Sept. 14, 1943. G. FIFE 2,329,173

DRAWING TOOL

Filed Dec. 3, 1941 3 Sheets-Sheet 1

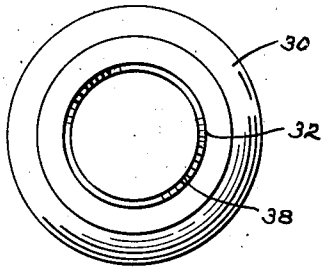


Fig. 1

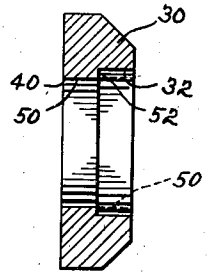


Fig. 3

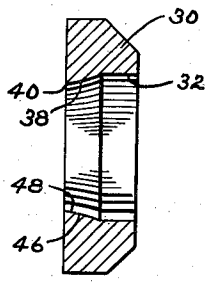


Fig. 2

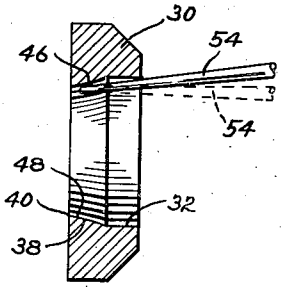


Fig. 4

Prior Art

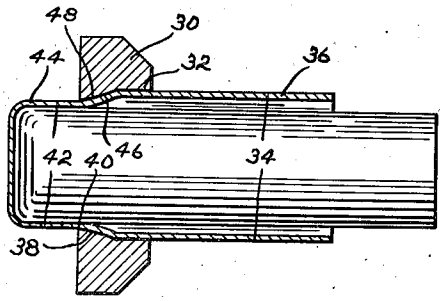


Fig. 5

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DRAWING TOOL

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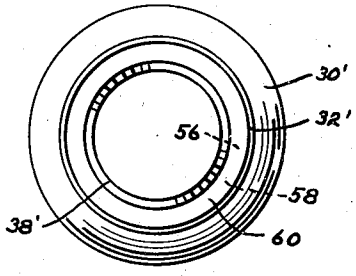


Fig. 6

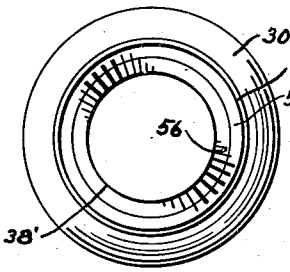


Fig. 7

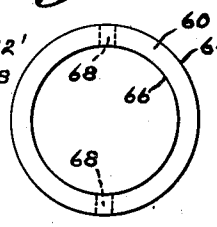


Fig. 8

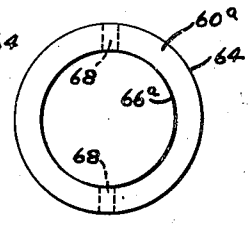


Fig. 9

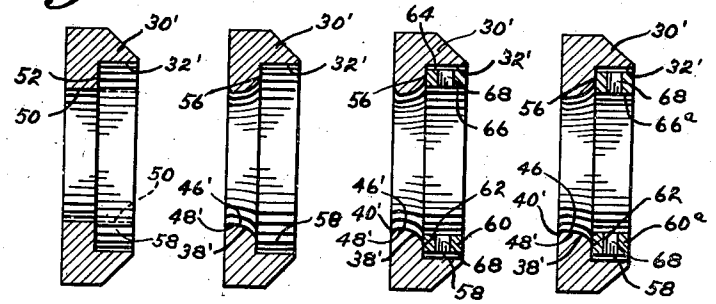


Fig. 13 Fig. 12 Fig. 10 Fig. 11

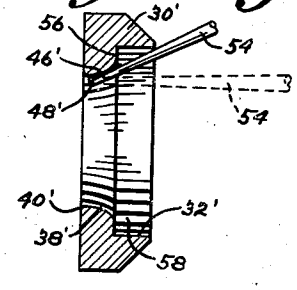


Fig. 14

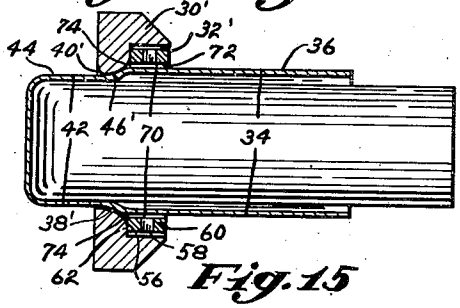


Fig. 15

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DRAWING TOOL

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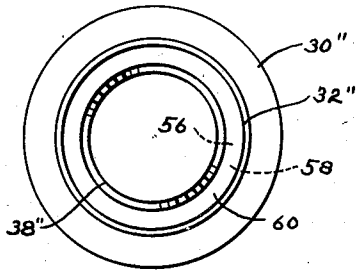


