The present invention is directed to a tablet making machine, and more particularly to a tablet making machine which can be operated at high speeds for sustained periods of time without mechanical malfunction. The use of automatic tablet making machines has become widespread, and machines for producing tablets of closely regulated size and shape at very high speeds have been developed. However, the powders supplied to such automatic tablet making machines frequently are not devoid of fine particles. These fine particles have a tendency to pass through the small radial clearances of the dies and the lower punches. This has been found to be true even though the radial clearances are maintained within a tolerance of 0.0002 inch for small diameters and 0.001 inch for larger diameters.

The accumulation of these fine powders in the lubrication film discharged between the lower punches and their respective sockets in which such lower punches reciprocate within the rotary head has been found to lead to complete malfunction of the tablet making machine. Thus, such fine powders accumulate within the lubricant until the lower punches bind in their sockets. Such binding of the lower punches can reach such proportions that severe damage ensues to the pull-down side of the punch head within a very short time period.

As the bearing contact between the pull-down side of the punch head and its associated cam track is limited, even a short period of operation after binding has been encountered will result in both damage to the punches and to the cam tracks.

Binding of the punches within their sockets is materially aggravated upon the increase of the tabletting speed. While resort has been had to careful selection of the lubricant in an attempt to avoid binding in high-speed operations, this has proved to be in the main unsatisfactory. In particular, it has been found that a lubricant which is satisfactory for one material may not work adequately with another.

The development of high speed feeding means which are capable of delivering powders containing a high proportion of fines has greatly aggravated the punch binding problem. In particular, when resort is had to pressure or force feeding of such materials the problem is acutely aggravated.

This invention has as an object the provision of a novel tablet making machine.

This invention has as another object the provision of a tablet making machine which may be used to form tablets from powders containing a high proportion of fines at high speeds.

This invention has as yet another object the provision of a tablet making machine in which binding of the lower punches within their sockets is substantially minimized.

This invention has as a still further object the provision of a tablet making machine in which lubrication of the lower punches is efficiently achieved.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentations shown.

FIGURE 1 is a fragmentary vertical sectional view through the tablet making machine of the present invention.

FIGURE 2 is an enlarged fragmentary sectional view revealing the air baffling means of the present invention in association with the socket of a lower punch of the tablet making machine of FIGURE 1 together with the oil reservoir.

FIGURE 3 is a fragmentary sectional view revealing the operation of the means for delivering lubricant and the means for delivering air to the lower punch sockets of the tablet making machine of the present invention.

FIGURE 4 is a sectional view taken on line 4–4 of FIGURE 3.

FIGURE 5 is a sectional view taken on line 5–5 of FIGURE 3.

Referring to the drawings, there is shown therein a rotary tablet making machine of the present invention with many of the commonly known elements which are non-essential to the operation of the present invention being omitted.

The tablet making machine of the present invention is designated generally as 10. The tablet making machine 10 comprises the stationary lower frame 12 on which the rotary head 14 is rotatably carried by the spindle 16. The upper punches 18 are provided in their sockets within the rotary head 14 and are in alignment with the dies 20. The dies 20 are carried within the rotary head 14 flush with the surface of the die table 22.

The lower punches 24 are carried within the lower punch sockets 26 within the rotary head 14. The lower punches 24 are in vertical alignment with the dies 20 and the upper punches 18 as will be evident to one having skill in this art.

The rotation of the rotary head 14 is achieved by the engagement of the worm 25 with the worm gear 26, the worm 25 being driven by the prime mover 33.

The lower punches 24 ride on the lower punch cam track 34, with the pull-down side 36 of the punch head 38 of each lower punch 24 being engaged with the lower punch cam track 34 during the portion of the tablet making cycle in which such lower punch 24 is in descended disposition. Such descended disposition for a lower punch 24 is shown at the left side of FIGURE 1.

During the compression portion of the tablet making cycle, the underside of the punch head 38 of each lower punch 24 is engaged with the lower roller 40 as shown at the right side of FIGURE 1.

The portion of the rotary tablet making machine 10 set forth above is of standard construction, and no claim of invention is made to the same independent of the portion of such machine set forth below. Accordingly, a wide variety of tablet making machine embodiments incorporating the elements set forth above may be utilized in the tablet making machine 10 of the present invention, since no claim is made to any particular type of element of the type specified above.

The tablet making machine 10 of the present invention comprises the air channel 42 disposed within the bottom portion of the rotary head 14. The air channel 42 is an annulus and is in communication with a plurality of upright ports 44, so that the combination of the air channel 42 and the upright ports 44 serves as a manifold. Each upright port 44 is provided with a lateral port 46 which is in communication with the lower punch socket 26 for a lower punch 24 as will be seen particularly in FIGURE 2. The discharge opening of the lateral port 46 is positioned in the wall of the lower punch socket 26 at a height such that it is just above the tip shoulder 48 of the lower punch 24 in its descended position.

