Aug. 1, 1944. E. T. MEAKIN 2,354,924

EXTRUSION MILL

Filed Jan. 15, 1941

Fig. 1.

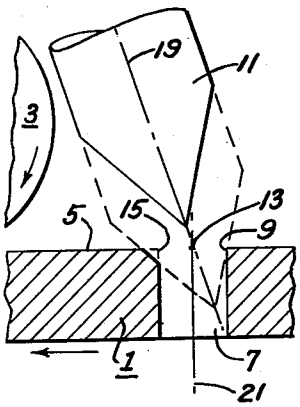


Fig. 2.

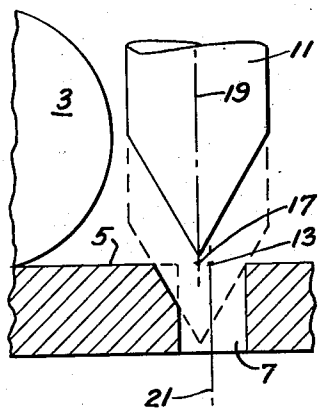


Fig. 3.

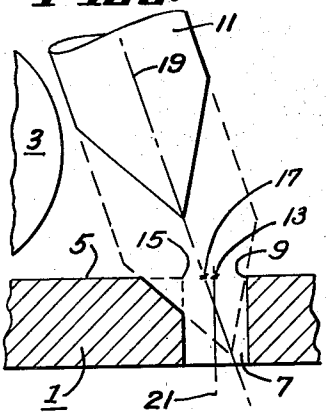


Fig. 4.

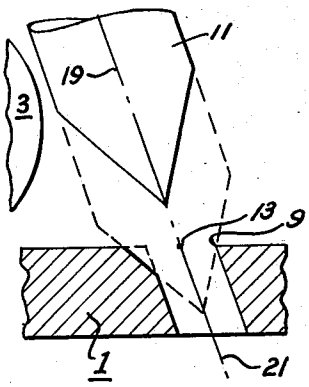


Fig. 5.

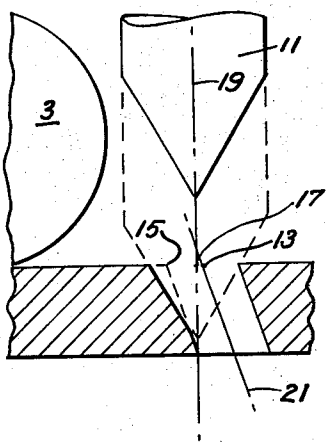


Fig. 6.

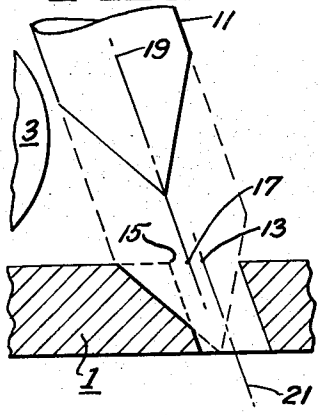
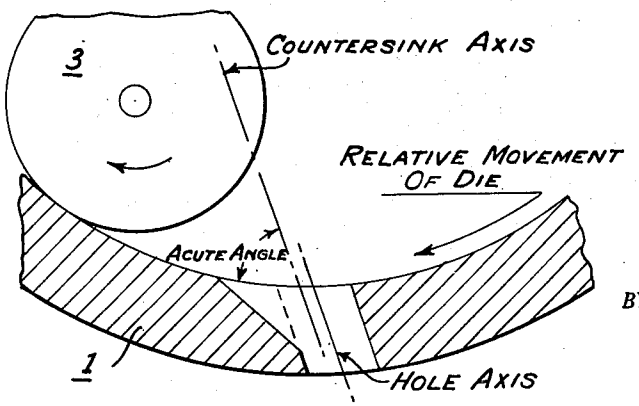


Fig. 7.



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UNITED STATES PATENT OFFICE

2,354,924

EXTRUSION MILL

Edgar T. Meakin, San Francisco, Calif.

Application January 15, 1941, Serial No. 374,447

4 Claims. (Cl. 76—107)

My invention relates to extrusion mills, and more particularly to a die structure for use in such mills.

