. 5.

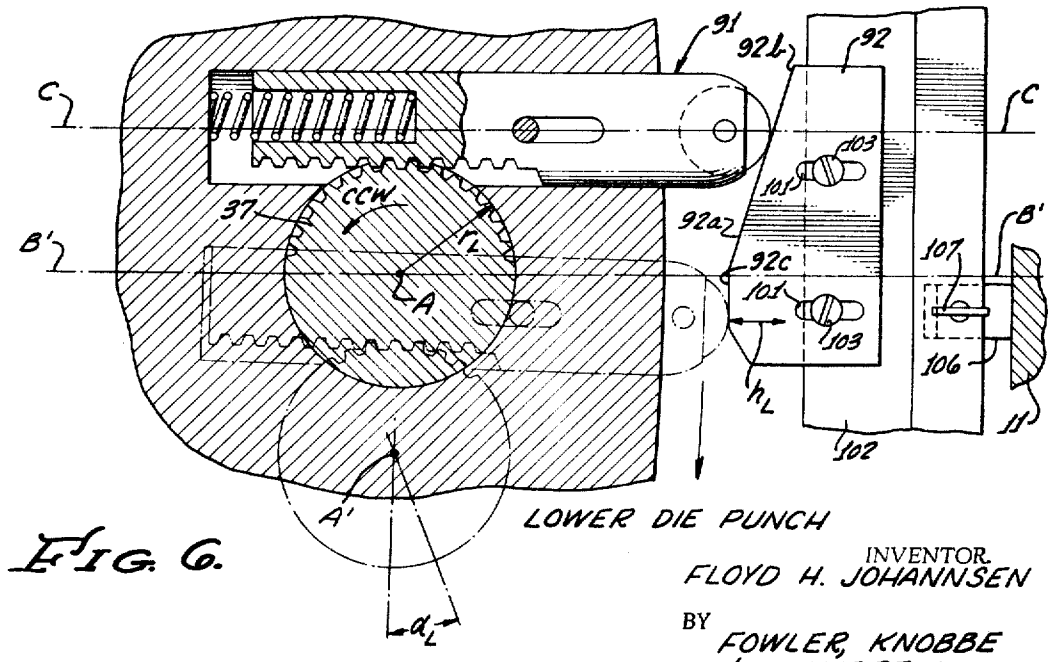


FIG. 6.

INVENTOR.
FLOYD H. JOHANNSEN

BY FOWLER, KNOBBE & GAMBRELL
ATTORNEYS.

Feb. 27, 1968 F. H. JOHANNSEN 3,371,136

DETERGENT TABLET FORMING MACHINE

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FIG. 7.

