Combination die and die support structures.

The task of securing dies (26, 36) of a die set (24) to appropriate supports (15, 16) such as for example, the die shoes of a set of die shoes or to upper and lower platens (12) of a punch press so that the dies are in precise alignment can be simplified by utilising expandable diameter fasteners (48, 50) to secure the dies to the supports. Each fastener used is located within a hole (44) extending through one of the dies and within an aligned hole (46) in the adjacent support. The fasteners used are of such a character as to be capable of firmly securing the dies and the supports even if such holes of a set of such holes are of not precisely the same diameter. Preferably each die is secured in place utilising at least two of such fasteners.
COMBINATION DIE AND DIE SUPPORT STRUCTURES.

The invention set forth in this specification pertains to the combination of a set of dies and a set of support structures serving to hold such dies so that they may be utilised. More specifically the present invention pertains to a new and improved manner of mounting or connecting such dies in such support structures so that they are in precise alignment.

Because of the fact that many mechanical terms are utilised by different individuals in somewhat different manners it is considered that an understanding of the present invention is best predicted upon a discussion of the meanings of the terms utilised in connection with it. The principal of these terms is the word "die".

This word is related to the expression "die shoes", "die sets", "die sections" and "die plates".

As used herein the word "die" is intended to designate a tool or mould which is employed in connection with the manufacturing operation to either impart shape to or to create an impression within a specific material. On many occasions such as, for example, in vacuum forming, in forming utilising hydraulic pressure or in explosive forming, a single die is normally utilised. The present invention is not concerned with the use of such a single die.

Instead it is concerned with the use of a set of dies which are used together. Normally such a set will consist of two dies but in some comparatively rare circumstances may consist of more than two dies which
are utilised together. Such a set of dies is commonly utilised in forming various types of metal parts or in embossing such parts. Such a set may also be utilised in moulding or otherwise forming various different types of thermoplastic and thermosetting polymer compositions or even in forming various types of inorganic compositions.

The dies of a set of dies as indicated in the preceding may be separately mounted upon different supports of a set of supports forming a part of or mounted on an appropriate piece of equipment constructed so that either one of the dies is capable of being moved towards the other or so that both of the dies can be concurrently moved towards one another. The latter is particularly prevalent in connection with inorganic type compositions such as are utilised in forming parts from metal powders. Most commonly such supports are referred to as "platens". On occasion they are also referred to as plates, movable members and the like. On occasion one support of a set of such supports will be referred to as an "anvil" while the other will be referred to as a "ram" or "hammer".

On occasion the term "die set" is utilised to designate two plates or similar holding structures connected by alignment rods on one of these members fitting within guide bushings or sleeve like members on the other of the bearings. Such rods and bushings or bearings are intended to make sure that only linear relative movement can occur between the two plates used.
The dies or the operative forming parts of die sets are normally mounted on such plates so as to be moved as they are moved. These plates or similar structures are commonly referred to as "die shoes" because of the function they serve. Normally, the die shoes of such a set will be mounted on supports, such as platens, which are also connected by a guide means or other mechanisms assuring that only linear movement can take place as one support is moved toward the other or as both supports are moved toward one another.

The expression "die set" is also utilised to designate elements which are mounted upon such die shoes. Commonly such elements include a sub-plate or a retainer plate positioned directly against a die shoe and a die plate or a die section located directly upon such a sub- or retainer plate. On occasion such a sub- or retainer plate is omitted. Normally, one of the die sections or plates used in such a die set is referred to as a male die while the other is referred to as a female die. This is the case even though each die plate may have one or more elements both capable of fitting into a cavity within the other die plate or of receiving an element on the other die plate. On occasion such die sections or plates may be mounted directly upon supports as noted in the preceding. The expression "die set" is sometimes utilised to designate a composite structure including platens and/or die shoes, sub-plates and die sections or die plates. As used in this specification the same expression "die sets" is not intended to designate any such composite structure, but is intended to designate the actual elements which are normally mounted only on die shoes, or on occasion on platens or related
supports. This terminology is utilised since a set of die shoes is normally considered to be used for the purpose of supporting or holding the actual forming dies - the die sections or plates - even when such die shoes are attached or secured to platens, plates or other supporting structures.

