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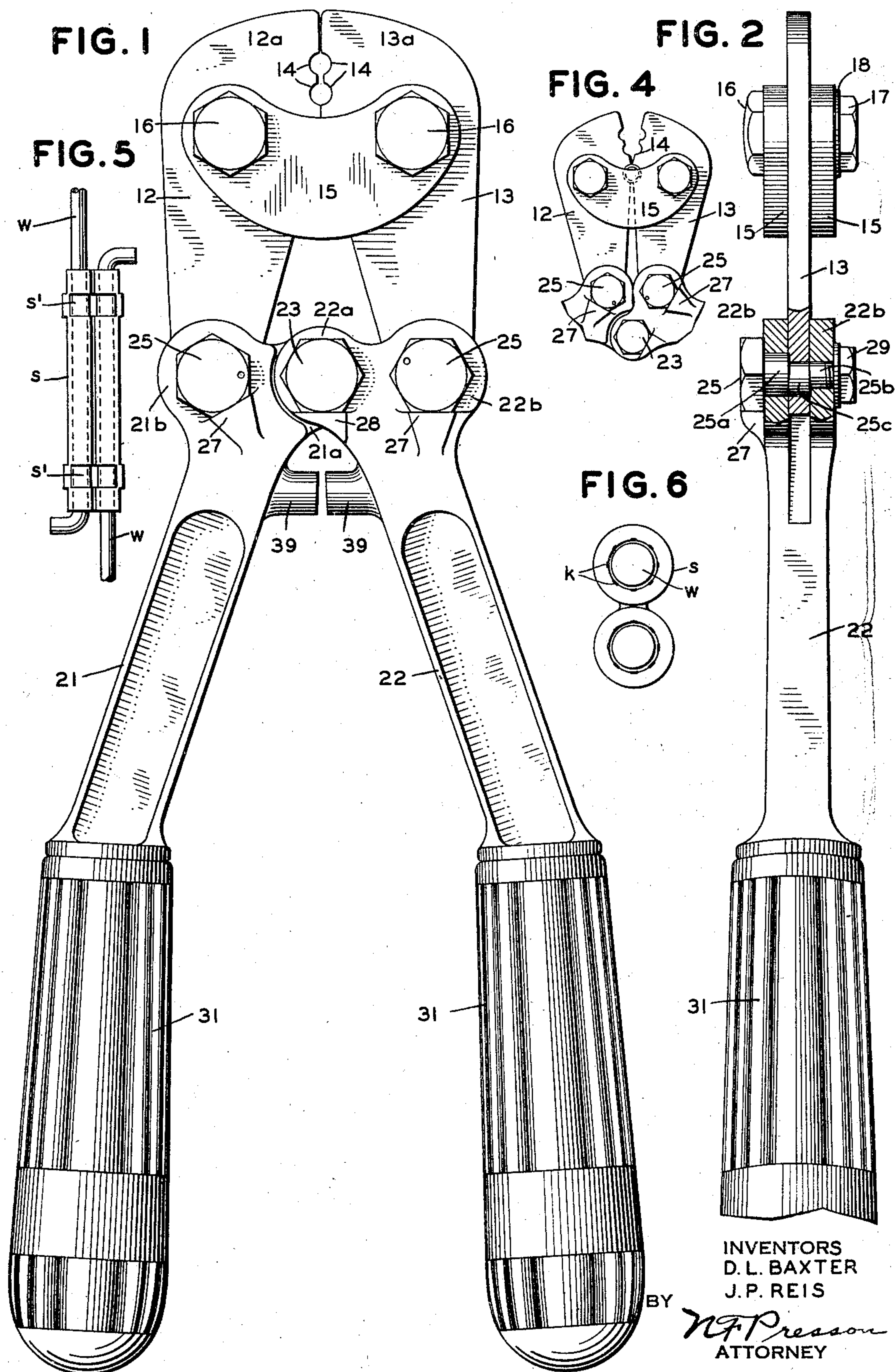
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2,244,482