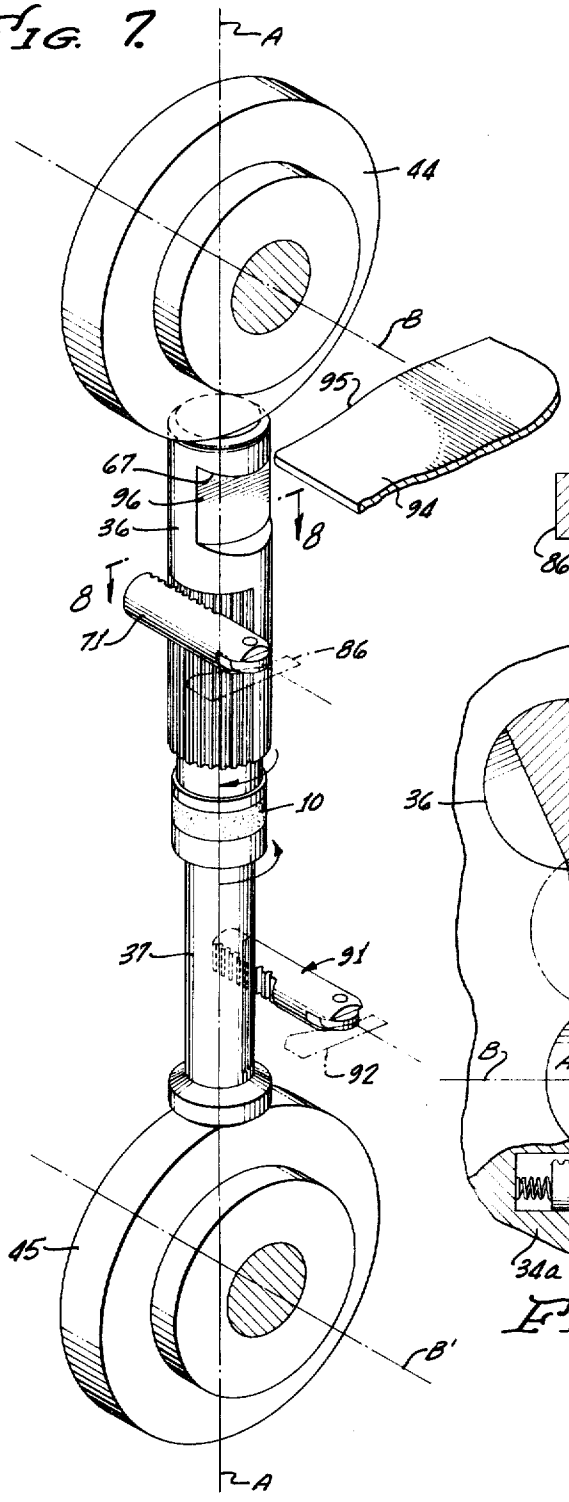


FIG. 10.

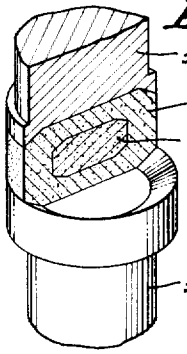
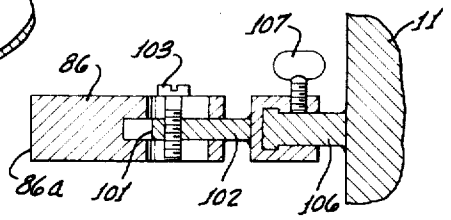


FIG. 9.



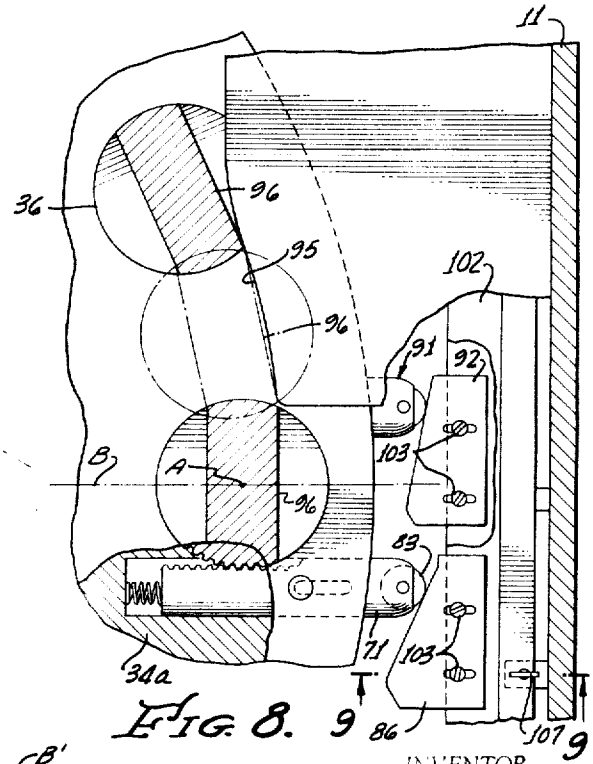


FIG. 8.

INVENTOR.
FLOYD H. JOHANNSEN

BY FOWLER, KNOBBE & GAMBRELL
ATTORNEYS.

United States Patent Office 3,371,136 Patented Feb. 27, 1968

3,371,136

DETERGENT TABLET FORMING MACHINE

Floyd H. Johannsen, Upland, Calif., assignor to United States Borax & Chemical Corporation, Los Angeles, Calif., a corporation of Nevada

Filed July 28, 1965, Ser. No. 475,488
15 Claims. (Cl. 264—109)

ABSTRACT OF THE DISCLOSURE

To prevent a detergent tablet from sticking to opposing tablet forming punch surfaces, the punches are provided with gear operated cam followers which twist the punches as the detergent is being compressed and untwist the punches just as they are being withdrawn. A pair of cams adjustably mounted on the machine displace the cam followers at the desired preselected points.

This invention relates to apparatus for manufacturing tablets and, more particularly, to an improvement in the means for preventing detergent tablets from sticking to the die surfaces during the course of their formation.

Coated and uncoated tablets of many types have been marketed over the years, particularly in the medicinal field, and the apparatus used to produce detergent tablets does not depart in major respects from the prior art apparatus used to produce these conventional tablets. However, certain unique problems do arise when detergent tablets are formed. It is to these problems that this invention is directed.

Many coated and uncoated tablets are formed in rotary presses which comprise a horizontally disposed rotating die head having a plurality of vertical die cavities extending therethrough at spaced-apart circumferential points. Aligned with and cooperating with each die cavity is a pair of die punches disposed above and below the die head. These are generally mounted in guide blocks for rotation in fixed relation to the die head and cooperate with fixed upper and lower cam tracks to perform the sequence of operations required to produce a finished tablet.