The seal mounting ring 50 is fixedly secured to the stationary lower frame 12 beneath the air channel 42. The seal mounting ring 50 forms the support on which the annular seals 52 and 52 are clamped by the seal holding ring 54.
The seals 52 and 52 may be formed of any suitable sealing material, with self-lubricating polymers, such as the lubricated polytetrafluoroethylene polymers designated Teflon, or with synthetic rubber or the like being satisfactory.

The seal mounting ring 50 is provided with an oil opening 56 which is in communication both with the oil duct 58 which enters into the seal mounting ring 50 from its underside, and the oil port 60 which extends upwardly from the seal holding ring 54 from its bottom to a point intermediate its uppermost surface and its bottom. The oil port 60 is in communication with the oil cross ports 62 and 62 which extend laterally through the seal holding ring 54 and discharge into the air channel 42 above the seals 52 and 52 (see FIGURE 4).

The seal mounting ring 50 is also provided with an air opening 64 which is in communication both with the air duct 66 which enters into the seal mounting ring 50 from its underside, and the air port 68 which extends upwardly within the seal holding ring 54 throughout its entire height. The air port 68 discharges into the air channel 42 above the seals 52 and 52 (see FIGURE 5).

The air duct 66 is provided with a 70 so that a bifurcation of the air duct 66 may be effected, one arm thereof going to the seal holding ring 54 as above-indicated, and the other arm 68 thereof extending to the upper portion of the oil reservoir 72.

The oil reservoir 72 may be fixedly secured at a convenient point to the stationary lower frame 12, and is preferably provided with a window 74 through which its contents may be visually observed.

A pressure regulator 76 with an attendant gauge 78 may be provided in the air duct 66. In addition, it is also desirable to provide the air duct 66 with a shut-off valve 89. In cases where it is desirable to lubricate punch sockets 26, a mist type lubricator 100 may be placed in the air duct 66 after pressure regulator 76. The mist type lubricator 100 may be any one of a plurality of commercially available lubricators such as the micro-fog lubricator sold by Norgren Co., Englewood, Colorado.

The securing of the seal holding ring 54 to the seal mounting ring 50 may be accomplished by a variety of means, as by the bolt 52 which extends from the seal holding ring 54 into a threaded socket within the seal mounting ring 50.

Referring now particularly to FIGURE 2, an annular exhaust seal 84 is provided in an undercut groove 86 beneath the die table 22 spaced from the wall of the lower punch sockets 26 and juxtaposed to the mouth of the lateral ports 46. The annular exhaust seal 84 is provided with seal members 88 and 88 which are clamped to its inside end portion by the clamping element 90. Such seal members 88 and 88 may be formed of the same material as the seals 52 and 52.

As seen in FIGURE 1, the annular exhaust seal 84 is provided with at least one vacuum opening 92 which establishes a communication between the vacuum channel 94, which is positioned intermediate the inner portion of the annular exhaust seal 84 and the lower punch socket 26, and the exhaust duct 96. The exhaust duct 96 is in communication with a vacuum pump 98 by which the vacuum channel 94 may be evacuated to a suitable extent. The exhaust duct 96 may be provided with a filter 99 which is diagrammatically shown in FIGURE 1.

The operation of the tablet making machine 10 of the present invention is as follows:

When the tablet making machine 10 is not in use the shut-off valve 80 may be closed (as for example by an automatic latching means connected to the spindle 16, not shown). This prevents the flow of air through the air port 68 in the seal holding ring 54. The level of oil in the oil reservoir 72 is equalized with that over seals 52 and 52 by the bifurcated line 66a which maintains the air pressure within oil reservoir 72 equal to that of air channel 42.

Air, and if lubrication is desired, oil dispersed into the air stream by mist lubricator 100 enters into the air channel 42 and the flow proceeds upwardly through the lower punch ports 44 and thence through the lateral ports 46. Dry or lubricated air in the form of an atomized spray is discharged onto the tip portion of each lower punch 24 when such lower punch 24 is in its descended disposition, as shown at the left side of FIGURE 1. The discharge of the oil or air enters into the lower punch port 44 from its bottom and is received in the lower punch port 24 in respect to its lower punch socket 26. The discharge of air from the lateral port 46 onto the tip portion of the lower punch 24 when the lower punch is in its descended disposition serves to provide an air buffer against the descent of power fines about the shank of the lower punch 24 which is received within the lower punch socket 26.

When the lower punch is in its raised disposition, thus effecting compression of the powder being tabletted within the die 20, as shown at the right side of FIGURE 1, the compression being effected by the engagement of the underside of the punch head 38 of the lower punch 24 with the lower roller 40, the shank of the lower punch 24 blocks the mouth of the lateral port 46. In this manner pulsing of the oil and air to the tip portion of each lower punch 24 is achieved.

Since the punch head 14 rotates and the seals 52 are stationary, the oil from reservoir 72 is conveyed to the seals 52 by the way of the duct 58 to prevent the seals 52 from overheating.