Fig. 16

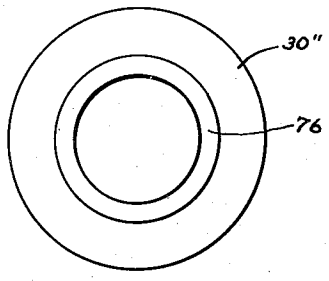


Fig. 17

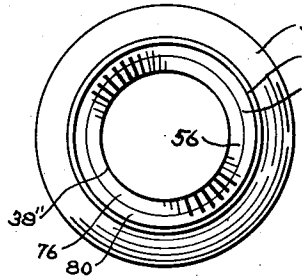


Fig. 18

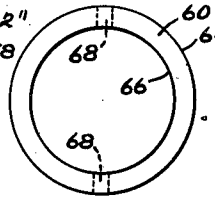


Fig. 19

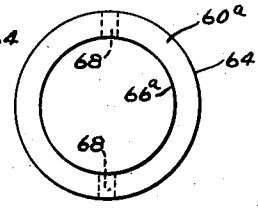


Fig. 20

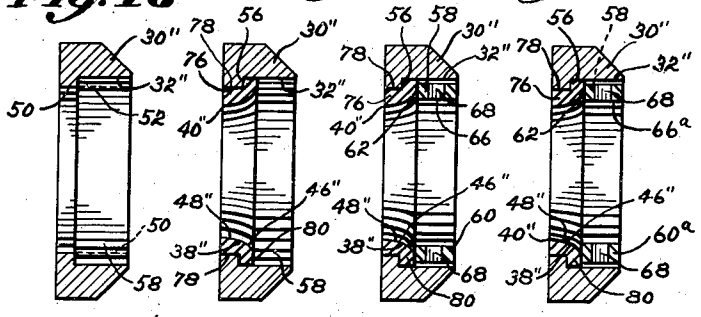


Fig. 24 Fig. 23 Fig. 21 Fig. 22

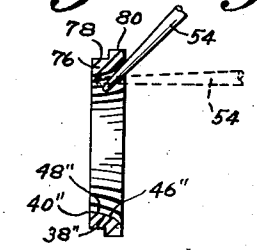


Fig. 25

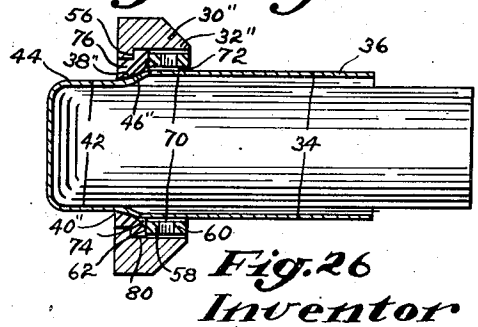


Fig. 26

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2,329,173

UNITED STATES PATENT OFFICE

2,329,173

DRAWING TOOL

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Application December 3, 1941, Serial No. 421,469

14 Claims. (Cl. 205—26)

My invention relates to improvements in drawing tools and methods of their manufacture and use. While my invention is particularly adapted for use in drawing tubing, it may, if desired, be also employed for use in drawing any cylindrical material, such as wire. It is primarily adapted for use in drawing cylindrical tubing, such as fountain pen stock, pencil stock, cartridge shells, shell casings, lipstick holders, etc. It is particularly adapted for use in drawing tubing of any material, but particularly suited, however, for drawing tubing of relatively soft metal, such as of brass, precious metal or precious metal plate.

In the prior art, dies for this purpose have usually comprised a cylindrical die holder having an inlet bore portion of substantially the inlet diameter of the tubing and an outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said inlet portion. Such dies have been constructed by drilling a hole through the die holder of substantially the desired outlet diameter of the drawn material, making a larger concentric inlet bore portion of substantially the inlet diameter of the material to be drawn forming a shoulder between said inlet and outlet portions and grinding or lapping off the shoulder at the inner edge of said inlet portion to form the annular drawing internal surface in said outlet portion. Inasmuch as it is usually impossible to draw down tubing much more than one-eighth inch in a single action press, there has only been room to grind or lap down the annular drawing surface on the internal periphery of the outlet drawing die portion with a relatively large radius due to the fact that it is impossible to swing the lapping tool through a large arc, its pivotal motion away from the axis being limited by the wall of the inlet portion to a small number of degrees. Another disadvantage of dies employed in the prior art is that they only permit the use of material of one inlet diameter and thus to draw down to one outlet diameter one has been limited to the use of material of a single inlet diameter, requiring the necessity of the expense of providing different dies if it be desired to draw down tubular stocks of different inlet diameters to a single outlet diameter. In the prior art the inlet bore portion of such a die has been of substantially the inlet diameter of the stock to be drawn and the material of the inlet bore portion of the die being integral with the material of the die portion has had to be of the same hardness and if any dirt should be carried by the tubing into the inlet portion of such a die, it has tended to scratch the hard metal in the inlet portion of such a die which in turn scratches the soft metal being drawn, and it has been necessary to continuously polish the metal of such an inlet portion to eliminate such scratches, thereby quickly wearing out the diameter of the inlet portion to such an excessive diameter that the die soon had to be discarded.