Where coated tablets are to be formed, as the die head and guide blocks are rotated through each revolution, a die cavity is filled with a layer of granular coating material, a core tablet is delivered to the center of the die cavity, the die cavity is again filled with granular material overlying the core tablet, the upper and lower punches are closed to form a coated tablet and the tablet is ejected. Rotary presses of this general type are well understood. For example, U.S. Patent 2,700,038, which was issued to W. F. Wyatt, Jr. and John R. Brownell on Mar. 31, 1959, describes a tablet coating machine of this sort, and Patent 3,000,331, which issued to R. G. Frank on September 19, 1961, relates to a coated tablet press.

More recently, dual rotary presses have been joined with a rotary transfer mechanism to provide unitary apparatus which can form the core tablet and the coating or outer layer. In the following discussion, the tablet will refer to the inner or core tablet and the coating to the outer coating or layer. One such dual rotary tablet press and transfer mechanism has been developed by Kux Machine Company, which is described in an article printed in the October, 1963 issue of Precision Metal Magazine entitled "Clad Parts by Powder Metallurgy." The Kux rotary tablet press, and similar ones, utilize a pair of rotary tablet presses and a transfer mechanism therebetween, all of which are tied together by a common drive.

The first of the two tablet presses forms the core tablet of the two-part product and the second press provides a coating thereabout. While there are a number of sophisticated problems which must be solved in synchronizing the moving parts of such tablet presses, and particularly in depositing the core tablet in the center of the die cavity of the coating press, the present invention constitutes an improvement over single or dual rotary presses of the general type described in the aforementioned article and patents.

To form detergent tablets at commercially feasible production rates creates a number of problems which are either not present when conventional coated pills are formed or which, at least, can be overcome without too much difficulty. For one thing, in forming detergent tablets it is necessary to use relatively low pressures and to intentionally build into the detergent tablets a desired rate of disintegration so that the tablets will dissolve sufficiently rapidly when placed in their operating environment. Not only is it necessary to build in void spaces that are predominantly inter-particulate in order to obtain predictable rates of disintegration, but it is necessary to find some means of breaking the detergent tablets away from the die punches after they are fully compressed at these low pressures inasmuch as heavy duty detergents have a strong tendency to adhere to the die surfaces. Failure to clear the die surfaces can not only create imperfect products, but cause breakdowns in the rotary presses due to the excessive wear of the rapidly moving parts. In the past, CO_2 generators, starch and the like have been employed as disintegration accelerators so that higher pressures can be used but they have not solved the problem.

Many of the problems involved, their solutions and specific compositions of detergent tablets found to be satisfactory are discussed in Patent 3,081,267 which issued on March 12, 1963 to Richard P. Laskey for "Detergent Tablet and Process for Making Same." Laskey and some other prior art references suggest that it is helpful to twist or rotate the die punches after the detergent tablet has been formed to clean the faces of the punch and prevent the build-up of material which would degrade the product or interfere with the operation of the press or both. It has been found helpful even when fatty foods, waxes and heavy chemicals are involved.

While the general concept of twisting the die punches in opposite directions is known, one of the difficulties with many prior art efforts in this direction is that the devices have lacked the versatility for selecting the desired quantum of twisting and for being able to select the point in the compression stage when the twisting is started and the time at which the punches are returned to their unrotated state. Because different detergent compositions cause different degrees and different kinds of smearing and sticking, each requires a different solution.

The present invention provides means for selectively twisting the upper and lower die punches in different directions whereby the angle of twist and the point of beginning and of termination of the twist may be easily selected and controlled. It has been found that careful control of these factors provide a better and more useful detergent tablet inasmuch as a small degree of twist at the proper time is far more beneficial and less harmful than the substantial twisting that many prior art machines employ.

Therefore, an object of this invention is to selectively twist the upper and lower die punches of a rotary tablet press at pre-selected points in the compression cycle to break the detergent tablet cleanly away from the surfaces of the die punches and cavity so that the working surfaces are not subject to excessive wear.

Other objects of the invention are to select the desired amount and speed of the circumferential twisting and to select the release point for the twisting mechanism.

A feature is means for rotating each of the die punches to attain these objects directly connected to the die punches so that they need not be synchronized with other

moving parts. Specifically, a movable cam follower assembly having a rack formed thereon is provided to mesh with the teeth cut on a part of the die punch so that a positive interconnection between the parts is provided when the punch is twisted.

Another feature of the invention pertains to the means for adjusting the cam means mounted on the frame of the press so that the twist begins and terminates at preselected points in the rotating position of the die head, taking into account the particular detergent being used in the rotary press and the forming pressures.

Yet another feature of the invention is the means for returning the upper and lower punches to their normal equilibrium or non-axially rotated positions just as the die punches break away from the detergent tablet and die cavity so that any flaking or filming on the surface of the detergent tablet is, in most cases, repaired by the reverse twisting of the die punches as the die punches separate from their die cavity.

