

June 13, 1967

A. F. BAUER
DIE CASTING APPARATUS WITH WEDGE LOCKING BLOCKS
AND RECTANGULAR GUIDE MEMBERS

3,324,936

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2 Sheets-Sheet 1

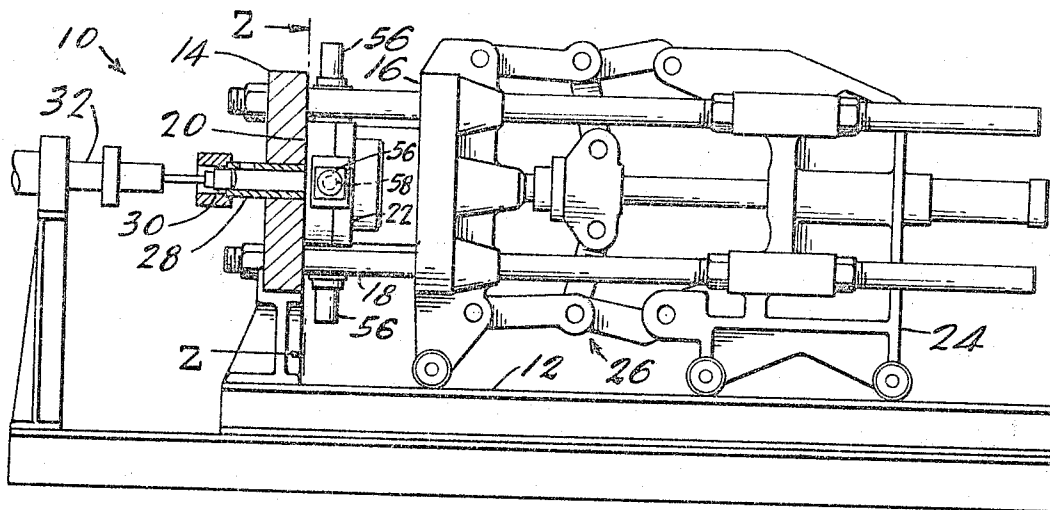


FIG-1-

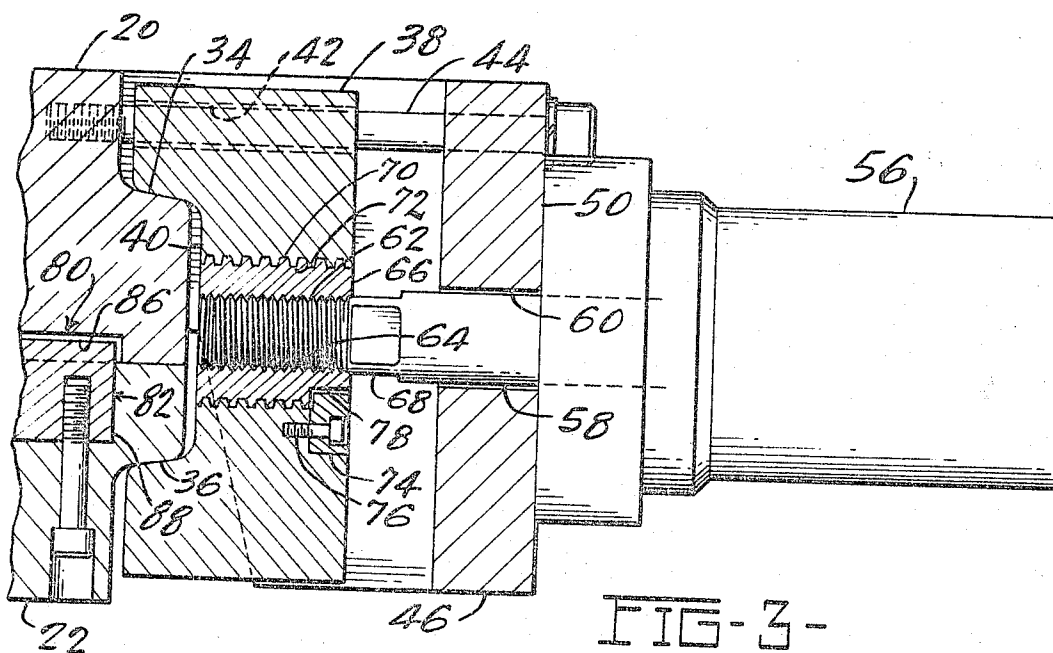


FIG-3-

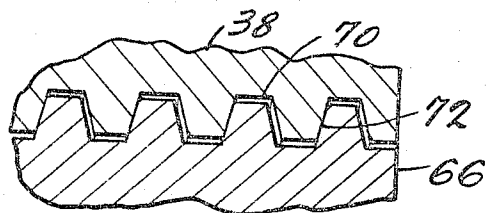


FIG-4-

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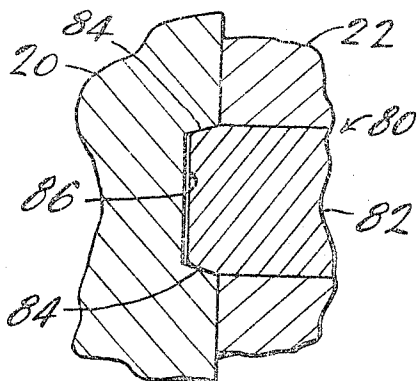
