Nov. 26, 1968 J. W. TOMKA 3,412,591

PRESS FOR ELBOWS AND THE LIKE

Filed March 31, 1966 4 Sheets-Sheet 1

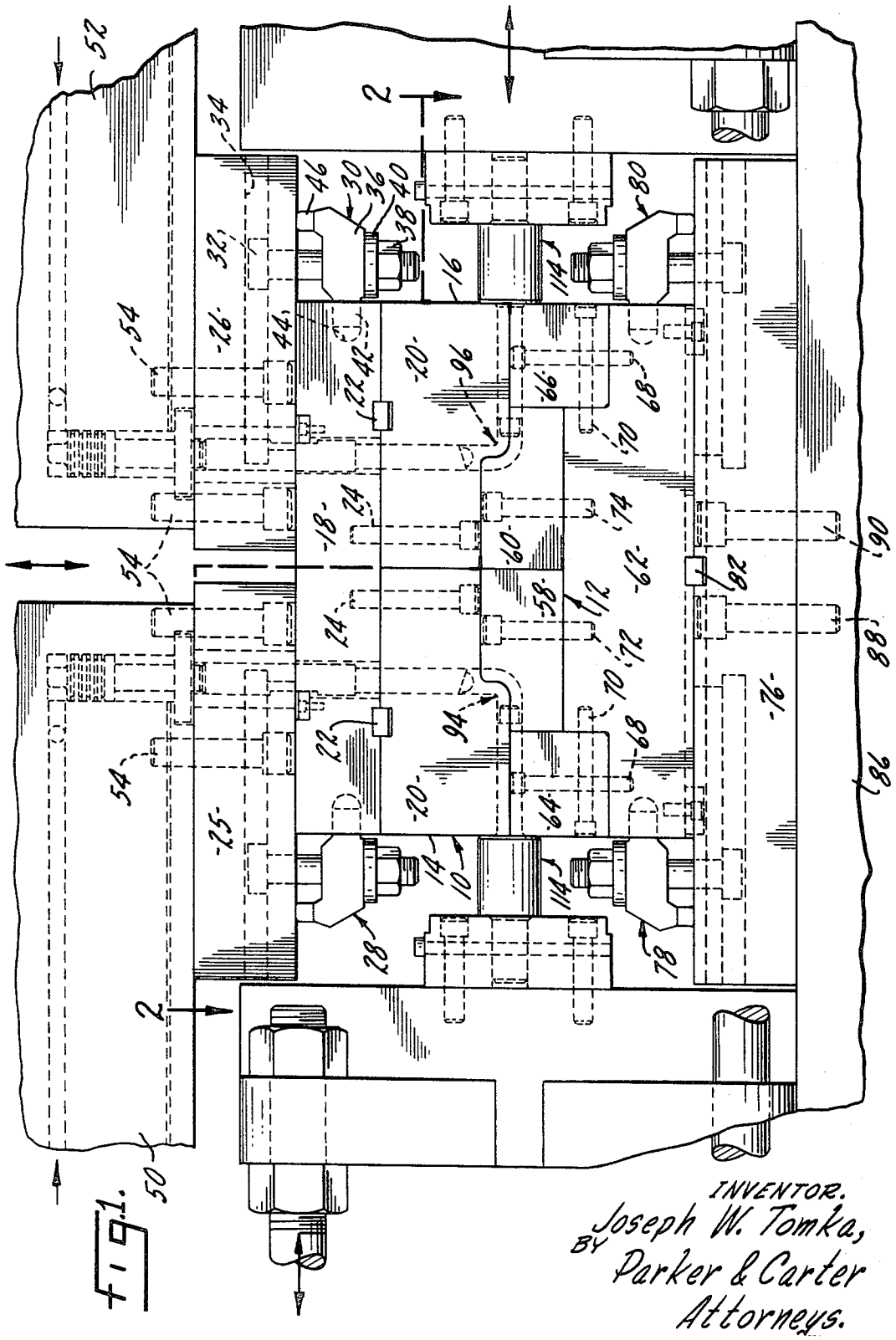

Fig. 1.

INVENTOR.
Joseph W. Tomka,
BY Parker & Carter
Attorneys.