COMPRESSION JOINT TOOL

Filed July 9, 1938

2 Sheets-Sheet 1



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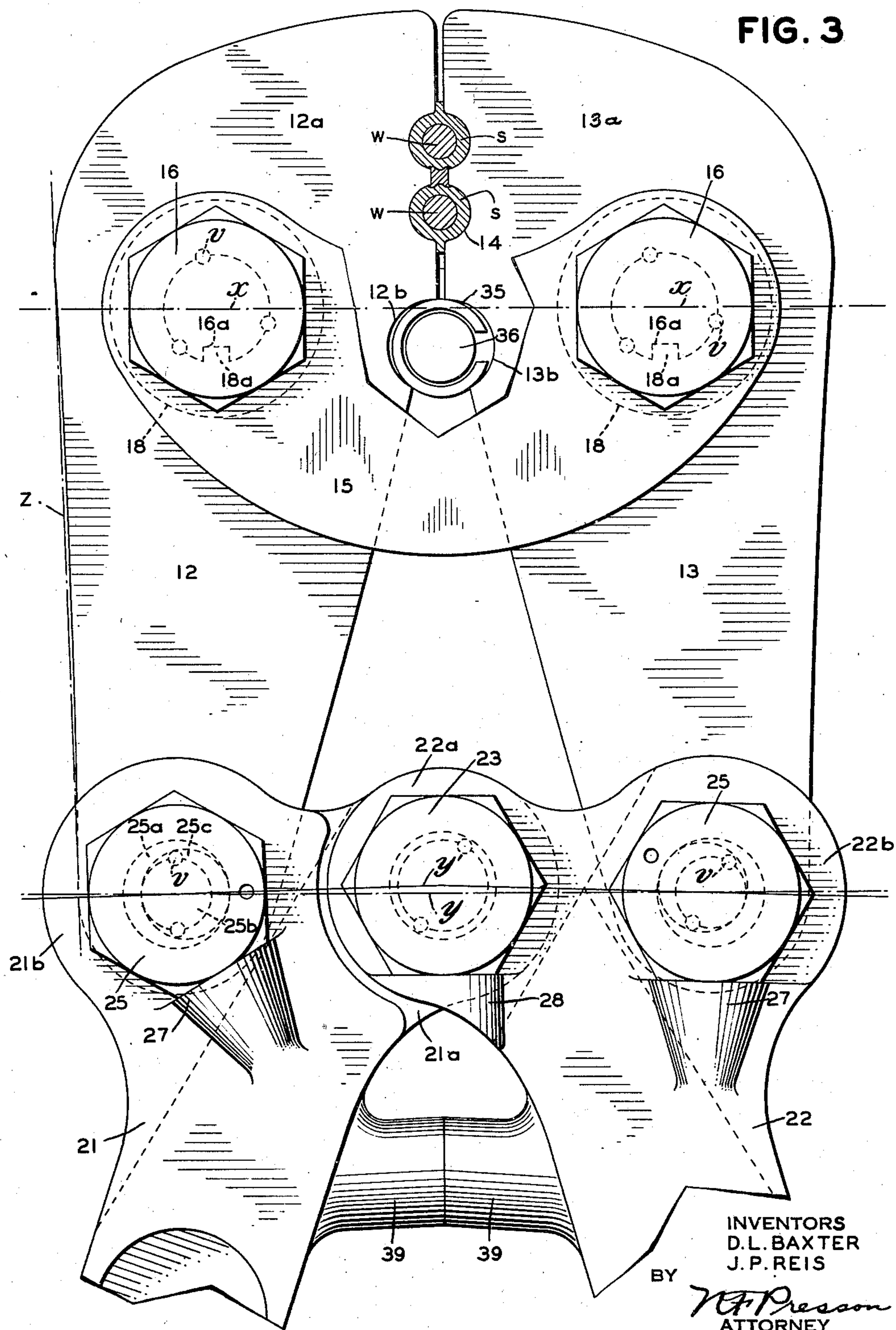
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FIG. 3



UNITED STATES PATENT OFFICE

2,244,482

COMPRESSION JOINT TOOL

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7 Claims. (Cl. 140—113)

This invention relates to a compression joint tool for compressing electrical connectors, and more particularly to an improved tool for compressing line wire sleeve connectors into intimate clamping contact with the line wires inserted therein.