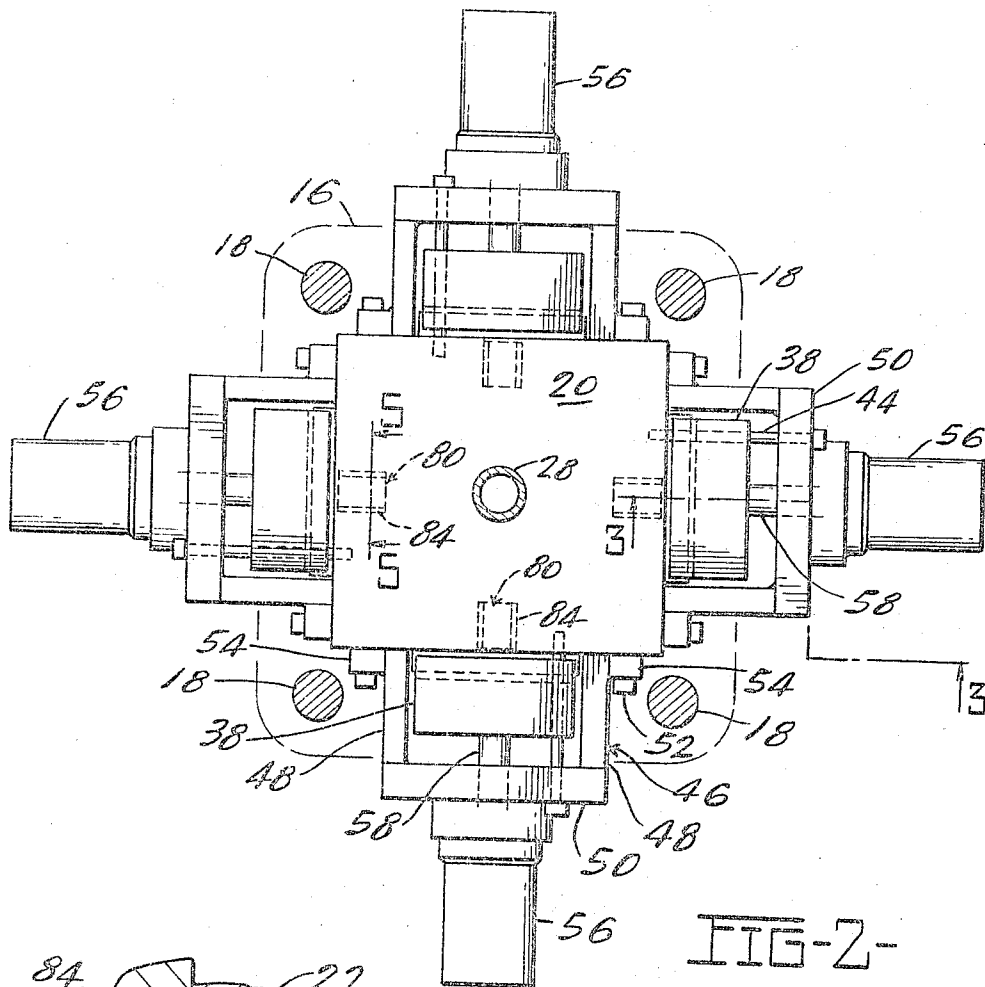


FIG-5-

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3,324,936

**DIE CASTING APPARATUS WITH WEDGE
LOCKING BLOCKS AND RECTANGULAR
GUIDE MEMBERS**

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6 Claims. (Cl. 164—314)

This invention relates to die casting apparatus and particularly to apparatus for die casting large bodies.