Nov. 26, 1968 J. W. TOMKA 3,412,591

PRESS FOR ELBOWS AND THE LIKE

Filed March 31, 1966 4 Sheets-Sheet 2

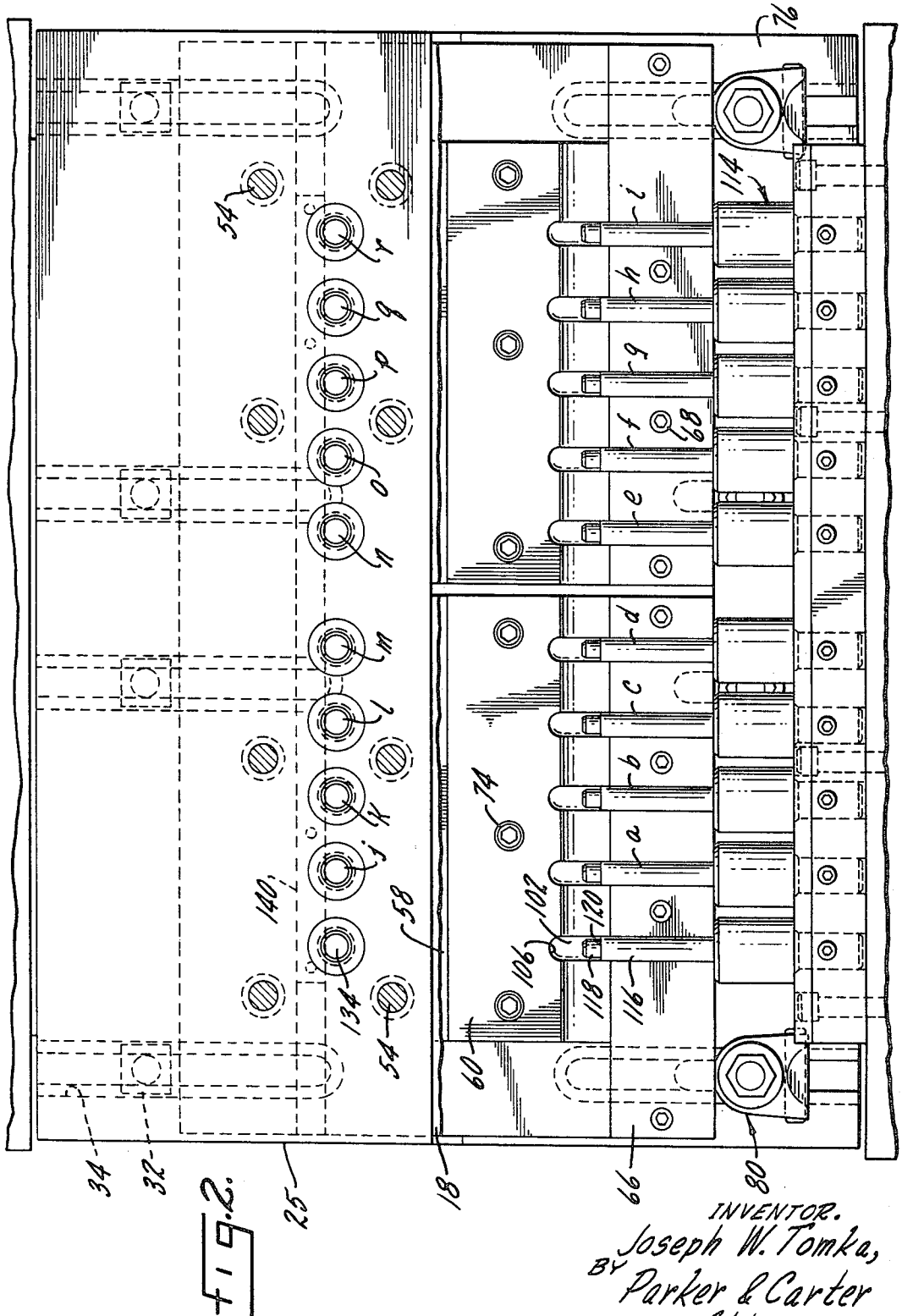

FIG. 2.

INVENTOR.
Joseph W. Tomka,
BY Parker & Carter
Attorneys.