For many years it was the practice to splice copper line wires by means of thin-walled copper connectors, commonly called sleeves, into which the line wires were inserted, the sleeves and wires then being given several complete twists by means of tools called "sleeve twisters." These connectors had various disadvantages in that the sleeve twisters injured the wire at the point where they gripped the sleeve and consequently the mechanical strength of the wire at the joint was appreciably less than that of the rest of the span, and the sleeves did not set so closely around the wires as to prevent corrosion of the wires and the inside of the sleeves, which corrosion in time caused a marked increase in the electrical resistance of the joints. For these reasons the sleeves were not suitable for high frequency communication circuits which require constant low resistance joints.

In order to overcome the foregoing disadvantages of the twisted sleeve connectors, connectors have been devised which comprise sleeves or tubes into which the wires are pushed from the opposite ends of the sleeves, the tubes then being rolled, pressed or squeezed by the operator, usually a lineman, until they are in intimate clamping contact with the wires. One type of such connector is shown in the patent to D. L. Baxter, No. 2,062,986, issued December 1, 1936. The line wire joints, however, are usually made in the field by linemen, often under difficult conditions and without close supervision, and the efficacy of the completed joints still depends in large measure upon the skill and degree of care exercised by the linemen when applying pressure to the connecting sleeves. If insufficient pressure is applied the joint does not have the necessary mechanical strength and also is not gas tight so that corrosion may result. On the other hand, if too much pressure is applied by the lineman, this is liable to so reduce the cross section of the wires as to cause breakage within the joint.

An object of the present invention is a compression joint tool which will make a satisfactory joint irrespective of the degree of skill and care exercised by the lineman when making the joint.

Another object is a compression joint tool which will make a satisfactory joint, with greater

permissible variations of tolerance in sleeve and wire than has heretofore been possible.

A further object is a compression joint tool which, when used with double tube sleeves, produces substantially equal pressures simultaneously on both tubes of the sleeves.

An additional object is a tool of the character described in which the efficiency of the tool may readily be maintained, notwithstanding wear of parts or rough usage over a long period of service.

A further object is a compression tool which is light in weight and properly balanced for use in difficult locations, when the tool must be operated at awkward angles and in close quarters.

Various other objects and advantages will be apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a view in elevation of the compression joint tool;

Fig. 2 is a view of the tool taken at right angles to Fig. 1, with certain parts broken away;

Fig. 3 is an enlarged view with certain parts broken away, showing the respective positions of various parts when compressing a sleeve connector;

Fig. 4 shows the positions of certain parts of the tool prior to its engagement with the connecting sleeve and line wires;

Fig. 5 is a view showing a straight line wire joint made with the compression tool of Figs. 1 to 4; and

Fig. 6 is a cross sectional view of a sleeve connector utilizing keying particles, showing the line wires inserted, prior to compression of the sleeves.

Referring to Figs. 1 to 3, the tool comprises two levers 12 and 13, having outer lever arms in the form of jaws 12a and 13a with identical pressing grooves or dies 14 which receive the tubes of the sleeve for compressing the sleeve into intimate clamping contact with the line wires inserted therein. The levers 12 and 13 are pivotally secured at their fulcrums back of the pressing grooves by curved straps 15 and closely fitting studs 16 that pass through the straps with a light tapping or push fit and through the levers 12 and 13 with a push fit, the studs being prevented from coming out by nuts 17, Fig. 2, screw-threaded on the studs. Washers 18, having keying portions 18a which engage in keyways 16a in the studs 16, shown by dotted lines in Fig. 3, are inserted between the nuts and the adjoining strap to facilitate pivotal movement of the levers 12 and 13, and to prevent such pivotal

movement from being communicated to the nuts 17.

The lever ends of the jaws, i. e., the inner arms of levers 12 and 13, are pivotally connected at 25, 25 to a pair of toggle-jointed handles 21 and 22. The handle 22 has two lugs or ears 22a integral therewith which lugs are spaced apart to receive a lug or ear 21a integral with the handle 21. The lugs 21a and 22a are pivotally connected by a closely fitting bolt or stud 23, the bolt being prevented from turning by a shoulder 28 on the handle 22 which engages the hexagonal head on one end of the bolt. A nut (not shown, but like the nut 29 in Fig. 2) is screw-threaded on the other end of the bolt to keep it from coming out. The lugs and bolt form a tongue-and-clevis joint that comprises the knuckle of a toggle between the handles 21 and 22 and the levers 12 and 13.