The mounting of dies or die sections or plates upon die shoes, platens or other similar or related structures is quite important. Normally the dies of a set are constructed so that they must fit quite precisely relative to one another as either one die is moved towards the other or as both dies are moved toward one another. Normally, die sections or plates are constructed so that if there is even a very slight amount of misalignment between them damage will occur during such relative motion. As a consequence of this the mounting of die sections or plates is quite critical in many different specific type forming operations.

It is considered that the principal method of mounting a set of dies involves the use of quite accurately formed sets of holes of the identical diameters in both a die section or plate, any sub-plate or retaining plate used and any appropriate support, such as, for example, a platen or die shoe. Normally, an accurately formed pin is used in such aligned holes for the purpose of preventing shifting of the parts traversed by the pin so as to make sure that the die sections or plates are held so as to be aligned in an intended manner.

While this method of mounting a set of dies is quite utilitarian it suffers from several significant
problems. The holes and pins used are apt to wear after prolonged use and especially after frequent exchange of the dies on a set of die shoes or on platens or the like. Such wear, of course, permits misalignment of the dies of a set. Further, it is somewhat difficult and expensive to create aligned holes of exactly the same diameter in the parts connected by such pins. Because of the natures of such holes and pins reasonably trained, comparatively expensive personnel are normally used to change a set of dies in order to minimise the chances of misalignment.

As a result of these considerations it is considered that there is a need for improvement in connection with the mounting of a set of dies on die shoes or other supporting structures as briefly indicated in the preceding discussion. More specifically it is considered that there is a need for new and improved composite structures consisting of the combination of dies and supports for such dies. More specifically it is considered that there is a need to make it easier to manufacture such a combination and to replace or exchange the dies on such supports. The present invention is intended to provide structures as indicated so as to fulfill the needs discussed.

In accordance with this invention these and various related objectives of this invention are achieved by providing in the combination of a die set and of a set of supports for holding the dies of said die set, means for connecting each die of said die set to one of said supports and means for causing relative movement between said supports so as to result in relative movement
between said dies of said die set the improvement which comprises: each of said connecting means including a hole extending through the die with which it is associated and another aligned hole in the adjacent support upon which it is located, each of said connecting means also including an expandable diameter fastener means having a generally cylindrical shank capable of being manipulated so as to expand to different diameters at different points along its length fitting tightly within said aligned holes of the connecting means of which it forms a part.

For a better understanding of the invention, and to show more clearly how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Fig. 1 is a front elevation view showing the combination of a set of dies and a set of supports for such dies in accordance with this invention;

Fig. 2 is a side elevational view of the combination shown in Fig. 1;

Fig. 3 is a partial cross sectional view taken on line 3-3 of Fig. 1;

Fig. 4 is a partial cross sectional view taken on line 4-4 of Fig. 1;

Fig. 5 is a partial cross sectional view of one presently preferred form of an expandable fastener as
used in the combination illustrated in the preceding figures; and

Fig. 6 is a side elevational view of another presently preferred form of an expandable fastener as used in the combination illustrated in the preceding Figs. 1 to 4.

The structure shown in the drawings is primarily intended to illustrate a particular manner of utilising the concepts of the present invention. Those skilled in routine mechanics will have little difficulty in realising that these concepts may be utilised in a variety of differently appearing and somewhat differently described structures.