Still another feature of the invention pertains to the means for preventing the rotation of the upper die punches as each moves interior of the die cavity under the influence of its pressure roll. By this preventive, the amount and timing of the twisting of the punches can be accurately controlled.

The product produced by the combination of these various features is a detergent tablet which will stand up well under routine handling and yet has the properties required to distintegrate in a reasonable short period of time upon being placed in water or another dissolving liquid.

These and other objects, advantages and features of the present invention will be more fully understood when the following detailed description is read with reference to the drawings, in which:

FIG. 1 is a perspective drawing of a dual rotary press with an integrated transfer mechanism embodying the present invention;

FIG. 2 is a plan view of the dual rotary tablet press of FIG. 1 with certain of the parts omitted to more clearly show the die heads and station positions;

FIG. 3 is an enlarged perspective of a detergent tablet formed with the apparatus of the present invention;

FIG. 4 is an enlarged rectilinear expansion of the rotary die head, punches, guide blocks and stationary cams of a rotary press constructed in accordance with the present invention to apply a coating to core tablets;

FIG. 5 is a section view taken along lines **5**—**5** of FIG. 4 to illustrate the novel twisting mechanism of the present invention which is associated with each upper die punch;

FIG. 6 is a section view taken along lines **6**—**6** of FIG. 4 to illustrate the novel twisting mechanism of the present invention which is associated with each lower die punch;

FIG. 7 is an enlarged perspective of the pressure rolls, upper and lower die punches and twisting mechanisms as they cooperate when the punches are at the compression station;

FIG. 8 is an enlarged plan section of a portion of the rotary die head and frame of the coating rotary press of FIGS. 1 and 2 taken through the head of the upper die punch (as at line **8**—**8** of FIG. 7) with certain parts cut away to more clearly illustrate the construction and cooperation of the cam follower assemblies and cams which provide the selective twisting of the upper and lower die punches in timed relation to the compression stage of operation;

FIG. 9 is a partial end section view taken along line **9**—**9** of FIG. 8 to illustrate the adjustable means for each cam which permit them to selectively operate their associated cam follower assemblies; and

FIG. 10 is an enlarged perspective of the upper and lower die punches at the compression station with part of the detergent tablet and upper die punch cut away to show a formed tablet and the cooperative relation of the surfaces of the die.

Referring to FIGS. 1 and 2, there is illustrated rotary tablet press apparatus including a pedestal or frame **11** having a tablet bed **12**, a core tablet rotary press **14**, a coating rotary press **16** and a tablet transfer mechanism **18** therebetween. The rotary presses **14** and **16** and rotary transfer mechanism **18** are rotatably mounted on parallel shafts projecting from the bed **12** and synchronized so that the core tablets formed by the rotary core press **14** are transferred by the fingers **19** of the rotary transfer mechanism **18** to the center portion of each die cavity **35** of the rotary coating press **16** as it rotates past the transfer mechanism **18**.

Looking more particularly to FIG. 2, it can be seen that the core tablet rotary press **14** has a circular die head **21** rotatably mounted on a shaft **22**. A plurality of die cavities **24** (fifteen in the die head of the exemplary embodiment) are circumferentially spaced around the die head **21** and with other equipment (similar to parts of the coating press **16** but not shown in detail) produce a core tablet each time the die head **21** is fully rotated beginning at a location adjacent fill hopper **26** and terminating at the junction of the transfer mechanism **18** and the die head **21**. The formation of the core tablet is not described in detail since it essentially duplicates the operation of rotary press **16**.

The transfer mechanism **18** is rotatably mounted on shaft **28** and has a plurality of fingers **19** which are coordinated with the rotation of die head **21** to engage each core tablet as it is finished and carry it off of the upper surface of the die bed **21** around to the die cavities **35** associated with the coating press **16**.

The coating rotary press **16** is similar to the core tablet press **14** and includes a die head **34** having fifteen die cavities **35** circumferentially formed through it. The die head **34** is rotatably mounted on the pedestal **11** by shaft **29**. It is rotated in timed sequence with the transfer mechanism **18** so as to receive a core tablet **9** in the center area of each of its die cavities **35** as the fingers **19** move over the upper surface of the die head **34**. The instant positions of the fifteen die cavities **35** of the coating die press **16** have been numbered S–1 through S–15 as shown, with the compression station being located at S–13, for ease of explanation. These station locations of FIGS. 1 and 2 are correlated with the rectilinear layout illustrated in FIG. 4.

