United States Patent [19]

Williamson

[11] **3,914,725**

[45] **Oct. 21, 1975**

[54] **IMPULSE RELAY**

[75] Inventor: **Harold L. Williamson,** Arlington Heights, Ill.

[73] Assignee: **Littelfuse, Inc.,** Des Plaines, Ill.

[22] Filed: **Aug. 30, 1974**

[21] Appl. No.: **502,038**

[52] **U.S. Cl.** **335/140;** 335/123

[51] **Int. Cl.²** **H01H 51/08**

[58] **Field of Search** ..... 335/140, 123; 339/221 M

[56] **References Cited**

UNITED STATES PATENTS

3,115,563	12/1963	Tomaro, Jr.	335/123
3,204,062	8/1965	Foster et al.	335/123
3,207,873	9/1965	Slonneger	335/123
3,412,350	11/1968	Carli	335/123
3,533,054	10/1970	Spriggs et al.	339/221 M

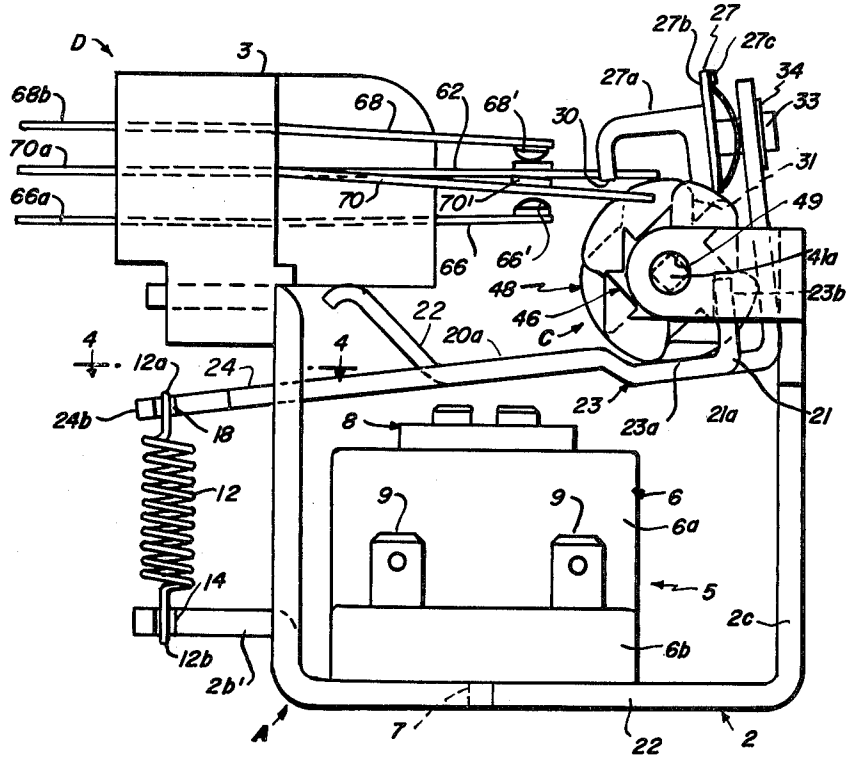
Primary Examiner—Harold Broome

Attorney, Agent, or Firm—Wallenstein, Spangenberg, Hattis & Strampel

[57] **ABSTRACT**

An impulse relay is formed by a U-shaped frame structure carrying a coil unit on the central wall thereof. A cam follower and contact-carrying arm sub-assembly is carried on a first transverse end wall and a cam and ratchet wheel sub-assembly is carried on an opposite confronting transverse end wall. An armature is pivoted on the first transverse end wall and spring urged away from the outer end of the coil unit. The armature extends in a space between the cam and ratchet wheel sub-assembly and terminates in transverse extensions which form pawl carrying and locking dog-forming portions which engage portions of the cam and ratchet wheels sub-assembly. The pawl carrying extension of the armature carries a flexibily mounted member from which extends pawl and locking dog-forming extensions which engage portions of the cam and ratchet wheel sub-assembly.

10 Claims, 12 Drawing Figures



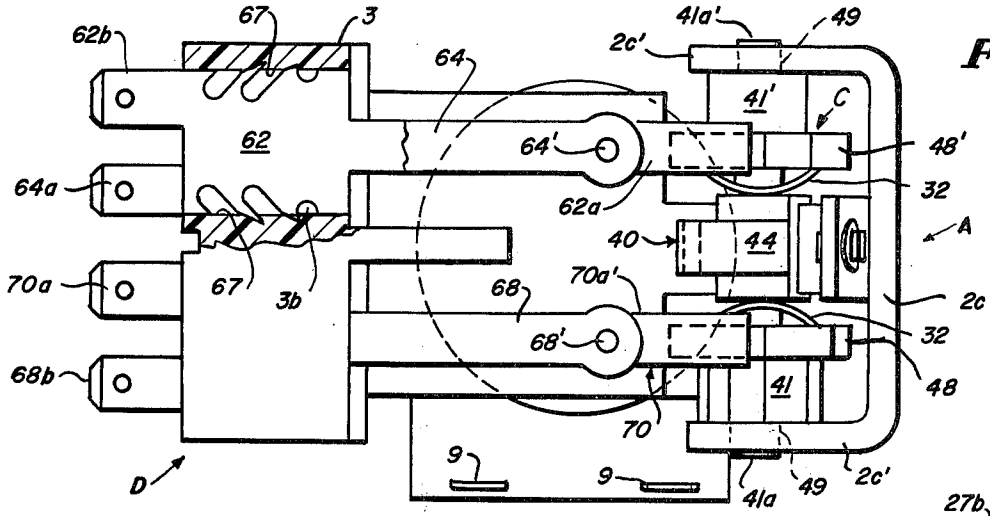


FIG. 1

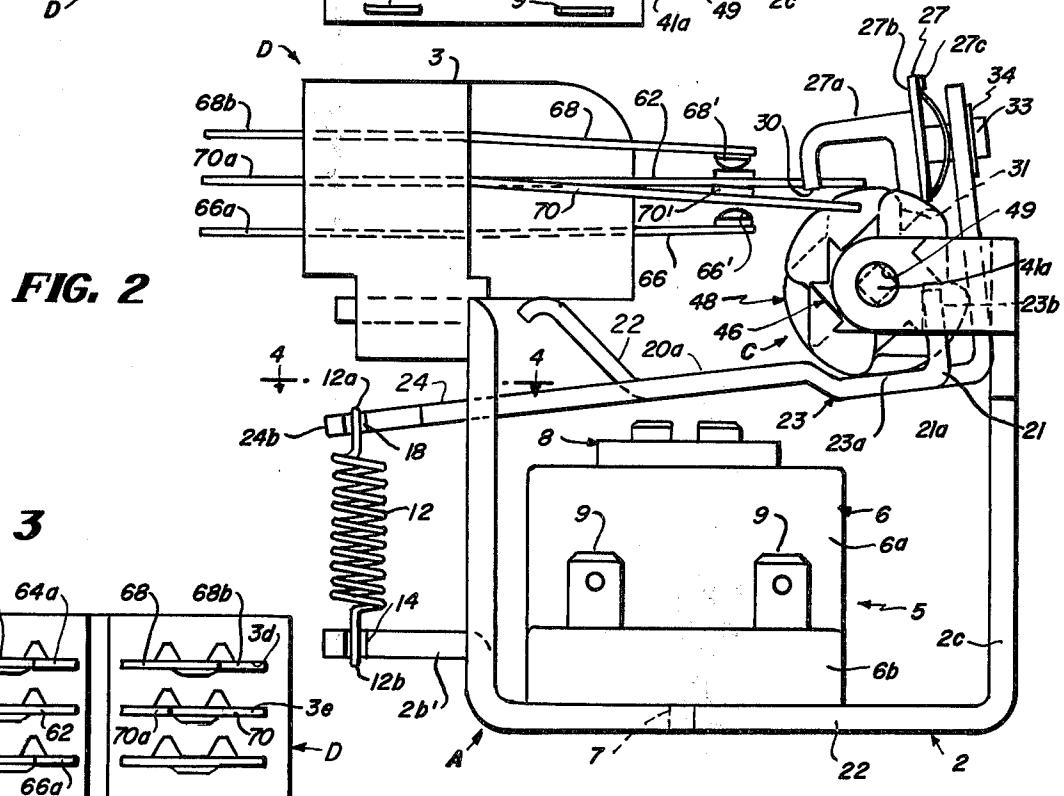
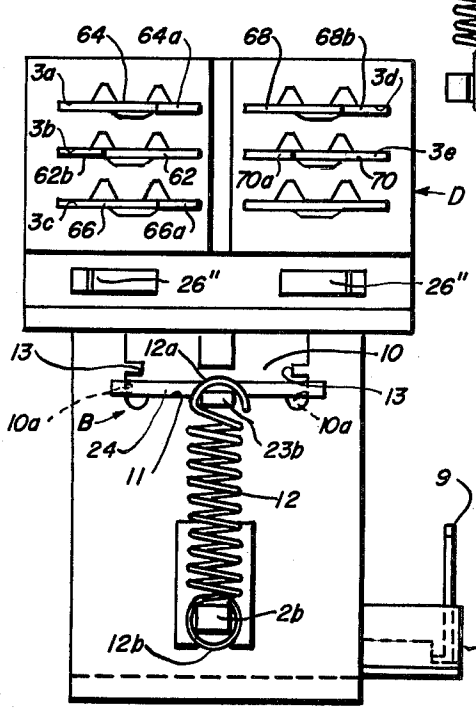


FIG. 2

FIG. 3



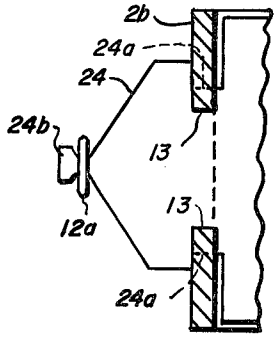


FIG. 4

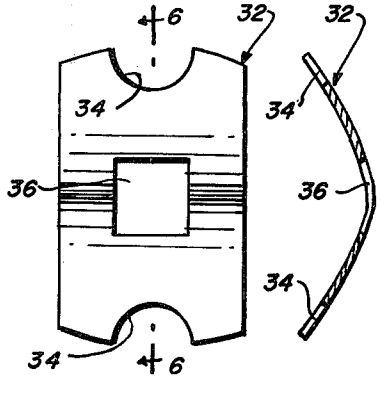


FIG. 5

FIG. 6

FIG. 7

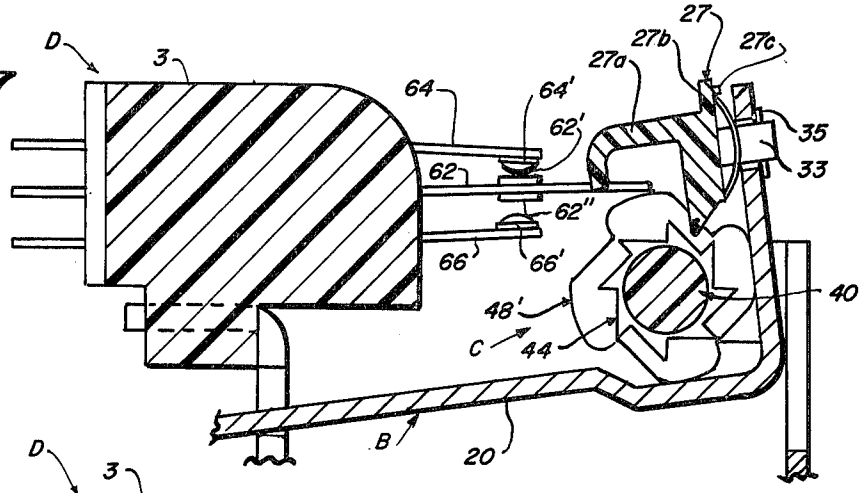


FIG. 8

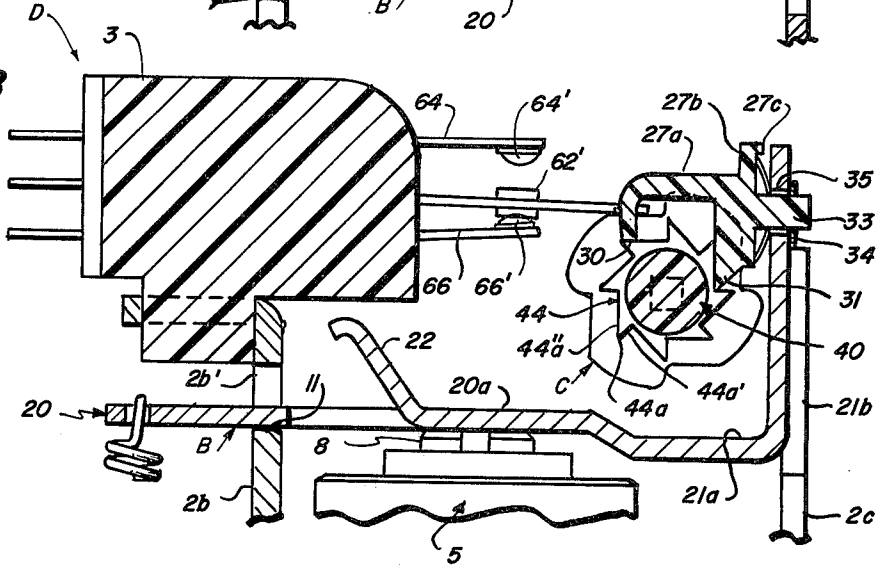


FIG. 9

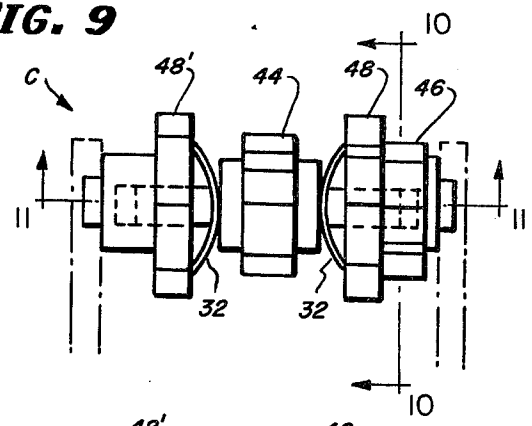
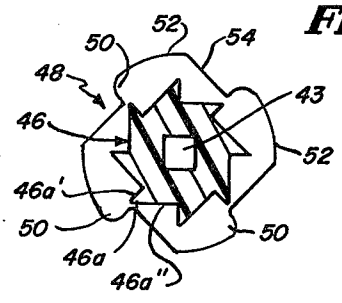


FIG. 10



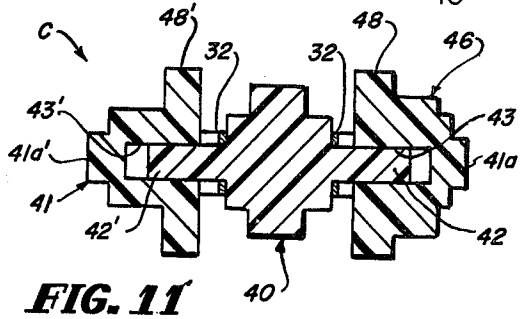
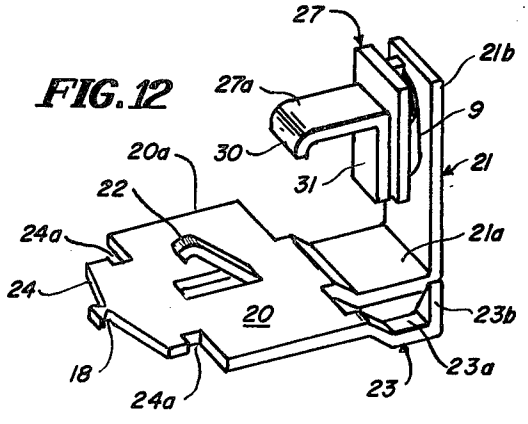


FIG. 11

FIG. 12



IMPULSE RELAY

BACKGROUND OF THE INVENTION

The present invention relates to impulse relays which generally include a coil unit, a pivotally mounted point operating armature movable toward and away from the coil unit as the latter is energized and de-energized and one or more rotatable cams upon which contact carrying cam follower arms ride to open and close sets of contacts as the cams are rotated given incremental angular amounts. The cams are rotated in steps by a ratchet wheel ganged thereto and engaged by an armature operating pawl movable toward and away from the ratchet wheel by the movement of the armature toward and away from the coil unit. As the coil unit receives successive impulses one or more cams are rotated given incremental amounts to sequentially open or close one or more contacts. Such an impulse relay, for example, has utility in garage door openers and other electrical applications where successive pulses are to alternately open and close contacts to energize and de-energize electric motors and other operating devices.

Prior impulse relays have left much to be desired from the standpoint of compactness, the number of parts used therein and the ease of assembly thereof.

It is an object of the present invention to provide an impulse relay construction of minimum compactness and number of parts. A related object of the invention is to provide an impulse relay as described which is sturdy and therefore reliable in operation for an indefinite period. A further object of the invention is to provide an impulse relay as described where the subcomponents thereof are so designed that they can be quickly and easily assembled into a completed impulse relay, preferably without the use of screws and rivets.

SUMMARY OF THE INVENTION

In accordance with one of the features of the present invention, the impulse relay comprises a frame having a central wall upon which a coil unit is supported, and confronting transverse end walls one of which carries a cam follower and contact carrying arm sub-assembly with the arms thereof extending generally in a direction parallel to the coil unit support wall. The other transverse end wall carrier a cam and ratchet wheel subassembly mounted for rotation about an axis extending in a plane generally parallel to the central and transverse end walls. The cam and ratchet wheel subassembly is located beyond the end of the coil unit facing away from the coil unit supporting wall and in confronting relationship to the edge portion of the core unit remote from the side thereof nearest the transverse end wall carrying the cam follower and arm subassembly. This placement of the cam and ratchet wheel sub-assembly produces a reduced overall width of the impulse relay in comparison to prior impulse relay constructions where, because of the relationship of the coil unit armature to such sub-assembly, it was located completely to one side of the coil unit. This unique placement of the cam and ratchet sub-assembly is made possible by an armature design which includes a main body portion which is most advantageously pivoted upon the transverse end wall carrying the cam follower and contact carrying arm sub-assembly and extends beyond the outer end of the coil unit and then passes in the space between the cam and ratchet wheel subassembly and the coil unit where it terminates in transversely outwardly extending pawl carrying and locking dog-forming portions. When the coil unit is deenergized, the locking dog-forming portion thereof engages one of a number of flats on the periphery of a locking dog wheel forming part of the cam and ratchet wheel sub-assembly. The pawl carrying armature portion has attached thereto a flexibly mounted member from which extends a pawl which when the coil unit is energized, engages a ratchet wheel on the latter subassembly, and an overshoot preventing dog which engages the ratchet wheel after the pawl has moved the ratchet wheel a given angular amount.

In accordance with another feature of the invention, the cam and ratchet wheel sub-assembly is preferably made of one or more parts interconnected so that they are normally spring urged into an axially outermost position, and are axially collapsable to permit ready insertion between a pair of aperture pivot-forming ears extending from one of the transverse end walls of the frame. Removal of the collapsing pressure on the subassembly after proper positioning thereof between the pivot-forming ears automatically results in its proper rotatably mounted positioning between the ears.

The above and other features and advantages of the invention will become apparent upon making reference to the specification to follow, the claims and the drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan partly broken away view of an impulse relay exemplifying the most preferred form of the present invention;

FIG. 2 is a side elevational view of the impulse relay shown in FIG. 1;

FIG. 3 is an end elevational view of the impulse relay shown in FIGS. 1 and 2;

FIG. 4 is an enlarged sectional view through the impulse relay shown in FIG. 2, taken along section line 4—4;

FIG. 5 is an enlarged plan view of the leaf spring used in the armature assembly and in the cam and ratchet wheel assembly;

FIG. 6 is a sectional view through the spring of FIG. 5, taken along section line 6—6 therein;

FIG. 7 is a fragmentary enlarged central longitudinal sectional view through the armature assembly and the cam and ratchet wheel assembly, showing the relative positions of the pawl and overshoot preventing dog when the coil unit is deenergized;

FIG. 8 is a view corresponding to FIG. 7 when the coil unit is energized;

FIG. 9 is a plan view of the cam and ratchet wheel assembly before being installed in the frame of the impulse relay;

FIG. 10 is a transverse sectional view through the assembly of FIG. 9, taken along section line 10—10;

FIG. 11 is a longitudinal sectional view through the cam and ratchet wheel assembly of FIG. 9, taken along section line 11—11; and

FIG. 12 is a perspective view of the armature assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

The impulse relay shown in the drawings comprises a frame and coil unit sub-assembly A, an armature, pawl and locking dog sub-assembly B, a cam and

ratchet wheel sub-assembly C and a cam follower and contact carrying sub-assembly D. The frame and coil unit assembly A includes a generally U-shaped frame **2** having a main or central support wall **2***a* from the opposite ends of which transversely extend spaced confronting end walls **2***b* and **2***c*. Struck from the end wall **2***b* is a tab **2***b'* extending transversely of the end wall **2***b*. The upper end of the end wall **2***b* terminates in a pair of mounting ears **2***b''*—**2***b''* which pass through openings in a housing **3** of the cam follower and contact-carrying sub-assembly D where the ends thereof are staked to anchor the housing **3** in place thereon. The transverse end wall **2***c* terminates at the top thereof in pivot-forming ears **2***c'*—**2***c'* which rotatably mount the cam and ratchet wheel sub-assembly C about an axis parallel to the main and transverse frame end walls **2***a*, **2***b* and **2***c* in a manner to be described. The end wall **2***b* includes an armature-receiving aperture **10** (FIG. **3**) having a rounded armature pivot-forming edge **11** at the inner margin thereof. The aperture **10** is interrupted by wall extensions **13**—**13** which form narrow aperture sections **10***a*—**10***a* within which the armature portion of the armature pawl and locking dog assembly B extend in a manner to be described.

The central wall **2***a* of the frame **2** supports on the inner face thereof a coil unit **5** including a housing **6** made of synthetic plastic material, the housing including a cylindrical section **6***a* within which a coil winding (not shown) and a core **8** are located, and a housing section **6***b* from which extend terminals **9**—**9** which electrically connect to the ends of the coil winding within the housing section **6**. The coil unit **5** may be held in place upon the main wall **2***a* in any suitable way, such as by staking the core **8** in place within a countersunk opening **7** within the central wall **2***a* of the frame. The core may be threaded at this point to receive a screw of anchoring the impulse relay on a support panel or the like.

The armature, pawl and locking dog sub-assembly B includes a metal armature **20** having a main body portion **20***a* pivoted within the armature-receiving recess **10** in the end wall **2***b* of the frame **2**. The main body portion **20***a* of the armature **20** pivots on the aforementioned pivot-forming edge **11** of the frame end wall **2***b*. The main body portion **20***a* of the armature terminates in a generally T-shaped extension **24** (FIG. **4** formed by narrow slots **24***a*—**24***a* forming a neck portion having a width equal to the length of the armature receiving aperture **10**. The armature interlocks with the defining walls of the bottom portion of the armature receiving aperture **10** in a way where the armature can pivot up and down over the edge **11**, but is otherwise held in place within the aperture **10** by the defining walls of the apertures **10***a*—**10***a*. A coil spring **12** has an end **12***b* hooked around a recessed portion **14** (FIG. **2**) of the tab **2***b'* and an end **12***a* which hooks around an indented portion **18** at the knobbed end **24***b* of the T-shaped extension **24** of the armature. The spring **12** biases the armature **20** so that the main body portion **20***a* inclines away from the outer end of the coil unit **6** as illustrated in FIG. **2** when the coil unit is de-energized. The outward movement of the armature is limited by the engagement of an abutment projection **22** struck from the main body portion **20***a* of the armature **20** with the inner face of the housing **3** of the cam follower and contact-carrying arm sub-assembly D.

The main body portion **20***a* of the armature terminates in a pair of a L-shaped extensions **21** and **23**. The extension **21** has a portion **21***a* extending in the space between the cam and ratchet wheel assembly C and the coil unit **5**, and a transversely outwardly extending end portion **21***b*. The transverse end portion **21***b* has flexibly secured thereto a molded synthetic plastic member **27** having an inverted L-shaped portion **27***a* defining a pawl-forming projection **31** and an overshoot preventing dog-forming projection **30**. The synthetic plastic member **27** has a rearwardly extending shank passing loosely through an opening **35** in the transversely extending end portion **21***b* of the armature which shank portion is anchored in place in any suitable way to the armature, as by a locking washer **34**. A leaf spring **32** positioned between the inner face of the transversely extending end portion **21***b* of the armature and a head portion **27***b* of the synthetic plastic member **27** so as to permit the member **27** to flex in a plane transverse to the axis of rotation of the cam and ratchet wheel sub-assembly C, to permit the pawl projections **31** to clear the teeth of the ratchet wheel to be described. While the spring **32** may take a variety of forms, as illustrated it is an arcurate shaped member having a central square opening **36** received over the similarly shaped shank portion **33** of the synthetic plastic member **27** and end apertures **34**—**34**, one of which stradles a projection **27***c* of the synthetic plastic member **27**.

The armature extension **23** has an inner end portion **23***a* which passes in the space between the cam and ratchet wheel sub-assembly C and the coil unit **5**, and a transversely outwardly extending end portion **23***b* which forms a locking dog in a manner to be described.

The preferred cam and ratchet wheel sub-assembly C is a collapsible assembly including a centrally disposed ratchet wheel-forming part **40** preferably made of a molded synthetic plastic material and having axial extensions **42**—**42'** preferably of square cross section slidably received within correspondingly shaped apertures **43**—**43'** in a pair of outer cam-forming parts **41**—**41'** also preferably made of molded synthetic plastic material. Sandwiched between the confronting end faces of the ratchet wheel-forming part **40** and each of the cam forming parts **41**—**41'** are spring means such as a leaf spring **32** previously described. The square shaped center apertures **36** of the leaf spring **32**—**32** are sized to fit over the correspondingly shaped axial extensions **42**—**42'** of the ratchet wheel-forming part **40**, the leaf springs urging these parts **40**, **41** and **41'** axially outwardly. The cam-forming parts **41** and **41'** respectively have axially aligned cylindrical extensions **41***a*—**41***a'* which fit within correspondingly shaped circular pivot-forming apertures **49**—**49** (FIG. **2**) in the frame ears **2***c'*—**2***c'*. To mount the cam and ratchet wheel sub-assembly C between the ears **2***c'*—**2***c'*, it is merely necessary to hold the assembly in a collapsed state while placing the same so that the cylindrical extensions **41***a*—**41***a'* are in alignment with the frame ear apertures **49**—**49**. Upon release of the assembly collapsing pressure, the assembly expands outwardly into interlocking relationship with the frame ears. In the process of collapsing the sub-assembly C, the axial extensions **42**—**42'** of the ratchet wheel-forming part **40** slide further within the apertures **43**—**43'** in the cam forming parts **41**—**41'**.

As best shown in FIGS. **7** and **8**, the ratchet wheel forming part **40** defines a ratchet wheel **44** having in

the illustrated embodiment of the invention 8 ratchet teeth 44*a*, each having a radially extending margin 44*a'* and a generally tangentially extending margin 44*a''*. When the coil unit 5 is energized and the armature is drawn against the core of the coil unit, the pawl-forming projection 31 of the armature carried member 27 engages the radially extending margin 44*a'* of one of the ratchet teeth 44*a* to impart a given amount of angular rotation equal to one-eighth of a revolution in the example illustrated when the armature reaches its position adjacent the core of the coil unit. The overshoot preventing projection 30 of the armature carried member 27 engages the tangentially extending margin 44*a''* of one of the ratchet teeth, as shown in FIG. 8, after the ratchet wheel rotates one-eighth of a revolution to prevent overshoot thereof. The coil unit is operated only be a momentary current pulse, and upon termination of this pulse the spring 12 will return the armature to its normal outermost position shown in FIG. 7. As the armature starts to return to its initial position, the locking dog 23*b* on the armature extension 23 engages a part of the sub-assembly C to be described to prevent movement thereof, and the flexibly mounted member 27 flexes to permit the pawl projection 31 to slip by the ratchet wheel tooth 44*a*.

The cam-forming part 41, in addition to forming a cam 48 to be described, also forms a locking dog wheel 46 which has the identical size and shape as the ratchet wheel 44 except that the teeth 46*a* thereof (FIG. 10) project in the opposite direction. Also, when the coil unit is de-energized, the circumferentially extending margin 46*a''* of one of the teeth thereof is engaged by the locking dog 23*b* of the armature extension 23 to lock the cam and ratchet wheel sub-assembly against rotation.

The cam-forming parts 41 and 41' form cams 48 and 48'. Refer now to FIG. 10 which also illustrates the configuration of the cam 48, it being understood that the configuration of the cam 48' is identical thereto except for a slightly different angular orientation. Corresponding parts thereof are similarly numbered except a prime has been added to the number identifying the part of cam 48'. The cam 48 has four lobes 50, each of which includes an outermost cam arm engageable portion 52 and a flat 54 positioned at a closer distance to the center of the cam than the outermost portion 52. In the illustrated embodiment of the invention, when the coil unit 5 is de-energized, the cams 48 and 48' have such different angular positions that the outermost cam engaging portion 52 or 52' of one of the lobes of the cam 48 or 48' faces outwardly to be engaged by a cam follower portion 62*a* or 70*a* of a contact carrying arm 62 or 70, while the flat 54 or 54' of one of the lobes of the other cam 48' or 48 faces outwardly where it is engaged by the cam follower-forming extension 70*a* or 62*a* of the contact-carrying arm 70 or 62. The arms 62 and 70 are anchored within the housing 3 in a manner to be described.

The arm 62 carries on one side thereof a contact 62' which, as shown in FIG. 8, respectively makes engagement with a stationary contact 64' on an arm 64 when the cam follower-forming extension 62*a* rides upon the outermost section 52' of the lobe of the cam 48'. The arm carries a contact 62'' which makes contact with a stationary contact 66' on a contact carrying arm 66 when the cam follower portion 62*a* of the arm 62 rides on a lobe flat 54' of the associated cam 48'.

The aforementioned arm 70 carries a contact 70' which is spaced from a stationary contact 68' on a contact carrying arm 68 when the cam follower-forming extension 70*a* rides on a flat 54 of a lobe 50 of the cam 48, and makes engagement with a stationary contact 68' when the cam follower-forming extension 70*a* rides upon the outermost portion 52 of one of the lobes 50 of the cam 48. Of course, the particular contact arrangement for the relay can vary widely, depending upon the needs of the electrical circuit in which the relay is placed. Thus, there can be either one or two stationary contacts associated with each cam follower-forming arm.

The various contact carrying arms 62, 64, 66, 68, and 70 respectively pass through aperture 3*a*, 3*b*, 3*c*, 3*d*, and 3*e* in the housing 3, where they terminate in exposed soldering terminals 62*b*, 64*a*, 66*a*, 68*b* and 70*a*—70*a'*.

Another unique aspect of the impulse relay illustrated is the manner in which the various arms 60, 64, 66, etc. are anchored within the housing 3. As best illustrated in FIG. 1, the portion of the various arms referred to which extend through the housing 3 have barbed contours like 67 along both longitudinal edges thereof so as to bite into the synthetic plastic material lining the sides of the various apertures 3*a*, 3*b*, 3*c*, 3*d* and 3*e* formed in the housing to receive these arms. Manifestly, the widths of the arms is slightly greater than the corresponding dimension of these apertures, so that they can be anchored in place by merely force fitting the same within these apertures.

It should be apparent that the present impulse relay has the advantage of maximum compactness because of the relationship of the armature 20, and the extensions 21 and 23 thereof with respect to the cam and ratchet wheel sub-assembly C. It is made of a minimum number of parts because of the manner in which the various operating portions thereof, such as the pawl 31 and the dogs 30 and 23*b*, are formed and located. Moreover, the collapsible construction of the cam and ratchet wheel sub-assembly C contributes to the low cost and ease of assembly of the impulse relay.

It should be understood that numerous modifications may be made in the most preferred form of the invention described above without deviating from the broader aspects of the invention.

I claim:

1. An impulse relay including a coil unit, cam follower and contact-carrying arms, an armature spring urged outwardly away from the outer end of the coil unit so upon energization of the coil unit the armature is drawn toward the coil unit against the restraining force of the spring, a cam and ratchet wheel assembly mounted for rotation about a common axis and located outwardly of the coil unit, said armature having portions extending in the space between the cam and ratchet wheel assembly, on the one hand, and said coil unit on the other hand, and terminating in transversely outwardly extending pawl carrying portion, said pawl carrying portion including a pawl-forming extension projecting toward the outer side of said cam and ratchet wheel assembly, said cam and ratchet wheel assembly including cam means and ratchet wheel means, said ratchet wheel means being engaged by said pawl-forming extension when said coil unit is energized, and when said coil unit is energized said cam means being engaged by said cam follower arms to effect opening

and/or closing of contacts carried thereby as said cam and ratchet wheel assembly is rotated, said armature also having a transversely outwardly extending locking dog-forming portion which, when the coil unit is deenergized, engages a portion of the cam and ratchet wheel sub-assembly to hold the same against rotation until the pawl is drawn to said coil unit, said pawl-forming extension being formed on a member flexibly secured to said pawl carrying portion of said armature, said member including in addition to said pawl-forming extension an overshoot preventing dog-forming extension projecting towards said cam and ratchet wheel sub-assembly on the outer side thereof, said overshoot preventing the dog-forming extension engaging a portion of said cam and ratchet wheel assembly to stop further rotation thereof after a given amount of rotation is imparted to the ratchet wheel means by said pawl-forming extension upon energization of the coil unit.

2. The impulse relay of claim **1** wherein said armature also has a transversely outwardly extending locking dog-forming portion which, when the coil unit is deenergized, engages a portion of the cam and ratchet wheel sub-assembly to hold the same against rotation until the pawl is drawn to said coil unit.

3. The impulse relay of claim **1** wherein said pawl-forming extension is formed on a member flexibly secured to said pawl carrying portion of said armature, said member including in addition to said pawl-forming extension an overshoot preventing dog-forming extension projecting towards said cam and ratchet wheel sub-assembly on the outer side thereof, said overshoot preventing dog-forming extension engaging a portion of said cam and ratchet wheel assembly to stop further rotation thereof.

4. The impulse relay of claim **1** wherein said cam and ratchet wheel assembly confronts the marginal end portion of the coil unit on the side thereof where said transversely outwardly extending pawl-carrying portion of the armature is located.

5. An impulse relay comprising a frame having a main support wall on which a coil unit is supported and from which outwardly extend a pair of spaced confronting transversely extending end walls, a cam follower and contact-carrying arm sub-assembly mounted on one of said transversely extending end walls and having contact carrying and cam follower-forming arms extending in the direction of the other transversely extending end wall, an armature mounted on said one transversely extending end wall and spring urged away from the outer end of the coil unit so upon energization of the coil unit the armature is drawn toward the coil unit against the restraining force of the spring, a cam and ratchet wheel sub-assembly mounted on said other transversely extending end wall and for rotation about an axis extending generally parallel to said main and transversely extending walls, and located beyond the outer end of the coil unit in a direction parallel to said transversely extending end walls, said armature having portions extending in the space between the cam and ratchet wheel sub-assembly, on the one hand, and said coil unit, on the other hand, and terminating in a transversely extending pawl carrying portion, said pawl carrying portion carrying a pwal-forming extension projecting toward said cam and ratchet wheel sub-assembly on the side thereof remote from said main support wall, said cam and ratchet wheel sub-assembly including cam means and ratchet wheel means engaged by said pawl-forming extension when said coil unit is energized, said cam means being engaged by said cam follower-forming arms of said follower and contact carrying arm assembly when said coil unit is energized to effect opening and closing of contacts carried thereby as said cam and ratchet wheel assembly is rotated, said armature also having a transversely outwardly extending locking dog-forming portion which when the coil unit is deenergized engages a portion of the cam and ratchet wheel sub-assembly to hold the same against rotation until the pawl is drawn to said coil unit, and said pawl-forming extension being formed on a member flexibly secured to said pawl carrying portion of said armature, said member including in addition to said pawl-forming extension an overshoot preventing dog-forming extension projecting towards said cam and ratchet wheel sub-assembly on the outer side thereof, said overshoot preventing dog-forming extension engaging a portion of said cam and ratchet wheel assembly to stop further rotation thereof after a given amount of rotation is imparted to the ratchet wheel means by said pawl-forming extension upon energization of the coil unit.

6. An impulse relay comprising a frame having a main support wall on which a coil unit is supported and from which outwardly extend a pair of spaced confronting transversely extending end walls, a cam follower and contact-carrying arm sub-assembly mounted on one of said transversely extending end walls and having contact carrying and cam follower-forming arms extending in the direction of the other transversely extending end wall; an armature mounted on said one transversely extending end wall and spring urged away from the outer end of the coil unit so energization of the coil unit the armature is drawn toward the coil unit against the restraining force of the spring; a cam and ratchet wheel sub-assembly mounted on said other transversely extending end wall and for rotation about an axis extending generally parallel to said main and transversely extending walls, and located beyond the outer end of the coil unit in a direction parallel to said transversely extending end walls, said armature having portions extending in the space between the cam and ratchet wheel sub-assembly, on the one hand, and said coil unit, on the other hand, and terminating in transversely extending pawl carrying and locking dog-forming portions, said pawl carrying portion having secured thereto a flexibly mounted member having a first pawl-forming extension projecting toward said cam and ratchet wheel sub-assembly on the side thereof remote from said main support wall and an overshoot preventing dog-forming extension projecting toward said cam and ratchet wheel assembly on the latter said of the assembly; said cam and ratchet wheel sub-assembly including cam means, ratchet wheel means and locking dog wheel means, said ratchet wheel means being engaged by said pawl-forming extension when said coil unit is energized, and by said overshoot preventing dog-forming extension when said coil unit is energized after a given amount of rotation is imparted to the ratchet wheel means, said locking dog wheel means being engaged and held by said locking dog-forming portion of said armature when said coil unit is deenergized, and said cam means being engaged by said cam follower-forming arms of said follower and contact carrying arm sub-assembly when said coil unit is energized to effect opening and closing of contacts

carried thereby as said cam and ratchet wheel assembly is rotated.

7. In an impulse relay including a coil unit, an armature movable toward and away from the coil unit as the latter is energized and de-energized, cam follower and contact-carrying arm means for effecting contact opening and closing operations when said coil unit is energized and/or de-energized, an assembly of rotatably mounted cam means upon which the cam follower arm means ride and rotatably mounted ratchet wheel means engagable by a pawl operated by said armature to effect incremental rotation of said cam means, the improvement in the support and arrangement of said ratchet wheel means and cam means comprising spaced confronting bearing-forming walls providing a rotatable support for said ratchet wheel means and cam means, said ratchet wheel means and cam means being formed by at least two separate members mounted together for relative axial movement and rotation about a common axis, spring means urging the ratchet wheels and cam-forming members axially apart where they are collapsible against the restraining force of said spring means to reduce the overall axial extend thereof, said spring urged assembly of said cam and ratchet wheel-forming members when in a collapsed condition being insertable between said confronting bearing-forming members, said cam and ratchet wheel-forming members and said confronting pivot-forming members having means which telescopingly engage when the collapsing pressure on said assembly is removed and said members assume their outermost positions relative to one another.

8. The impulse relay of claim 7 wherein one of said members of said assembly is an axially extending projection slidably received within a slot in the other of same, so that when the assembly is in its collapsed condition said axially extending projection extends to a greater degree within said slot.

9. The impulse relay of claim 7 wherein said assembly of said cam and ratchet-forming members comprise a central ratchet wheel-forming member positioned between a pair of outermost cam-forming members, said central ratchet wheel-forming member having means interconnecting with each of said cam-forming members to permit relatively axial movement therebetween, said spring means urging said ratchet wheel-forming member and each of said cam-forming members apart and permitting the collapsing of the assembly to reduce the overall axial extent of the assembly to enable the insertion thereof between said bearing-forming members.

10. The impulse relay of claim 9 wherein there is formed as an integral part of one of said cam-forming members a locking wheel against which a locking dog is urged to hold the same against rotation when the coil unit is in a de-energized state, said locking dog being withdrawn from said locking where when the coil unit is energized.

* * * * *