The apparatus according to the invention has been specifically developed for die casting large airfield mats. Mats of this type are used principally by the military to lay down runways rapidly and establish bases for fighters and bombers. Heretofore, the mats have been made of either expanded metal or plywood and other materials which have been fairly satisfactory but lacking as high a strength-to-weight ratio as is desirable. The mats must be very strong to withstand the tremendous forces often involved in the landing of heavy aircraft. They also must be light in weight because a tremendous number of mats are needed to make up a runway and, therefore, weight is important from a shipping, handling, and economic standpoint. For example, in one runway, 27,000 mats measuring 48" by 48" are required.

It has been found that metal mats of honeycomb design have especially favorable strength-to-weight ratio when die-cast. The mats can be made advantageously of two complementary plates or parts measuring approximately 48" by 24" which are then welded together. Even the smaller plates, however, are much larger than any heretofore die-cast.

The large castings pose several problems not encountered in small die castings. In particular, the large castings require very high die locking pressures. The locking pressures may be as high as 4500 tons, whereas the largest die casting machine now conveniently available produces a locking pressure of only 2500 tons. It has been found, however, that a die casting machine capable of producing a locking pressure of 2500 tons can be made to achieve a locking pressure of 4500 tons by the use of a wedge lock which will be discussed subsequently. While wedge locks have been known heretofore, the wedge locks of the invention are mounted uniquely for freely floating movement whereby they are self-centering and will seat on the die halves in an improved manner.

Another problem arising from large die castings is in the maintenance of close tolerances. In the casting of airfield mats of honeycomb design having nominal wall thicknesses of 0.080", a misalignment of the die halves of 0.005" may be excessive since it can result in an excessive variation in strength of the mats. Dies heretofore used have employed mating centering pins or guides of the type shown in United States Patent 2,912,730, for example. These guides have long, slightly tapered surfaces which are capable of producing accurate centering. I have found, however, that the centering surfaces tend to wear as they are moved into and out of engagement with the corresponding recesses in the opposite die halves. Consequently, it is possible for the wear on the long centering guides to reach 0.005" or more in a relatively few operations and thereby to cause tolerances to be exceeded relatively rapidly.

The new die guides of the present invention comprise relatively few operations and thereby to cause tolerances to be exceeded relatively rapidly.

The new die guides of the present invention comprise relatively sharply tapered, stubby centering guides with extremely close fits which enable precise tolerances to be attained and maintained. The new centering guides are

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only from 10% to 20% as long as those previously employed and from included angles of 10°–20°, and preferably 15°, compared with an angle of approximately 5° or less for those guides heretofore used. The tapered surfaces on the new guides are on only two opposed sides thereof with the other opposed surfaces being parallel. Consequently, each coating centering guide and recess serve to position the die halves in one direction only. Positioning in the other direction is accomplished by additional centering guides which are perpendicular to the first.

It is, therefore, a principal object of the invention to provide improved die casting apparatus for producing large die-cast bodies.

Another object of the invention is to provide die casting apparatus incorporating floating wedge locks to lock the die halves together.

Still another object of the invention is to provide improved die casting apparatus employing short, sharply tapered centering guides which provide more accurate positioning of the die halves with less wear than heretofore.

Other objects and advantages of the invention will be apparent from the following detailed description of a preferred embodiment thereof, reference being made to the accompanying drawing, in which:

FIG. 1 is a somewhat schematic view in elevation, with parts broken away and with parts in cross section, of overall die casting apparatus embodying the invention;

FIG. 2 is a greatly enlarged view in cross section taken along the line 2—2 of FIG. 1;

FIG. 3 is a further enlarged view in cross section taken along the line 3—3 of FIG. 2;

FIG. 4 is a greatly enlarged, fragmentary view in cross section of a threaded connection shown in FIG. 3; and

FIG. 5 is a fragmentary view in cross section on a still further enlarged scale taken along the line 5—5 of FIG. 2.