Nov. 26, 1968 J. W. TOMKA 3,412,591

PRESS FOR ELBOWS AND THE LIKE

Filed March 31, 1966 4 Sheets-Sheet 3

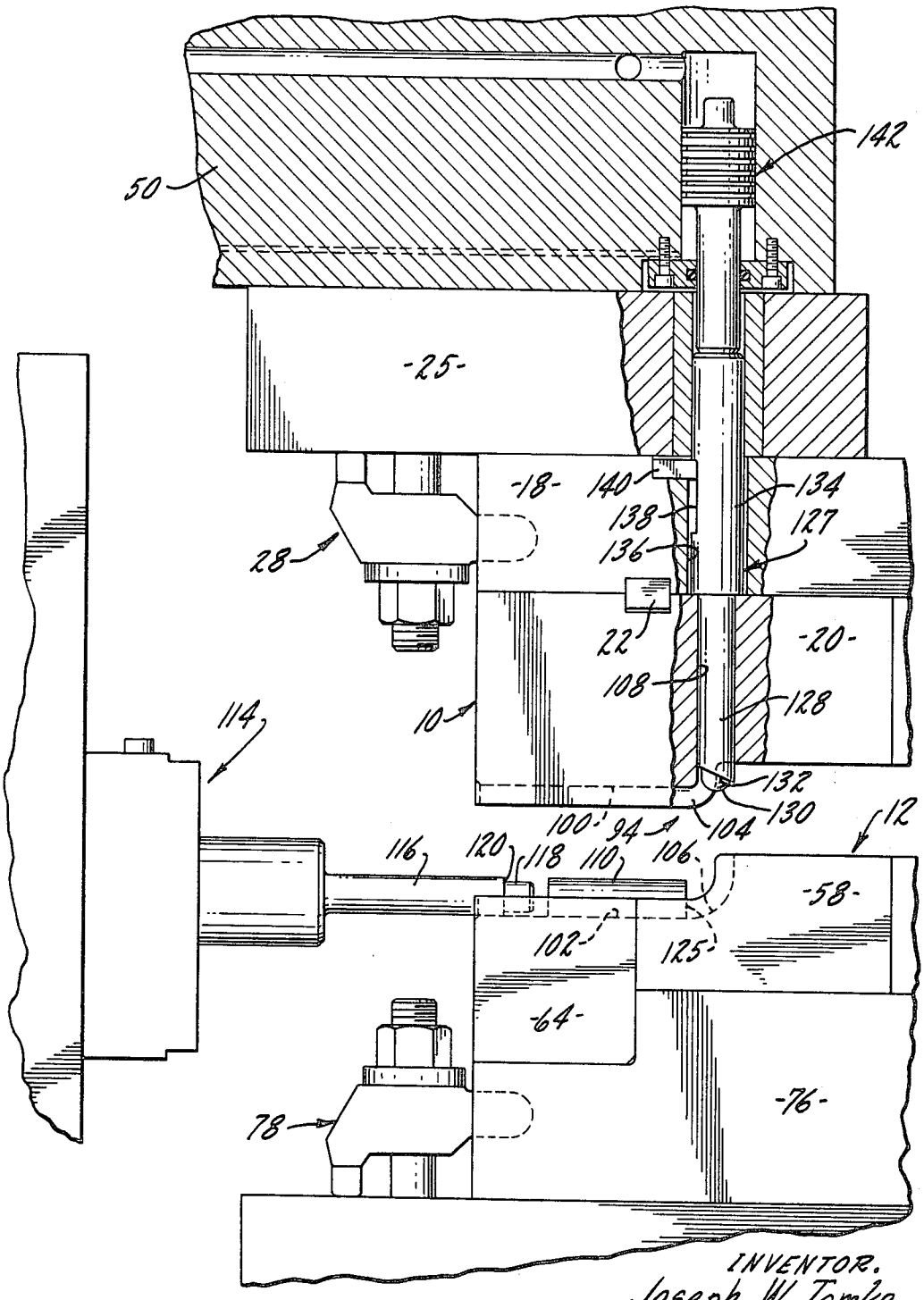

Fig. 3.

INVENTOR.
Joseph W. Tomka,
BY Parker & Carter
Attorneys.

Nov. 26, 1968 J. W. TOMKA 3,412,591

PRESS FOR ELBOWS AND THE LIKE

Filed March 31, 1966 4 Sheets-Sheet 4

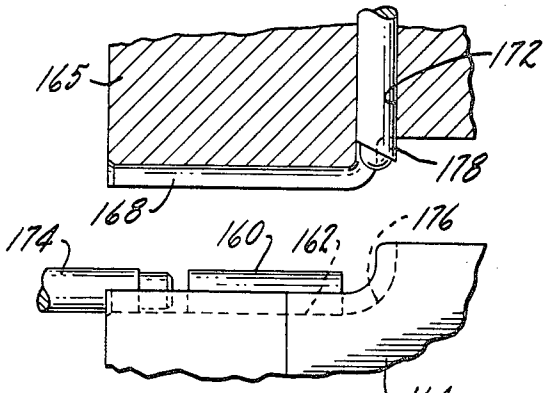

Fig. 4.