The handle 21 also has two lugs or ears 21b which receive the lower end of the lever 12, and the handle 22 has two lugs or ears 22b which receive the lower end of the lever 13. Studs 25 pass through circular openings in these lugs, and as shown in Fig. 2 each stud has closely fitting portions 25a and 25b that engage circular openings in the lug 21b or 22b through which the stud passes. The studs also have eccentric portions 25c that closely engage circular openings in the levers 12 and 13. The extent of throw or pivotal movements of the levers may be adjusted, by rotating the studs 25 and hence the eccentric portions 25c to different positions relative to the levers 12 and 13, to accommodate the closure of the tool to variations in the tolerances of the different sizes of the tool elements; to adjust the amount and distribution of pressure exerted on the sleeve connectors by the dies 14; and to compensate for wear in the bearing surfaces of the various parts.

The studs have hexagonal heads, as shown, and shoulders 27 formed on the handles 21 and 22 engage the heads and maintain the studs 25 in their adjusted positions, it being understood that the studs must be pulled out until their heads clear the shoulders 27 in order to turn the studs and eccentric portions 25c to the desired positions. Nuts 29 prevent the studs from coming out, washers 30 being inserted between the nuts and adjoining ears 21b and 22b.

After the nuts on the various bolts and studs have been properly tightened, they are punched to lock the nuts in position, as indicated by the small dotted circles *v* in Fig. 3. Preferably, and as shown, the handles 21 and 22 are provided with grips 31 of rubber or other suitable insulating material.

The construction provides a form of secondary toggle pressure in the dies 14 as a result of the pivotal mounting and shape of the jaws 12a and 13a and the operation of the primary toggle. In Figs. 1 and 2, the various parts of the tool are drawn to scale; these figures in the application drawings show the tool actual size, and in the patent drawings approximately two-thirds actual size. The closing of the handles by the operator forces the lever ends of the jaws apart by primary toggle action thereby attaining in a tool having the parts proportioned as shown, a separating force or pressure on the lever ends of approximately twenty times the force applied at the handles. Thus, with a tool which has an overall length of less than twelve inches, the force applied at the handles serves to bring the die ends of the jaws together

with a force under direct leverage of approximately 2500 pounds when a force of 25 pounds is applied at the handles, and in addition to the direct leverage the spacing of the die impressions 14 relatively close to the center line *x* joining the two studs 16 induces an additional mechanical advantage by a reverse toggle action which augments the pressure at the die impressions to over 4000 pounds, this being a gain of over 60% and making it substantially in excess of that obtained by simple leverage. Preferably, the distance from the lowermost portion of the dies 14 to the center line *x* is less than one-sixth of the distance between the centers of the studs 16. It is possible to further increase the die pressure by moving the position of the die impressions still closer to the above mentioned center line, although the die members should be kept far enough away from the center line to obtain a few thousandths of an inch adjustment when the eccentric studs 25 are rotated to obtain such adjustment.

Referring again to Fig. 3, a spring 35 and roller 36 mounted in recessed portions 12b and 13b of the levers 12 and 13 are provided to coordinate the action of the two jaws 12a and 13a and also the dies 14, 14, the position of the spring 35 (slightly compressed) and its supporting roller 36 being below the center line *x* when the tool is closed, as at this position the sleeve *S* itself, being under compression around the wire *w*, acts to coordinate the jaws and hold them in alignment. When the tool starts to close, the roller and spring, now under partial compression and holding the jaws in perfect alignment while empty, move downwardly from the position shown in Fig. 4, the spring compresses further and the fit of spring and roller is tightest when they are in the center line position which is the critical point where the sleeve is first gripped by the dies. As the compression of the sleeve progresses it takes up the duty of keeping the jaws in alignment, and when the tool is fully closed, as shown in Fig. 3, the roller has passed over the center line, and the jaws are held in alignment both by the sleeve and the compression left in the spring.

Studs 39 integral with the handles 21 and 22 limit the extent of over-travel of the primary toggle structure, as indicated by the line *y'* in Fig. 3, the dot-and-dash line *y* indicating the dead center position of the toggle. It will be noted that as the handles are operated, the toggle structure passes from its open position, shown in Fig. 4, to its dead center position, shown in Fig. 1 and indicated by the line *y* in Fig. 3, which is the position of predetermined maximum pressure of the tool, and then from *y* to its final over-travel position *y'*, as shown in Fig. 3, at which time the pressure exerted on the sleeve connector begins to decrease since the pivotal action of levers 12 and 13 about their fulcrums 16 is reversed at this time, and therefore the pressure exerted by the tool cannot exceed the predetermined maximum pressure obtained in the dead center position of the toggle.

The shape and thickness of the levers 12 and 13, Figs. 1 and 2, are such as to cause a slight but predetermined deflection of the jaws under load, as is indicated by the dot-and-dash line *z* in Fig. 3, which deflection takes place well within the elastic limits of the materials used. This deflection of the lever produces parallelism of the jaws 12a and 13a when the jaws are stressed to the pressure required to make a suitable joint,

that is, the contact planes of the adjustable jaws are always parallel at maximum pressure after deflection of the levers 12 and 13, these contact planes being equidistant from the longitudinal center line passing through the toggle, but at right angles to the plane of action of the toggle.

The construction hereinbefore described causes the tool to make a satisfactory press in either a single or multiple sleeve connector with one movement of the handles, and enables a satisfactory joint to be made with greater variations of tolerance in sleeve and wire than has heretofore been possible. The tool produces an accurately predetermined maximum pressure on the sleeve and wire when compressing a joint, which pressure is independent of the speed of working the tool or amount of effort exerted by the operator, and by previous adjustment to give the desired pressure when all three pivots 23, 25, 25 of the toggle are in a straight line, i. e., at dead center, the tool operates correctly at all times irrespective of the skill of the operator so long as dead center is reached or passed by the toggle action. The selection of materials and hardness of the parts is such that the smallest and least expensive pieces are subject to the most wear, and are, therefore, the easiest to replace, thus securing economical maintenance of the tool at all times. The provision of a press fit of the studs 16 into the levers 12 and 13 divides the movable bearing load between the studs and the two straps 15, thereby utilizing the largest available bearing surface, increasing the usable life of the tool and permitting a lighter and more compact design, yet providing a tool adequate for the severe service required, which tool is light and properly balanced for use by linemen and therefore may be operated at awkward angles in close quarters.

Fig. 5 shows the completed joint in which the multiple tube sleeve connector *s* has been compressed at *s'*, *s'* into intimate clamping contact with the line wires *w*, *w* to provide a gas tight joint of constant, low electrical resistance and of mechanical strength sufficient to permanently hold the strain on the line wires. If desired, as shown in Fig. 6, keying particles *k* composed of metal harder than that of the sleeve and line wires, may be employed. The keying particles may be applied to the sleeve in the manner disclosed in a copending application of Dickie and Wheeler, Ser. No. 49,814, filed November 14, 1935, now Patent No. 2,149,209, issued February 28, 1939.

Various other modifications and forms of the tool will readily suggest themselves to those skilled in the art, and we, therefore, do not wish to be restricted except as indicated by the scope of the appended claims.

We claim:

1. A tool for compressing an electrical conductor, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary die portions for receiving said conductor, means extending between said levers for pivotally securing said levers at their fulcrums, said means causing the die portions to approach each other and compress the conductor received therein when the inner lever arms are rotated in a direction to cause the die portions to approach each other, two handles each having a fulcrum and a first lever arm, means pivotally connecting the fulcrums of said handles to said inner lever arms respectively,

said handles each having a second lever arm, and means pivotally connecting the second lever arms of the handles together to form an over-travel toggle joint between the fulcrums of the handles, said levers and toggle joint acting to multiply the force exerted on the handles and cause a predetermined amount of pressure invariably to be exerted on the conductor by the die portions when the handles are operated to their working position for compressing the conductor, said toggle joint preventing pressure from being exerted on the conductor in excess of said predetermined amount by passing to its over-travel position as the handles are operated.

2. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving a sleeve connector, means extending between said levers for pivotally securing said levers at their fulcrums, said means causing the dies to approach each other and compress the sleeve connector when the inner lever arms are rotated away from each other, two handles each having a fulcrum and a first lever arm, means pivotally connecting the fulcrums of said handles to said inner lever arms respectively, said handles each having a second lever arm, and means pivotally connecting the second lever arms of the handles together to form an over-travel toggle joint between the fulcrums of the handles, said levers and toggle joint acting to enormously multiply the pressure exerted on the handles by an operator and cause a predetermined amount of pressure invariably to be exerted on the sleeve connector by the dies, when the handles are brought towards each other by the operator, to compress the connector into intimate clamping contact with a wire inserted therein, said toggle joint preventing pressure from being exerted on the sleeve connector in excess of said predetermined amount by passing to its over-travel position as the handles are brought together by the operator.

3. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving a sleeve connector, means extending between said levers for pivotally securing said levers at their fulcrums, said means causing the dies to approach each other and compress the sleeve connector when the inner lever arms are rotated away from each other, two handles each having a fulcrum and a first lever arm, means pivotally connecting the fulcrums of said handles to said inner lever arms respectively, said handles each having a second lever arm extending substantially at a right angle to said first lever arm and means pivotally connecting the second lever arms of the handles together to form an over-travel toggle joint acting to enormously multiply the pressure exerted on the handles by an operator and cause a predetermined amount of pressure invariably to be exerted on the sleeve connector by the dies, when the toggle reaches or passes dead center as the handles are brought towards each other by the operator, to compress the connector into intimate clamping contact with a wire inserted therein, said toggle joint preventing pressure from being exerted on the sleeve connector in excess of said predetermined amount by passing

to its over-travel position as the handles are brought together by the operator.

4. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving a sleeve connector, means extending between said levers for pivotally securing said levers at their fulcrums, said means causing the dies to approach each other and compress the sleeve connector when the inner lever arms are rotated away from each other, two handles each having a fulcrum and a first lever arm, means pivotally connecting the fulcrums of said handles to said inner lever arms respectively, said handles each having a second lever arm, means pivotally connecting the second lever arms of the handles together to form a toggle joint between the fulcrums of the handles, said levers and toggle joint acting to enormously multiply the pressure exerted on the handles by an operator and cause a predetermined amount of pressure to be exerted on the sleeve connector by the dies to compress the connector into intimate clamping contact with a wire inserted therein, and resilient means positioned in and acting on said jaws for maintaining the dies in alignment relative to each other.

5. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving and compressing a sleeve connector, means pivotally securing said levers at their fulcrums, said means causing the dies to compress the sleeve connector when the inner lever arms are rotated in a direction to cause the jaws to approach each other, means including handles for rotating said inner lever arms, said jaws having apertured portions, and resilient means positioned in said apertured portions and acting

on said jaws for maintaining the dies in alignment relative to each other.

6. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving and compressing a sleeve connector, means pivotally securing said levers at their fulcrums, said means causing the dies to compress the sleeve connector when the inner lever arms are rotated in a direction to cause the jaws to approach each other, means including handles for rotating said inner lever arms, said jaws having apertured portions, and means positioned in said apertured portions for maintaining the dies in alignment relative to each other, said last named means comprising a compressible spring member engaging said apertured portions and a member positioned within said compressible spring member for limiting the extent of deformation of the spring member.

7. A compression joint tool for compressing a wire sleeve connector, comprising two levers each having a fulcrum and outer and inner lever arms, the outer lever arms comprising jaws having oppositely disposed complementary dies for receiving and compressing a sleeve connector, means including a tie member extending between said levers for pivotally securing the levers at their fulcrums, said dies being positioned relatively close to the center line passing through said fulcrums, said jaws having complementary apertured portions, a compressible tubular spring member positioned in said apertured portions and acting on said jaws to maintain the dies in alignment relative to each other, and a circular member positioned within said tubular spring member for limiting the extent of deformation of the spring member as the jaws are brought into clamping engagement with a sleeve connector.

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