

W. H. J. FITZGERALD ET AL

DOUBLE LIFT DROP HAMMER

Filed May 9, 1939

4 Sheets-Sheet 1

WILLIAM H. J. FITZGERALD, DEC'D
By JOSEPHINE M. FITZGERALD, EX'RIX.
REGINALD S. P. FITZGERALD
by Edward Smith & Tennant
Attys.

Oct. 29, 1940.

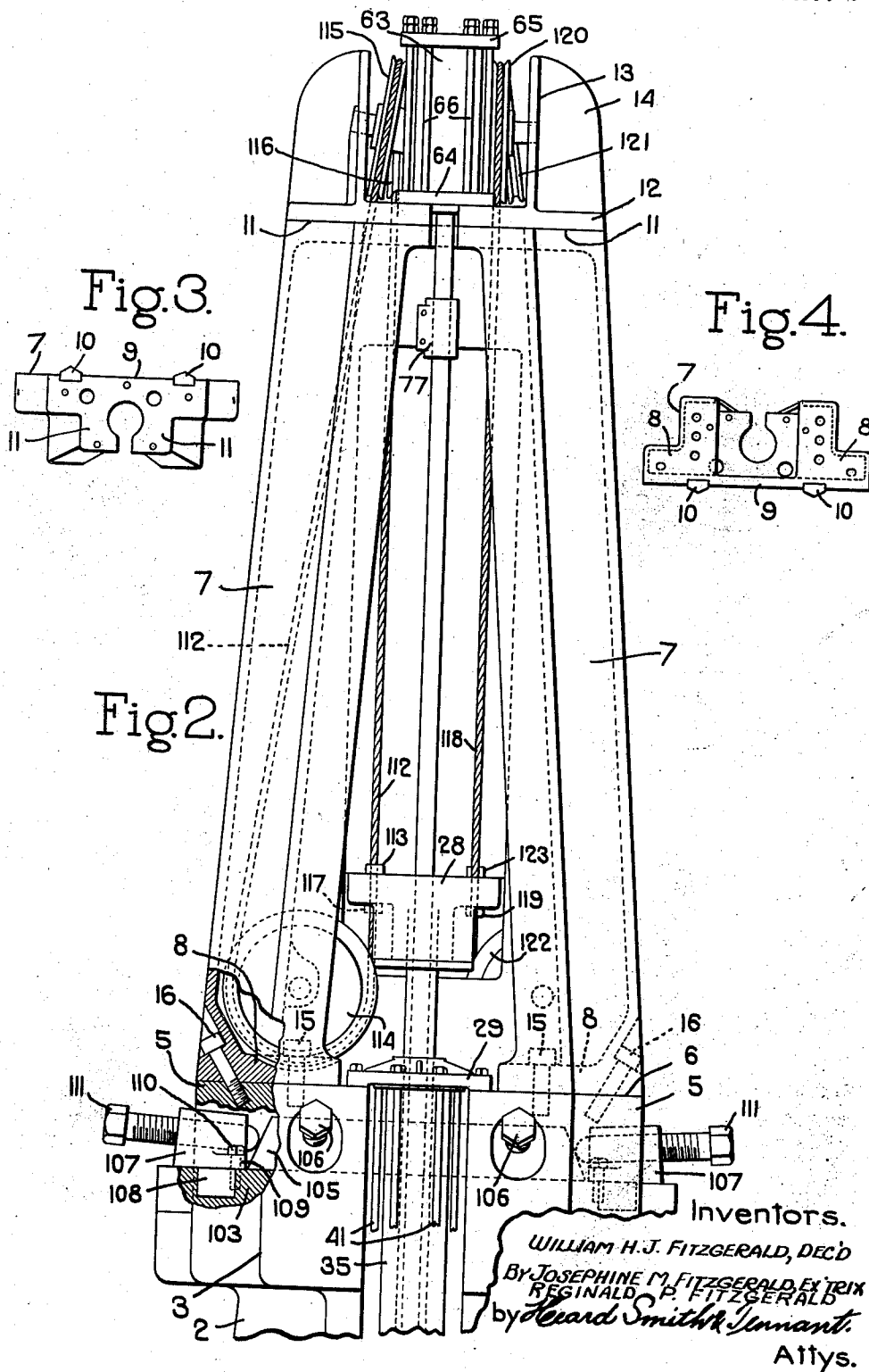
W. H. J. FITZGERALD ET AL

2,220,036

DOUBLE LIFT DROP HAMMER

Filed May 9, 1939

4 Sheets-Sheet 2



Oct. 29, 1940.

W. H. J. FITZGERALD ET AL

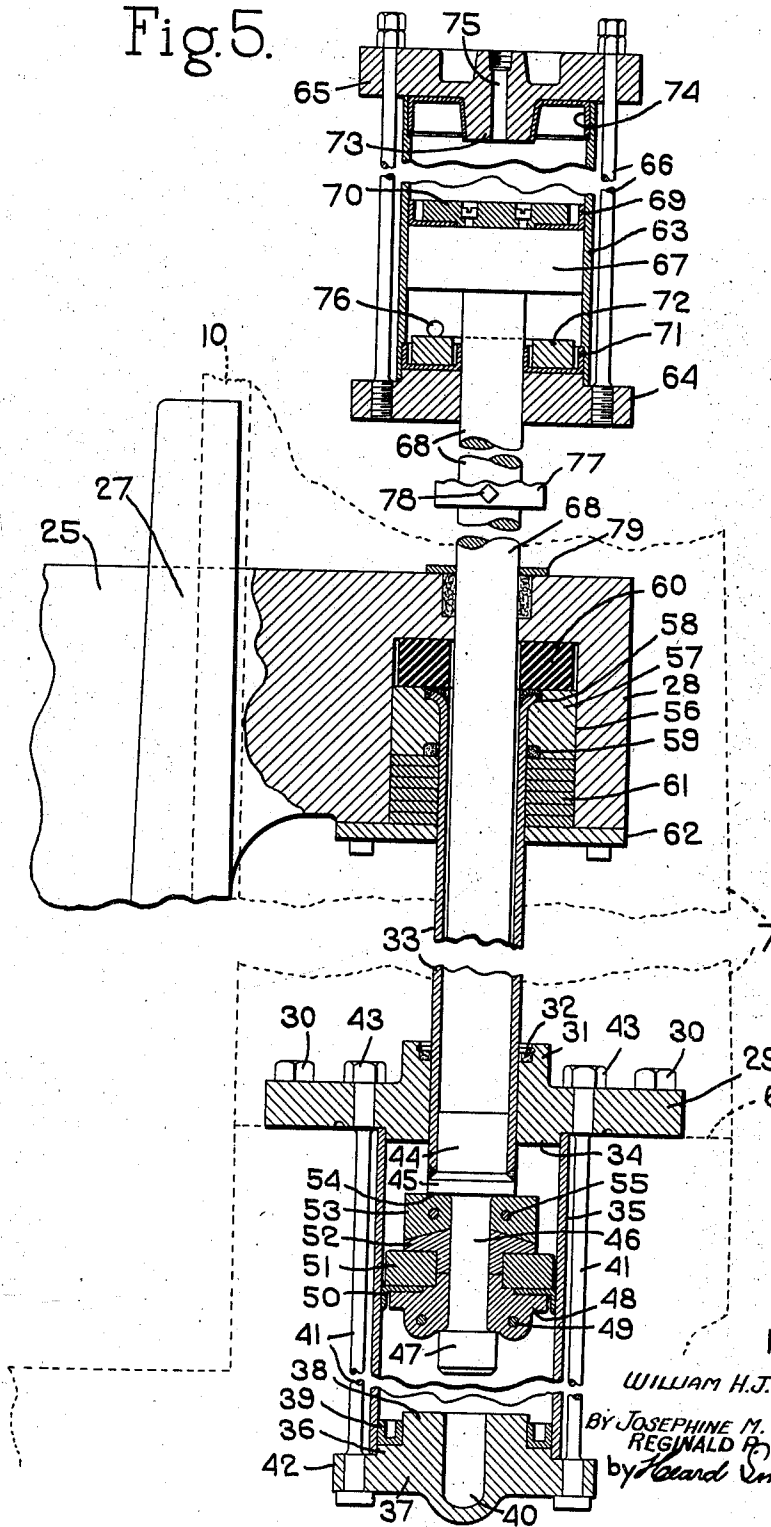
2,220,036

DOUBLE LIFT DROP HAMMER

Filed May 9, 1939

4 Sheets-Sheet 3

Fig. 5.



Inventors.

WILLIAM H. J. FITZGERALD, DEC'D

BY JOSEPHINE M. FITZGERALD, EX'RIX.
REGINALD R. FITZGERALD

by Heard Smith & Tennant.

Attys.

Oct. 29, 1940.

W. H. J. FITZGERALD ET AL

2,220,036

DOUBLE LIFT DROP HAMMER

Filed May 9, 1939

4 Sheets-Sheet 4

Fig.6.

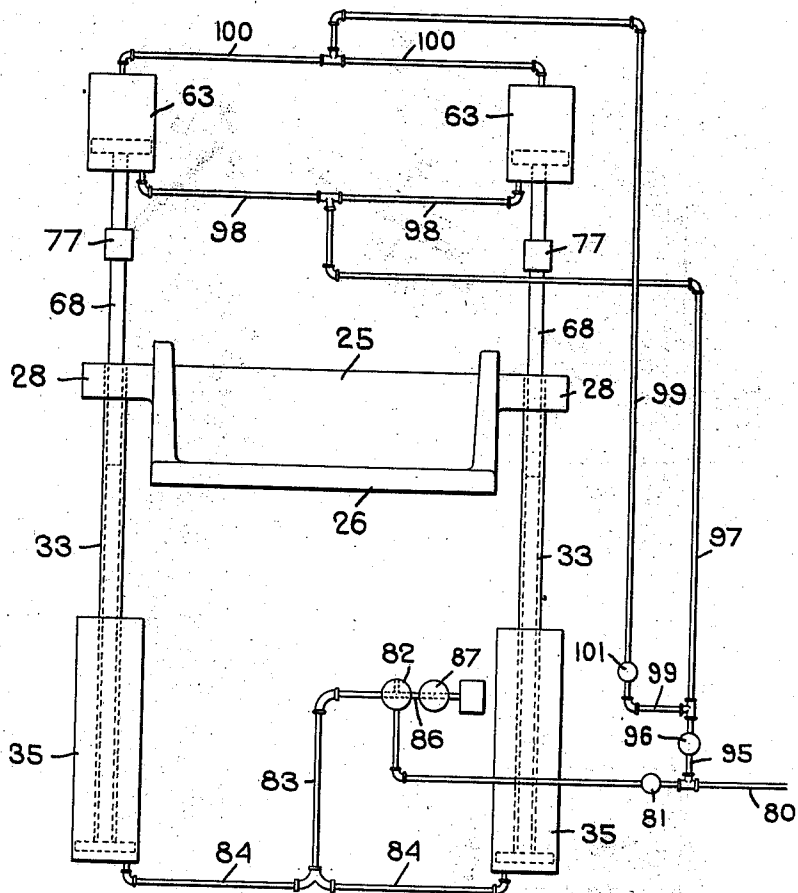


Fig.7.

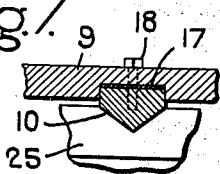


Fig.8.

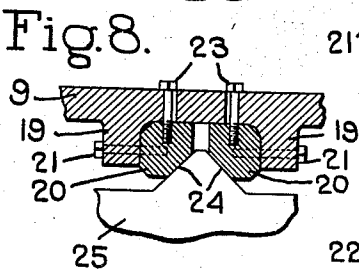
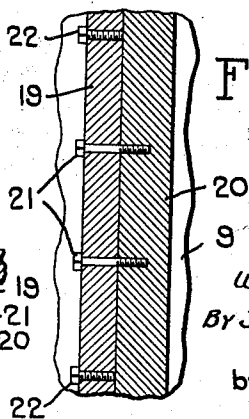


Fig.9.



Inventors.

WILLIAM H. J. FITZGERALD, DEC'd

By JOSEPHINE M. FITZGERALD, EX TRIX.

REGINALD P. FITZGERALD

by *Heard Smith & Tennant.*

Attys.

UNITED STATES PATENT OFFICE

2,220,036

DOUBLE LIFT DROP HAMMER

William H. J. Fitzgerald, deceased, late of Braintree, Mass., by Josephine M. Fitzgerald, executrix, Braintree, Mass., and Reginald P. Fitzgerald, Braintree, Mass., assignors to Pneumatic Drop Hammer Company, Braintree, Mass., a corporation of Massachusetts

Application May 9, 1939, Serial No. 272,584

16 Claims. (Cl. 78—25)

This invention relates to improvements in drop hammers of the type in which the hammer is raised by fluid pressure actuated mechanism and dropped by gravity, and more particularly in double lift drop hammers in which the hammer is raised by fluid actuated mechanism which applies lifting force to the end portions of the hammer, and upon release of the fluid pressure permits the hammer to drop.

In drop hammers which have a base provided with an anvil and a frame structure mounted upon said base having guideways for the hammer, the vibration produced by the reciprocating hammer has heretofore loosened the connection between the base and the frame, thereby interfering with the accuracy of the blow struck by the hammer. This is particularly objectionable where the drop hammer is employed in die work in which an inaccurate blow would injure or destroy the pattern or ornamentation produced by the dies upon the work.

One of the objects of the invention is to provide a rigid frame construction so secured to the base as effectively to prevent such displacement of the frame and to insure accuracy of the blow of the hammer.

A further object of the invention is to provide adjustable guideways for the hammer adapted to insure proper alinement of the movement of the hammer, and to permit take-up in compensation of wear.

Another object of the invention is to provide a drop hammer, particularly when used for die work, with a removable die-supporting bolster to enable replacement thereof when worn or injured.

A further improvement comprises means for accurately and effectively clamping the anvil die in proper alinement with the complementary die carried by the hammer.

The present invention is shown herein as embodied in a fluid actuated double lift gravity drop hammer of the type disclosed in our prior application for patent Serial No. 152,544, filed July 8, 1937, in which the lifting force is applied from beneath to opposite end portions of the hammer and which includes automatic mechanism for equalizing the rates of movement of the end portions of the hammer during the lifting and dropping thereof, thereby neutralizing any condition of off-center loading, off-center striking, or uneven lifting and preventing cramping of the hammer upon its guides on either the up or down strokes or on impact.

An object of the present invention is to provide a construction of this type in which all members

pertaining to the lifting and equalizing mechanism and the buffer mechanism for arresting the upward movement of the hammer can be readily removed without dismantling the hammer.

In usual drop hammer constructions the lifting mechanism and also the buffer mechanism for cushioning and arresting the upward movement of the hammer is located centrally of an overhead beam or yoke mounted upon the side frames or uprights of the machine so that oil and condensation of moisture which accumulates upon such mechanisms is likely to fall upon the hammer and therefrom upon the work.

One of the objects of the present invention is to provide a construction in which the lifting mechanism and buffer mechanism is located at or adjacent the ends of the frame, thereby avoiding this objection.

A further and important object of the invention is to provide a novel fluid operated buffer mechanism, preferably located in axial alinement with the lifting mechanism, and in the provision of means for permitting restricted circulation of fluid under pressure from the upper chamber to the lower chamber of the buffer mechanism without permitting back pressure of the fluid which is compressed in the upper portion of the buffer to enter into the conduit which supplies fluid under pressure to the buffer mechanism.

These and other objects and features of the invention will more fully appear from the following description and the accompanying drawings and will be particularly pointed out in the claims.

A preferred embodiment of the invention is illustrated in the accompanying drawings, in which,

Fig. 1 is a perspective view of a double lift gravity drop hammer embodying the invention;

Fig. 2 is a side elevation of the construction shown in Fig. 1, with a portion broken away in section to illustrate the improved means for clamping the uprights to the anvil base and the means for adjusting and clamping the die plate firmly in position upon the bolster;

Fig. 3 is a top plan view of one of the uprights or side frames on a smaller scale;

Fig. 4 is an underneath plan view of the same on a smaller scale;

Fig. 5 is a detail view, mainly in vertical section, showing the assemblage of the lifting cylinder, the hammer, and the buffer mechanism for arresting the upward movement of the hammer;

Fig. 6 is a diagrammatic view showing the relative positions of the hammer, the lifting mecha-

nism and the buffer mechanism, and illustrating the manner in which fluid under pressure is supplied to the lifting cylinders and to the buffer cylinders and the conduits through which the fluid under pressure is permitted a restricted flow from the upper chambers of the buffer cylinders to the lower chambers of the buffer cylinders when compressed, and vice versa to establish equalization of pressure upon opposite sides of the pistons of said cylinders;

Fig. 7 is a horizontal detail sectional view of means for adjusting the guides for the hammer;

Fig. 8 is a similar view of another form of mechanism for adjusting the guides for the hammer; and,

Fig. 9 is a vertical sectional view illustrating the means for effecting such adjustment.

The drop hammer construction illustrated in the accompanying drawings comprises a preferably integral base and anvil of cast iron having a preferably rectangular bottom portion 1 of considerable area, an intermediate portion 2 of smaller cross sectional area and desirably convergingly tapered upwardly, and an anvil portion 3 of considerably greater cross sectional area than said intermediate portion and overhanging the latter to provide a support upon which the cylinders for the lifting mechanism of the hammer may be conveniently mounted in such manner as to be easily removed. The ends of the base portion 1 and of the anvil portion 2 are provided with recesses adapted to receive the cylinders of the lifting mechanism and the open ends of the recesses of the anvil portion desirably are provided with cover plates 4.

The anvil portion 3 desirably is provided with upwardly extending end sections 5 having horizontal surfaced faces 6 upon which uprights having guides for the hammer are rigidly mounted.

As illustrated in the accompanying drawings the uprights 7 are of identical construction and are hollow steel or iron castings which preferably converge upwardly and are provided at their lower ends with foot portions, as illustrated in Fig. 4, having webs 8 which present surfaced faces complementary to the faces 6 of the anvil section and are connected by a web 9 in which guides 10 for the hammer are adjustably secured. The central portion of the webs 9 of the frame are cut away to permit the ends of the hammer to extend therethrough for engagement with the lifting mechanism, as will hereinafter be described.

The upper ends of the uprights are likewise provided with horizontal surfaced faces 11 and the uprights are connected rigidly together by a yoke 12 having surfaced end portions complementary to the surfaces 11 of the uprights. The yoke is secured to the upper ends of the uprights by suitable bolts and dowel pins to provide a rigid structure. The yoke is provided with suitable integral strengthening reinforcing flanges 13 which extend longitudinally of the yoke and also preferably with transverse strengthening webs 14.

One of the objects of the invention as above described is to provide means for so securely anchoring the lower ends or feet of the uprights to the anvil section of the base that the uprights will not be capable of lateral movement or displacement by the vibration produced by the hammer. In the construction illustrated the webs or foot portions 8 of the uprights are secured to the anvil section 3 of the base by a plurality of cap screws 15 which extend through the

webs 8 perpendicularly to the plane of the contacting faces of the surfaced webs and end portions of the base. A further anchorage is secured by providing cap screws 16 which extend convergingly downwardly through the lower foot portions of the uprights into the anvil portion of the base. These angularly positioned cap screws in cooperation with the vertical cap screws not only prevent lateral movement of the lower ends of the uprights, but more effectively secure the uprights rigidly to the base and effectively prevent loosening of the connection in response to the vibration of the frame produced by the reciprocation of the hammer. These cap screws desirably have socket heads and all are readily accessible if any tightening becomes necessary.

Suitable means are provided for adjusting the vertical guides 10 for the ends of the hammer in compensation of wear. A simple and effective means is illustrated in Fig. 7 in which the guides 10 are fitted in vertical recesses in the vertical webs 9 of the uprights and which adjustment may be secured by the insertion of suitable shims 17 between the rear faces of the guides and the bottom of the recesses in which they are seated, the guides being secured in place by a series of cap screws 18.

In a modified construction which is shown in Fig. 8 the webs 9 are provided with parallel, suitably spaced, vertical integral ribs 19, and gibs 20 are secured to the opposite inner faces of the ribs 19 by cap screws 21, while alternately arranged adjusting screws 22 mounted in the ribs 19 serve in combination with the cap screws 21 to adjust the gibs toward or from each other. The gibs 20 are also anchored to the web 19 by cap screws 23. The gibs are also provided with oppositely disposed angular faces 24, complementary to similar faces upon extensions of the ends of the hammer 25. Other means of adjustment of the guides may however be employed, as will be obvious to those skilled in the art.

While the uprights as herein illustrated and described are formed in single castings, it will be obvious that each of the uprights may be formed in two sections, thereby providing four standards or uprights instead of two. Such construction will be advantageous where hammers of large width are employed. By reason of the rigid connection of the uprights to the yoke and the secure anchorage of the lower ends of the upright to the anvil, such a modified frame construction may be satisfactorily employed.

The hammer 25 may be of any suitable form and weight. As illustrated herein the lower portion 26 of the hammer is of rectangular form of any desired area and presenting a flat lower face. The hammer is provided with means (not shown) for supporting a hammer die, and with a central longitudinally extending reinforcing web and wide and lengthy end flanges 27 having V-shaped grooves or ribs complementary to the guides and slidably mounted thereon. The ends of the hammer have extensions 28 which project through the openings in the side frames and are engaged by fluid actuated lifting devices which are mounted on the ends of the base and are provided with pistons which are connected to the hammer extensions 28.

One of the important objects of the invention is to provide mechanism for lifting the hammer and for arresting the upward movement thereof which can be readily and conveniently assembled and removed for repair or replacement.

A preferred form of hammer lifting mechanism, which is detachably mounted upon the base, is illustrated in Fig. 5, and comprises two fluid actuated, preferably pneumatically actuated, cylinders and pistons which are mounted in the recesses in the upwardly extending opposite ends of the anvil portion of the base. These lifting mechanisms are identical in construction and a description of one will serve for a description of both. The cylinder has a head 29, preferably of rectangular form, detachably secured by bolts 30 to the upper surfaced face of the upward extension 5 of the anvil member and overlies the vertical recess therein. The head 29 has an upwardly extending boss 31 provided with a suitable packing 32 to form a bearing for a cylindrical tubular piston rod 33. The under face of the head 29 has a cylindrical downward extension 34 and the cylinder 35 tightly fits upon the periphery of this extension. The lower end of the cylinder fits upon a cylindrical portion 36 of a lower cylinder head 37 which has an upwardly extending boss 38 of smaller diameter than the cylinder and a suitable packing 39 of U-shaped cross section is located in the space between the boss and the cylinder.

The head is provided with a central vertical recess 40 having communication with the source of supply of fluid under pressure. The cylinder 35 is clamped between the upper head 29 and the lower head 37 by a series of vertical bolts 41 which lie in proximity to the periphery of the cylinder and are mounted at their lower ends in a flange 42 and extend through the upper head 29 and have upon their upper ends nuts 43 which when set up serve to clamp the cylinder firmly between the heads. The lower end of the piston rod 33 is provided with a solid extension comprising a cylindrical plug 44 which extends into the lower end of the tubular piston rod a suitable distance to secure rigidity and has at its lower end an enlarged shouldered portion 45 which is securely welded to the end of the tubular piston rod. The piston rod extension has a reduced cylindrical portion 46 of much smaller diameter provided at its lower end with an enlarged shouldered portion 47.

The piston head is formed in two semi-circular sections 48 adapted to fit upon the reduced portion 46 of the piston rod extension, so that the lower face of the head will abut against the shouldered portion 47 of the piston rod extension. The sections of the piston head are secured together by clamping screws 49. The piston head is provided with an annular recess to receive the horizontal portion of a cup packing 50, the flange of which tightly fits the wall of the cylinder. The head is also provided with an upwardly extending cylindrical boss of smaller diameter than that of the packing recess and an integral ring 51, which is mounted upon the boss, is of considerably greater thickness than the height of the boss. A pair of semi-circular plates 52 are mounted upon the ring 51 and provided with extensions which fit within the upper portion of the ring 51 and contact or nearly contact with the upper end of the boss on the piston head. The plates 52 are provided with downwardly and outwardly inclined surfaces and a pair of semi-circular clamping members 53 having lower surfaces complementary to the inclined surfaces of the plates 52 are interposed between said plate sections and a shoulder 54 on the enlarged shouldered portion 45 of the piston rod extension. The clamping members 53 are

connected by screws 55 adapted when set up to draw the sections of the clamping members toward each other and by reason of the complementary inclined surfaces between the clamping member and the plates 52 securely clamp the piston head between the shoulder 54 and the shouldered head 47 of the piston rod extension.

The upper end of the tubular piston rod is suitably secured to the extension 28 of the hammer. In the preferred construction illustrated herein the hammer extension 28 is provided with a cylindrical recess 56 which extends from the lower face of the extension a considerable portion of the distance through it. A ring 57, which is reciprocally fitted in the recess 56, is provided at its upper end with a recess 58 having a circularly curved lower wall and the upper end of the tubular piston is expanded in said recess and securely welded thereto. The lower face of the ring 57 is likewise provided with a recess 59 which surrounds the tubular rod and is secured to the piston rod by welding filling the recess. Suitable shock absorbing means are provided on opposite sides of the ring 57. In the preferred construction a resilient ring 60, preferably of rubber or rubber composition, is interposed between the upper face of the ring and the bottom wall of the recess 56. The lower portion of the recess 57 desirably is filled with a series of washers 61 of leather or other fibrous material and are secured therein by a cover plate 62 secured by cap screws to the under face of the piston.

By reason of the construction above described sufficient flexibility is provided between the hammer and the piston rod to avoid binding or distortion of the piston rod which might occur as a result of slight inequality of movement of the ends of the hammer or from vibration of the hammer caused by impact.

Furthermore, the lifting mechanism can be readily installed and connected to the hammer or dismantled for the purpose of repair as the hammer can be supported at a suitable height, the cover plate 62 removed, and the ring and packing removed from the hammer extension. The piston rod may then be permitted to descend by exhaustion of air from the lower chamber of the lifting cylinder, the head 29 released from the anvil by unscrewing the bolts 30, and the cylinder and piston then readily removed from the recess in the end of the anvil cylinder.

As above stated, similar lifting cylinders are provided for each end of the hammer and suitable means hereinafter to be described are provided for supplying fluid under the same pressure to both of the lifting cylinders simultaneously.

A further object of the invention as above described resides in the provision of a plurality of buffers located in proximity to the ends of the hammer to cushion and arrest the upward movement of the hammer.

In the preferred construction illustrated herein identical fluid actuated buffer mechanisms are mounted upon the yoke in axial alinement with the piston rods of the lifting mechanisms and a description of one will be sufficient for both. This assemblage is illustrated in Figs. 1 and 3 and in detail in Fig. 2. The buffer mechanism comprises a cylinder 63 the ends of which engage and are clamped between a lower head 64 and an upper head 65 by a series of bolts 66 having screw threaded lower ends mounted in the lower head and provided with nuts engaging the upper faces of the upper head. The lower head 64 rests upon

and is secured to a flat surface of the yoke 12 with the cylinder in axial alinement with that of the lifting cylinder. A piston 67 is reciprocally mounted in the cylinder 63 and is provided with a vertical piston rod 68 which extends down through a suitable bearing in the hammer extension 28 and is telescopically mounted in the tubular piston 33 of the lifting mechanism. The upper face of the piston 67 is provided with an annular cup packing ring 69 which is secured to it by a plate 70 of somewhat smaller diameter which is connected to the piston by cap screws. Suitable packings are provided for the lower and upper ends of the cylinder. As illustrated herein the lower end portion of the cylinder is provided with a countersink in which the outer wall 71 of a U-shaped packing ring is mounted with the inner wall of the packing ring closely engaging the piston rod 68. The packing ring is held in place by a suitable plate 72 the upper surface of which lies above the upper edges of the packing ring to prevent them from injury when the piston descends to its lowest position.

The upper head 65 of the buffer is provided with a downwardly extending integral boss 73 and a U-shaped packing ring 74 which is mounted upon the boss has its peripheral vertical wall seated in a countersink in the upper end of the cylinder 63. The boss 73 is provided with a vertical bore 75 having a countersunk internally screw threaded upper end portion adapted to be connected to a conduit for supplying fluid under pressure to the upper chamber of the cylinder. The lower portion of the cylinder is provided with a suitable boss (not shown) having a bore 76 communicating with the lower chamber of the cylinder and desirably provided with an internally screw threaded wall for the attachment of a conduit through which fluid under pressure may be introduced into the lower chamber of the cylinder.

The piston rod 68 of the lifting cylinder has an adjustable collar 77 secured to it by one or more clamping screws 78 and is adapted to be engaged by a rigid annular plate 79 which surrounds the piston 68 and is detachably secured to the upper face of the hammer extension 28.

The buffer mechanism can be readily assembled upon the yoke and may be easily removed therefrom by releasing the clamping screw 78 on the collar 77 and thereafter removing the clamping screws which secure the base 64 to the yoke.

Any suitable valve controlled means may be provided for supplying and for controlling the admission of fluid under pressure to the lifting cylinder to raise the hammer and for permitting the escape of fluid under pressure from the lifting cylinder to permit the hammer to drop. Novel means are also provided for simultaneously supplying the fluid under pressure to the upper and lower chambers of the buffer cylinder and for permitting restricted flow of the fluid from the upper chamber to the lower chamber of each cylinder and vice versa in response to the raising and lowering of the piston thereof.

The conduits for supplying fluid under pressure to the respective cylinders and for controlling the flow of fluid are graphically illustrated in Fig. 6 and also mainly shown in the form in which they appear in the commercial machine in Fig. 1. Fluid under pressure, preferably air, is supplied through a main inlet pipe 80 and passes through a main valve 81 to a control valve 82 and from the control valve 82 through a pipe

83 to oppositely extending branch pipes 84 which lead to the lower chambers of the lifting cylinder. The control valves for admitting fluid under pressure to the lifting cylinders and for permitting the exhaust of fluid under pressure therefrom are mounted in a valve block 85 which is seated in a suitable recess in the upper intermediate portion 2 of the base, and desirably are similar in principle and in operation to those disclosed in our prior Patent No. 1,924,545 Figs. 6 to 10 inclusive.

The control valve 82 is in the form of a three-way valve adapted to establish communication between the main fluid pressure supply line 80, the pipe 83, and branches 84 which lead to the lower ends of the lifting cylinders or upon quarter-turn movement to establish communication between the pipe 83 and an exhaust pipe 86 having a regulating valve 87. The stem of the valve 82 is connected to a vertical rod 88 which extends upwardly through the anvil portion of the base and is mounted at its upper end in a boss 89 extending outwardly from one of the reinforcing flanges 13 of the yoke. The rod 88 has secured to it a suitable collar provided with a handle 90 by means of which the valve 82 may be manually controlled to cause admission of fluid under pressure into the cylinders or to exhaust fluid under pressure therefrom.

By proper manipulation of the handle 90 fluid under pressure can be so admitted to the lifting cylinders as to raise the hammer slowly or rapidly or to raise the hammer to any desired height in accordance with the force of the blow which is to be struck. Where however it is desirable to strike a series of blows of equal force the rod 88 may be provided with an adjustable inclined or spiral cam 91 adapted to be engaged by a complementary member on the hammer and so positioned as to rotate the valve from exhaust position to a position which will admit fluid under pressure to the lifting cylinder just before the blow is struck by the hammer so that the hammer will be caught upon the rebound and lifted in the manner disclosed in our prior Patent No. 1,924,545 aforesaid.

The cam 91 is illustrated in full lines at the upper end portion of the rod 88 where it is ineffective, but is illustrated in dotted lines in position for producing repeated blows of the hammer with equal force, the upward movement of the hammer being limited by the buffer mechanism.

The exhaust valve 87 desirably is of the general character described in our prior Patent No. 1,924,545, provided with an angularly arranged adjustable outlet port adapted to be positioned to permit the air to be exhausted from the lifting cylinders at a predetermined rate corresponding to the desired force of the blow.

In the present construction the exhaust valve is controlled by a manually operable handle 92 which is fixedly secured to the upper end of a rod 93, the lower end of the rod being connected to the exhaust valve stem by chain and sprocket mechanism 94.

Fluid under pressure preferably is supplied to the cylinders of the buffer mechanism from the main supply pipe 80 through a pipe 95 having in it a check valve 96 adapted to admit pressure to a pipe 97 having at its upper end branches 98 leading to the lower chambers of the buffer

cylinders. Another pipe 99, which is connected to the pipe 97, leads to branch pipes 100 which communicate with the upper chambers of the buffer cylinders. The pipe 99 has in it a restricting valve 101 for partially impeding the flow of fluid from the upper chambers to the lower chambers thereof and vice versa.

In the operation of the machine fluid under pressure supplied through the pipe 80 passes to the valve 82 which as illustrated in Fig. 6 is in the position to prevent admission of air into the lifting cylinders. Fluid under pressure however passes through the pipes 97 and branch pipes 98 to the lower chambers of the buffer cylinders. At the same time fluid under pressure passes through the restricting valve 101 and branch pipes 100 to the upper chambers of the buffer cylinders and when balance of pressure upon opposite sides of the piston is established, the piston will, by reason of its weight and that of the piston rods and collar 77, descend until the piston head rests upon the ring 72 in the lower portion of the cylinder 63.

When the valve 82 is rotated a quarter turn to establish communication between the fluid supply pipe 80 and the pipe 82 and branches 84, fluid under pressure will be forced into the chambers of the lifting cylinders 35 thereby raising the piston therein and through the tubular piston rod 33 raising the hammer 24. As the hammer ascends the extensions thereof engage the collars 77 upon the piston rods 68 of the buffer mechanism thereby forcing the pistons 67 upwardly. The upward movement of the pistons 67 compresses the fluid in the upper chamber of the buffer cylinders 63, thereby forcing the fluid from the upper portions of the cylinders through the pipe 99 and restricting valve 101, thus gradually arresting the upward movement of the piston and so cushioning it that it comes to rest without shock. The fluid under pressure which is gradually forced through the restricting valve 101 passes into the pipe 97 and through the branch pipes 98 to the lower chambers of the buffer cylinders.

When the fluid under pressure is released from the lifting cylinders the hammer descends and the collar 77 released from engagement with the hammer extensions 28. The weight of the piston rod and collar then causes the pistons of the buffer to descend, thereby forcing the fluid under pressure through the branch pipes 98, the pipe 97, restricting valve 101, pipes 98, and branches 100 into the upper chambers of the cylinders until pressure upon the opposite sides of the piston is equalized as above described.

It will be noted that because of this construction fluid under pressure is caused to flow from the upper chambers of the buffer cylinders to the lower chambers thereof and vice versa without substantial loss in volume or pressure and without exerting any back pressure against that of the fluid supplied through the main supply pipe 80. Any additional fluid which is necessary to maintain proper fluid pressure in the buffer cylinders is however supplied through the one-way check valve 96. By reason of this circulating system for the fluid under pressure supplied to the buffer cylinders back pressure in the main supply line is avoided, additional strains upon the compressor are eliminated, and the power required to be applied to the compressor is reduced to a minimum.

Another object of the invention is to provide a novel mechanism for supporting and accurately adjusting the anvil die which is particularly es-

sential where die-shaping of materials is being produced. As illustrated herein the central portion of the anvil section 4 is cut away from front to rear to produce a recess 102 having upwardly and inwardly tapered side walls. A bolster 103 is detachably mounted in said side walls and preferably held in place by means including a wedge 104 interposed between the edge of the bolster and one of the inclined side walls of the recess. The bolster is provided with suitable bolt holes (not shown) by means of which the die 105 may be fixedly clamped to it. The die 105 desirably is of rectangular form and provided with upwardly inclined edges. The means for adjusting and securing the die fixedly in position preferably comprises heavy adjusting screws 106 which are mounted in the upward extensions 5 of the anvil portion of the base and incline downwardly in such manner as to engage the inclined side edges of the die. By proper adjustment of these bolts the die can be fixedly positioned against sidewise movement.

In order properly to position the die accurately and against fore and aft movement poppets 107 are secured to the bolster. These poppets are in the form of castings having downwardly extending stems 108 fitting in complementary recesses in the bolster plate located centrally of the machine and the opposite sides of the die. The poppets are provided with flanges 109 which are secured to the bolster plate by cap screws 110. Clamping and adjusting screws 111 are mounted in the poppets 107 and are inclined downwardly to engage the front and rear inclined edges of the die 105. By virtue of the construction above described the die can be accurately positioned on the anvil base in such manner that proper registration with a complementary die mounted upon the hammer will be insured.

In order to insure accurate vertical reciprocating movements of the hammer and to avoid binding of the ends of the hammer on its guides suitable equalizing mechanism desirably is provided. The equalizing mechanism illustrated herein is the same in principle and substantially the same in construction as that disclosed in our copending application Serial No. 152,544 filed July 8, 1937, and to which reference is made for detailed description. Briefly stated the equalizing mechanism comprises reversely arranged complementary cables which are connected at their opposite ends to the upper and lower surfaces of the ends of the hammer and extend over suitable sheaves mounted upon the lower portions of the uprights and upon the yoke. As illustrated herein one of the cables 112 is connected at one end by a suitable clamping nut 113 to the upper face of the extension 28 of the hammer, passes downwardly therethrough, thence around a sheave 114 mounted in the lower portion of the upright, thence upwardly over a sheave 115 which is mounted upon the yoke, thence lengthwise of the yoke across another sheave 116, thence vertically downwardly through the extension upon the other end of the hammer where its end is fixedly secured to the under face of the hammer by a suitable clamping nut 117.

A complementary cable 118 has one end extending through the hammer extension 28 and clamped to the under face thereof by a nut 119 and extends vertically upwardly over a sheave 120, thence lengthwise of the yoke, and across an inclined sheave 121, thence downwardly around a sheave 122 and vertically upwardly through the

extension of the hammer at the other end where it is secured by a suitable nut 123.

By reason of the hollow frame construction and the accessibility through the inner and outer spaces in the upright and by reason of the exposure of the sheaves which are mounted upon the yoke, the equalizing mechanism is readily accessible for adjustment, repair, or replacement.

In order that the hammer may be sustained in a raised position for adjustment of the dies or for assemblage and repair or replacement of the various mechanisms, means are provided upon the frame for locking the hammer in such position. A convenient means which is illustrated herein comprises a post 124 having its lower end mounted in a socket 125 on the anvil portion of the base and its upper end mounted in a boss 126 extending forwardly from the reinforcing web 113 of the yoke with a block 127 having a split sleeve adjustably clamped on the rod 124 and adapted to be swung beneath the hammer to sustain it in raised position. The post 124 desirably has mounted upon its upper end portion a spiral spring 128 one end of which is anchored to the post and the other to the boss 126 and which normally tends to swing the block 124 out of the path of the hammer. The lower end portion of the post has secured to it a handle 129 by means of which the rod may be rotated to position the block 127 beneath the hammer. Rotation of the post in the opposite direction by the spring 128 may be limited by a collar 130 fixedly secured to the rod having an extension adapted to rotate in the cut-away portion of the socket member 125 and to limit such rotation upon engagement with the shoulder at the end of such cut-away portion.

It will be understood that the particular embodiment of the invention shown and described herein is of an illustrative character and is not restrictive of the meaning and scope of the following claims.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. A pneumatic drop hammer construction for accurate die work comprising a heavy rigid metal base having an anvil, pneumatic cylinders mounted respectively in the ends of said base having vertical piston rods, a hammer having its end portions connected to said piston rods, pairs of hollow integral steel uprights mounted on said base mainly enclosing and protecting said piston rods and rigidly connected at their upper ends by a yoke and having complementary vertical guides for the drop hammer, each of said uprights having a foot surfaced to rest upon a complementary surfaced section of said base, means for securing said uprights to said base, including cap screws mounted in opposite portions of said uprights and said base and converging toward each other in angular relation to said engaging surfaces, thereby preventing lateral displacement of said uprights and insuring accurate vertical movements of the hammer.

2. A pneumatic drop hammer construction for accurate die work comprising a heavy rigid metal base having an anvil, pneumatic cylinders mounted respectively in the ends of said base having vertical piston rods, a hammer having its end portions connected to said piston rods, pairs of hollow integral steel uprights mounted on said base mainly enclosing and protecting said piston rods and rigidly connected at their upper ends by a yoke and having complementary vertical guides for the drop hammer, the uprights of each

pair being connected at its lower end by an integral web forming a foot surfaced to rest upon a complementary surfaced section of said base, means for securing said uprights to said base comprising a plurality of cap screws extending through each of said webs into said base perpendicular to the surfaced sections thereof, and cap screws mounted in opposite lower portions of said uprights and said base converging toward each other in angular relation to said engaging surfaces, thereby preventing lateral displacement of said uprights and effectively increasing the anchorage of said uprights to the base.

3. A drop hammer construction comprising a base having an anvil, a frame having uprights rigidly mounted on said base and rigidly connected together at their upper ends by a yoke, a drop hammer mounted in said frame, lifting means connected to the respective ends of the hammer operable to raise the hammer and to permit it to drop, fluid pressure operated buffers to cushion and arrest the upward movement of the hammer symmetrically mounted on said frames in proximity to the ends of said hammer, and means for supplying fluid under pressure simultaneously to each of said buffers to arrest the upward movement of said hammer.

4. A drop hammer construction comprising a base having an anvil, a frame having uprights rigidly mounted on said base and rigidly connected together at their upper ends by a yoke, a drop hammer mounted in said frame, lifting means connected to the respective ends of the hammer operable to raise the hammer and to permit it to drop, fluid pressure operated buffers to cushion and arrest the upward movement of the hammer symmetrically mounted on said frames in proximity to the ends of said hammer, comprising vertical cylinders having pistons provided with downwardly extending piston rods provided with means adapted to be engaged by the upwardly moving hammer, means for supplying fluid under pressure simultaneously to the chambers of said cylinders above the pistons, and to the lower chambers of said cylinders beneath said pistons, and means for restricting the flow of fluid under pressure from the upper chambers of said cylinders to the lower chambers thereof when the pistons are moved upwardly by engagement of said piston rods with said hammer during its upward movement.

5. A drop hammer construction comprising a base having an anvil, a frame having uprights rigidly mounted on said base and rigidly connected together at their upper ends by a yoke, a drop hammer mounted in said frame, lifting means connected to the respective ends of the hammer operable to raise the hammer and to permit it to drop, fluid pressure operated buffers to cushion and arrest the upward movement of the hammer symmetrically mounted on said frames in proximity to the ends of said hammer, comprising vertical cylinders having pistons provided with downwardly extending piston rods provided with means adapted to be engaged by the upwardly moving hammer, means for supplying fluid under pressure simultaneously to the chambers of said cylinders above the pistons, and to the lower chambers of said cylinders beneath said pistons, comprising a conduit for fluid under pressure having a check valve, a conduit leading from said valve having branches leading to the lower chambers of the respective cylinders, and a conduit having a restricting valve leading from said check valve to branches com-

communicating with the upper chambers of said cylinders, whereby upon engagement of the hammer with the piston rods of the respective cylinders and the upward movement of said pistons thereby produced will cause the fluid compressed in the upper chambers of the cylinders to flow through the restricting valve to the lower chambers of said cylinders, thereby gradually to arrest the upward movement of the hammer and upon arrest and descent of the hammer to permit counterflow of the fluid under pressure to establish balanced pressure upon opposite sides of said pistons.

6. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted in said frame, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with piston rods connected respectively to opposite end portions of the hammer, fluid pressure operated buffers for arresting the upward movement of the hammer comprising cylinders having pistons and piston rods in axial alignment with the piston rods of the respective lifting means and provided with adjustable means adapted to be engaged by the hammer when raised to a predetermined height, means for supplying fluid under pressure to said buffers and to said lifting cylinders, and means for releasing the fluid under pressure from said lifting cylinders to permit the hammer to drop.

7. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted in said frame, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods connected respectively to opposite end portions of the hammer, fluid pressure operated buffers for arresting the upward movement of the hammer comprising cylinders mounted on the upper portion of said frame having pistons provided with piston rods telescopically mounted in the tubular piston rods of said lifting means and provided with adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure simultaneously to the upper and lower chambers of said buffer cylinders, means for permitting a restricted flow of fluid under pressure from the upper chambers of said cylinders to the lower chambers thereof when the pistons of the buffer cylinders are moved upwardly by the hammer, valve controlled means for supplying fluid under pressure to the lifting cylinder to raise the hammer and for releasing fluid under pressure from said lifting cylinder to permit the hammer to drop.

8. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted in said frame, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods connected respectively to opposite end portions of the hammer, fluid pressure operated buffers for arresting the upward movement of the hammer comprising cylinders mounted on the upper portion of said frame having pistons provided with piston rods telescopically mounted in the tubular piston rods of said lifting means and provided with adjustable means adapted to be engaged

by the hammer during its upward movement, means for supplying fluid under pressure simultaneously to the upper and lower chambers of said buffer cylinders, means for permitting a restricted flow of fluid under pressure from the upper chambers of said cylinders to the lower chambers thereof when the pistons of the buffer cylinders are moved upwardly by the hammer, means for preventing flow of fluid from the buffer cylinder to the source of supply of fluid under pressure, and valve controlled means for supplying fluid under pressure to the lifting cylinder to raise the hammer and for releasing fluid under pressure from said lifting cylinder to permit the hammer to drop.

9. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted in said frame having end portions provided with recesses extending upwardly from the under faces thereof, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods extending into the respective recesses and yieldably anchored therein, fluid pressure operated buffers for arresting the upward movement of the hammer comprising cylinders mounted on the upper portion of said frame having pistons provided with piston rods reciprocally mounted in the ends of said hammer and telescopically extending into said tubular piston rods, and provided with adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure simultaneously to the upper and lower chambers of said buffer cylinders, means for permitting a restricted flow of fluid under pressure from the upper chambers of said cylinders to the lower chambers thereof when the pistons of the buffer cylinders are moved upwardly by the hammer, and valve controlled means for supplying fluid under pressure to the lifting cylinder to raise the hammer and for releasing fluid under pressure from said lifting cylinder to permit the hammer to drop.

10. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted on said frame having end portions provided with cylindrical recesses extending upwardly from the under faces thereof, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods extending into the recesses in the ends of said hammer, steel rings reciprocally mounted in said recesses and welded to the upper ends of said tubular piston rods, resilient members on opposite sides of said steel rings, plates secured to the under faces of said end portions of the hammer clamping the contents of said recesses firmly together, and fluid pressure actuated buffers mounted upon the upper portions of said frame having piston rods reciprocally mounted in said hammer and telescopically extending into said tubular pistons having adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure to said buffer, and valve controlled means for supplying fluid under pressure to said lifting cylinder to raise the hammer and to release said fluid under pressure to permit the hammer to drop.

11. A drop hammer construction comprising a base having an anvil, a frame mounted on and

extending upwardly from said base, a drop hammer mounted on said frame having end portions provided with cylindrical recesses extending upwardly from the under faces thereof, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods extending into the recesses in the ends of said hammer, steel rings reciprocally mounted in said recesses, the upper ends of said tubular pistons being secured to said rings by the expansion of the upper ends of the tubular pistons into complementary recesses in the upper portions of said rings and welding said ends to said rings and also by welding contained in a cylindrical recess in the lower portion of said ring, resilient members on opposite sides of said steel rings, plates secured to the under faces of said end portions of the hammer clamping the contents of said recesses firmly together and fluid pressure actuated buffers mounted upon the upper portions of said frame having piston rods reciprocally mounted in said hammer and telescopically extending into said tubular pistons having adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure to said buffer, and valve controlled means for supplying fluid under pressure to said lifting cylinder to raise the hammer and to release said fluid under pressure to permit the hammer to drop.

12. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base, a drop hammer mounted on said frame having end portions provided with cylindrical recesses extending upwardly from the under faces thereof, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods extending into the recesses in the ends of said hammer, steel rings reciprocally mounted in said recesses and welded to the upper ends of said tubular piston rods, a rubber buffer interposed between said ring and the upper wall of said recess, a series of washers of relatively less resilience beneath said rings, cover plates secured to the under faces of said end portions of the hammer clamping the contents of said recesses firmly together, resilient members on opposite sides of said steel rings, plates secured to the under faces of said end portions of the hammer clamping the contents of said recesses firmly together, and fluid pressure actuated buffers mounted upon the upper portions of said frame having piston rods reciprocally mounted in said hammer and telescopically extending into said tubular pistons having adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure to said buffer and valve controlled means for supplying fluid under pressure to said lifting cylinder to raise the hammer and to release said fluid under pressure to permit the hammer to drop.

13. A drop hammer construction comprising a heavy rigid metal base having a large bottom portion, an intermediate portion of substantially smaller horizontal cross sectional area and an anvil portion of larger horizontal cross sectional area than said intermediate portion overhanging said intermediate portion and provided with upwardly extending end portions presenting upper horizontal surfaces and vertically recessed at its ends, hollow integral uprights having surfaced lower ends complementary to the horizontal sur-

faces of said anvil portion rigidly secured thereto and rigidly connected together at their upper ends by a yoke and provided with vertical guides for the hammer, a hammer reciprocally mounted in said guides and having its ends extending into the chambers of said hollow uprights, means for lifting said hammer comprising lifting cylinders detachably mounted in the vertical recesses of the ends of said anvil portion and having tubular piston rods connected to the respective ends of the hammer, buffers mounted on said yoke to arrest the upward movement of the hammer having rods reciprocally mounted in said hammer ends and extending into said tubular piston and provided with means adapted to be engaged by the hammer during its upward movement, and valve controlled means for supplying fluid under pressure to said lifting cylinder to raise the hammer and to release the fluid under pressure from said cylinder to permit the hammer to drop.

14. A drop hammer construction comprising a base having an anvil, a frame mounted on and extending upwardly from said base having guides for the hammer, a drop hammer reciprocally mounted in said frame, means for raising said hammer comprising vertical lifting cylinders mounted on opposite sides of said base having pistons provided with tubular piston rods connected respectively to opposite end portions of the hammer, fluid pressure operated buffers for arresting the upward movement of the hammer comprising cylinders having pistons and piston rods reciprocally mounted in the ends of said hammer and extending telescopically into said tubular piston and provided with adjustable means adapted to be engaged by the hammer during its upward movement, means for supplying fluid under pressure to said buffer cylinders and for permitting restricted flow of fluid under pressure from the upper chambers of the buffer cylinders to the lower chambers thereof as the fluid is compressed in said upper chamber and to permit stabilization of the fluid pressure upon opposite sides of the pistons of the buffer cylinder upon cessation of movement or downward movement of said pistons, means for supplying fluid under pressure simultaneously to said lifting cylinders to raise the hammer, means for releasing the fluid under pressure from said lifting cylinders to permit the hammer to drop, and means for equalizing the movements of the guiding portions of said hammer during the upward and downward movements thereof, thereby to avoid binding of the hammer upon the guides.

15. A pneumatic drop hammer construction for accurate die work comprising a rigid metal base having an anvil, and pneumatic cylinders mounted respectively in the ends of said base having vertical piston rods, a hammer having its end portions connected to said piston rods, pairs of uprights mounted on said base mainly enclosing and protecting said piston rods and rigidly connected at their upper ends by a yoke, vertical guides for the ends of the hammer adjustably mounted in the respective uprights, each pair of said uprights being connected at its lower end by an integral web forming a foot surfaced to rest upon a complementary surfaced section of said base, means for securing said uprights to said base comprising a plurality of cap screws extending through each of said webs into said base perpendicular to the surfaced sections thereof, and cap screws mounted in opposite lower portions of said uprights and said base converging toward each other in angular relation to said

engaging surfaces, thereby preventing lateral displacement of said uprights and effectively increasing the anchorage of said uprights to the base.

- 5 16. A pneumatic drop hammer construction for accurate die work comprising a heavy rigid base having an anvil portion provided with upwardly extending side members having horizontal surfaced faces, pneumatic cylinders
10 mounted respectively in the ends of said base having vertical piston rods, a hammer provided with means for supporting a die, having its end portions connected to said piston rods, pairs of hollow integral steel uprights mounted on said
15 base mainly enclosing and protecting said piston rods and rigidly connected at their upper ends by a yoke having vertical guides for the drop hammer, each of said uprights having a foot surfaced to rest upon a complementary surfaced
20 section of said base, means for securing said uprights to said base including cap screws mounted in opposite portions of said uprights and said

base and converging toward each other in angular relation to said engaging surfaces thereby preventing lateral displacement of said uprights, a bolster removably secured in a recess in the anvil portion having means for supporting a die, downwardly inclined clamping screws mounted in the upward extensions of said anvil portion to engage said anvil plate, and front and rear poppets having downwardly extending cylindrical shanks mounted in complementary recesses in said
10 bolster plate and having flanges rigidly secured to said bolster plate and provided with downwardly inclined clamping screws to engage said anvil die plate thereby providing means for accurately adjusting and positively anchoring the
15 bolster plate in such manner as to insure and maintain accurate alinement of the dies carried respectively by the hammer and bolster plate.

JOSEPHINE M. FITZGERALD,

Executrix of the Last Will and Testament of
William H. J. Fitzgerald, Deceased. 20

REGINALD P. FITZGERALD.