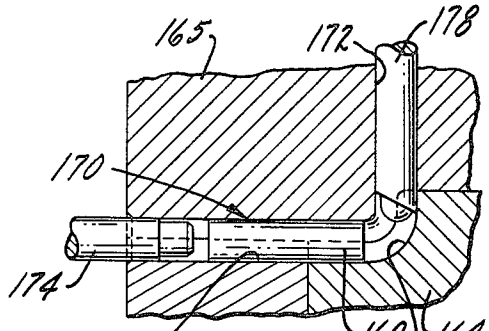

Fig. 5.

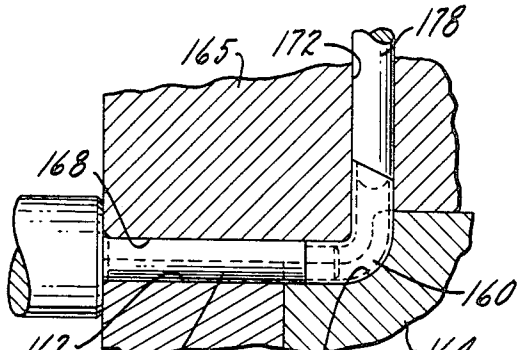

Fig. 6.

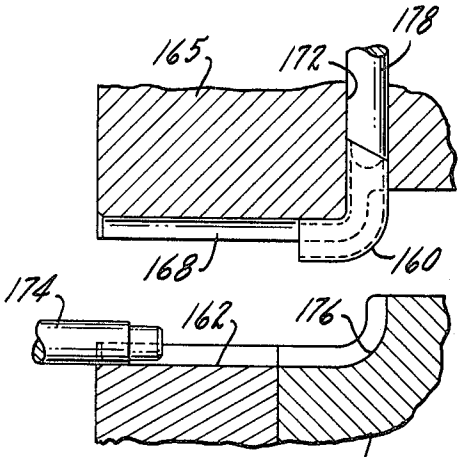

Fig. 7.

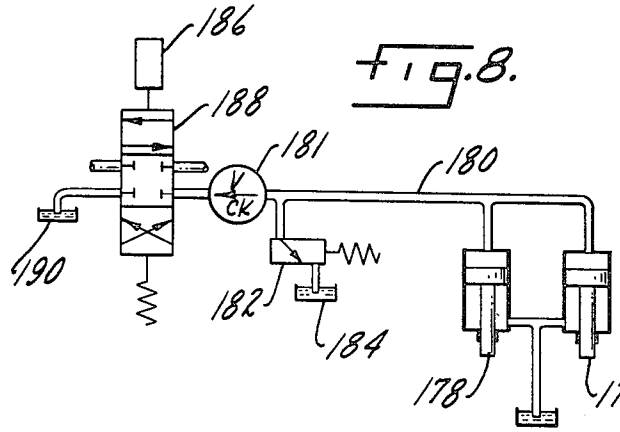

Fig. 8.

INVENTOR.
Joseph W. Tomka,
BY Parker & Carter
Attorneys.

United States Patent Office 3,412,591 Patented Nov. 26, 1968

3,412,591

PRESS FOR ELBOWS AND THE LIKE

Joseph W. Tomka, Cape Coral, Fla., assignor to Nordberg Manufacturing Company, Milwaukee, Wis., a corporation of Wisconsin

Filed Mar. 31, 1966, Ser. No. 539,175
6 Claims. (Cl. 72—150)

ABSTRACT OF THE DISCLOSURE

This is a press for making elbows from tubular workpieces which includes applying pressure at one end with a controlled pressure withdrawal at the other, the workpiece being filled with a deformable substance.

This invention relates to a press and method for bending a tubular workpiece, and particularly rates to bending a plurality of tubular workpieces such as copper pipes into angular forms such as elbows.

The main object of this invention is a press for forming angular tubular workpieces such as pipe elbows in a sequence of steps characterized by efficiently feeding, forming and removing said workpieces in an improved manner.

Another main object of this invention is a press in which a plurality of tubular workpieces may be formed generally simulaneously in an advantageous manner by utilizing to best advantage the pressure forces developed to bend the workpieces.

Another object is a press with a minimum number of separable die parts which, at the same time, are capable of efficiently forming a large number of bent workpieces.

Another object is a press in which a ram presses a tubular workpiece in each of a plurality of angular channels, and each angular channel is provided with means which both offers resistance and knocks out the formed workpiece in steps of controlled sequence.

Another object is a method whereby a tubular workpiece is subjected to pressures in a forming step, and means respond to a pressure gradient to remove the formed workpiece from the forming means.

Another object is a method whereby a plurality of tubular workpieces may be efficiently formed by utilizing opposite pressure forces which both lead to many formed workpieces and also prevent undue overbalanced pressure strain in the forming operation.

Another object is a press and method which permit a number of tubular workpieces to be efficiently formed with a tight radius.

The foregoing objects are realized as well as other objects which will become apparent from considering the following disclosure, including drawings wherein:

FIGURE 1 is a side elevational view with some parts romeved for reasons of clarity;

FIGURE 2 is a partly sectional view taken along line 2—2 of FIGURE 1, which line in part passes through a die cavity between upper and lower die parts;

FIGURE 3 is a side elevational view, on an enlarged scale and partly in section, showing selected separated die parts;

FIGURES 4–7 are side elevational illustrations, partly in section, showing different steps in the method of forming the tubular workpiece; and

FIGURE 8 is a schematic illustration of a hydraulic control for resistance and knockout plungers in the press.

The use of the same numerals in the different views will indicate reference to the same elements and structures.

FIGURE 1 shows the upper die **10** and the lower die **12** in closed position. A unitary upper die is shown which is partly defined by sides **14** and **16**. The unitary structure includes an upper position **18** keyed to lower portions **20**, **20** by keys **22**, **22**. Socket head screws such as **24** additionally join parts **18**, **20**. A top bolster plate made up of two halves **25** and **26**, is shown joined to upper die **10**.

The upper die may be laterally repositioned relative to the top bolster plates **25**, **26** by swivel assemblies shown generally as **28** and **30**. Looking at swivel assembly **30**, a T bolt **32** is adapted to ride in T bolt slot **34** in one of the top bolster plates. The T bolt **32** is held to a swivel clamp **36** by swivel nut **38** and swivel washer **40**. Swivel clamp **36** has extension **42** seated in socket **44** of upper part **18**. The other end of swivel clamp **36** has an upper extension **46** adapted to position and engage the swivel clamp relative to the top bolster plate **26**. By loosening nut **38**, bolt **32** can be slid along slot **34** to a desired position.

The bolster plates **25**, **26** are respectively secured to portions **50** and **52** of a press assembly. The fasteners for such connection are shown as a plurality of socket head screws **54**. Further details of the press assembly, of which portions **50**, **52** comprise parts, shall not be shown or described in additional detail since such includes the conventional hydraulic circuit and press components. It is only necessary to say that the press is adapted to reciprocally open and close the upper die **10** relative to the lower die **12**.

The lower die **12** is also a unitary structure but is further shown to be composed of upper sections **58**, **60**, lower section **62**, and lateral sections **64**, **66**. The lateral sections are shown secured to the lower section by crossed socket head screws such as **68**, **70**; and the upper sections are shown fastened to the lower sections by other socket head screws **72**, **74**. The relative positions of bottom bolster plate **76** and lower die part **12** can be changed with the help of swivels shown generally as **78** and **80**, said swivels being similar to swivel **30**. The unitary lower die may be keyed to the bottom bolster plate as at **82**, and the bottom bolster plate is shown fastened to a bottom base **86** by socket head screws **88**, **90**.

The upper and lower dies form opposed angular channels shown generally as **94** and **96**. FIGURE 3 illustrates further details on an enlarged scale of the angular channel. Upper die cavity **10** has a half-round die cavity **100** and a complementary lower half-round cavity **102**. Both die cavities also have complementary bend cavities **104**, **106**. The upper die is shown as having an upright tubular cavity **108**. Portions **100**, **102** may be considered as forming a lateral branch of the angular channel, cavities **104**, **106** as forming the bend, and upright cavity or passageway **108** as forming the upright branch of the angular channel. A tubular blank workpiece **110** is placed in the lateral branch and pressed through the bend into the upright branch to form the finished angular workpiece or elbow. Such tubular workpieces have conventionally deposited therein a suitable plastic filler such as Wood's metal to support the workpiece during the bending operation.

The workpieces are pressed through the bend by a punch shown generally as **114** positioned alongside the lateral branch. Such a punch reciprocally moves a ram **116** in and out of the laterial branch, and such ram has a pressure applying member or head **118** which is conventionally applied against the filler material (not shown). Shoulder **120** of the ram engages the edge of the annular wall of the tubular workpiece **110**. Details of said side ram or punch will not be further described since its components are conventionally assembled and its operation is conventionally executed.

The end **125** of the workpiece which is remote from head **118** of the ram will turn the bend and then engage a resistance plunger shown generally as **127**. The resistance plunger has a lower part **128** dimensioned to be slidably received in the upright branch of the die cavity. Part **128** has a hemispherical head **130** attached to the end, and the face **132** of said end is shown chamfered to accommodate the varying rate of movement of the inner and outer portions of the annular walls as the workpiece turns the bend. The lower part **128** of the ram is joined to an upper part **134** of increased diameter which reciprocally moves in a passageway **136** of slightly increased diameter. The enlarged part **134** has a flattened cutout **138** which is adapted to intercept a stop **140** fixed in section **13** of the upper die **10**. When the top end of cutout **138** hits stop **140** downward displacement of the resistance plunger is limited, and when the other end of the cutout hits stop **140** the upward displacement of the resistance plunger is limited. The extent of such displacement is predetermined to control the length of the leading end of the workpiece relative to the bend. The resistance plunger is reciprocated by a cylinder assembly shown generally as **142**.

It is an important feature of the invention that angular channels such as **94**, **96** are opposed as shown in FIGURE 1; and it is still a further advantage that a plurality of angular channels are disposed in each opposed set such as indicated in FIGURE 2. One side of the press is shown as having a set of the individual angular channels and ten side rams. The first ram is indicated by **116**, the lower die cavity of the first angular channel is indicated by **102** and the lower bend cavity by **106**. Nine similar assemblies are represented at *a–i*. Ten corresponding plungers are shown at the other end of the press in opposed relationship. The first plunger is indicated by **134** and the nine other plungers at *j–r*. It will be realized that plungers similar to **134** and *j–r* will be positioned over the lower die cavities **102**, **106**. Also, lower die cavities similar to **102**, **106**, **116** and *a–i* will be below plungers **134** and *j–r*. It is seen in the illustrated form that ten workpieces are formed on one side of the press in one set, and another set of ten are formed on the other side of the press in the other set. Not only do the opposed sets lead to a greater number of workpiece formations, but this is done more efficiently since the pressures for forming such workpieces are directed toward one another to prevent undue strain from pressure overload on one side of the press. The number of angular channels and side rams or punches in a given set may be further increased by building larger presses to meet a particular operation. In any event, advantages will be realized from forming a plurality of workpieces in an efficient manner because of the opposed relationship of the angular channels and rams or punches on each side of the press.

The use and operation of the invention are as follows:

Preferably a number of tubular workpieces, such as copper pipe, are formed in opposite set to realize the advantage of multiple formation in a generally single operation, and to more efficiently execute the formation by preventing undue pressure strain from opposed pressure forces. Elbows with a tight radius, that is substantially right angle elbows, can be successfully formed with such a press and method. A method is provided for realizing such advantages and the steps of a method may be illustrated by reference to FIGURES 4–7. In FIGURE 4, a tubular workpiece **160** is placed in a lower die cavity **162** of a first die part **164** after a second die part **165** has been moved away.

When closed, the die cavities **168–162** form a lateral branch **175** of the angular channel **170**. This lateral branch is dimensioned for the tubular workpiece **160**. The remaining portion of the angular channel is the upright branch **172** which has been shown as a passageway formed in the second die part **165**. The ram **174** of the side punch is then moved into the lateral branch **175** of the angular channel to press the workpiece **160** around the bend **176** and into the upright branch **172**. FIGURE 6 shows the workpiece formed in that it has been pressed around the bend and against the resistance plunger **178**. The plunger in FIGURE 6 has been displaced from its first position as shown in FIGURES 4 and 5.