A further objection to prior art dies has resided in the fact that initially there has been insufficient clearance between the inlet diameter of the stock and the diameter of the inlet portion of the die to permit the stock to carry any appreciable amount of lubricant to the drawing surface, tending to form dry spots on the drawing surface portion to which gold plate might stick, scratch or scuff.

General objects of my invention, therefore, are to overcome these difficulties of prior art dies, and my invention includes initially making the inlet bore portion of the die holder of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn, preferably terminating in a shoulder at the inner end thereof and providing an annular pocket for the reception of a guide ring of softer material, usually substantially of the hardness of the material to be drawn. Inasmuch as initially the inlet bore of the die holder is much larger than formerly, it will provide plenty of room for tilting or lapping the grinding tool through a much greater arc to provide a drawing surface with a desirable small radius on the internal periphery of the outlet die portion. This feature is desirable as it provides a greater surface for more evenly drawing the tubing, hence eliminating stretch in the material drawn, which is particularly disadvantageous in plated tubing and shells.

A further object of my invention is to provide a guide ring of a hardness substantially that of the metal to be drawn. As stated, scratches have been caused by pieces of dirt scratching the hard metal of the inlet portion of former die holders, which have thus been transmitted from the hard metal to the soft metal being drawn therethrough. Even if scratches are made on the internal periphery of my improved guide ring, it is of such a hardness that such scratches will not be transmitted to the cylindrical material of substantially the same hardness being drawn therethrough. In the event that the internal periphery of my improved guide ring becomes too scratched, it is obvious that the guide ring may be replaced,

without repeatedly polishing the outlet surface as formerly, to quickly wear out the die.

A highly desirable object of my invention is to permit the use of stock or material of different inlet diameters which may be drawn to a single outlet diameter. As stated, in the prior art it has been impossible to do this without providing a die for each different inlet diameter. In my invention I may employ a plurality of guide rings having external peripheries of similar size to fit in the pocket and internal peripheries of different sizes corresponding to the inlet diameters of the different diameter material to be drawn, whereby a selected guide ring may be inserted on each change of material of different inlet diameter so that said tool may draw the material to a predetermined outlet diameter from materials of different inlet diameters.

A further object of my invention is that due to the improved structure of my improved drawing tool I am able to provide better lubrication. In the prior art there has been a tendency to make the inlet portion with substantially no clearance to partially eliminate the ingress of dirt causing scratches, and to provide sufficient material on the internal periphery of the inlet portion so that the die may be polished down to eliminate scratches and still remain useful for a greater period of time. Employing my structure, however, I am able to provide each guide ring with an internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn, which may be used a substantial number of times without repolishing, and being of such a standard clearance distance will permit the ingress of fluid to the drawing surface for better lubrication.

A further object of my invention is to provide means for the ready removal of individual guide rings from the outlet pocket, in my preferred embodiment comprising diametric holes in the internal periphery of each guide ring, which holes may tend to fill up with lubricant to form a reservoir adjacent the drawing surface. In addition, in my improved embodiment an annular reservoir is formed between the inner surface of the guide ring and the outer edge of the drawing surface, which provides a supplemental lubricant reservoir immediately adjacent the drawing surface to provide such lubrication that the dry spots heretofore referred to are substantially eliminated.

A further object of my invention is to provide a structure which will permit the more facile polishing or regrinding of the drawing surface on removal of a guide ring, inasmuch as the polishing tool is able to swing through a wider arc than formerly as in the initial shaping operation.

A further object of my invention is to provide a structure which is particularly advantageous for use with a die insert of hard drawing material which may have a cylindrical outer periphery shrunk or otherwise affixed to the outlet bore, and if desired a retaining flange projecting radially outwardly from the inlet end thereof over the aforedescribed pocket shoulder, substantially filling the inner portion of said annular pocket, and an internal periphery which may be readily formed or ground through a still wider arc with no limitation to the swinging movement of the grinding tool, prior to its insertion within the outlet bore, and which, if desired, may thus be provided with a still smaller radius. I am aware that others have provided inserts covering the entire internal periphery of a die holder. My improved construction of a drawing tool permits the use of a die insert of the length of the outlet portion of the die holder only, thereby requiring much less of the expensive hard material formerly thought necessary.