The extrusion mill to which my invention in particular pertains, is of that type employed for the consolidation of meal, mashes, chemicals and the like, into pellet form. Such mill includes as its main components, a die 1 and an extrusion element such as a roller 3, operatively associated therewith. The material to be consolidated is introduced upon the compression surface 5 of the die, and upon initiating relative movement between the die 1 and the extrusion element 3, the material is forced through die apertures or holes 7, to emerge in the form of strings or rods of consolidated material from which the pellets are formed by severance.

It has been the general practice in the past to manufacture the dies with the die holes normal to the compression surface of the die, and in some cases, to bevel or countersink the compression end of such holes to facilitate entrance of material therein. A countersink tool preferably employed, is one tapered to an angle of about 60°. It has been found possible to increase the capacity of a die of this type by slanting the die holes, preferably to an angle of the order of 18° to the perpendicular, in accordance with the disclosure of the patent to Edgar N. Meakin, No. 2,171,039, of August 29, 1939. The die holes of this patent, accordingly, also lie at an acute angle to the compression surface of the die. In either of the above types, where countersinking has been employed, the countersink has been formed in the natural and customary manner by applying the countersinking tool centrally of the compression end of the die hole, and countersinking normal to the die surface. The effect of this is to produce a bevel around the entire periphery of the compression end of the die hole.

Among the objects of my invention are—

(1) To increase the normal output of extrusion mills,

(2) To increase the output of extrusion mills through a slight modification of the die structure thereof and without necessitating the addition of extra parts to the mill structure,

(3) To provide an improved die which will require less power in the extrusion of material therethrough, and thus bring about an increase in the output of the mill, and

(4) To provide an improved method of forming a die to increase its efficiency by reducing its resistance to extrusion of material therethrough.

Additional objects of my invention will be brought out in the following description of the same taken in conjunction with the accompanying drawing wherein—

Figures 1, 2 and 3 illustrate three embodiments of my invention as applied to die holes which are normal to the compression surface of the die,

Figures 4, 5 and 6 illustrate corresponding embodiments as applied to dies incorporating slanting holes, and

Figure 7 is a fragmentary view of a cylindrical die and associated roller, incorporating holes of the type depicted in Figure 6 and bearing descriptive legends.

I have discovered that die holes formed with a countersink in accordance with prior art practice, have certain limiting characteristics in the matter of extruding material therethrough, and this I attribute to the existence of the slope formed at the trailing edge 9 of the compression end of the die hole. As I analyze what takes place during a compression cycle, a good percentage of the material which should be passing through the die hole is permitted to slide out of the die hole by way of the sloping trailing edge of the countersink, during the early approach of the die hole toward the extrusion member in the compression cycle. This represents a waste of energy which produces no useful result in so far as extruding material through the die hole is involved, and serves to cut down the efficiency of the die.

Another factor which I believe is involved, takes effect as the die hole approaches closer to the extrusion member, because when the sloping trailing edge presents a surface normal to the compression force of the extrusion roller, which it must do at some point in the compression cycle, the material will be compacted against this same sloping surface of the countersink, which is equivalent to pre-compaction and serves no useful purpose in extruding the material through the die hole. Following its pre-compaction in this manner, the material, in its compacted condition, must then be caused to change its direction of movement as the die hole approaches closer to the extrusion roller, all of which represents wasted energy, resulting in a further lowering of the efficiency of the die member.

I have found that, without changing the countersink tool, the efficiency of a die may be increased to a surprising degree by so countersinking the die holes as to leave no appreciable slope at the trailing edge 9 of the compression end of the die hole. One way of accomplishing this, as depicted in Figures 1 and 4, is to cause the countersinking tool 11 to approach the die hole 7

toward the center 13 of the compression end thereof in a direction against the intended relative movement of the die at an acute angle to the compression surface 5 of the die. This will enable the tool to countersink the leading edge 15 of the entrance to the hole, without engaging the trailing edge 9, though, in practice, I prefer to countersink to the point where the tool will just about take the sharpness off the trailing edge. This is done primarily as a precaution against chipping, particularly in the event some hard foreign material should accidentally find its way into the mill.