The level of the oil within the channel 42 is identical with the level of the oil in reservoir 72 since the pressure of the air in duct 66 is acting on both the upper surface of the oil in reservoir 72 and the lower surface of the oil in channel 42. The oil in reservoir 72 is maintained at a level so that the level of the oil in channel 42 is below the upper surface of the ring 54. Thus, the oil in channel 42 does not interfere with the flow of pressurized air or pressurized air having an aerosolized lubricant which is being conveyed to the socket 26 by the ports 44.

The provision of the vacuum channel 94 minimizes the creation of airborne dust. The suction within the vacuum channel 94 is not sufficiently great as to interfere with the lubrication of the lower punches 24, but it is sufficiently great to remove the powder fines blown from the tip portion of the lower punches 24 by the air issuing from the lateral ports 46. Such powder fines may be removed by filter 99 within the exhaust duct 96. Any oil recovered from the aerosolized lubricant spray introduced into socket 26 and withdrawn from the socket 26 26 by the suction of the vacuum pump 98 is blown away since the oil is dispersed within the air stream. The air removed from socket 26 by the vacuum pump 98 is discharged into the atmosphere through the exhaust port of the vacuum pump 98.

The air blast from the lateral port 46 prevents the flow of powder fines into the radial clearance between the lower punches 24 and their lower punch sockets 26, and accordingly eliminates the binding heretofore encountered from this cause. Furthermore, the discharge of oil onto the lower punches 24 from the lateral ports 46 provides a most efficient type of lubrication for the lower punches 24.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

1. In a tablet making machine including a rotary head, upper and lower punches carried within respective sockets in vertical alignment with dies in said rotary head, and means for introducing a pressurized fluid into each of the sockets for the lower punches just below each die comprising a separate port in said rotary head adjacent each of the sockets for the lower punches which discharges into its associated lower punch socket.
2. In a tablet making machine including a rotary head, upper and lower punches carried within respective sockets in vertical alignment with dies in said rotary head, and means for introducing both a pressurized gas and a lubricant into each of the sockets for the lower punches just below each die.

3. In a tablet making machine as set forth in claim 2 wherein said means includes a passage in said rotary head, and conduit means connected to said passage for injecting said lubricant into said passage in response to flow of pressurized gas therethrough.

4. In a tablet making machine including a rotary head, upper and lower shouldered punches carried within respective sockets in vertical alignment with dies in said rotary head, a separate port in said rotary head adjacent each of the sockets for the lower punches, with each of said ports discharging into the upper portion of its associated lower punch socket at a point which is blocked by a shank of the lower punch received within such socket at one stage of the tablet making cycle and which is above a tip shoulder intermediate the ends of the lower punch at another stage of the tablet making cycle.

5. In a tablet making machine including a rotary head, upper and lower punches carried within respective sockets in vertical alignment with dies in said rotary head, means for introducing a fluid into each of the sockets for the lower punches comprising a separate port in said rotary head adjacent each of the sockets for the lower punches which discharges into its associated lower punch socket below each die, and means for exhausting such fluid from the tablet making machine in communication with each of the sockets for the lower punches.

6. In a tablet making machine including a rotary head, upper and lower shouldered punches carried within respective sockets in vertical alignment with dies in said rotary head, a separate port in said rotary head adjacent each of the sockets for the lower punches, with each of said ports discharging into the upper portion of its associated lower punch socket at a point which is blocked by the shank of the lower punch received within such socket at one stage of the tablet making cycle and which is above the tip shoulder of the lower punch at another stage of the tablet making cycle, and means for introducing both a pressurized gas and an aerosolized lubricant into each of said ports.

7. In a tablet making machine including a rotary head, upper and lower punches having a shank and a die entering portion carried within respective sockets in vertical alignment with dies in said rotary head, a separate port in said rotary head adjacent each of the sockets for the lower punches, with each of said ports discharging into the upper portion of its associated lower punch socket at a point which is blocked by the shank of the lower punch received within such socket at one stage of the tablet making cycle and which is above the shank of the lower punch at another stage of the tablet making cycle, means for introducing both a pressurized gas and a lubricant spray in communication with each of said ports, and means for exhausting gas from the tablet making machine in communication with each of the sockets for the lower punches.

8. In a tablet making machine including a fixed frame, a rotary head disposed above said fixed frame, upper and lower punches carried within sockets in vertical alignment with dies in said rotary head, an annular channel means in the bottom portion of said rotary head, sealing means on the upper surface of said fixed frame providing a fluid-tight floor for said annular channel means, a separate port in said rotary head adjacent each of the sockets for the lower punches, with each of said ports being in communication with its associated lower punch socket and with said annular channel means.

9. In a tablet making machine in accordance with claim 8 wherein said annular channel means and said sealing means are concentrically positioned relative to said rotary head.

10. In a tablet making machine in accordance with claim 8 which includes means for introducing a fluid through said frame into said annular channel.

11. In a tablet making machine in accordance with claim 10 which includes separate means for introducing a pressurized gas and a liquid lubricant into said annular channel with the level of liquid lubricant being below the point at which the gas is introduced into said channel, with each of said separate means extending through the fixed frame.

12. In a tablet making machine in accordance with claim 10 which includes means for exhausting the fluid introduced into the annular channel in communication with each of the sockets for the lower punches.

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