Further objects of my invention relate to improvements in drawing cylindrical material, which comprises drawing the material through a die having a drawing surface of relatively small radius while accurately aligning the material to be drawn within said die.

Further objects of my invention relate to improvements in the method of making my improved drawing tool which permit grinding the drawing surface of the tool with a much smaller desirable radius than formerly.

These and such other objects of my invention as may hereinafter appear will be best understood from a description of the accompanying drawings, which illustrate various embodiments thereof.

In the drawings,

Figs. 1–5 illustrate features of prior art structures of drawing dies for single action drawing presses;

Figs. 6–15 illustrate similar views of a single integral die and die holder constructed in accordance with my invention; and

Figs. 16–26 illustrate similar views of a die holder constructed in accordance with my invention, employing a drawing die insert of hard drawing material in the die holder.

Fig. 1 is a face view of a typical prior art drawing die for use in a single action press.

Fig. 2 is a diametric sectional view of the die shown in Fig. 1.

Fig. 3 is a diametric sectional view therethrough illustrating an initial stage in its manufacture prior to grinding the drawing surface.

Fig. 4 is a diametric sectional view similar to Figs. 2 and 3, illustrating the grinding tool in the act of arcuately grinding the drawing surface and illustrating the possible tiltable movement of the grinding tool in grinding such a surface with this prior art structure inhibiting the drawing of a grinding surface of desirable small radius.

Fig. 5 is a diagrammatic sectional view illustrating a punch in the act of punching a suitable shell through the drawing die shown in Figs. 1 and 2, showing the punch in elevation.

Fig. 6 is a face view of one embodiment of a drawing tool constructed in accordance with my invention.

Fig. 7 is a face view of the combination die holder and die thereof with the guide ring removed.

Fig. 8 is a face view of a guide ring insertable within the pocket of the die holder shown in Fig. 7 to make up the drawing tool shown in Fig. 6.

Fig. 9 is a face view of a guide ring similar to the guide ring shown in Fig. 8 but having a different internal diameter which may be selectively alternatively inserted in the pocket shown in Fig. 7.

Fig. 10 is a diametric sectional view of the die holder shown in Fig. 7 with the guide ring shown in Fig. 8 inserted in the pocket thereof to make up the drawing tool.

Fig. 11 is a diametric sectional view of the die holder shown in Fig. 7 with the guide ring shown in Fig. 9 inserted in the pocket thereof to make up the drawing tool.

Fig. 12 is a diametric sectional view taken

through the combination die and die holder shown in Fig. 7.

Fig. 13 is a diametric sectional view taken through the combination die holder and die shown in Figs. 7 and 12, illustrating an initial stage in its manufacture prior to grinding the drawing surface.

Fig. 14 is a diametric sectional view similar to Fig. 13 illustrating the grinding tool in the act of arcuately grinding the drawing surface and illustrating the possible tilting movement of the grinding tool in forming the drawing surface with a die holder constructed in accordance with my invention, permitting the formation of an internal drawing surface of desirable small radius.

Fig. 15 is a diametric sectional view illustrating a punch in the act of punching a suitable shell through the drawing tool shown in Figs. 6 and 10, showing the punch in elevation.

Fig. 16 is a face view of a different embodiment of a drawing tool constructed in accordance with my invention employing a hard metal drawing insert.

Fig. 17 is a reverse view of the embodiment of the drawing tool shown in Fig. 16.

Fig. 18 is a face view of the combination die holder and die with the guide ring removed of the embodiment of my invention shown in Figs. 16 and 17.

Fig. 19 is a face view of a guide ring insertable within the pocket of the die holder shown in Fig. 18 to make up the drawing tool shown in Figs. 16 and 17.

Fig. 20 is a face view of a guide ring similar to the guide ring shown in Fig. 19 but having a different internal diameter which may be selectively inserted in the pocket of the die holder shown in Fig. 18.

Fig. 21 is a diametric sectional view of the die holder shown in Fig. 18, with the guide ring shown in Fig. 19 inserted in the pocket thereof to make up the drawing tool.

Fig. 22 is a diametric sectional view of the die holder shown in Fig. 18, with the guide ring shown in Fig. 20 inserted in the pocket thereof to make up the drawing tool.

Fig. 23 is a diametric sectional view taken through the combination die and die holder shown in Fig. 18.

Fig. 24 is a diametric sectional view taken through the combination die holder and die of the embodiment of my invention shown in Fig. 23, illustrating an initial stage in its manufacture prior to affixing the insert thereto.