Forming a part of the rotary press **16** and carried in rotationally fixed relation to the die head **34** are guide blocks **34***a* and **34***b* which support upper die punches **36** and lower die punches **37**, respectively, for vertical movement with respect to their associated die cavities **35** of die head **34**. These guide blocks may actually be a part of the die head proper. Each die cavity **35** has an upper and lower die punch **36** and **37** cooperating therewith and is controlled by a series of stationary cams (FIG. 4) as the die head and guide blocks rotate, as hereinafter explained.

Also associated with the rotary press **16** illustrated in FIGS. 1 and 2 are fill hoppers **41** and **42** which are arranged with respect to positions S–1 through S–15 to provide the granular material forming the coating supplied at the proper point in the process.

To coat tablets delivered by the transfer mechanism **18**, the coating die press **16** rotates so that each die cavity **35** passes in sequence by the fill hopper **41** where it is charged with coating material in pulverant form to provide a bed for the core tablet which is thereafter delivered to the die cavity by the transfer mechanism **18**. After the core tablet **9** is deposited in the die cavity **35**, a second filling operation (from hopper **42**) provides an overlay of pulverant material needed to form the finished coating of the tablet.

Following these operations, the die cavity **35** and its cooperating upper and lower die punches **36**, **37** reach the compression station S–13 where a pair of compression rolls **44** and **45** force the upper and lower die punches **36**

and **37** together to fully form the coating on the core tablet. The pressure rolls **44** and **45** are rotatably mounted on the frame **11** of the press and act to cam the upper and lower die punches **36, 37** into close juxtaposition interior of their associated die cavity **35**.

There is also provided a discharge chute **48** adjacent the position S–**15** where means (not shown) deflect the finished coated tablets **10** onto the discharge chute for movement out of the press for storing or packaging.

The two rotary presses **14** and **16** and the transfer mechanism **18** are synchronously rotated through a common drive **51** which is, in turn, rotated by motor **42** through the belt drive identified as **53**.

Looking to FIG. 4, the sequence of operations of the rotary press **16** can be most easily understood. In FIG. 4 there is illustrated the rotating die head **34**, die punches **36** and **37**, and upper and lower guide blocks **34***a* and **34***b* which support the upper die punches **36** and the lower die punches **37** for vertical movement in cooperation with their respective die cavities **35**.

A series of stationary cams **61, 62** and **63** cooperate with the lower ends of the lower die punches **37** to move them in timed sequence with the filling and other operations of the rotary press. Similarly, stationary cam **66** cooperates with the upper parts of upper die punches **36** to control their movement with respect to their die cavities **35**.

Starting at the beginning of a cycle marked 0° (360°), which is identified by line **55**, a lower die punch **37** is moved downwardly through stations S–**1** and S–**2** as pulverant material from fill hopper **41** is deposited in the die cavity **35** on top of the face of lower die punch **37**. As the lower die punch **37** moves from station S–**2** to S–**3**, the punch is moved upwardly and means (not shown) scrape off the excess pulverant material so that a measured charge of the pulverant material, as illustrated at station position S–**4**, is provided. Thereafter, as the die cavity and die punches we are following in this sequence reach station S–**5**, the lower die punch **37** has moved downwardly fully capturing the first charge of pulverant material in preparation for receiving a core tablet **9**, which is shown resting on the upper surface of the rotating die head **34** adjacent station S–**6**. As the die cavity and punches reach station S–**6**, the transfer mechanism **18** deposits the core tablet **9** on top of the first charge of pulverant material and the lower die punch **37** is moved downwardly so that the second charge of pulverant material from fill hopper **42** may be deposited on top of the core tablet **9** through the positions illustrated as stations S–**7** and S–**8**.

Following this, as the lower die punch **37** moves from station S–**8** to station S–**9**, the die punch **37** moves upwardly to push the excess pulverant material out of the die cavity **35** and means (again not shown) scrapes off the excess to provide a measured amount above and below the core tablet **9**, as depicted at station S–**11**.

During the first eleven stations of rotation of the die head **34** and its associated die punches **36** and **37**, the upper die punch **36** has been held in a retracted position by the stationary cam **66** on which the shoulders **67** of the upper die punch **36** rides.

At the beginning of station S–**11**, the stationary cam **66** permits the upper die punch **36** to move downwardly under the force of gravity preparatory to moving under the upper pressure roll **44** at station S–**13**. As the die punches and their die cavity reach station S–**13**, upper and lower punches **36** and **37** fully compress the pulverant material about the core tablet **9**. Immediately past station S–**13**, the upper die punch **36** begins to move away from the die head **34** following the stationary cam track **66**. Just past the station S–**13**, the die punches **36, 37** break away from each other, the coated tablet **10** is slowly moved toward the upper surface of die head **34** where means adjacent station S–**15** (not shown) direct the tablet onto the conveyor discharge chute **48**.

Also shown in FIG. 4 are the cam follower assemblies

70 which are associated with each upper die punch **36** and cam follower assemblies **91** which are associated with each lower die punch **36**. These cam follower assemblies and the cams with which they cooperate can be more clearly understood by looking to FIGS. 5–9.