Any selected control means may be used to close the first and second die parts, and such will include conventional hydraulic circuitry. Such a control need not be described because it is not otherwise unusual or essential to the practice of the method.

Once the displacement of the resistance plunger has reached its predetermined limit, continued pressure build-up will occur from the urging of ram **174** against the workpiece **160**. This continued pressure build-up will cause the die parts to separate after the pressure build-up or gradient reaches a preselected level.

Referring now to FIGURE 8, the pressure gradient against resistance plungers such as **178** and **178***a* will be transmitted along hydraulic line **180** against check valve **181** until a preslected level of the relief valve **182** is exceeded, say 3,000 p.s.i. The relief **182** will then open to sump **184**. A higher pressure gradient will then open the second die part to a first control station which is slightly below top dead center. This open position is represented in FIGURE 7.

The workpiece **160** is securely seated within die cavity **168** of the second die part. When the die parts are opened, receiving means are inserted between the second and first die part to receive the workpiece after it is dislodge from cavity **168**. Such receiving means are not illustrated or described because they can be any conventional tray or equivalent operated manually, semi-automatically or automatically. The point is that such receiving means are interposed between the open die parts at this first control station to receive the workpieces when they are dislodged. Once the receiving means are in position, then the second die is moved to a second control station which is preferably at top dead center, but may be otherwise. Again, any conventional hydraulic circuit and assembly may be used to move the second die part to such second station. The important point is that at such a preselected second station, means actuate the resistance plunger **178** so it is suddenly displaced towards the first die part in a knockout step.

One of the ways for actuating said resistance plungers is further illustrated in FIGURE 8. A second die part at the second control station energizes a solenoid **186** which operates a three way valve **188** so that it delivers a sudden high pressure level of fluid along line **180** to knockout resistance plungers **178**, **178***a*. Following the knockout step, conventional control means may be used to retract the resistance plunger to its displaced position from the first die part or a position as shown in FIGURE 4. At this point the cycle is ready to be started again, and another workpiece may be deposited in the first die cavity **162**. Such control means may include repositioning of the three way valve **188** so that a fluid pressure may be moved along line **180** to sump **190**. This may be conventionally accomplished by providing fluid pressure on the opposite side of the cylinders controlling the resistance and knockout plungers **178**, **178***a*. Such return line is not shown because it is conventional.

To realize the fullest advantages of the invention it is required that some of the various controls operate or be

operated simultaneously. The side rams or punches aligned with the lateral branches of the angular channels in each of the opposite sets will be actuated by any suitable control means to generally simultaneously urge the workpieces around the bends and against the resistance plungers. All the resistance plungers will be generally simultaneously displaced away from the first or lower die parts as the angular or elbow workpieces are being formed. This generally simultaneous pressure operation will be counteracted by the opposite set to prevent undue strain on the press. Following the angular formation of the workpieces, the side rams may be withdrawn simultaneously although this is not required. After the upper die is raised to the second control station, the resistance plungers will preferably be actuated generally simultaneously. It is not particularly required that the resistance plungers in both sets be executed generally simultaneously although the convenience associated with the hydraulic circuit design may make this advisable.

The other control steps are operated with attention directed only to their occurrence in the sequential steps of the process and not to any feature of simultaneous operation. Thus, control means are actuated to close the second or upper die port, to move the workpiece receiving means between the separated die parts, and to further open the second die part to a second control station to actuate the knockout plungers.

The foregoing invention can now be practiced, and such practitioners will know that the invention is not necessarily restricted to the particular embodiments presented therein. The scope of the invention is to be defined by the terms of the following claims as given meaning by the preceding description.

I claim:

1. A method for bending a tubular blank into a general elbow configuration by using separable die cavities which form an angular channel, which includes the steps of ramming a tubular blank workpiece containing filler into said angular channel, contacting the end of said tubular blank away from the end in ramming contact against a resistance plunger, setting said resistant plunger at a predetermined level so that it will yield to pressure urging of the ramming means above said predetermined level, limiting the displacement of said resistance plunger to a predetermined degree, opening the angular channel by separating the die cavities, said bent workpiece being lodged in one of the die cavities, actuating the resistance plunger to knock out the formed workpiece from said die cavity, opening the channel by moving one mold cavity to a first control station, introducing an elbow receiving means between the separated cavities of the channel, moving a die cavity to a second control station, and actuating the resistant plunger at said second control station to knock out the formed workpiece from said die cavity.