Fig. 25 in a diametric sectional view illustrating the grinding tool in the act of arcuately grinding the drawing surface on the insert prior to affixing it within the die holder and illustrating the possible tilting movement of the grinding tool in forming the grinding surface on such an insert, permitting the formation of an internal drawing surface of extremely small desirable radius.

Fig. 26 is a diametric sectional view illustrating a punch in the act of punching a suitable shell through the drawing tool shown in Figs. 16, 17 and 21, showing the punch in elevation.

In the drawings, wherein like characters of reference generally indicate like parts throughout, in order that the novel features of the embodiments of my invention shown respectively in Figs. 6–15 and 16–26 may be better understood, I have illustrated in Figs. 1–5 a typical prior art drawing tool for use in drawing tubing or wire particularly adapted for use in a single action press in drawing tubing or wire. In order that the advantages of my invention may be more clearly understood I will first describe such a prior art die and then describe the novel features of my invention. In the prior art such a drawing tool has comprised an integral drawing die and die holder **30** having an inlet bore portion **32** of substantially the inlet diameter of the cylindrical material to be drawn, such as the inlet diameter **34** of the tubing **36**, and an outlet die portion **38** having an inner edge **40** of substantially the diameter of the desired outlet diameter **42** of the drawn cylindrical material **44**, having an annular drawing internal surface **46** tapering arcuately axially and radially outwardly as at **48** to the inner edge of said inlet portion **32**. Such dies have usually been constructed, as shown in Fig. 3, by drilling a hole **50** through the die holder of substantially the desired outlet diameter **42** of the drawn material **44** and then drilling a larger concentric inlet bore portion **32** of substantially the inlet diameter **34** of the material **36** to be drawn, forming a shoulder **52** between said inlet portion **32** and outlet portion **38**, and grinding or lapping off said shoulder **52** at the inner edge of said inlet portion to form the annular drawing internal surface **46** tapering arcuately axially and radially outwardly as at **48** to the inner edge of said inlet portion. With this type of prior art construction, inasmuch as it is usually impossible to draw tubing down more than ⅛ of an inch on a single action press, there has only been room, as shown in Fig. 4, to grind or lap down the annular drawing surface **46** of the outlet drawing die portion **38** with a relatively large radius **48**. This annular surface **46** may be drawn or lapped down in any suitable manner, but it is usually ground or drawn down, as shown in Fig. 4, by pressing the inner end of a grinding tool **54** against said surface **50** while rotating the die holder **30** at high speed. Inasmuch as there is usually only ⅛" difference between the inlet bore **32** and the outlet bore **50**, as also illustrated in Fig. 4, it has only been possible to swing the drawing tool **54** through a very small arc from the position shown in dotted lines in Fig. 4 to the position shown in full lines in Fig. 4, the full line position being limited by the grinding tool **54** striking the internal periphery of the inlet bore **32**, thus limiting the possible tilting movement of the grinding tool **54** to an angle of a few degrees only permitting the formation of an annular drawing surface **46** of relatively large radius. It is obvious that drawing tools made in this manner can have only one inlet diameter **32** and that if it is desired to draw stocks of different inlet diameters down to a standard outlet diameter it has been necessary to employ different dies. In the prior art dies the entire die holder has usually been constructed of integral metal, usually hard steel. Any dirt, therefore, which may be carried by the tubing or other material being drawn into the inlet bore **32** will tend to scratch the hard metal of the inlet bore, which scratches may be readily imparted to the softer material being drawn, and scratches have been so frequent that in order to remove them it has been necessary to grind down the inlet bore so frequently that the bore gets so large that the die has to be soon discarded. To make these dies last longer the inlet bore portion **32** has been made of substantially the diameter of the inlet diameter **34** of the material **36** to be drawn, thus inhibiting suitable lubrication for the drawing surface **46**. These types of dies are usually employed for drawing tubing or shells made of soft metal, such as brass,

bronze, precious metal or precious metal plate, and with insufficient lubrication dry spots have been formed on the drawing surface to which precious metal plate would stick, scratch or scuff.

As stated hitherto, objects of my invention have been to overcome these prior art difficulties, and in the embodiment of my invention shown in Figs. 6–15, I have illustrated a drawing tool having an integral die holder and die, and in the embodiment of my invention shown in Figs. 16–26, a die holder having a hard metal die insert of substantially the length of the outlet portion of the die holder only.

The use of inserts on dies has been common, but they have usually comprised cylindrical members extending through the entire body of the dies including the inlet and outlet portions. A suitable composition for such an insert usually comprises a carbide, such as tungsten carbide, boron carbide, usually with a small percentage of cobalt binder. Such products have been sold under various trade names, such "Carboloy" and "Widia Metal" and the like and are extremely hard and efficient for drawing purposes.

In the embodiments of my invention shown in Figs. 6–15 and 16–26, I initially make the inlet bore 32' or 32'' of the die holder of substantially larger diameter than the inlet diameter 34 of the cylindrical material to be drawn, preferably in the finished state terminating in the shoulder 56 at the inner end thereof and providing an annular pocket 58 for the reception of a guide ring 60 of softer material, usually substantially the hardness of the material to be drawn. As shown in Fig. 14, inasmuch as initially the inlet bore 32' of the die holder is much larger than formerly, it will provide plenty of room for tilting or lapping the grinding tool 54 through a much greater arc to provide a drawing surface 46' with a desirable small radius 48' on the internal periphery of the outlet die portion. As stated hitherto, this feature is desirable as it provides a greater surface for more evenly drawing the tubing and eliminating the stretch. My invention also includes a guide ring 60 of a hardness substantially that of the material to be drawn and of substantial axial length removably contained within said pocket 58 with the inner edge 62 thereof abutting said shoulder 56. As shown in the embodiment shown in Figs. 6–15, the annular drawing surface 46' is not only ground to extend arcuately up to said shoulder 56, but preferably leaves a substantial shoulder 56 at all times for the inner edge 62 of the guide ring 60 to abut. As stated hitherto, my improved drawing tool covering the combination of the integral die holder and die having a pocket and the guide ring inserted within said pocket not only permits the provision of a drawing surface 46' with a desirable smaller radius, but has three additional features about to be described. As stated, a selected guide ring may be selected from a group of guide rings 60 or 60^a having an external periphery 64 of similar size and an internal periphery 66 or 66^a of different sizes corresponding to the inlet diameters of different sized cylindrical material, whether it comprises tubing or wire to be drawn. The outlet diameter 42 of the tubing is always the same and as stated is governed by the inner edge 40 of the drawing surface 46' or 46'', but with the substitution of the ring 60^a for the ring 60 in the pocket 58, it is apparent that a material of a smaller inlet diameter than the material for which the guide ring 60 is used may be employed and that each may be drawn down to the same outlet diameter 42. The guide rings 60 or 60^a are preferably constructed of a relatively soft metal, such as brass, bronze, etc. While the internal peripheries of such soft material may be scratched, they are of substantially the hardness of the cylindrical material 36 to be drawn so that scratches on the internal peripheries 66 of the guide rings will not be imparted to the external periphery of the tubing, thereby eliminating the necessity for polishing off the scratches and wearing away the inlet bore 32 of the die holder in the manner previously described, requiring the early discarding of the entire die. Thus drawing tools constructed in accordance with my invention not only wear much longer, but a single tool may be employed in drawing down material of different inlet diameters to a predetermined outlet diameter by merely selectively changing the guide ring 60 thereof.

In addition, the removable guide ring 60 may be provided with suitable means for the ready removal thereof from the pocket 58, in the embodiment shown said means comprising the diametric holes 68 in the internal periphery thereof which may be gripped by any suitable tool. A further result of my improved drawing tool is that I am able to provide a standard and proper amount of lubrication at all times by providing the guide ring with an internal periphery of a diameter 70 of a clearance distance greater than the inlet diameter 34 of the material to be drawn so that there will always be an annular passage 72 between the external periphery of the material to be drawn and the internal periphery 70 of the guide ring 60 to permit the tubing to always carry lubricant to the drawing surface 46' or 46''. In addition, an annular reservoir 74 will be formed between the inner edge 62 of the guide ring 60 and the outer portion of the drawing surface 46' or 46'' immediately interior of the annular shoulder 56 and a supplemental lubricant reservoir will be provided by the diametric holes 68. Thus with my improved construction proper lubrication is at all times assured, eliminating dry spots on the drawing surface 46' or 46'' and consequent damage to plated drawn material.

As stated, the embodiment of my invention shown in Figs. 16–26 is exactly similar to the embodiment of my invention shown in Figs. 6–15, with the exception that a small substantially cylindrical hard metal insert 76 is shrunk or otherwise affixed within the outlet bore portion 50 of the die holder. As stated, said insert 76 may be constructed of tungsten carbide or other suitable hard material. The die insert 76 has a cylindrical external periphery 78 secured to, preferably by shrinking, said outlet bore 50. In the preferred embodiment shown, said insert 76 also has a retaining flange 80 projecting radially outwardly from the inlet end thereof over said shoulder 52 formed between said inlet and outlet bores 32 and 50, said flange 80 substantially filling the inner portion of said annular pocket 58. Said insert has an internal periphery 46'' having an inner edge 40'' of substantially the diameter of the desired outlet diameter 42 of the drawn cylindrical material 44 having an annular drawing internal surface 46'' tapering arcuately axially and radially outwardly as at 48'' with a relatively small radius to said insert flange 80. Thus the embodiment shown in Figs. 6–15 is substantially identical to the embodiment shown in Figs. 16–26 with the

exception that the latter embodiment has a drawing surface 46'' constructed on a cylindrical insert 76 shrunk or otherwise secured within said outlet bore portion 50 instead of having the drawing surface 46' formed on said outlet bore 50, as in the embodiment of my invention shown in Figs. 6–15. The insert 76 is not only shrunk within said outlet bore portion 50 but also is preferably provided with the retaining shoulder 80 to abut the shoulder 52 to positively prevent the insert 76 from being pulled out of the die holder 30''. As stated, while inserts have been employed in the prior art, they have usually extended the entire internal length of the die holder and it is apparent that inasmuch as my improved insert 76 only extends substantially the length of the outlet bore portion 50, it takes up much less expensive hard drawing material than former types of inserts. As shown in Fig. 25, the insert preferably has the drawing surface 46'' formed thereon prior to insertion within the bore 50. As shown in Figs. 25, the grinding tool 54 may be tilted through a larger arc in grinding the drawing surface 46'' on the internal periphery of the insert 76 than is even possible in grinding the drawing surface 46' on the embodiment of my invention shown in Figs. 6–15, the grinding tool 54 being swingable from the dotted to the full line position shown through an arc substantially unlimited by any abutting surface, and thereby permitting the formation of an extremely even and small radius on the arcuate drawing surface 46''. In the drawings, for drawing tubing down to an outlet diameter of one inch, I have illustrated suitable guide rings for drawing stock down from tubing of $1\frac{3}{32}$ inch, $1\frac{4}{32}$ inch and $1\frac{5}{32}$ inch, with the suitable guide rings varying $\frac{1}{32}$ for this purpose, although for larger sizes a wider range of inlet diameters and internal diameters for guide rings is possible.

It is thus apparent that I have provided a novel method of drawing cylindrical material of a uniform outlet diameter from materials of different inlet diameters, which comprises forcibly passing said material through a die having a frustro-conical drawing surface tapering arcuately axially and radially outwardly, preferably with a small radius while guiding said material into said drawing surface through a selected guide of substantial length immediately adjacent the inlet end of said drawing surface of a diameter only slightly greater, preferably only a clearance distance greater than the inlet diameter of the selected material to be drawn.

It is also apparent that I have provided a novel method of making a drawing tool, which comprises constructing the die holder and die in such a manner that the grinding tool may be applied against the internal periphery of the outlet portion from the outer edge thereof to provide an annular drawing internal surface tapering arcuately axially and radially outwardly from the inner edge thereof with a relatively small radius, a feature long sought in the prior art but never attained in the prior art dies of this description, as illustrated in Figs. 1–5.

It is apparent, therefore, that I have provided a novel type of drawing tool and a novel method of making the same, and a novel method of drawing cylindrical material, with the advantages described above.

It is understood that my invention is not limited to the specific embodiments shown or methods described and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What I claim is:

1. A tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn terminating in a shoulder at the inner end thereof providing an annular pocket and an integral outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said shoulder with a relatively small radius and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket with the inner edge thereof abutting said shoulder having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn selected from a plurality of guide rings having external peripheries of similar size and internal peripheries of different sizes corresponding to the inlet diameters of different sized material to be drawn whereby said tool may draw material to a predetermined outlet diameter from material of different inlet diameters, said removable ring having diametric holes in the internal periphery thereof for ready removal from said pocket.

2. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn terminating in a shoulder at the inner end thereof providing an annular pocket and an integral outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said shoulder and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket with the inner edge thereof abutting said shoulder having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn.

3. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn terminating in a shoulder at the inner end thereof providing an annular pocket and an integral outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said shoulder with a relatively small radius and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket with the inner edge thereof abutting said shoulder having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn.

4. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn providing an annular pocket and an integral outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn.

5. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn providing an annular pocket and an integral outlet die portion having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket having an internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn selected from a plurality of guide rings having external peripheries of similar size and cylindrical internal peripheries of different sizes corresponding to the inlet diameters of different sized material to be drawn whereby said tool may draw material to a predetermined outlet diameter from material of different inlet diameters.

6. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn terminating in a shoulder at the inner end thereof providing an annular pocket and an integral outlet die retaining portion of smaller bore extending inwardly from said shoulder, a die insert of hard drawing material having a cylindrical external periphery secured to said outlet bore, a retaining flange projecting radially outwardly from the inlet end thereof over said shoulder substantially filling the inner portion of said annular pocket and an internal periphery having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said insert flange with a relatively small radius and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket with the inner edge thereof abutting said insert flange having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn selected from a plurality of guide rings having external peripheries of similar size and internal peripheries of different sizes corresponding to the inlet diameters of different sized material to be drawn whereby said tool may draw material to a predetermined outlet diameter from material of different inlet diameters, said removable ring having diametric holes in the internal periphery thereof for ready removal from said pocket.

7. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn terminating in a shoulder at the inner end thereof providing an annular pocket and an integral outlet die retaining portion of smaller bore extending inwardly from said shoulder, a die insert of hard drawing material having a cylindrical external periphery secured to said outlet bore, and an internal periphery having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly to said shoulder with a relatively small radius and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket with the inner edge thereof abutting said shoulder having a cylindrical internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn ~~selected~~ from a plurality of guide rings having external peripheries of similar size and internal peripheries of different sizes corresponding to the inlet diameters of different sized material to be drawn whereby said tool may draw material to a predetermined outlet diameter from material of different inlet diameters, said removable ring having diametric holes in the internal periphery thereof for ready removal from said pocket.

8. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn providing an annular pocket and an outlet die retaining portion of smaller bore extending inwardly from said shoulder, a die insert of hard drawing material having a cylindrical external periphery secured to said outlet bore, a retaining flange projecting radially outwardly from the inlet and thereof substantially filling the inner portion of said annular pocket and an internal periphery having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket having a cylindrical internal periphery of a diameter greater than the inlet diameter of the material to be drawn.

9. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn providing an annular pocket and an outlet die retaining portion of smaller bore, a die insert of hard drawing material having a cylindrical external periphery secured to said outlet bore, and an internal periphery having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly and a guide ring of a hard-

ness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket having a cylindrical internal periphery of a diameter greater than the inlet diameter of the material to be drawn.

10. A drawing tool for drawing shells and tubes, comprising the combination of a die holder having an inlet bore portion of substantially larger diameter than the inlet diameter of the cylindrical material to be drawn providing an annular pocket and an outlet die retaining portion of smaller bore, a die insert of hard drawing material having a cylindrical external periphery secured to said outlet bore, and an internal periphery having an inner edge of substantially the diameter of the desired outlet diameter of the drawn cylindrical material having an annular drawing internal surface tapering arcuately axially and radially outwardly with a relatively small radius and a guide ring of a hardness substantially that of the material to be drawn and of substantial axial length removably and entirely contained within said pocket having a cylindrical internal periphery of a diameter greater than the inlet diameter of the material to be drawn.

11. The method of drawing cylindrical material of a uniform outlet diameter from material of different inlet diameters which comprises forcibly passing said material through a die having a frustro-conical internal drawing surface tapering arcuately axially and radially outwardly with a relatively small radius while guiding said material into said drawing surface through a separate selected guide ring of substantial axial length immediately adjacent the inlet end of said drawing surface of a diameter a clearance distance only greater than the inlet diameter of the selected material to be drawn.

12. The method of drawing cylindrical material of a uniform outlet diameter from material of different inlet diameters which comprises forcibly passing said material through a die having a frustro-conical internal drawing surface tapering arcuately axially and radially outwardly while guiding said material into said drawing surface through a separate selected guide ring of substantial axial length immediately adjacent the inlet end of said drawing surface of a diameter a clearance distance only greater than the inlet diameter of the selected material to be drawn.

13. The method of making a drawing tool for drawing shells and tubes, which comprises forming a die holder with an annular inlet pocket portion and an outlet portion of smaller bore separated from said inlet pocket portion by an annular shoulder, applying a grinding tool against the internal periphery of said outlet portion from the inlet portion edge thereof while tilting it through an arc extending within said inlet portion while rotating said die to provide an annular drawing internal surface tapering arcuately axially and radially outwardly from the inner edge thereof to said shoulder with a relatively small radius, and inserting a guide ring member of a hardness substantially that of the material to be drawn, of substantial axial length and having an internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn entirely within said annular inlet pocket with the inner edge thereof abutting said shoulder.

14. The method of making a drawing tool for drawing shells and tubes, which comprises forming a die holder with an annular inlet pocket portion and an outlet portion of smaller bore separated from said inlet pocket portion by an annular shoulder, applying a grinding tool against the internal periphery of said outlet portion from the inlet portion edge thereof while tilting it through an arc extending within said inlet portion while rotating said die to provide an annular drawing internal surface tapering arcuately axially and radially outwardly from the inner edge thereof to said shoulder and inserting a guide ring member of a hardness substantially that of the material to be drawn, of substantial axial length and having an internal periphery of a diameter of a clearance distance greater than the inlet diameter of the material to be drawn entirely within said annular inlet pocket with the inner edge thereof abutting said shoulder.

GEORGE FIFE.