Referring to the drawings, and more particularly to FIG. 1, a die casting machine is indicated by the reference numeral 10 and includes rails 12 which support a stationary front plate 14 and a movable rear plate 16. Four tie bars 18 are supported in part by the front plate 14 and extend through the rear plate 16 to serve as guides therefor. The front plate 14 also supports a cover die 20 while the rear plate 16 supports an ejector die 22. The ejector die 22 forms a die cavity with the cover die 20 when moved into registry therewith by means of a crab 24 and suitable linkage indicated at 26, as is known in the art. When the die halves 20 and 22 are in register, metal is forced into the die cavity from a shot sleeve 28 by a shot plunger 30 operated by a hydraulic ram 32, as is well known in the art.

The cover die 20 and the ejector die 22 have pairs of wedges 34 and 36 extending along central portions of the edges thereof, which are clamped together by a wedge locking block 38 having a longitudinally extending recess or groove 40 which is slightly smaller than the thickness of the combined wedges 34 and 36 in order to clamp them tightly together when moved toward the die halves 20 and 22. For this purpose, the angular surfaces of the wedges 34 and 36 as well as the sides of the recess 40 form included angles of 12°–18° and preferably 15°. If the angle is 10°, the surfaces tend to gall and stick, while if the angle is as much as 20°, an excessive force against the wedge locking block 38 is required to provide sufficient locking of the die halves. The angular surfaces of the wedges 34 and 36 are also such that if they were extended, the line of intersection would be parallel to the faces of the dies. The depth of the recess 40 exceeds the width of the wedges 34 and 36 so that they cannot bottom in the recess.

The block 38 has a guide passage 42 extending there-through which freely receives a guide rod or bolt 44

threaded into the cover die 20. The passage 42 and the bolt 44 thereby freely guide the block 38 as it is moved toward and away from the cover die 20 and the ejector die 22. The bolt 44 passes through a generally U-shaped bracket 46 which includes legs 48 extending alongside the block 38 and connected by a heavy web 50. The bracket 48 is affixed at each side to the cover die 20 by bolts 52 extending through flanges 54.

A locking ram 56 which can be hydraulically or pneumatically operated, constitutes a satisfactory drive means for the locking block 38 to move it toward and away from the die halves 20 and 22. A piston rod 58 of the ram 56 extends through an opening 60 in the bracket web 50 and is connected to the locking block 38 by a shank 62 threaded into a tapped hole 64 of a threaded bushing 66. The piston rod 58 also has a square intermediate portion 68 which can be engaged by a wrench, for example, to enable the rod 58 to be adjusted relative to the threaded bushing 66 so as to adjust the initial position of the locking block 38 relative to the actuating rod 58. The threaded bushing 66, in turn, is engaged with the locking block 38 by Acme threads 70 which have a substantial predetermined clearance with mating threads in a threaded hole 72 in the block 38. The bushing 66 is held against turning in the block 38 by a bar 74 which is recessed in the block 38 and held in by a suitable machine screw 76, with the bar 74 cooperating with a notch 78 in the bushing 66. The major and minor diameters of the threads 70 of the bushing 66 are designed to be substantially less, by 0.020", for example, than the corresponding diameters of the threads with which they engage (FIG. 4). With this arrangement, the locking block 38 can make random movements relative to the bushing 66, which movements are also made possible, in part, by the free fit between the passage 42 and the bolt 44. The locking block 38 can thereby seek its own center relative to the wedges 34 and 36 and a uniform locking force will be imparted to both of the wedges even if they should not be symmetrical with respect to the axis of the locking ram 56. The floating action of the locking block 38 also minimizes the possibility that the cover and ejector dies 20 and 22 will be moved out of their aligned positions by the force of the ram 56. This is particularly important when the locks are used on all four sides of the die halves 20 and 22. While the Acme threads 70 of the bushing 66 loosely fit with the threaded passage 72 of the block 38, the flanks of the threads provide substantial thrust surfaces by means of which the wedging force of the locking ram 56 can be imparted to the block 38.