2. A method as in claim 1 further characterized by and including the steps of:

ramming a first plurality of tubular blanks in a first plurality of aligned channels, and

substantially simultaneously ramming a second plurality of tubular blanks in a second plurality of channels in a direction opposite to the ramming action of said first plurality.

3. A method as in claim 2 further characterized in that the angular channels are formed by separable upper and lower die cavities, and each upper die cavity is moved to the first control station where its movement is interrupted, means are inserted during said interrupted movement between the upper and lower cavities to receive the formed workpieces, and each of said upper die cavities is then moved to the second control station where a knockout plunger is actuated to knock out the formed workpieces lodged in the upper die cavities onto the means between the upper and lower die cavities.

4. A press for bending tubular workpieces into elbows or the like which includes, in combination, separable die parts, each die part having a complementary die cavity which forms an angular channel when the die parts are closed, a first branch on the angular channel adapted to receive a tubular blank workpiece, a second branch, a reciprocal resistance plunger disposed in said second branch, a bend in the angular channel separating said first and second branches, a press associated with said first branch, a ram of the press aligned with said first branch, said ram adapted to press the workpiece around said bend in said angular channel, means to limit the displacement of the resistance plunger in said second branch when said tubular workpiece contacts the resistance plunger, said limited displacement corresponding to a predetermined length of said workpiece on one side of the bend, pressure responsive means adapted to separate the dies when the pressure on the resistance plunger from the blank exceeds a predetermined level, means to actuate the resistance plunger when said dies are separated to knock out the formed tubular workpiece from one of the complementary die cavities, a first die separable from a second die, said first and second dies having opposed complementary cavities which, when the dies are closed, form opposed angular channels, each first branch of said opposed channels having aligned punches adapted to receive a ram to press a tubular workpiece around a bend, said punches adapted to ram the tubular workpieces in each of the opposed angular channels generally simultaneously to form additional angular workpieces to counteract opposite pressure forces, a first set of a plurality of angular channels between the separable dies, a punch being associated with each channel in the first set, a resistance plunger being associated with each channel in the first set, an opposed second set of a plurality of angular channels, a punch being associated with each channel in said second set, and a resistance plunger being associated with each channel in said second set so that the respective punches and respective resistance plungers in said first and second sets operate generally simultaneously in forming the angular tubular workpieces, each resistance plunger in a set including an angular channel formed between a separable upper die and a lower die, substantial portions of said upper and lower dies having cavities which together conform to the shape of the workpiece inserted into the angular channel, said upper die further having a passageway to receive a portion of the workpiece after it has moved around the bend in the angular channel, and a resistance plunger reciprocally mounted in said passageway of the upper die.

5. A press for bending tubular workpieces into elbows or the like which includes, in combination, separable die parts, each die part having a complementary die cavity which forms an angular channel when the die parts are closed, a first branch on the angular channel adapted to receive a tubular blank workpiece, a second branch, a reciprocal resistance plunger disposed in said second branch, a bend in the angular channel separating said first and second branches, a press associated with said first branch, a ram of the press aligned with said first branch, said ram adapted to press the workpiece around said bend in said angular channel, means to limit the displacement of the resistance plunger in said second branch when said tubular workpiece contacts the resistance plunger, said limited displacement corresponding to a predetermined length of said workpiece on one side of the bend, pressure responsible means adapted to separate the dies when the pressure on the resistance plunger from the blank exceeds a predetermined level, means to actuate the resistance plunger when said dies are separated to knock out the formed tubular workpiece from one of the complementary die cavities, means associated with the resistance plunger to limit the movement of said resistance plunger towards the angular channel to initiate resistance at a desired point, and to limit movement of

the plunger away from the angular channel to correspond with the desired length of the formed tubular workpiece.

6. A press as in claim 4 further characterized by and including means to limit the movement of the upper die to a first position after the workpieces are formed to permit interposing a workpiece receiving means between the dies, control means to move the upper die to a second position, and means actuated at said second position to knock out the formed workpieces lodged in the upper die cavities.

References Cited

UNITED STATES PATENTS

2,701,002	2/1955	Arbogast	72—57
2,907,102	10/1959	Armstrong	29—157
3,220,098	11/1965	Arbogast	72—57

FOREIGN PATENTS

904,645	8/1962	Great Britain.

CHARLES W. LANHAM, *Primary Examiner.*