In the drawings there is shown a combination die and die support structure 10 of the present invention which, within the broad scope of the invention, includes two spaced, parallel platens 12. These platens 12 are adapted to be moved toward and away from one another as the complete combined die and die support structure 10 of the present invention is used. The precise means of moving such platens 12 will vary to a significant extent depending upon the nature of the machine (not shown) within which such platens 12 are used. For this reason no effort is made in this specification to specifically illustrate or describe any specific structure for moving these platens 12. These platens 12 are shown as being connected by a schematically illustrated conventional mechanism 14 which could be any known mechanism for this purpose.
These platens 12 are normally utilised with a set of die shoes consisting of two separate shoes 15 and 16. These shoes 15 and 16 are adapted to be mounted upon the platens 12 in any conventional manner such as, for example, through the use of conventional bolts 18 or other similar fasteners (not shown). One of the die shoes 15 carries upwardly extending alignment rods 20 which fit within guide bushings or sleeve bearings 22 carried by the other die shoe 16. These rods 20 and the bushings 22 connect the shoes 15 and 16 in such a manner that these shoes 15 and 16 can only be moved linearly with respect to one another as the platens 12 are moved in a corresponding manner.

These shoes 15 and 16 are adapted to support and carry a set 24 of the dies 26 and 36. One of these dies 26 includes a sub-plate 28 which primarily serves to support a die plate or section 30 on the platen 12 upon which it is located. These two plates 28 and 30 are normally attached to one another as, for example, by brazing or the like so as to serve as an integral unit. The die plate 30 may carry any desired number of projecting male elements 32 which are adapted to fit within corresponding cavities 34 in the second die 36. Because the presence of these elements 32 the die 26 may be referred to as a male die. Because of the presence of the cavities 34 this die 36 may be referred to as a female die.

On occasion the die 36 may also be referred to as an anvil because normally a lower die in a machine remains stationary in much the manner in which an anvil is used by a blacksmith as a piece of metal is formed over the anvil. The die 36 includes a sub-plate 38 corresponding
to the sub-plate 28 previously described and a die plate 40 corresponding to the previously described die plate 30. These plates 38 and 40 are adapted to be secured together so that they may be handled and used as an integral unit in any manner used to secure the plates 28 and 30 to one another.

The dies 26 and 36 are held in place relative to the platens 12 and the die shoes 15 and 16 through the use of connecting means 42. Each of these connecting means 42 includes a cylindrical hole 44 in a die 26 or 36 and an aligned cylindrical hole 46 in a die shoe 15 or 16. Each hole 44 and the adjacent hole 46 constitutes a set (not shown) of such holes. Preferably these holes 44 and 46 of each set of adjacent holes 44 and 46 are of approximately the same diameter. It is important to note that with the present invention these holes 44 and 46 need not be of exactly the same diameter.

The connecting means 42 associated with the die 26 and the adjacent shoe 15 also utilises a fastener 48 as indicated in Fig. 5 of the drawing. Each connecting means 42 associated with the die 36 and its adjacent die shoe 16 utilises a fastener 50 as indicated in Fig. 6 of the drawing. These fasteners 48 and 50 are preferably constructed in the manner indicated in U.S. Patent Specification No. 3192820, issued July 6, 1965 entitled "Quick Release Pin". Except as hereinafter indicated the fasteners 48 and 50 are substantially identical in construction. Prior to their use both of these fasteners 48 and 50 are of a generally cylindrical configuration.
Each of these fasteners 48 and 50 includes a centrally located support shaft or shank 52 having a bullet-like enlarged end 54 which is adapted to facilitate insertion of a fastener 48 or 50 into a hole such as the hole 44. A plurality of spaced collars 56 each having sloping outer walls 58 are located around the shank 52. These in turn are surrounded by split rings 60 having generally cylindrical exteriors 62 and interior sloping walls 64 which are adapted to be fit against the walls as shown. These walls 64 are adapted to coact with the walls 58 when the collars 56 are moved generally toward one another so as to expand the rings 60.

In the fastener 48 a flanged nut-like sleeve 66 is fitted around the shank 52 in such a manner that when a nut 68 threaded on the shank 52 is manipulated the sleeve 66 will apply pressure to the adjacent collar 56. This will, of course, apply pressure to the sleeve 66 so as to ultimately result in an outward expansion of the rings 60. The individual rings 60 will expand to varying extents so as to conform to the interiors of the holes 44 and 46. In the fastener 50 corresponding expansion is achieved by the manipulation of an elongated handle 70 mounted upon a cross shaft 72 threaded on the shank 52. This handle 70 carries lower cam surfaces which are adapted to press against a flanged collar 76 taking the place of the sleeve 66 so as to cause expansion as previously indicated.