With the wedge locking arrangement, very high locking forces can be obtained with machines of lesser capacity. For example, in the die casting of the large airfield mats which have been used as an example of an extended surface casting, a locking pressure of 4500 tons can be achieved with a machine normally capable of a locking pressure only of 2500 tons, and the locking force is so applied that the danger of die distortion is eliminated.

Close matching of the die halves 20 and 22 is required when they are moved into registry, particularly because the walls of the casting, such as the honeycomb mats, must be of uniform thickness. Close tolerances are particularly difficult to achieve with large casting cavities such as are incorporated in the die halves 20 and 22. However, effective positioning of the die halves has been found to be possible with four centering devices 80, indicated in dotted lines in FIG. 2, and shown in cross section in FIGS. 3 and 5. The centering devices 80 are preferably uniformly peripherally positioned at the edges of the die halves. The devices 80 each include a rectangular guide member 82 having sharply tapered longitudinal surfaces 84 (FIG. 5) at the edges of the guides 82 which are perpendicular to the adjacent peripheral edges of the ejector die 22. The surfaces 84 of the guides 82 cooperate in a close and preferably force fit with the side edges of a recess 86 of similar shape in the cover 20, with the depth

of the recess 86 slightly exceeding the distance from the end of the guide to the intersections of the surfaces 84 with the sides of the guide. The angular surfaces 84 and the edges of the recess 86 taper at an angle from approximately 10° to approximately 20° and preferably about 15°. With this angle, the surfaces cannot seize and gall or wear nearly as rapidly as when a very shallow angle, or even parallel, surfaces are employed. By reason of the force fit between the moving and stationary parts the centering guides 82 and recesses 86 position the die halves 20 and 22 very accurately in a direction transverse to the longitudinal extent of the guide members 82. However, the end walls 88 (FIG. 3) of the guides 82 are spaced slightly from the ends of the recesses 86 so that the guides 82 are capable of centering only in one direction. For centering in the other direction, the guides 82 along the adjacent edges of the die halves are disposed in mutually perpendicular directions so that a plane intersecting the included angle of the surfaces 84 of one of the guides will be perpendicular to similar planes of adjacent guides.

From the above, it will be seen that the die casting apparatus according to the invention is extremely effective for large castings and particularly for those castings requiring very close tolerances. The new apparatus provides both effective and secure locking and at the same time enables die halves to be positioning in accurate alignment so that the desirable tolerances can be maintained. The centering guides provide accurate positioning in the first place and the freely-floating locking blocks then provide the desired locking action without tending to move the die halves out of position or placing any strain on the centering guides.

Various modifications of the above described embodiment of the invention will be apparent to those skilled in the art, and it is to be understood that such modifications can be made without departing from the scope of the invention, if they are within the spirit and the tenor of the accompanying claims.

What I claim is:

1. Apparatus for die casting large pieces comprising a cover die, an ejector die, said ejector die having four centering guide members uniformly peripherally spaced thereon, each guide member being of generally rectangular configuration with opposed edges which are perpendicular to the adjacent die edge, said opposed edges having slanted surfaces forming an included angle of 10°-20°, with a plane bisecting each included angle of the surfaces being perpendicular to similar planes of adjacent guide members, said cover die having recesses corresponding in size, shape and location to said edge portions of said guide members, the depths of said recesses slightly exceeding the distance from the ends of the guide members to the junctions of the slanted surfaces and the sides of said guide members, said cover and ejector dies having pairs of locking wedge surfaces formed on the peripheries thereof with opposed lock surfaces tapering toward one another and forming an included angle of 12°-18°, the planes of said lock surfaces, if extended, intersecting along lines parallel to the faces of said dies, a wedge locking block for each pair of locking wedge surfaces having a recess with sides forming an included angle substantially equal to that of the locking surfaces and having a depth exceeding the depth of the wedge surfaces to prevent the wedges from engaging the bottom of said recess, each of said blocks having a passage therethrough, a fluid-operated ram including a piston rod for each of said wedge locking blocks, means connecting said rods to said wedge locking blocks for free rotational movement to enable said blocks to pivot and move transversely on said piston rods with respect to said wedging surfaces, and a guide rod cooperating with each of said block passages to guide each of said blocks toward and away from the corresponding pair of locking wedges, said guide rod and said passage having a loose fit to enable the locking block to

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move relative to the guide rod and to seek its own fitting position on said locking surfaces.

