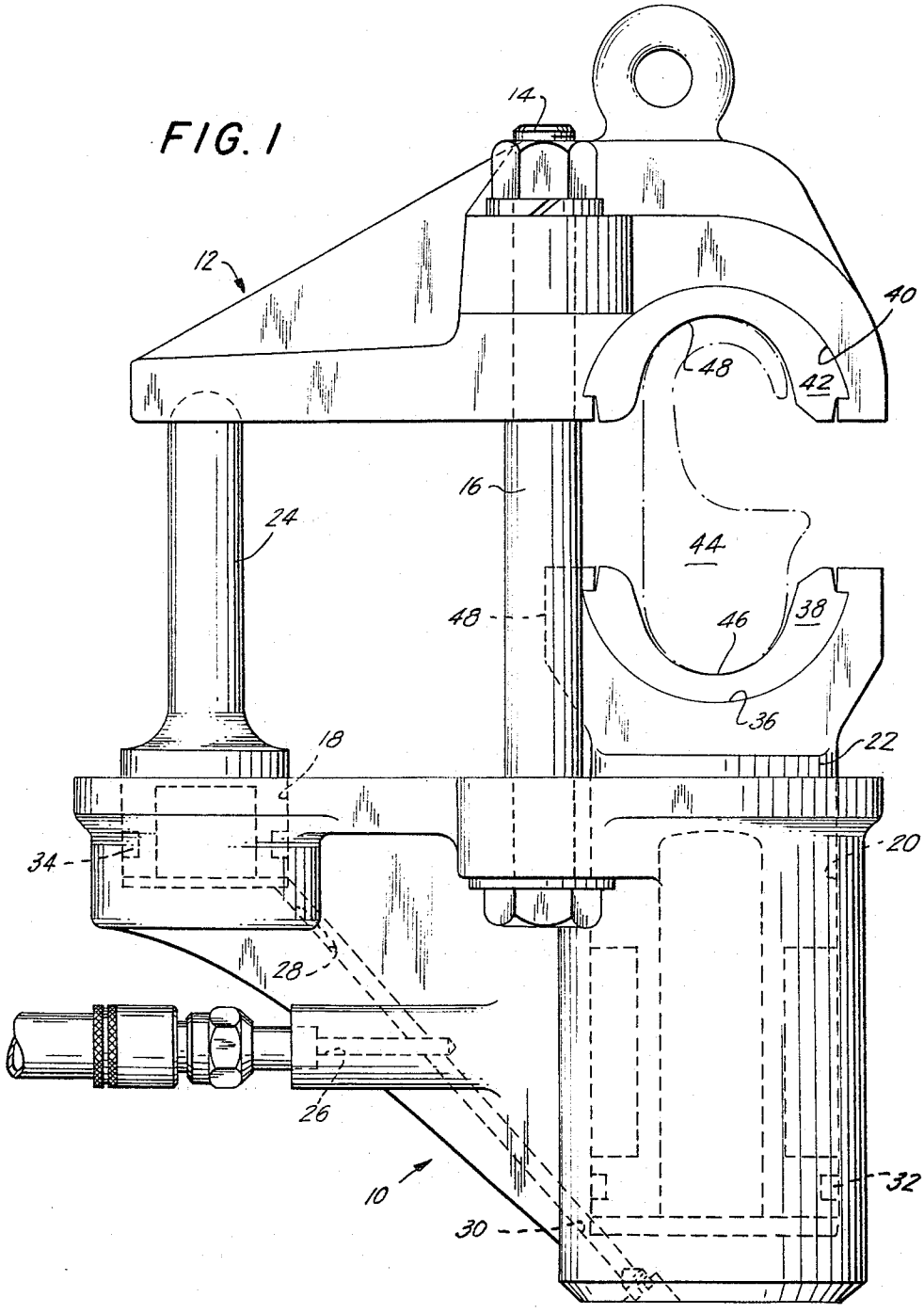
Aug. 23, 1966 W. REISCHER 3,267,717

OPEN-SIDE COMPRESSION TOOL

Filed Jan. 10, 1964 2 Sheets-Sheet 1

FIG. 1



INVENTOR.
WALTER REISCHER
BY Howard A. Peiter
ATTORNEY

Aug. 23, 1966 W. REISCHER 3,267,717

OPEN-SIDE COMPRESSION TOOL

Filed Jan. 10, 1964 2 Sheets-Sheet 2

FIG. 3

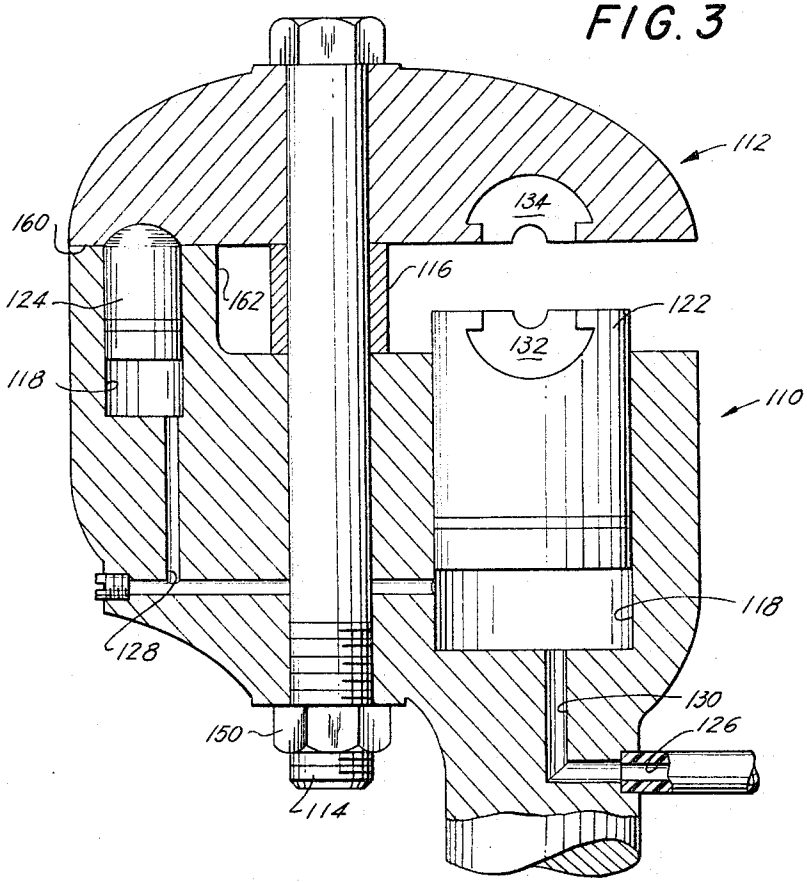
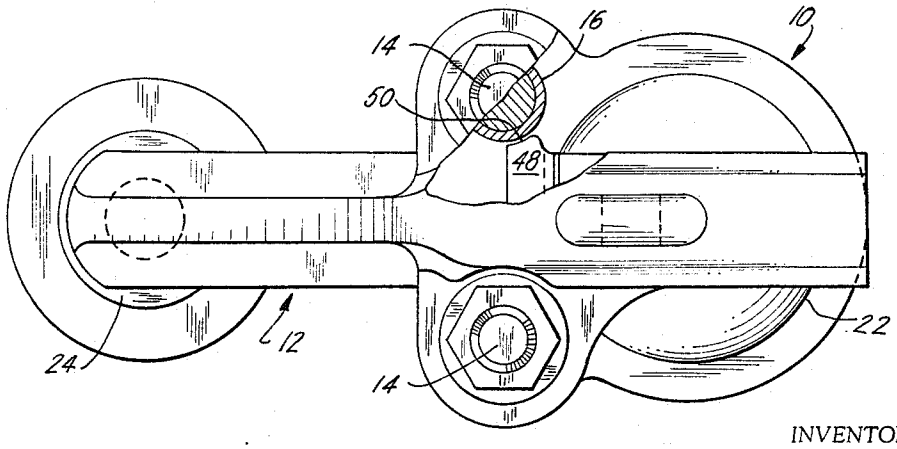


FIG. 2



INVENTOR.
WALTER REISCHER
BY Howard A. Peiler
ATTORNEY

United States Patent Office 3,267,717 Patented August 23, 1966

3,267,717

OPEN-SIDE COMPRESSION TOOL

Walter Reischer, Darien, Conn., assignor to Burndy Corporation, a corporation of New York

Filed Jan. 10, 1964, Ser. No. 337,033
8 Claims. (Cl. 72—416)

This invention relates to an open-side operating head for a compression tool, commonly referred to as a C-head. Such operating heads are employed in fluid powered (hydraulic and pneumatic, for example) tools which are used for a wide variety of purposes, such as crimping of electrical connectors, where it is not possible or convenient to axially remove the work piece from the tool. The opposed force applying jaws of these operating heads are commonly provided with a pair of removable crimping dies which may be interchanged to accommodate work pieces of varying size. Due to the magnitude and nature of the stresses developed in use, C-shaped or open-side operating heads are generally of massive construction in order to provide the necessary support for the dies and sufficient rigidity to prevent deflection and consequent die misalignment; they are therefore usually extremely heavy.

It is an object of the present invention to provide a C-head for a compression tool which is lighter in weight than conventional heads of equal capacity and yet suffers no increase in structural deflection and die misalignment under equivalent compression force.

Conversely, it is object of this invention to increase the allowable maximum force which may be generated in a C-head of given bulk and weight while limiting structural deflection and die misalignment to values equal to or less than those encountered in existing tools of similar size.

A still further object is to provide the foregoing advantages in a construction which is applicable to both mechanical and hydraulic compression tools.

These and other objects are obtained and new results accomplished by this invention as will become apparent from consideration of the C-heads which are hereinafter described, particularly pointed out in the appended claims, and illustrated in the accompanying drawings in which:

FIGURE 1 is a cross sectional view of a hydraulic tool compression head incorporating this invention;

FIGURE 2 is a partially sectioned top view of the C-head of FIGURE 1; and

FIGURE 3 is a side section view of another embodiment of this invention.

In broad concept, the C-head of this invention is provided with means for providing a balancing force which is in opposition to the forces generated by the jaws of the head in compressing work piece. By balancing rather than rigidly resisting the bending force generated during use, it is possible to substantially reduce the mass of the tool below that of the rigid resisting structures commonly employed. The balancing forces may be made equal in effect to the forces generated by closing of the compressing jaws and may be varied in proportion to the load, as shown by the construction illustrated in FIGURE 1; alternatively, the balancing forces may be selected to obtain a specific predetermined value sufficient to counterbalance the forces likely to be encountered in a specific application.

Referring now more particularly to the drawings, the variable balancing force compression head of FIGURE 1 may be seen to comprise a lower body portion **10** and an upper opposed body portion **12** which are joined together by one or more axial tension bolts **14**. In the embodiment shown, the upper and lower body portions are spaced apart by a pair of tubular spacers such as **16**,

which are coaxial with the tension bolts intermediate the two body portions. Other spacing means may obviously be used in connection with the bolts in place of the tubular spacers; these latter provide the advantages of low weight, low cost and simplicity of assembly.

A pair of cylindrical bores **18** and **20** are formed in lower body portion **10** for cooperatively receiving compression force applying ram **22** and balancing force applying ram **24**, respectively. Pressure fluid inlet **26** is operatively connected to fluid passages **28** and **30** for applying fluid pressure to the force applying rams within the two bores **18** and **20**. Each of the rams **22** and **24** may be provided with a piston ring **32** and **34** respectively to seal the ram to the bore wall.

The upper part of ram **22** is provided with a seat **36** for receiving one half-section **38** of compressing die. The opposed part of upper body portion **12** similarly includes a seat **40** for removably receiving a mating die half-section **42**. As fluid pressure is applied to ram **22** the ram advances axially toward the upper body portion **12** to compress an electrical connection such as **44** (shown in dot dash lines) between the substantially channel-shaped die surfaces **46** and **48**, in a well known manner.

To prevent rotation of the ram **22** about its own axis to thereby assure maintenance of the parallel relationship between the axes of the two die-half-sections, the die-receiving upper portion of the ram includes a projection **48** which extends between the spacers **16** on the bolts **14** as shown in FIGURE 2. The opposed transverse edges **50** of the projection **48** form a pair of bearing surfaces (only one being shown in FIGURE 2) which engage the spacers or "collars" **16** in sliding relationship to permit longitudinal movement of the ram while preventing axial rotation.

As a connector is compressed between the jaws by the application of fluid pressure to the base of ram **22**, the force transmitted through the connector to upper body portion **12** tends to tilt the body portion relative to the plane defined by the axes of the bolts **14**. However, the fluid pressure applied to ram **22** is simultaneously applied to balancing ram **24** which produces an opposing force tending to tilt the body portion **12** in the opposite direction. The bolt axes thus define "a neutral plane" through the body portion **12**, with bending-moment deformation of the body portion occurring to the left and right of the plane.

In a side-opening operating head of the commonly known type having a unitary structure, the portion of the head corresponding to the area between the axes of the bolts **14** and the axis of the balancing ram **24** might be formed of a solid mass of material integral with the upper and lower body portions **10** and **12**. The neutral axis of such a structure would be substantially to the left of the effective neutral axis of this invention, the indicated mass of material would be in tension to the right of the neutral axis and in compression to the left, and the resultant total reflection of the upper die section relative to the lower die section would correspondingly be substantially greater than in the compression head of this invention.

It should be noted that in the present invention any elongation of the tension bolts **14** during operation which tends to permit upper body portion **12** to tilt relative thereto as a result of the force applied in compressing the connector, is fully compensated by the corresponding displacement of the body along the axis of the balancing force applying ram.

The factors involved in determining the desirable design dimensions of an operating head constructed in accordance with this invention are in essence, the pressure applied by each of the force applying rams as a result

of a given fluid pressure, and the distance from the central axis of each of the rams to the effective "neutral plane." Thus, if A22 and A24 are assumed to represent the areas respectively of the rams **22** and **24**, and D22 and D24 are assumed to represent the respective distances between the axis of each ram and the plane defined by the tension bolts **14**, then for a given fluid pressure, bending moment balance will be achieved if the simple relationship $A22 \times D22 = A24 \times D24$ is satisfied.

In the modified version of this invention illustrated in FIGURE 3, the operating head comprises a lower body portion **110** and an upper body portion **112** which are joined together by tension bolt **114**, and spaced apart by a spacing collar **116**. Body portion **110** is provided with a cylindrical bore **118** having a compression force applying ram **122** fitted therein; and both the ram and the upper body portion **112** are fitted with complementary die half sections **132** and **134** respectively. Compression forces are transmitted to any connector disposed between the die half sections **132** and **134** by means of fluid pressure applied through fluid inlet passage **126**, to ram **122** in the well-known manner described with reference to the embodiment of FIGURES 1 and 2. The balancing ram arrangement of the embodiment of FIGURE 1 uses tubular element **16** merely to space body portions **10** and **12**; in the present embodiment, body **112** is provided with a balancing force receiving pad **160** which rests upon the surface of a corresponding offset portion **162** of the lower body portion **110**, and the tension bolt **114** is preloaded, by tightening tension bolt nut **150** beyond the force necessary merely to secure the upper and lower body portions together, in order to seat pad **160** securely on portion **162**. The initial deflection of the entire head assembly due to preloading of the bolt is then relieved during compression of a connector to thereby limit the maximum total deflection caused by compression. A lower total deflection is achieved by this method than would occur in the absence of preloading. The deflection stresses generated in this embodiment, during application of maximum compression force, are balanced by ram **124** in substantially the same manner as those generated in the corresponding portions of the embodiment of FIGURE 1. The portions of the embodiment of FIGURE 3 which correspond to like portions of FIGURE 1 are denoted by identical numbering transposed to the "100's" series.

The advantages of the two embodiments herein described, over conventional rigid C-shaped operating heads, include reduced volume and weight of material employed, feasibility of selecting optimum deflection-resisting configurations for the various parts; and, more accurate maintenance of alignment between the die sections during compression operation. It should be noted that the forces developed in the retaining bolts of both embodiments are tension forces only, and these may be easily handled by adequately designed bolts formed of any one of many well known materials. The head assemblies of this invention may nevertheless be designed with the bolts as the weakest link, so that, upon failure or permanent deformation, substantial savings may be effected by salvaging the principal and most costly parts of the operating head through simple replacement of the bolts. It is thus clear that even the entire upper body portion, including the connecting bolt or bolts, may be replaced without loss of the costly cylinder bore and fluid passage bearing portion, as would be necessary in unitary operating heads of conventional design.

It should be understood that the force applied to the died parts may be developed by means others than the fluid power mechanisms selected for illustration in the drawings. The force may be derived for example, from electric motors or from manually operated linkages employing well known techniques for obtaining the necessary mechanical advantage and for moving one die section relative to the other.

The invention has thus been described but it is desired to be understood that it is not confined to the particular forms or usages shown and described, the same being merely illustrative, and that the invention may be carried out in other ways without departing from the spirit of the invention; therefore, the right is broadly claimed to employ all equivalent instrumentalities coming within the scope of the appendent claims, and by means of which objects of this invention are attained and new results accomplished, as it is obvious that the particular embodiments herein shown and described are only some of the many that can be employed to obtain these objects and accomplish these results.

I claim:

1. An operating head for a compression tool, comprising: a first body portion supporting a die section, a second body portion supporting a complementary die section; means for holding the first body portion to the second body portion; means on one side of said holding means for advancing one die section toward the other die section independently of said body portions; and means for applying a counterbalancing force, on substantially the opposite side of said holding means, to resist tilting of the two body portions with respect to each other.

2. The operating head of claim **1** wherein said holding means includes a tension bolt disposed intermediate said advancing means and said counterbalancing means.

3. The operating head of claim **1**, wherein said die section advancing means includes a fluid pressure actuated ram, and said counterbalancing force applying means includes another fluid pressure actuated ram.

4. The operating head of claim **3**, wherein said rams are operated by a common source of fluid pressure such that the force applied by said counterbalancing ram varies directly as the value of the force applied by said advancing means.

5. The operating head of claim **3**, wherein the perpendicular distance between the axes of said advancing means ram and said holding means, multiplied by the instantaneous force applied by said advancing means ram, is equal to the perpendicular distance between the axis of said counterbalancing ram and said holding means, multiplied by the force applied by said counterbalancing ram at the corresponding time during compression.

6. The operating head of claim **3** wherein said holding means includes at least a tension bolt disposed intermediate said advancing means ram and said counterbalancing means ram, and said advancing means ram includes means engaging said bolt for preventing rotation of said advancing ram.

7. The operating head of claim **1**, wherein said holding means includes a pair of parallel spaced-apart tension bolts disposed intermediate said counterbalancing force applying means and said advancing means, said bolts being disposed in a plane which is substantially perpendicular to the plane defined by the axes of said force applying and advancing means.

8. The operating head of claim **7** wherein: said counterbalancing force means includes a portion of said first body portion directly engaging an opposed portion of said second body portion; and, said tension bolt is pretightened to hold said engaging body portions together with a force substantially equal to the maximum force applied by said die section advancing means during compression.

References Cited by the Examiner

UNITED STATES PATENTS

2,869,407	1/1959	Swanson	72—453
3,017,905	1/1962	Klein	72—416

CHARLES W. LANHAM, *Primary Examiner.*

R. D. GREFE, *Assistant Examiner.*