

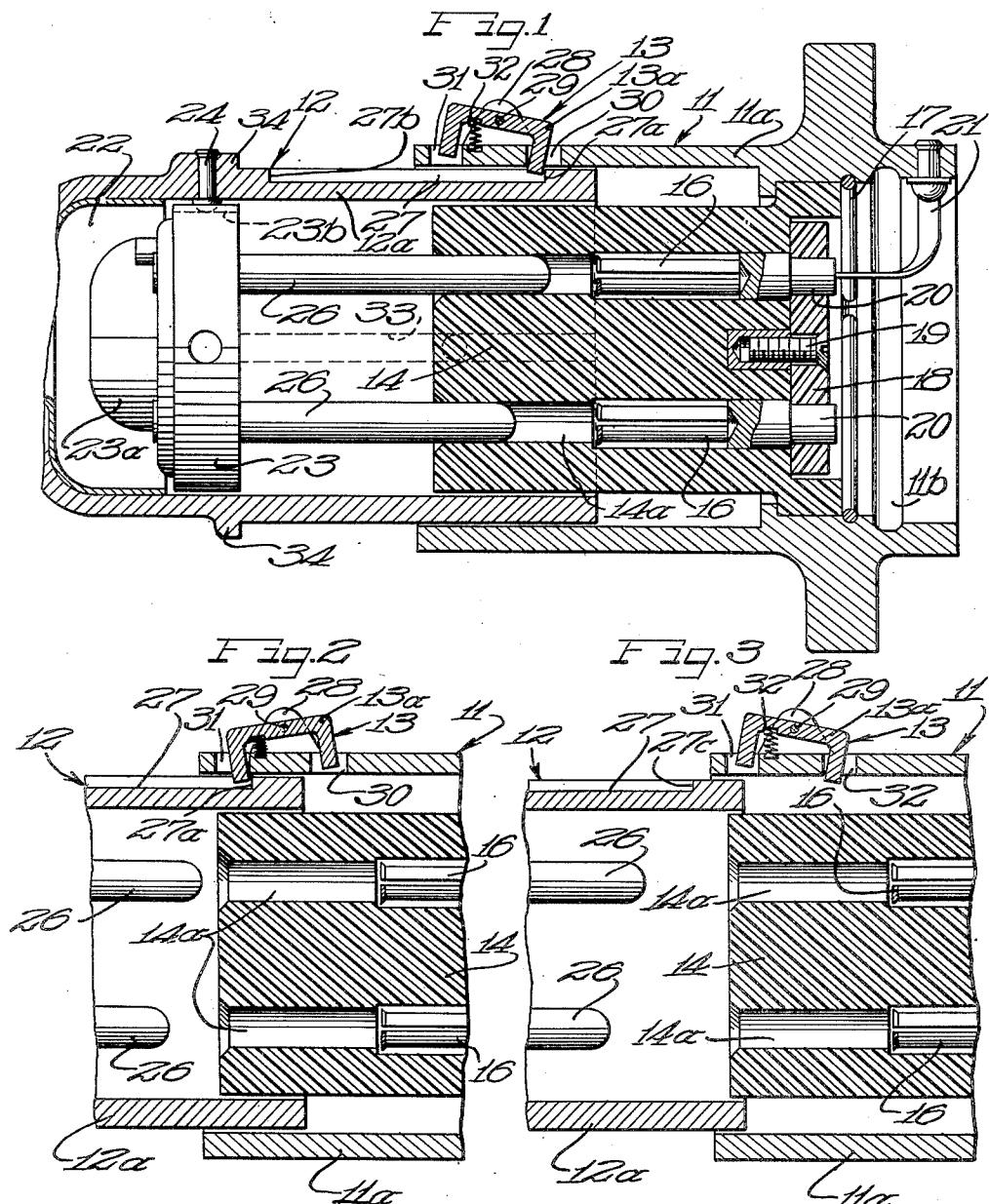
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P. S. ROCKWELL ET AL.
DELAYED ACTION STRUCTURE FOR AN
EXPLOSION-PROOF PLUG AND SOCKET

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Filed Sept. 16, 1949

2 SHEETS--SHEET 1



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By the Grace of God and the Help of His Angels

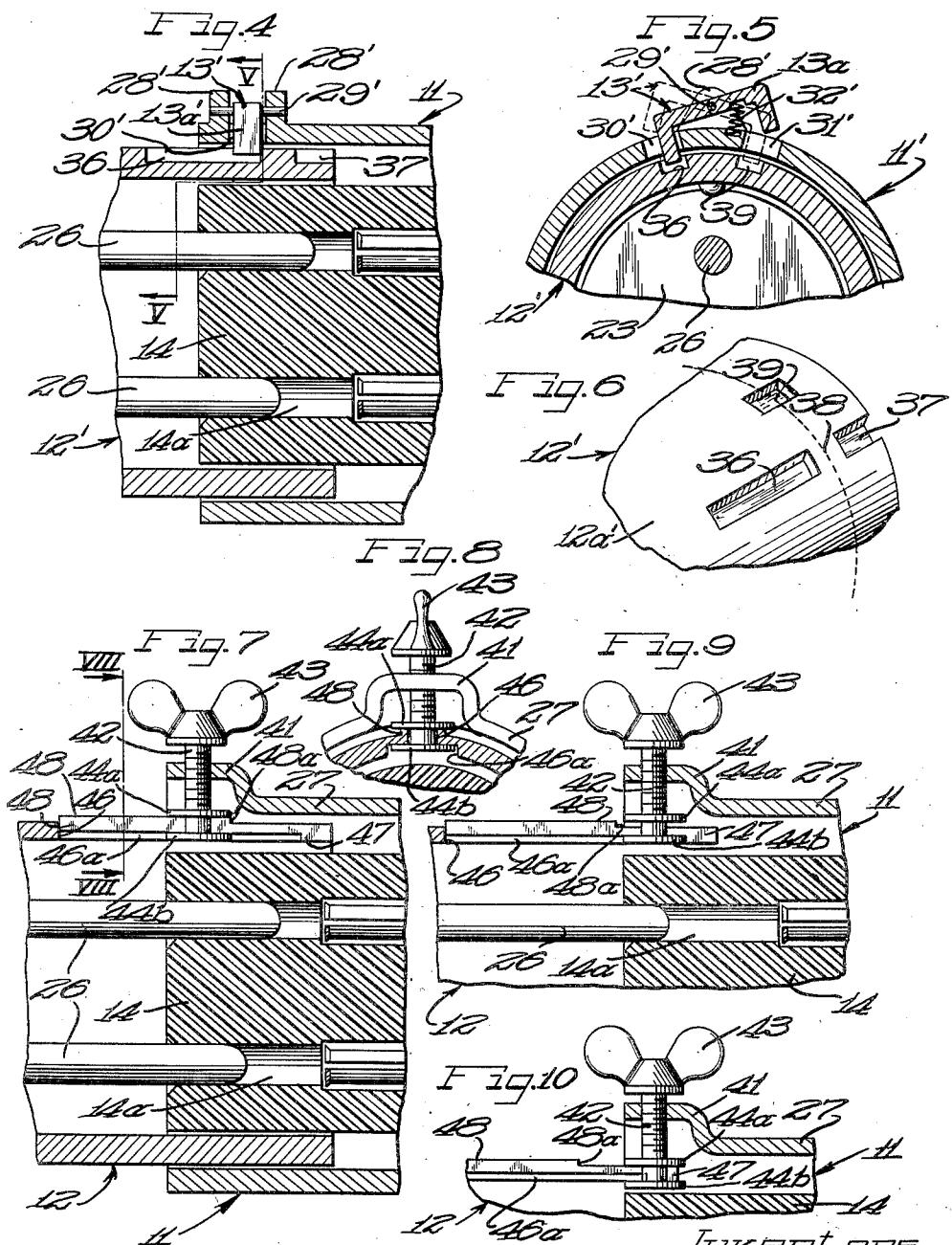
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2 SHEETS—SHEET 2



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DELAYED ACTION STRUCTURE FOR AN EXPLOSION-PROOF PLUG AND SOCKET

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This invention relates generally to an electric plug and socket structure and more particularly to an electric plug and socket structure of the so-called explosion-proof type wherein a novel delayed action structure is incorporated for the purpose of introducing a momentary time delay into the withdrawal action of a plug from a socket.

According to the general features of the present invention, a plug member is provided which is movable on a straight line into and out of a socket member. The socket member is provided with terminals which are situated at the end of arc-tight passages. The socket member carries a stop element which is constructed to cooperate with the plug body so as to stop withdrawal movement of the plug member at a predetermined point when the terminals are separated and before the plug and socket members are separated and with the plug terminals substantially contained within the arc-tight passages. The stop member is constructed to be movable out of its engaging position, whereupon further straight-line withdrawal of the plug member from the socket member may be permitted. Polarizing means may be provided between the plug and socket members so as to maintain a predetermined alignment of the plug and socket components.

Most explosion-proof plug and socket structures heretofore provided have been constructed in accordance with designs which necessitate the employment of a rotatable locking member or zig-zag detent means which require a twisting or relative rotative motion between the plug and socket components in order that a suitable time delay be provided for rendering the plug and socket fitting explosion-proof.

An object of the present invention is, therefore, to provide an explosion-proof electric plug and socket adapted for use in hazardous locations wherein all necessity for relative rotative motion between the plug and socket components is completely eliminated.

A further object of the present invention is to provide an electric plug and socket structure suitable for use in hazardous locations whereby a suitable time delay for rendering the plug and socket fitting explosion-proof may be accomplished by manual operation of a simple movable stop element.

An additional object of the present invention is to provide a delayed action structure for an explosion-proof electric plug and socket whereby a laterally movable stop member cooperates with

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a specially constructed plug member to stop withdrawal of the plug member from the socket member at a predetermined axial location.

Many other features, advantages and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the annexed sheets of drawings in which a preferred embodiment of the present invention is shown.

On the drawings:

Figure 1 is a cross-sectional view with parts in elevation and with parts broken away of an electric plug and socket according to the present invention;

Figures 2 and 3 are fragmentary cross-sectional views of the time delay mechanism incorporated in the electric plug and socket according to the present invention showing steps in a typical operational sequence;

Figure 4 is a fragmentary cross-sectional view showing a modified form of a time delay mechanism according to the present invention;

Figure 5 is a fragmentary cross-sectional view with parts in elevation taken on line V—V of Figure 4;

Figure 6 is a fragmentary, enlarged, perspective view showing certain details of construction of a plug member embodied in the modification shown in Figures 4 and 5;

Figure 7 is a fragmentary cross-sectional view with parts in elevation of an additional modified form of a time delay mechanism according to the present invention;

Figure 8 is a fragmentary cross-sectional view taken on line VIII—VIII of Figure 7; and

Figures 9 and 10 are fragmentary cross-sectional views showing the steps of a typical operational sequence of the modified electric plug and socket shown in Figures 7 and 8.

As shown on the drawings:

A particularly advantageous feature of the delayed action mechanism which is to be described more fully hereinafter lies in the fact that all necessity for producing a relative rotative motion between the plug and socket components, as has been necessary in most explosion-proof plug and socket fittings heretofore provided, has been completely eliminated and a suitable time delay for rendering the plug and socket fitting explosion-proof may be accomplished by a simple manual actuation of a movable stop member. Three separate species of the present invention will be herein described, however, it

may be pointed out at the outset that each of the

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embodiment shown is characterized by the provision of a stop member which is movable substantially laterally with respect to the axis of the plug and socket members to permit complete straight-line withdrawal of the plug member.

Referring first to Figures 1, 2 and 3, the electric plug and socket of the present invention is shown as including a socket member indicated generally by the reference numeral 11, a plug member indicated generally by the reference numeral 12 and a stop mechanism indicated generally by the reference numeral 13.

The socket member 11 includes a generally tubular housing 11a having the usual sub-assembly of electrical elements therein. Thus, a receptacle 14 made of an electrically non-conductive material and defining arc-tight passages 14a with appropriate female terminals 16 therein may be firmly assembled in the socket housing 11a by means of a conventional snap ring 17. A receptacle cap 18 secured to the receptacle 14 by a fastener 19 may be seated on reduced diameter terminal end caps 20 formed on the ends of the terminals 16.

One of the terminals 16 may be grounded by an appropriate grounding wire 21 as shown or other suitable arrangement conventional in the art. The entire end of the socket housing 11a may be sealed by an appropriate sealing material (not shown), for purposes of which retaining means such as the groove 11b may be provided in the bore of the socket housing 11a.

The plug member 12 is also provided with a generally tubular housing preferably made of metal and indicated by the reference character 12a. An insulation shell 22 may be seated in one end of the plug housing 12a and a plug body 23 made of electrically non-conductive material is also provided having a cap portion 23a. The plug body 23 may be retained against rotation by means of a keyway 23b formed in the plug body and a key 24 carried by the plug housing 12a.

Within the plug body 23 and cap 23a is firmly assembled a plurality of prong-like male electrical terminal elements indicated by the reference numeral 26. In accordance with a conventional practice, one of the terminals 26 may be of somewhat longer length than the others so as to function as a ground terminal.

A slot or flattened portion 27 of predetermined length and located axially at a specific point relative to the longitudinal axis of the plug member 12 is formed in the outer periphery of the plug housing 12a. It will be evident that the slot or flattened portion 27 defines shoulders 27a and 27b at the terminating ends thereof, the purpose of which will become manifest presently.

The stop mechanism 13 is shown as comprising a pivotally mounted yoke element 13a which is pinned to a support lug 28 situated on the outer periphery of the socket housing 11a by a pivot pin 29. A pair of apertures indicated by the reference numerals 30 and 31 may be formed in the tubular wall of the socket housing 11a and are so situated as to permit the respective arms of the yoke element 13a to extend therethrough.

If desired, a small resilient element such as a coil spring 32 may be seated in appropriate recesses or on appropriate bosses formed in or on the yoke element 13a and the socket housing 11a, as shown. When a spring 32 is so provided, one leg of the yoke element 13a will be pivoted downwardly as, for example, to extend through the aperture 30.

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As is indicated on Figure 1, the usual polarizing means may be provided between the socket member 11 and the plug member 12 so as to insure proper pre-alignment of the terminals 16 and 26 as well as to maintain alignment of the plug and socket members during relative movement thereof. In the present embodiment, the polarizing means may take the form of a bead and groove structure, an appropriate bead being provided in the inside bore of the socket housing 11a and a cooperating groove 33 being formed longitudinally in the wall of the plug housing 12a.

When the plug member 12 is completely inserted in the socket member 11, the male terminals 26 are completely seated within the arc-tight passages 14a so that electrical contact is made along the entire length of the female terminals 16. In this position, an annular shoulder 34 formed on the plug housing 12a of the plug member will be snugly seated up against the end of the socket housing 11a.

Referring now to Figures 1, 2 and 3, the operational sequence of a withdrawal movement will be described particularly with respect to how the time delay mechanism of the present invention is employed to introduce a momentary time delay into the manipulation of the telescopically related plug and socket elements.

When the plug member 12 is fully inserted into the socket member 11, the yoke element 13a will be normally biased in the direction shown in Figure 1 so as to have one leg thereof lie in the slot or flattened portion 27.

When the plug member 12 is partially withdrawn to the position shown in Figure 1, the one leg of the yoke element 13a riding in the recess presented by the slot or flattened portion 27 will engagingly abut the shoulder 27a thereby stopping the withdrawal of the plug member 12 with the terminals 16 and 26 separated but with the plug terminals 26 substantially contained within the arc-tight passages 14a.

In order to permit further withdrawal of the plug member 12 from the socket member 11, the yoke element 13a may be depressed against the bias of the resilient member or spring 32 so that the other leg of the yoke element will enter the recess presented by the slot or flattened portion 27 and permit the first leg of the yoke element 13a to clear the shoulder 27a. It will be readily apparent that it is highly convenient to make the slot or flattened portion 27 of a dimension which is at least slightly larger than that defined by the overall length of the yoke element 13a so as to easily accommodate movement of the stop member 13 relative to the plug member 12.

After the yoke element 13a is depressed, further withdrawal movement of the plug member 12 is permitted as shown in Figure 2 until such a time as the second leg of the yoke element 13a engages the shoulder 27a and again stops the withdrawal action. It will be understood that any arc or flame drawn between the terminals 16 and 26 will be cooled below ignition temperatures before the plug terminals 26 leave the arc-tight passages 14a.

By releasing the stop member 13, the yoke element 13a will again be biased toward its initial position and the shoulder 27a will be cleared so that the plug member 12 may be completely withdrawn from the socket member 11 as is shown in Figure 3.

In Figures 4, 5 and 6, a modification of the delayed action mechanism shown in Figures 1, 2

and 3 is provided. In this modification, the stop member 13' is mounted transversely to the longitudinal axis of the plug and socket members. A pair of mounting lugs 28' are provided and pivotally support a yoke element 13a' by means of a pivot pin 29'. The apertures 30' and 31' in the socket housing 11a' of the socket 11' are radially spaced instead of being longitudinally spaced as before.

A spring 32' may again be provided between the socket housing 11a' and the yoke element 13a' to normally bias the yoke element 13a' with one leg thereof extending through the aperture 30'.

In this embodiment, the plug housing 12a' of the plug member 12' may be provided with a plurality of slots or flattened portions for cooperation with the stop mechanism 13' as may best be seen in Figure 6. Thus, a pair of slots or flattened portions 36 and 37, respectively lying on a co-linear axis in a predetermined spaced relationship may be provided to lie in registry with the aperture 30' of the socket housing 11a'. A shoulder 38 defined by the normal peripheral wall portion of the plug housing lies between the slot or flattened portions 36 and 37.

An additional slot or flattened portion 39 radially spaced from the shoulder 38 and arranged in a predetermined position relative to the slots 36 and 37 is also provided in the outer periphery of the plug housing 12a'.

In effecting the withdrawal movement of the plug member 12' from the socket member 11', one arm of the yoke element 13a' of the stop member 13' being normally biased radially inward toward the slots or flattened portions 36 and 37 through the aperture 30' will enter the slot or flattened portion 36 and slidably move therein until the stop member 13' engagingly abuts the shoulder 38. At this point, the stop member 13' and the shoulder 38 will prevent withdrawal of the plug member from the socket member until the yoke element 13a' is pivotally displaced and the arm clears the shoulder 38. The second arm of the yoke element 13a', having entered the recess presented by the slot or flattened portion 39, will permit a limited additional withdrawal movement, whereupon the yoke element 13a' may be released so the first arm will enter the recess presented by the slot or flattened portion 37 to permit complete withdrawal of the plug.

As shown in Figure 4, the various components of the stop mechanism are axially spaced so that the stop mechanism prevents withdrawal of the plug member from the socket member after the terminals are separated and before the plug terminals have left the arc-tight passages. Thus, any arc or flame drawn between the terminals at the time of separation will be cooled below ignition temperature before the plug member is completely withdrawn from the socket member, thereby precluding inadvertent ignition of explosive mixtures surrounding the electric plug and socket.

Referring now to Figures 7, 8, 9 and 10, a modified stop mechanism is shown. In this particular embodiment the end of the socket member housing 27 is provided with a raised boss 41 suitably apertured and tapped to receive in threaded assembly therewith a stud 42 having a wing nut 43 on one end thereof and a pair of spaced washers or shoulders 44a and 44b on the other end thereof.

A longitudinally extending slot 46 is provided in the upper portion of the plug housing to slid-

ably receive the stud 42. The edges of the slots 46 are preferably arranged to define a series of steps forming shoulder portions which, in co-operation with the washers or shoulders 44a and 44b carried by the stud 42 prevent withdrawal of the plug member from the socket member after the terminals are separated and before the plug terminals have left the arc-tight passages, thereby rendering the electric plug and socket explosion-proof.

Referring particularly to Figures 7 and 8 it will be seen that a recessed portion 46a is provided on the inner bore side of the slot 46 so as to provide a recessed portion for receiving the washer or shoulder 44b. The recessed portion 46a terminates in a shoulder 47 near the end of the plug housing. Adjacent the upper edges of the slot 46 is a shoulder portion 48 defined by the outer peripheral portion of the plug housing. The shoulder 48 terminates abruptly as at 48a with the remaining portion of the slot 46 extending outwardly to the end of plug housing through a reduced diameter portion corresponding to the normal peripheral contour defined by the plug housing.

When the plug member is fully inserted into the socket member, the washers or shoulders 44a and 44b straddle the shoulder 48 so that the lower washer or shoulder 44b is seated within the recess presented by the recess portion 46a and the upper washer or shoulder 44a rides on the surface of the shoulder 48.

When the plug member is partially withdrawn from the socket member to such an extent that the terminals are separated but before the plug terminals have left the arc-tight passages, the lower washer or shoulder 44b engagingly abuts the shoulder 47, thereby precluding further withdrawal movement of the plug member from the socket member. The stud 42 is then moved radially inward, such movement being readily accomplished by manipulation of the wing nut 43, so that the washer or shoulder 44a moves downwardly to the reduced diameter portion and the lower washer or shoulder 44b clears the shoulder 47, as shown in Figure 10, thereby permitting complete straight line withdrawal of the plug member from the socket member.

It will be evident that the stop mechanism described herein whereby a slotted plug housing may be employed to cooperate with a stop member movable laterally with respect to the axis of the plug and socket component serves not only to introduce the necessary momentary time delay into the manipulation of the telescopically related plug and socket elements but also serves as polarizing means for guiding the plug and socket elements in correct longitudinal alignment.

Although it is possible that a person skilled in the art might suggest various minor modifications to the structure herein described by way of preferred embodiment and illustrative example only, it should be understood that we do not propose to be limited to the precise details set out only for the sake of clarity but wish to embrace within the scope of this patent all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. In an electric plug and socket structure having axially separable plug and socket members with coacting terminals therein, a manually operated time delay means including a stop member transversely disposed relative to the socket member and pivotally carried thereby for rocking

movement laterally with respect to the axis of the plug and socket members, said stop member having a pair of spaced leg portions extending inwardly toward the plug member, a plurality of spaced recesses formed in said plug member in registry with the leg portions of the stop member and resilient means to normally bias the stop member so that one leg thereof will extend into one of said recesses, said one recess and said one leg cooperable to stop withdrawal of the plug member from the socket member after the terminals are separated but before separation of the plug from the socket, whereupon said stop member may be pivotally displaced against the normal bias exerted thereon to move the other leg portion of the stop member into the recess in registry therewith, thereby permitting further withdrawal of the plug member from the socket member, whereupon said other leg portion in the recess in registry therewith will cooperate to stop withdrawal of the plug, said stop member being pivotally returnable to its initial position to permit complete withdrawal of the plug from the socket.

2. An electric plug and socket structure, comprising, a socket member having terminals therein, a plug member movable into and out of said socket member and having terminals coacting with the socket terminals, a stop member comprising a lever arm, means medially supporting said lever arm for pivotal movement of the end portions thereof toward and away from the plug member, said lever arm being aligned transversely to the axis of the plug and socket members, biasing means continuously urging one of the end portions of said stop member in one direction, a shoulder means on said plug member confronting said one of the end portions of said stop member for temporarily blocking the plug member after a partial withdrawal from the socket member, said stop member being pivotally actuated to move the other end portion in said one direction, and a shoulder means on said plug member confronting said other end portion of said stop member for temporarily blocking said plug member a second time after a further partial withdrawal from said socket member, said stop member being pivotally actuated a second time to effect complete withdrawal of the plug member from said socket member.

3. An electric plug and socket comprising, axially telescoping separable plug and socket members, and latch means cooperating between said plug and socket members, including a movable stop member carried by the outermost of said plug and socket members and having a pair of separate latch shoulders extending radially inwardly of said outermost member for cooperation with a peripheral wall portion on one side of the innermost of said plug and socket members, said peripheral wall portion being recessed to provide at least one additional latch shoulder and said stop member latch shoulders being movable radially inwardly and outwardly with respect thereto, a first pair of said latch shoulders between said stop member and said innermost member confronting one another for temporarily blocking the

movement of said plug and socket members after a partial separation, a second pair of said latch shoulders between said stop member and said innermost member confronting one another for temporarily blocking the movement of said plug and socket members after a further partial separation, said movable stop member being selectively actuated to relatively displace the latch shoulders out of confronting blocking relation, said stop member having two spaced leg portions providing said separate latch shoulders and extending generally radially inwardly toward said innermost member, said outermost member pivotally mounting said stop member between said leg portions and having apertures below said leg portions, said leg portions being selectively rocked through said apertures into the recessed portions of said peripheral wall portion, said peripheral wall including a plurality of circumferentially spaced recesses, said stop member and said apertures being transversely disposed, and a spring between said stop member and said outermost member biasing one of said legs into a corresponding one of said recesses.

4. An electric plug and socket comprising, axially telescoping separable plug and socket members, and latch means cooperating between said plug and socket members, including a movable stop member comprising a stud threaded through a wall portion of the outermost of said plug and socket members and having spaced washers thereon providing a pair of separate latch shoulders extending radially inwardly of said outermost member for cooperation with a peripheral wall portion on one side of the innermost of said plug and socket members, said peripheral wall portion being recessed to provide at least one additional latch shoulder and said stop member latch shoulders being movable radially inwardly and outwardly with respect thereto, said peripheral wall portion further including an axially extending slot receiving said stud, a first pair of said latch shoulders between said stop member and said innermost member confronting one another for temporarily blocking the movement of said plug and socket members after a partial separation, a second pair of said latch shoulders between said stop member and said innermost member confronting one another for temporarily blocking the movement of said plug and socket members after a further partial separation, said movable stop member being selectively actuated to relatively displace the latch shoulders out of confronting blocking relation.

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