2. Apparatus according to claim 1 wherein said connecting means for said rod and said locking block comprises an Acme thread on the end of said rod, a hole in said block having an Acme thread therein with the Acme thread of said rod being of substantially smaller diameter than the Acme thread of said hole to enable said block to achieve the desired movement with respect to said rod.

3. Apparatus according to claim 2 wherein said connecting means is characterized by said block hole being formed in a threaded bushing which, in turn, is threadedly engaged with said block.

4. Apparatus for die casting large pieces comprising a cover die, an ejector die, one of said dies having centering guide members peripherally spaced thereon, each guide member being of generally rectangular configuration with two opposed edges having slanted surfaces with a plane bisecting the included angle of the slanted surfaces being perpendicular to similar planes of adjacent guide members, the other of said dies having recesses corresponding in size, shape, and location to end portions of said guide members, said dies having pairs of locking guide surfaces symmetrically spaced on the peripheries thereof with opposed lock surfaces tapering toward one another, said lock surfaces, if extended, intersecting along lines parallel to the faces of said dies, a wedge locking block for each pair of locking wedge surfaces having a recess with sides forming an included angle substantially equal to that of the locking surfaces and having a depth exceeding the depth of the locking surfaces to prevent said surfaces from engaging the bottom of said locking block recess, each of said blocks having a passage therethrough, drive means connected to said locking blocks to force said blocks into locking engagement with said wedge surfaces, the connection between said drive means and block being arranged for limited relative movement and to enable said blocks to pivot and move transversely with respect to said driving means, and a guide rod cooperating with each of said passages to guide each of said blocks toward and away from the corresponding pair of locking wedge surfaces, said guide rod and said passage having a free fit to enable the block to move relative to the guide means.

5. Apparatus for die casting large pieces comprising a cover die, an ejector die, said cover and ejector dies having at least one pair of locking wedge surfaces formed on the peripheries thereof with opposed lock surfaces tapering toward one another and forming an included angle of 12°-18°, the planes of said lock surfaces, if extended, intersecting along lines parallel to the faces of said dies, a

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wedge locking block for each pair of locking wedge surfaces having a recess with sides forming an included angle substantially equal to that of the locking surfaces and having a depth exceeding the depth of the wedge surfaces to prevent the wedges from engaging the bottom of said recess, each of said blocks having a passage there through, a fluid-operated ram including a piston rod for each of said wedge locking blocks, means connecting said rods to said wedge locking blocks for free rotational movement to enable said blocks to pivot and move transversely on said piston rods with respect to said wedging surfaces, and a guide rod cooperating with each of said block passages to guide each of said blocks toward and away from the corresponding pair of locking wedges, said guide rod and said passage having a loose fit to enable the locking block to move relative to the guide rod and to seek its own fitting position on said locking surfaces.

6. Apparatus for die casting large pieces comprising a cover die, an ejector die, said dies having pairs of locking wedge surfaces symmetrically spaced on the peripheries thereof with opposed lock surfaces tapering toward one another, said lock surfaces, if extended, intersecting along lines parallel to the faces of said dies, a wedge locking block for each pair of locking wedge surfaces having a recess with sides forming an included angle substantially equal to that of the locking surfaces and having a depth exceeding the depth of the locking surfaces to prevent said surfaces from engaging the bottom of said locking block recess, each of said blocks having a passage therethrough, drive means connected to said locking blocks to force said blocks into locking engagement with said wedge surfaces, the connection between said drive means and block being arranged for limited relative movement and to enable said blocks to pivot and move transversely with respect to said driving means, and a guide rod cooperating with each of said passages to guide each of said blocks toward and away from the corresponding pair of locking wedge surfaces, said guide rod and said passage having a free fit to enable the block to move relative to the guide means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,324,936

June 13, 1967

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It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 66, beginning with "The new die" strike out all to and including "relatively rapidly." in line 68, same column 1.

Signed and sealed this 26th day of December 1967.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents