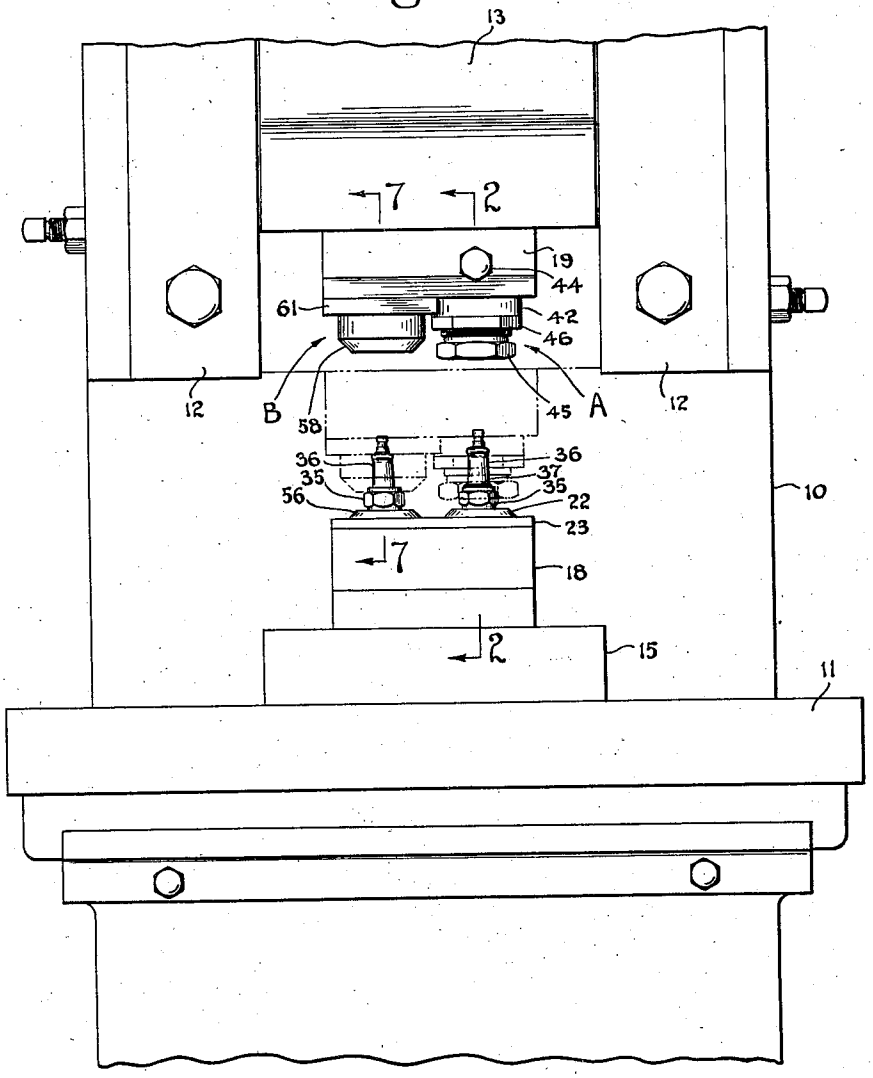
Jan. 25, 1938. A. M. BROWN 2,106,451

APPARATUS FOR ASSEMBLING SPARK PLUGS

Filed Jan. 28, 1936 3 Sheets-Sheet 1

Fig. 1



INVENTOR
Archibald M. Brown

BY Albert L. Ely

ATTORNEY

Jan. 25, 1938. A. M. BROWN 2,106,451

APPARATUS FOR ASSEMBLING SPARK PLUGS

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Fig. 2

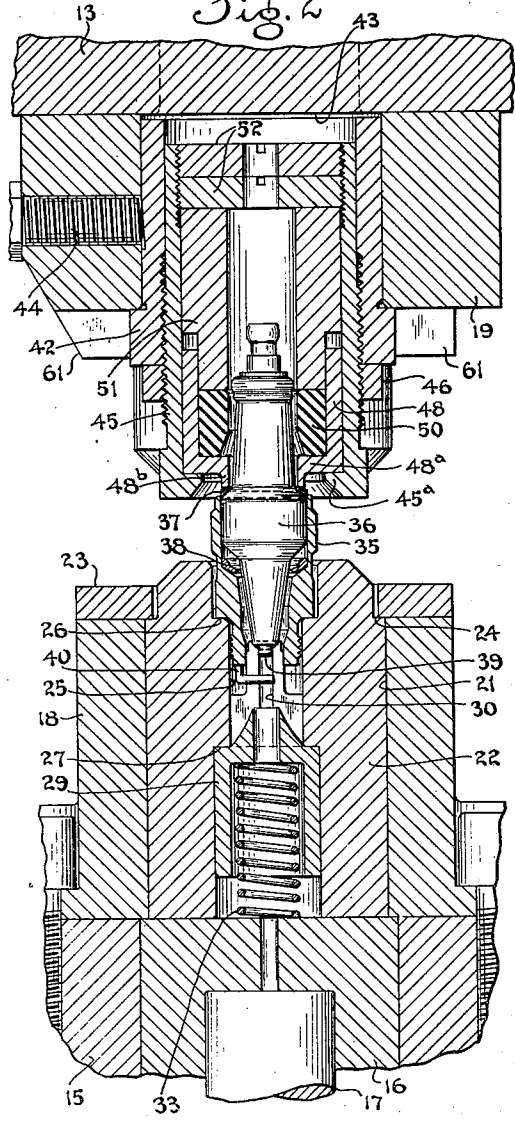


Fig. 3

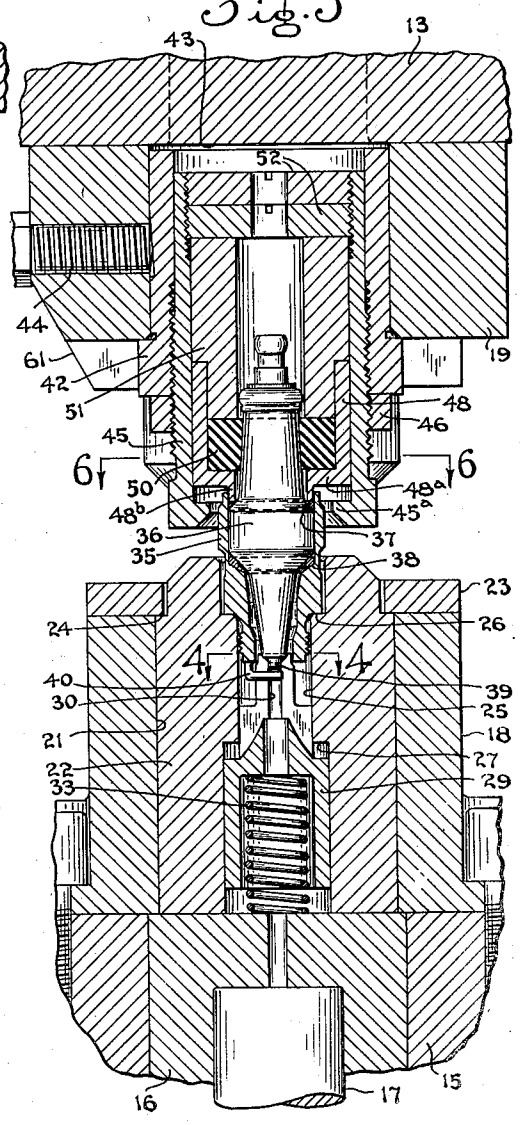


Fig. 4

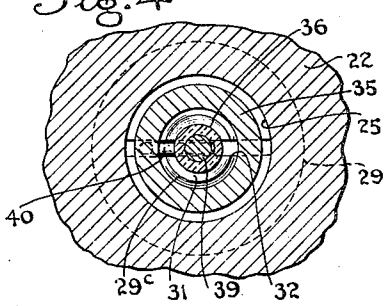
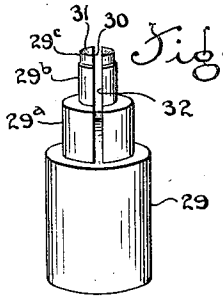


Fig. 5



INVENTOR
Archibald M. Brown

Albert L. Ely

ATTORNEY

Jan. 25, 1938. A. M. BROWN 2,106,451

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Fig. 7

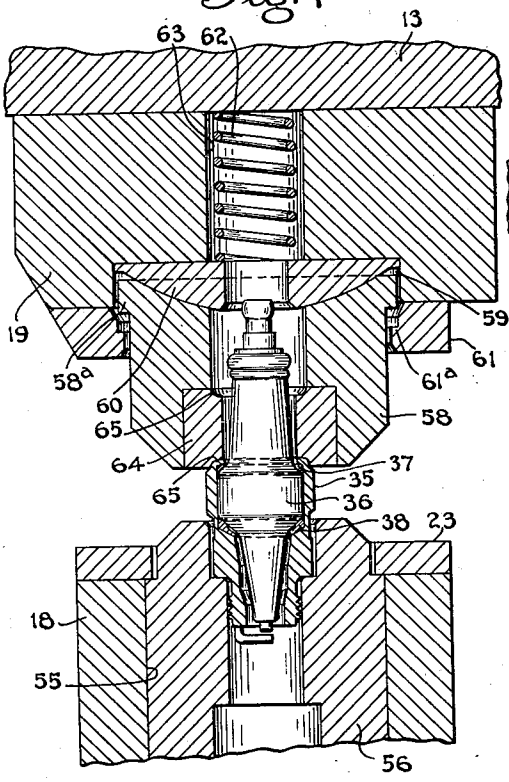


Fig. 8

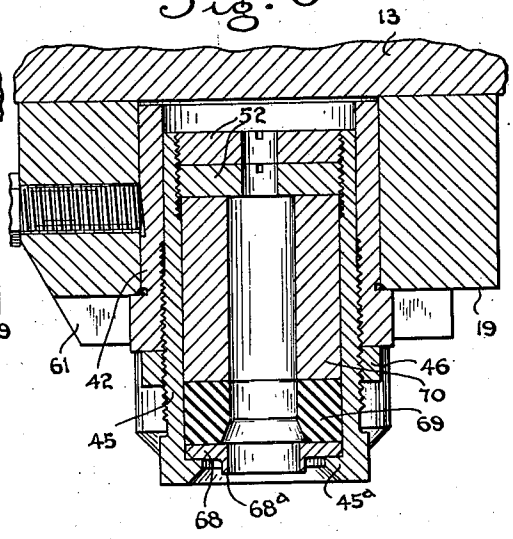


Fig. 9

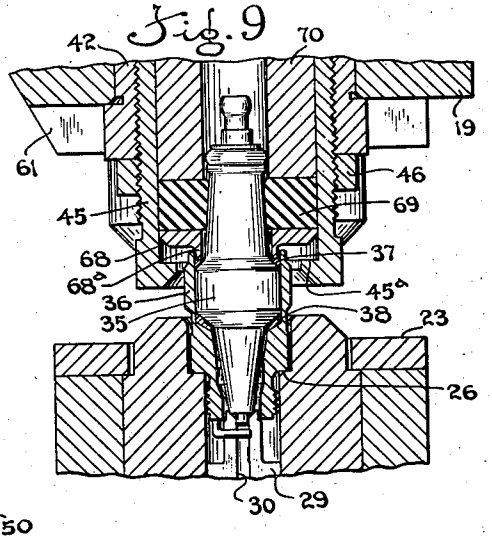
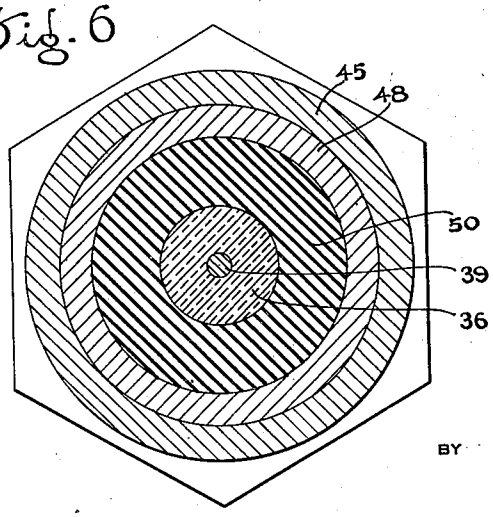


Fig. 6



INVENTOR
Archibald M. Brown

BY Albert L. Ely

ATTORNEY

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2,106,451

UNITED STATES PATENT OFFICE

2,106,451

APPARATUS FOR ASSEMBLING SPARK PLUGS

Archibald M. Brown, Akron, Ohio, assignor to The Firestone Steel Products Company, Akron, Ohio, a corporation of Ohio

Application January 28, 1936, Serial No. 61,162

14 Claims. (Cl. 29—84)

This invention relates to apparatus for assembling spark plugs, and more especially it relates to improved mechanism for assembling the porcelains and metal washers in metal spark plug shells of the crimped type.

Apparatus for the purpose mentioned as heretofore provided has not been satisfactory and has resulted in many spark plugs being rejected because of eccentricity of the central pole or electrode, and large numbers of porcelains have been broken. The aforesaid difficulties have been due primarily to the fact that the porcelains are not uniformly of true shape, and the assembling apparatus has not been adapted to compensate for slight variations from true shape.

The chief objects of the invention are to avoid the rejections and breakage that heretofore obtained in the manufacture of spark plugs; and to improve the quality of the spark plugs by assuring accurate concentricity of the porcelain of the plugs. More specifically the invention aims to provide apparatus of the character mentioned comprising means for accurately centering the porcelain with relation to the metal shell of a spark plug before the application of metal-deforming pressure upon the assembly. Other objects will be manifest.

Of the accompanying drawings:

Figure 1 is a front elevation of apparatus embodying the invention, in its preferred form, shown in inoperative position in full lines and in operative position in broken lines, and the work therein;

Figure 2 is a section on the line 2—2 of Figure 1, on a larger scale, showing the respective elements in the position they assume in the first phase of operation;

Figure 3 is a view of the elements shown in Figure 2 as they appear in the final phase of operation;

Figure 4 is a section on the line 4—4 of Figure 3;

Figure 5 is a perspective view of a centering plunger constituting one element of the apparatus;

Figure 6 is a section on the line 6—6 of Figure 3;

Figure 7 is a section on the line 7—7 of Figure 1;

Figure 8 is a vertical diametric section through the upper head of a modified embodiment of the invention, in inoperative position; and

Figure 9 is a view of the elements shown in Figure 8 in operative relation to a lower head, and the work therebetween.

Referring to the drawings, particularly Figure 1 thereof, 10 is the frame of a machine of the type known as a punch press, 11 is the table or bed plate thereof, 12, 12 are parallel, vertical guideways formed on the frame above said bed plate, and 13 is a slide movable in said guideways. The usual means (not shown) is provided for reciprocating the slide 13 vertically in its guideways, said means including a one-revolution clutch which causes the slide to descend and rise once during a cycle of operation of the apparatus. The apparatus for operating upon the spark plugs is carried in part upon the bed plate 11 and in part by the slide 13. Said apparatus consists of two units, one of which is designated A and serves to assemble a porcelain, metal shell, and metal gaskets in proper concentric relation and to deform said gaskets; the other unit, designated B, serves to crimp the metal shell to confine the porcelain and gaskets therein.

Suitably mounted upon the bed plate 11 of the apparatus is a die shoe 15 that includes a pair of pressure blocks, such as the pressure block 16, Figures 2 and 3, the latter being mounted upon the upper end of an upwardly urged rod 17 and having its upper face flush with the top face of the die shoe 15. Secured to the top of the die shoe 15 is a die holder 18 that carries the die elements of the centering unit A and the crimping unit B. Suitably secured to the bottom face of the slide 13 is a punch holder 19 that carries the punch elements of the centering unit A and crimping unit B. The details of the centering unit A will be described first, attention being directed especially to Figures 2, 3 and 4.

Mounted within a vertical, through bore 21 in the die holder 18 is a cylindrical centering die 22 that rests upon the upper face of pressure block 16, said centering die being retained in said bore by an apertured face plate 23 that is secured to the top face of the die holder and overlies a shoulder 24 formed on the said die near the upper end thereof, the top of the die projecting above the top of the face plate. The centering die 22 is formed with an axial bore 25 that is substantially smaller in diameter in its medial region than at the respective end portions thereof, the arrangement being such as to provide a ledge or shoulder 26 at the upper end of the medial region of the bore and a shoulder 27 at the lower end thereof.

Slidably mounted in the lower end portion of bore 25 is a centering plunger 29 that has an upward extension 29a of reduced diameter that is slidable within the reduced medial portion of the bore 25. Upwardly of extension 29a the plunger is formed with a further reduced portion 29b of such diameter as to fit nicely within the bore of a spark plug shell at the lower end of the latter.

The upper terminal portion of the plunger extension 29b is still further reduced in diameter, as shown at 29c, so as to have a clearance of at least 1/64 inch with the wall of the plug-shell-bore for a purpose presently to be explained. The plunger 29 is formed with an axial bore 30 that is relatively small at its upper end portion to receive and confine the central electrode that projects from the lower end of the porcelain of the work, the upper terminus of bore 30 having a flared or countersunk orifice 31 adapted to receive the lower end of said porcelain. Portions 29a, 29b and 29c of the plunger 29 are diametrically slotted at 32, which slot is of such width as to accommodate the angular electrode secured to the metal shell of a spark plug. The lower end portion of the plunger-bore 30 is of larger size so as to accommodate a compression spring 33. The latter rests upon the top of pressure block 16 and urges the plunger 29 upwardly, the upward movement of the plunger being limited by the shoulder 27 which abuts the shoulder on the plunger at the bottom of extension 29a thereof.

The ledge or shoulder 26 in the centering die 22 constitutes a seat for the work to be operated upon by the apparatus. Said work comprises a tubular metal shell 35, a porcelain 36, and upper and lower deformable metal gaskets 37 and 38 respectively. The porcelain includes a central metal electrode 39 that projects somewhat from the lower end thereof, and the usual angular, ground electrode 40 projects from the lower end of the metal shell 35. When mounted in the apparatus initially, the usual shoulder near the lower end of the shell rests upon ledge 26 in centering die 22, the extension 29b of plunger 29 fitting easily within the lower end of the bore of the shell and electrode 40 fitting within slot 32 of the plunger. The electrode 39 of the porcelain 36 fits snugly within bore 30 of the plunger, and the lower end of the porcelain rests in countersink 31 in the top of the plunger. Because the spring 33 normally holds the plunger in raised position, the porcelain 36 is consequently held in an elevated position as compared to its final, assembled position within the shell 35, as is most clearly shown in Figure 2. Gaskets 37 and 38 encircle the porcelain above and below the enlarged medial portion of the latter.

The punch mechanism of the centering unit of the apparatus comprises a tubular bushing 42 that is mounted within a vertical bore 43 in the punch holder 19 and removably retained therein by a set screw 44. The bushing 42 has its bore interiorly threaded at its lower end portion, and threaded thereinto is a tubular punch holder 45. The lower end of the latter is formed with a radially inwardly extending flange 45a, and exteriorly is of hexagonal shape as shown in Figure 6, to permit of engagement by a turning tool such as a wrench. A lock nut 46 is threaded onto the exterior of punch holder 45 for securing it in proper axial position within bushing 42.

Slidably mounted within the center bore of the punch holder 45 is a tubular centering punch 48, the lower end of which is formed with an inwardly extending circumferential flange 48a that normally rests upon flange 45a of the punch holder in the inoperative position of the apparatus. The inner perimeter of said flange 48a is formed with a concentric, downwardly-extending portion 48b of such inside diameter as to circumscribe a porcelain 36 and to engage the upper metal gasket 37 thereon, and of such length and outside diameter as to enter the upper end of the bore of shell 35 during the operation of the apparatus. Mounted within punch 48 and resting upon flange 48a at the bottom thereof is a ring 50 of deformable material such as rubber, said ring fitting snugly within the punch and having an inside diameter somewhat larger than the upper tapered portion of a porcelain 35. Resting upon the top of the rubber ring 50 is a tubular metal spacer 51 that slidably fits within the bore of punch 48, and above the latter is of larger outside diameter so as to have a sliding fit with the bore of punch holder 45. Above the spacer a pair of nuts 52, 52 are threaded into the bore of the punch holder for retaining the spacer therein. The inside diameter of the spacer 51 preferably is the same as the inside diameter of the ring 50 so that the upper end portion of a porcelain 35 may be received therein. The reduced lower end portion of the spacer 51, which fits within punch 48, is of such length as to permit limited axial movement of the spacer relatively of the punch upon deformation of the ring 50 when under compression. The resistance to compression of the rubber ring 50 is less than that of the spring 33 which opposes it in the operation of the apparatus as now will be explained.

The operation of the centering unit A of the apparatus is as follows: With the press in the inoperative position shown in full lines in Figure 1 of the drawings, a loosely assembled spark plug is mounted in die portion of the apparatus wherein it assumes the position shown in Figure 2 as previously described. The press mechanism is then actuated to effect an operative cycle of the apparatus wherein the slide 13 of the press descends and then rises again. As the slide 13 moves downwardly, the punch structure telescopes with the spark plug elements as shown in Figure 2, and the tubular extension 48b of the punch 48 engages the upper gasket 37 on the porcelain 35 of the spark plug. The spring 33 resists downward movement of the porcelain 35, with the result that downward movement of the punch 48 temporarily ceases, and continued downward movement of the spacer 51 with other parts of the punch structure applies a compressive force upon the rubber ring 50. The latter is thereby deformed and distended radially inwardly so that it grips the upper tapered portion of the porcelain 35 and centers it exactly. As the pressure upon the rubber ring increases, the resistance of spring 33 is overcome and plunger 29 is moved downwardly thereby permitting porcelain 36 and upper gasket 37 to move downwardly in the shell 35 until said porcelain engages lower gasket 38 in said shell. Compression of ring 50 also permits spacer 51 to move axially downwardly relatively of punch 48 so that in the fully compressed condition of ring 50 the upper end of the punch is in abutting relation with the shoulder at the base of the enlarged upper portion of said spacer, as shown in Figure 3.

Thus the full force of the descending slide 13 is translated to the punch for pressing and deforming the gaskets 37 and 38 in the spark plug shell, while the porcelain is held in properly centered position in the manner described. As shown in Figure 3, when the plunger 29 is moved downwardly to its lowermost position by the pressure of the porcelain 36, portion 29b of the plunger is below the lower end of the shell 35 and only the smaller terminal portion 29c of the plunger is within the bore of the said shell. This permits of slight lateral movement of the shell 35 on its seat 26, relatively of the plunger 29, to

compensate for any irregularities in the shape of the porcelain. Any excessive pressure of the centering mechanism upon the spark plug elements will be transmitted to the centering die 22, which being yieldingly mounted, will move downwardly and relieve the work of such pressure. The deforming of the gaskets 37, 38 causes the spark plug elements frictionally to engage each other so that thereafter they may be handled as a unit without disturbing the perfect concentricity of the parts. When the slide 13 rises, the work is partly ejected from the die structure by the plunger 29 which rises under the impetus of spring 33. This completes a cycle of operation of the centering unit.

The crimping unit B, for convenience, is mounted in the same press as the centering unit A, beside the latter. The details of the crimping unit are shown in Figure 7 to which attention now is directed.

Mounted in a vertical bore 55 in the die holder 18, beside centering die 22, is a cylindrical crimping die 56 that is identical with said centering die and is retained in the same manner as the latter by face plate 23. The work as it comes from the centering unit is received in the axial bore of the crimping die, and seats upon a ledge therein identical with the ledge 26 of the said centering die, there being no plunger within the bore of the crimping die.

The punch mechanism of the crimping unit is mounted in the punch holder 19 hereinbefore described. It comprises an axially apertured punch 58 that is mounted in a shallow recess 59 in the bottom face of punch holder 19, the top face of said punch being concave and engaging the complementally convex bottom face of an axially apertured centering plate 60 also mounted in said recess, the arrangement constituting a ball and socket connection between said members. The punch 58 and centering plate 60 are retained in said recess by a retaining plate 61 mounted upon the bottom face of punch holder 19, said retaining plate being formed with an aperture through which the punch extends. The plate aperture is formed with a circumferential, inwardly extending flange 61*a* engageable with an outwardly extending circumferential flange 58*a* on the upper end of the punch 58, the arrangement being such as to permit limited axial movement of the punch and centering plate relatively of the punch holder 19 and plate 61. The centering plate 60 is backed by a compression spring 62 seated in a bore 63 in the punch holder 19, which spring normally urges the punch and centering plate downwardly. An annular punch-filler 64 is seated with a force fit in an axial recess in the bottom of the punch. Both annular corners of the inner periphery of the punch filler 64 are grooved or concaved, as shown at 65, 65 so as to effect a crimping of the open end of a spark plug shell 35 when forcibly pressed thereagainst. The axial apertures in the punch-filler, punch, and centering plate receive the porcelain 36 of a spark plug during a crimping operation. The position of the punch-filler 64 may be reversed and the grooves 65 used alternatively as either becomes worn.

In the operation of the crimping unit B, an assembled, centered spark plug as it comes from the centering unit A is mounted in the crimping die 56 as shown. When the slide 13 is caused to descend, the punch-filler 64 and punch 58 telescope with the work, it being understood that the punch flange 58*a* is bearing against the retaining plate flange 61*a* at this time. When the punch filler 64 engages the open upper margin of the shell 35 of the spark plug with its groove 65, downward movement of the punch and punch filler temporarily ceases, continued downward movement of the punch holder 19 and slide 13 serving to compress the spring 62. At this time, because of the ball and socket joint between centering plate 60 and punch 58, the latter is permitted such movement relatively of the spark plug as to effect accurate centering of the punch-filler 64 upon the top margin of the spark plug. As soon as relative axial movement of the punch 58 and punch holder 19 carries centering plate 60 to the bottom of recess 59, the full force of the punch holder is transmitted to the punch-filler 64 and crimping of the open margin of the spark plug shell 35 onto the gasket 37 is effected, as is clearly shown in Figure 7. The slide 13 then rises to inoperative position thus completing the cycle of operation.

The invention assures concentricity of the spark plug elements, largely eliminates breakage of porcelains, and achieves the other objects set out in the foregoing statement of objects.

In the embodiment of the invention shown in Figures 8 and 9 the die mechanism of the centering unit is identical with the die mechanism of the previously described centering unit A. The punch mechanism is somewhat similar to that previously described and includes a number of identical elements, namely, the punch holder 19, bushing 42, punch holder 45, lock nut 46, and spacer-retaining nuts 52, 52. Slidably mounted within the central bore of the punch holder 45 is a centering punch 68 consisting of an annular disc-like structure having a downwardly extending circumferential flange 68*a* formed about its inner periphery. Said flange is of such inside diameter as to circumscribe the porcelain 36 of a spark plug and to engage the upper metal gasket 37 thereon when the loosely assembled spark plug is in the die mechanism of the centering unit. The die 68 normally rests upon the inwardly directed flange 45*a* at the lower end of the punch holder 45. Superposed upon the punch 68, within the bore of the bushing 42, is an annular rubber ring 69, and superposed upon the latter is a tubular metal spacer 70, the upper end of the latter abutting the lowermost nut 52. The axial openings in the ring 69 and spacer 70 are of such size as to receive the tapered upper end portion of a porcelain 36 of a spark plug.

The operation of this embodiment of the invention is substantially the same as that previously described. As the slide 13 descends, flange 68*a* of punch 68 engages upper gasket 37 of the spark plug assembly and stops, further movement of the other elements of the punch structure serving to compress and deform rubber ring 69 so that it engages and centers the porcelain of the spark plug. Pressure upon the rubber ring increases until it overcomes the resistance of the yielding support 29 for the porcelain 36, and the latter moves downwardly and the gaskets 37 and 38 are deformed in the same manner as in the previously described embodiment, except that all of the deforming pressure is transmitted through the deformable rubber ring 69.

Other modification may be resorted to without departing from the spirit of the invention or the scope of the appended claims, which are not

limited wholly to the specific construction shown and described.

What is claimed is:

1. Apparatus for assembling spark plugs, said apparatus comprising a relatively stationary support for the metal shell of a spark plug, a yielding support for the porcelain thereof adapted normally to hold said porcelain in partly telescoped relation to said shell, a punch structure for moving said porcelain into fully telescoped relation to said shell and for deforming the metal gaskets about the porcelain, and means adapted to engage the porcelain and to position it concentrically with relation to the punch before the latter moves the porcelain toward fully telescoped relation with the shell, said porcelain centering means being operated by the pressure of the punch upon the porcelain.

2. Apparatus for assembling spark plugs, said apparatus comprising a relatively stationary support for the metal shell of a spark plug, a yielding support for the porcelain thereof engaging the lower end of said porcelain and normally holding the latter elevated in partly telescoped relation to said shell, a reciprocable punch structure engageable with the upper gasket about the porcelain for moving said porcelain downwardly into fully telescoped relation to said shell with sufficient pressure to deform both metal gaskets about said porcelain, a porcelain centering device carried by the punch structure adapted to engage the porcelain to position it concentrically of the punch, and means for operating said porcelain centering device by means of the pressure exerted by the punch structure upon the porcelain.

3. In spark plug assembling apparatus, the combination of a relatively stationary support for a metal shell, a yielding support for a porcelain adapted to hold the latter elevated in partly telescoped relation to said shell, a reciprocable punch adapted to force the porcelain into said shell, against the pressure of the yielding support of the porcelain, and a constrictable centering device adapted to engaging a peripheral region of the porcelain to center it with relation to the punch, and means responsive to pressure of the punch against the porcelain for effecting constriction of said centering device.

4. In spark plug assembling apparatus, the combination of a relatively stationary support for a metal shell, a yielding support for a porcelain adapted to hold the latter elevated in partly telescoped relation to said shell, a reciprocable punch adapted to force the porcelain into said shell, against the pressure of said yielding support of the porcelain, a porcelain-centering device of deformable material adapted to engage the porcelain and center it with relation to the punch, and means for deforming said centering device prior to the telescoping of the shell and porcelain under impetus of the punch.

5. In spark plug assembling apparatus, the combination of a relatively stationary support for a metal shell, a retractible support for a porcelain adapted to hold the latter elevated in partly telescoped relation to said shell, a reciprocable punch adapted to force the porcelain into fully telescoped relation to said shell, a porcelain centering device of deformable material adapted to be deformed into engagement with the perimeter of the porcelain to center it with relation to the punch, said device being deformed by the resistance of the porcelain to movement under pressure of the punch, and means for utilizing the pressure of the punch upon the porcelain for retracting the porcelain support after the centering device has been deformed.

6. In spark plug assembling apparatus, the combination of a relatively stationary support for a metal shell, a retractible support for a porcelain adapted to hold the latter elevated in partly telescoped relation to said shell, a reciprocable punch adapted to force the porcelain into fully telescoped relation to said shell, a porcelain centering device of deformable material adapted to engage the porcelain and center it with relation to the punch, said device being deformed by the resistance of the porcelain to movement under pressure of the punch, and a yielding backing for the porcelain support having greater resistance to deformation than said centering device, whereby the latter functions before the porcelain moves downwardly into the shell.

7. In spark plug assembling apparatus, the combination of a relatively stationary support for a metal shell, a retractible support for a porcelain adapted to hold the latter elevated in partly telescoped relation to said shell, a reciprocable punch adapted to force the porcelain into fully telescoped relation to said shell, a porcelain centering device consisting of a rubber ring carried by the punch structure adapted to be deformed and constricted upon the porcelain to center the latter with relation to the punch, when the punch engages the porcelain, and a compression spring backing the retractible porcelain-support, said spring having greater resistance to compression than said rubber ring whereby the ring is deformed to center the porcelain before the spring yields to permit telescoping movement of the porcelain.

8. Apparatus for assembling spark plugs, said apparatus comprising an annular punch, a deformable rubber ring concentric therewith, and means for deforming the rubber ring against a portion of the spark plug assembly to center said portion with relation to the punch in timed relation to the operation of the punch upon a spark plug assembly.

9. Apparatus for assembling spark plugs, said apparatus comprising an annular punch, means for forcing the latter into engagement with a spark plug assembly, and a deformable rubber ring concentric with said punch and constituting a yielding backing for the latter, said ring being deformed under pressure and constricted about a portion of the spark plug assembly to center the same with relation to the punch.

10. Apparatus for assembling spark plugs, said apparatus comprising a reciprocable punch support, an annular punch carried thereby, said punch being movable axially, relatively of said support, a concentric annular ring of deformable material constituting a backing for said punch, said ring being so confined as to reduce in diameter upon compression when the punch is forced against a spark plug assembly, and thereby to constrict about a portion of the latter to center it relatively of the punch.

11. Apparatus for assembling spark plugs, said apparatus comprising a relatively stationary support for a metal shell, a retractible device engageable with the shell for centering it on said support, means for forcing a porcelain into telescoped relation with said shell, and means for utilizing the movement of the porcelain to withdraw the retractible device from engagement with the shell as the porcelain moves thereinto.

12. In apparatus of the character described, the combination of a relatively stationary support for a tubular metal shell, a retractible device engageable within the lower end portion of the shell for determinately positioning the shell on its support, and means for forcing a porcelain into telescoped relation with said shell, said retractible device being so constructed and arranged as to be depressed and moved out of engagement with the shell by pressure of the porcelain against its upper end.

13. In apparatus of the character described, the combination of a support for a tubular metal shell, a yieldingly mounted device engageable within the lower end portion of the shell for determinately positioning the shell on said support, said device being adapted to support a porcelain in elevated, partly telescoped relation to the shell, and means for forcing the porcelain downwardly into fully telescoped relation to the shell, said yielding device being so constructed as to be depressed out of engagement with the shell to permit a modicum of movement of the latter relatively of its support before the porcelain is fully seated.

14. In apparatus of the character described, the combination of a support for a tubular metal shell, a yieldingly mounted device therein having a generally cylindrical upper end portion adapted slidingly to fit within the bore of said shell, there being a terminal region of reduced diameter on said upper end portion, and means for forcing a porcelain into fully telescoped relation with said metal shell, said yielding device being so positioned as to be engaged by said porcelain and depressed during the telescoping operation whereby its upper end portion is moved out of contact with the bore of the shell by reason of the reduced diameter of its terminal region.

ARCHIBALD M. BROWN.