Another manner of accomplishing this result depicted in Figures 2 and 5, is to locate the center 17 of countersink eccentric with respect to the center 13 of the die opening in the compression surface of the die, and in the direction of intended relative movement of the die member. By thusly locating the center of countersink, the tool 11 may be operated in a direction normal to the compression surface 5 of the die, and a substantial countersinking of the hole may be obtained before the countersinking tool reaches the trailing edge 9 of the die hole. This method is preferred for use with holes which are normal to the compression surface of the die, as in Figure 2, in which case, the axis 19 of countersink will be parallel to the axis 21 of the die hole.

As for dies in which the holes slant with respect to the compression surface, I prefer a combination of the methods just discussed, that is, to locate the center 17 of the countersink eccentric to the center 13 of the compression end of the die hole, and in the direction of the intended relative movement of the die, and then cause the tool 11 to approach the compression surface 5 at an acute angle to the compression surface, as depicted in Figure 6. The acute angle is preferably the same as that which the hole proper makes with the compression surface, in which case, the axis 19 of countersink will parallel that of the hole. Thus, in both preferred forms, the same parallel relationship will exist between the hole axis 21 and the countersink axis 19.

The offset center 17 and angular approach depicted in Figure 6 can also be applied to holes which are normal to the compression surface. This is illustrated in Figure 3, though this is not the preferred way of countersinking holes of this character.

In each of the above cases, I prefer to smooth off the sharpness of the trailing edge 9 of the compression end of each hole for the purpose previously indicated. Such smoothing off of the edge in question is not to be considered as essential to the improved countersink of my invention and the method of forming the same.

When the die hole is constructed in accordance with any of the above methods, leaving the trailing edge 9 of the compression end of the hole substantially free of any bevel or slope, practically none of the material which enters the countersink can be forced out over the trailing edge during the compression cycle, and must, therefore, enter into the hole proper, to which it was initially directed.

At the same time, my improved method of countersinking has the effect of streamlining the countersink, thereby enabling the material to be guided into the die hole proper with less resistance to its movement and, accordingly, less pre-compaction.

The application of my invention to holes of the slanting type, such as disclosed in the aforementioned Meakin patent, has brought about surprising results, as compared to the output obtained from a similar die in which the countersinks were formed in the customary manner, that is, normal to the compression surface of the die, as illustrated in the drawings in the aforementioned Meakin patent. Whereas, with a die constructed in accordance with this Meakin patent, I have been able to obtain an output of the order of 17 bags per hour; with a corresponding die countersunk in accordance with my present invention, I have been able to increase the output of the same mill to from 50 to 60 bags per hour, representing an increase of the order of 300%–350%, accompanied by a very material decrease in power consumption.

My invention is not limited to die holes of circular cross section, but is applicable to holes of any cross-sectional configuration and regardless of whether the countersinking is to be accomplished with a conical countersink tool or by beveling the edges of the hole.

While I have disclosed my invention in detail, the same is subject to variation and modification, without departing from the principles thereof, and I accordingly do not desire to be limited in my protection to the details set forth, except as may be required by the prior art and the appended claims.

I claim:

1. The method of forming a die hole in a die comprising a compression surface for use in an extrusion mill, wherein there is relative movement between said die and an extrusion element cooperatively disposed with respect to the compression surface of said die, the extreme limits of the hole in the direction of movement of the element being defined by a leading edge and trailing edge respectively, comprising, forming a hole through said die, countersinking the material bounding said hole by rotating a tool provided with a cutting edge about an axis eccentric of the axis of the hole, said tool having a radius greater than the radius of the hole and the locus of the cutting edge of the tool is substantially tangential to the mid-portion of the trailing edge of the hole, whereby the material adjacent the mid-portion of the trailing edge is removed.

2. A method according to claim 1, wherein the axis of the tool is parallel to the axis of the die hole.

3. A method according to claim 1, wherein the axis of the tool intersects the axis of the die hole.

4. A die for a pellet mill wherein an extrusion element is caused to move over a die, said die comprising a compression surface and having an extruding hole therethrough, the material of said die defining the end of said hole adjacent the compression surface terminating in a countersink, said countersink substantially encompassing the hole and being tangential to the hole at only the trailing edge thereof.

EDGAR T. MEAKIN.