Looking first at FIG. 5, there is depicted a cross-section view along line **5**—**5** of FIG. 4 which illustrates the cooperative relation between the cam follower assembly **70** and its associated upper die punch **36**. The upper die punch **36** is rotatably and slideably supported in the guide block **34***a* which rotates in fixed relation to the rotating die head **34**, and the cam follower assembly **70** is slideably but non-rotatably mounted in the cylindrical recess **73**, the axis of which is generally along the radial axis D and at right angles to the axis A of the die punches **36** and **37**.

The cam follower assembly **70** cooperating with a central portion of the upper die punch **36** has a cylindrical body member **71** having a series of teeth **74** in the form of a rack formed on one side. A coil spring **78** is disposed between the back of the radial aperture **73** and a hollowed rear portion **72** of the body assembly **71** to normally urge the cam follower body **71** radially outward as illustrated by the solid line drawing of FIG. 5. A screw or vertical pin **79** depends through a radial slot **81** in the cam follower body **71** to hold the body **71** slideably but non-rotatably inside its radially oriented housing **73**. The pin **79** may be pressed or threaded into the die head block **34***a*.

A cam follower or roller **83** is rotatably attached to the outer end of the cam follower body **71** and is adapted to cooperate with a stationary cam **86** which is affixed to the frame **11** of the press **16** in the manner hereinafter described.

The dotted outline of the cam follower assembly **70** illustrated in FIG. 5 depicts the position of the cam follower assembly at its fully retracted position just before the cam roller **83** moves beyond the cam surface **86***a*. Thereafter the cam follower assembly may return the upper die punch **36** to its normal, non-rotated position following the clockwise rotation of the punch at the compression station about its own axis A. This will occur when the compressive forces are relieved enough to allow the compressed spring **78** to force the assembly outward to its normal position. The angle of rotation α_U of the upper die punch **36** is determined, of course, by the relative displacement of the cam follower assembly **70** which, in turn, depends upon the vertical distance h_U of the cam **86** which controls it. The rate of twisting depends upon the angular distance between the beginning of cam surface **86***a* (at **86***b*) and its maximum point (at **86***c*).

Looking to the cam follower assembly **91** associated with the lower die punch **37**, it is similar in construction (see FIG. 6). It differs only in that it is positioned with respect to the lower die punch **37** so that the punch **37** is rotated counterclockwise when the cam follower assembly **91** is moved to its fully retracted position by its fixed cam **92**. The assembly **91** is movable along axis C, which it will be noted is on the opposite side of punch axis A from the axis D of cam assembly **70**. This is so that the upper die punch **36** is rotated clockwise and the lower die punch **37** is rotated counterclockwise to twist the die punch surfaces with respect to the tablet **10** being formed therebetween. Again, the angle of rotation α_L of the lower die punch **37** is a function of the radial displacement of the cam follower assembly **91** which, in turn, depends upon the displacement height h_L of cam **92**. Again, the rate of twisting depends upon the angular distance between the points **92***b* and **92***c*, which define the cam surface **92***a*.

As shown in FIG. 5, the dotted outline of the cam follower assembly **91** in FIG. 6 illustrates the fully retracted position of the cam follower assembly **91** after the die punch **37** has been fully rotated counterclockwise.

The cooperative rotation of these upper and lower twisting mechanisms may be seen more clearly in FIGS. 7 and 8. FIG. 7 illustrates in perspective the relationship between the cam follower assemblies **70** and **91** which are disposed on opposite sides of their respective upper and lower die punches **36** and **37**. The cams shown in phantom provide opposite twists as the outer ends of the punches **36** and **37** are cammed inwardly by the respective pressure rollers **44** and **45**. The axes B and B' of the pressure rolls **44** and **45**, it will be noted, intersect the axis of rotation of the upper and lower die punches A. It has been found that a circumferential rotation of approximately $\frac{3}{16}$ of an inch permits the advantages of the present invention to be obtained.

FIG. 7 also illustrates generally the means provided to prevent the upper die punch **36** from rotating before its cam follower **83** actually contacts the inclining surface **86***a* of fixed cam **86**. The plate **94** is affixed to the frame **11** (see FIG. 8) of the press **16** and has an outer edge **95** which rides along the flat inner surface **96** defined by the shoulder **67** on the upper die punch **36**. The die punch cannot twist in either direction until the flat surface **96** clears the tip of the fixed plate **94**.

In the case of the upper die punch **36**, it is necessary to provide plate **94** since the upper die punch **36** will tend to pivot in a clockwise direction as it is moved under the pressure roller **44**. On the other hand, no such preventive is needed for the lower die punch **37** since it will tend to rotate clockwise as it is compressed by pressure roll **45**. Since this tendency is exerted only against the fully extended position of the cam follower assembly **91**, it will not cause the lower punch **37** to rotate.