Because of the fact the fasteners 48 and 50 can expand to different extents along their lengths so as to closely conform to variations in the internal diameters of the holes 44 and 46 these fasteners are capable of
compensating for minor variations in internal diameters in the holes 44 and 46 provided that the axes (not shown) of the holes 44 and 46 of any set of such holes 44 and 46 are aligned. This is considered to be quite important since it makes it possible to dispense with precisely dimensioned alignment pins as were previously used in conjunction with precisely dimensioned holes. The use of the fasteners 48 and 50 is important in other respects. These fasteners 48 and 50 serve as alignment and serve to hold and secure the dies 26 and 36 in place on the platens 12. Further, because of the nature of these fasteners 48 and 50 they may be easily and quickly manipulated so that individual dies 26 and 36 may be replaced or exchanged with minimal difficulty.

All of these factors are considered to be quite important and to contribute to the acceptability of the present invention. It is to be emphasised that various minor changes within the scope of routine skill may be made in connection with the invention. Thus, for example, it is possible to utilise identical fasteners such as either the fasteners 48 or 50 in mounting one or both dies of a set 24 in place. It is considered that when the two dies 26 and 36 are located one above another as shown that it is normally most convenient to mount the uppermost of the two dies utilising a fastener such as a fastener 48 which can be manipulated between a non-use and a use configuration through the use of a nut such as the nut 66 instead of a cam actuator of the type utilised in conjunction with a fastener 50.
1. The combination (10) of a die set (24) and of a set (15,16) of supports for holding the dies (26,36) of said die set, means (42) for connecting each die of said die sets to one of said supports and means (14) for causing relative movement between said supports so as to result in relative movement between said dies of said die sets characterised by: each of said connecting means including a hole (44) extending through the die with which it is associated and another aligned hole (46) in the adjacent support upon which it is located; and each of said connecting means also including an expandable diameter fastener (48,50) means having a generally cylindrical shank (52) capable of being manipulated so as to expand to different diameters at different points along its length fitting tightly within said aligned holes of the connecting means of which it forms a part.

2. The combination claimed in claim 1 characterised in that: at least two of said connecting means are used to hold each die of said die sets to one of said supports; and one of said dies is a male die and the other of said dies is a female die.

3. The combination claimed in claim 1 or 2 characterised in that: said set of supports comprises a set of die shoes (15,16); said die shoes including alignment means (20) permitting said die shoes to be moved linearly toward and away from one another; said means for causing relative movement comprises a set of platens (12) and means (14) for causing relative
movement between said platens; and one of said die shoes being attached to one of said platens and the other of said die shoes being attached to the other of said platens.

4. The combination claimed in claim 1, 2 or 3 characterised in that: each of said expandable diameter fastener means (48,50) is constructed so as to include a plurality of separate expansion rings (60) located in alignment with one another between the ends of said fastener means and means (68,66,56) for applying forces to said rings so as to expand said rings outwardly to a sufficient extent so as to bring them into contact with the internal walls within said holes.

5. The combination claimed in claim 1 characterised in that: at least two of said connecting means (42) are used to hold each die of said die sets to one of said supports; one of said dies is a male die and the other of said dies is a female die; said set of supports comprises a set of die shoes; said die shoes including alignment means permitting said die shoes to be moved linearly toward and away from one another; said means for causing relative movement comprises a set of platens and means for causing relative movement between said platens; one of said die shoes being attached to one of said platens and the other of said die shoes being attached to the other of said platens; each of said expandable diameter fastener means is constructed so as to include a plurality of separate expansion rings (60) located in alignment with one another between the ends of said fastener means and means (68,66,56) for applying forces to said rings so as
to expand said rings outwardly to a sufficient extent so as to bring them into contact with the internal walls within said holes.