It is necessary to prevent premature rotation of the die punches **36** and **37** so that the amount and timed beginning of the rotation can be controlled to provide the necessary twisting to effect a cleaning of the die cavity surfaces and die punch surfaces, and yet not an excessive amount which would cause the tablets to flake or put such a hard surface on the coated tablet that a desired rate of disintegration cannot be obtained.

The manner of mounting the cams **86** and **92** on the frame **11** is more clearly depicted in FIGS. 8 and 9. Both are mounted similarly so cam **86** may be taken as exemplary. Cam **86** has a pair of radially oriented slots **101** formed through it and is mounted on an inverted T-shaped member **102** by screws **103** which depend through the slots and can be turned to bind the cam **86** against the side of the T-member **102**. The rigid member **102** is horizontally oriented and is, in turn, slideably supported along a T-track **106** which is affixed to the frame **11** of the press **16**. A thumb screw or similar device **107** is provided to lock the member **102** at a desired transverse position between the front and rear sides of the rotary press (based on the orientation of the apparatus of FIG. 1).

By this technique of mounting the cams **86** and **92**, means are provided for changing the slope of the cam **86** and the point at which its cam follower assembly **71** first contacts the inclined surface **86***a* thereof. These simple adjustments permit the point in the cycle at which the twisting begins to be adjusted in accordance with the best results for the composition of the detergent being used.

Moreover, it is possible by this means to arrange each cam follower assembly and its actuating cam so that the cam roller just clears the cam surface before the die punches break away from the tablet. Thus, a reverse shearing force occurs at the tablet surface due to the returning of the die punches to their normal unrotated positions. This latter shearing force compensates for any excessive smearing of the detergent that may have occurred during the initial twist in the early part of the compression stage and permits the coated tablet **10** to be extracted without harming the surface of the tablet and without gumming up the die surfaces.

While this invention has been described with reference to an exemplary embodiment involving the coating of tablets, it should be apparent to those skilled in the art that certain modifications, including the formation of core tablets only, can be carried out without departing from the spirit and scope of the invention. For this reason, the invention should only be limited to the extent of the appended claims.

I claim:

1. In detergent tablet forming apparatus of the type having a rotatable die head with a plurality of die cavities and upper and lower punches cooperating therewith, the improvement in means for selectively rotating each set of upper and lower punches comprising, in combination,

(a) rotating means associated with each die punch operable to rotate said punch;

(b) controlling means mounted on the frame of the tablet forming press to initiate the operation of said rotating means as the die punch with which it is associated moves through the compression station with the die head; and

(c) means to adjust the controlling means so that each punch is rotated a preselected circumferential distance during a preselected portion of the compression stage of the rotary press.

2. An improvement in tablet forming apparatus in accordance with claim **1** wherein the rotating means are directly connected to their die punches, and means are included to reverse the operation of the rotating means at a preselected angular point in said compression stage so that said die punches are returned to their normal unrotated positions.

3. In tablet forming apparatus of the type having a rotatable die head with a plurality of die cavities and upper and lower punches lying in common axes cooperating therewith, the improvement in means for selectively rotating each set of upper and lower punches comprising, in combination,

(a) a cam follower assembly for each die punch operable to rotate said punch;

(b) cam means mounted on the frame of the press to operate each cam follower assembly as it moves past the compression station during the rotation of the the die head, die punches and cam follower assemblies; and

(c) means to adjust the operating relationship of said cam follower assemblies and said cam means to provide angular rotations of preselected magnitudes and preselected points of operation and release with respect to the compression stage of the press.

4. An improvement in tablet forming apparatus in accordance with claim **3** and including means mounted on the frame of said press adjacent the compression stage thereof to prevent each successive die punch from rotating until its cam follower assembly is operated by said cam means.

5. An improvement in tablet forming apparatus in accordance with claim **3** and including

(a) means for mounting each of said cam follower assemblies slideably interior of said die head for movement in a radial direction; and

(b) gear means directly connecting each cam follower assembly to its associated die punch.

6. An improvement in tablet forming apparatus in accordance with claim **3** wherein

(a) the cam follower assemblies for the upper and lower punches which cooperate with a given die cavity are mounted on opposite sides of the axes of the die punches to cause the punches to rotate in opposite directions, and

(b) said adjusting means is a pair of cams mounted on the frame with each having at least two degrees of freedom so that the angle of twist for each die punch of a pair and the circumferential points of commencement and termination of the twisting can be preselected.

7. In tablet forming apparatus of the type having a rotatable die head with a plurality of die cavities formed therethrough at circumferentially spaced-apart locations, upper and lower punches cooperating with each die cavity, and cam means for preselectively moving the sets of upper and lower punches interior of their respective die cavities, the improvement involving means for selectively rotating each set of upper and lower punches at times comprising, in combination,

(a) a cam follower assembly for each die punch slideably mounted in the die head adjacent its die punch;

(b) means directly connecting said cam follower assembly to its die punch so that movement of said assembly causes the punch to rotate;

(c) means urging said cam follower body radially outward whereby the cam follower assembly projects outwardly beyond the periphery of said rotatable die head; and

(d) a pair of cams adjustable mounted on the frame of said press in staggered circumferential relation to move the cam follower assemblies associated with the respective lower and upper die punches selectively to rotate said upper and lower die punches preselected angular distances during the compression stage.

8. In tablet forming apparatus in accordance with claim 7 wherein said cams are positioned with respect to said compression stage and the axes of said die punches to initiate the rotation after the compression of a tablet begins and to permit the cam follower assemblies to return their associated punches to their normal non-rotated positions just as the die punches separate whereby the coated tablet therebetween is cleanly sheared from the sides of said die cavity and the faces of said die punches.

9. An improvement in tablet forming apparatus in accordance with claim 8, and including means mounted on the frame of said machine adjacent the compression station thereof to cooperate with the upper punch as it approaches said compression station to prevent it from rotating until its cam follower assembly operatively contacts the stationary cam with which it is designed to cooperate.

10. In tablet forming apparatus of the type having a rotatable die head with a plurality of die cavities formed therethrough at circumferentially spaced-apart locations, upper and lower punches cooperating with each die cavity, means for moving preformed core tablets to positions coincident with the centers of successive die cavities as the die head is rotated, means for filling the die cavities with granular material to form a coating about the core tablets, and means for preselectively moving the sets of upper and lower punches interior of their respective die cavities; the improvement in means for selectively rotating each set of upper and lower punches at times comprising, in combination,

(a) a cam follower assembly for each die punch having a body mounted in the die head adjacent its die punch for generally radial movement with respect to the axis of rotation of the die head and having rack teeth cut therein;

(b) a series of gear teeth formed about at least a part of the periphery of an intermediate section of each die punch to act as a pinion for the rack formed on said body;

(c) spring means intermediate a part of the die head and the end of said cam follower body urging said body radially outward so that the outer end of said cam assembly projects outwardly beyond the periphery of said rotatable die head;

(d) a pair of cams adjustably mounted on the frame of the tablet forming press adjacent the compression station thereof in staggered circumferential relation to displace the respective cam follower assemblies associated with the lower and upper die punches of each pair as they move past the compression station during the rotation of the die head;

(e) said cams being proportioned to cause the upper and lower cam follower assemblies to move radially inward compressing said springs to rotate said upper and lower die punches simultaneously preselected angular distances, and said cams positioned with respect to said compression stage of the press and the axes of said die punches to initiate said rotation after the compression of a tablet begins and to permit the cam follower assemblies to return said punches to their normal non-rotated positions by the forces of said springs as the die punches separate whereby the coated tablet therebetween is cleanly sheared from the sides of said die cavity and the faces of said die punches.

11. An improvement in tablet forming apparatus in accordance with claim 10 and including a flat plate mounted on the frame of said machine adjacent the compression station thereof to bear against a flat formed on the upper punch as it approaches said compression station to prevent said die punch from rotating until its cam follower assembly operatively contacts the stationary cam with which it is designed to cooperate.

12. An improvement in tablet forming apparatus in accordance with claim 11, and including means for mounting each of said cam follower assemblies slideably interior of said die head so that the racks thereon are maintained in proper engagement with the teeth on the intermediate section of their associated die punches and said assemblies cannot extend radially outward beyond a preselected distance.

13. An improvement in tablet forming apparatus in accordance with claim 10, and including adjustable means mounting each of said cams on the frame of the press whereby the angle of twist for each die punch of a pair and the circumferential points of commencement and termination of the twisting can be selected to accommodate the multifold characteristics of tablets formed of different detergent compositions.

14. A process for preventing tablets formed by compressing granulated detergent between a pair of die punches from sticking to the surfaces thereof, comprising the steps of:

(a) twisting the die punches in opposite directions as a tablet is being formed with the initial twisting of the punches being after the beginning of the compression of the granulated detergent; and

(b) reverse twisting the punches to their original position just as they separate following the full compression of the granulated detergent to form a tablet.

15. A process for preventing tablets formed by compressing granulated detergent between a pair of die punches from sticking to the surfaces thereof in accordance with claim 14, and including initially twisting the punches approximately three-sixteenth of an inch at their periphery.

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WALTER A. SCHEEL, *Primary Examiner.*

J. SHEA, *Assistant Examiner.*