

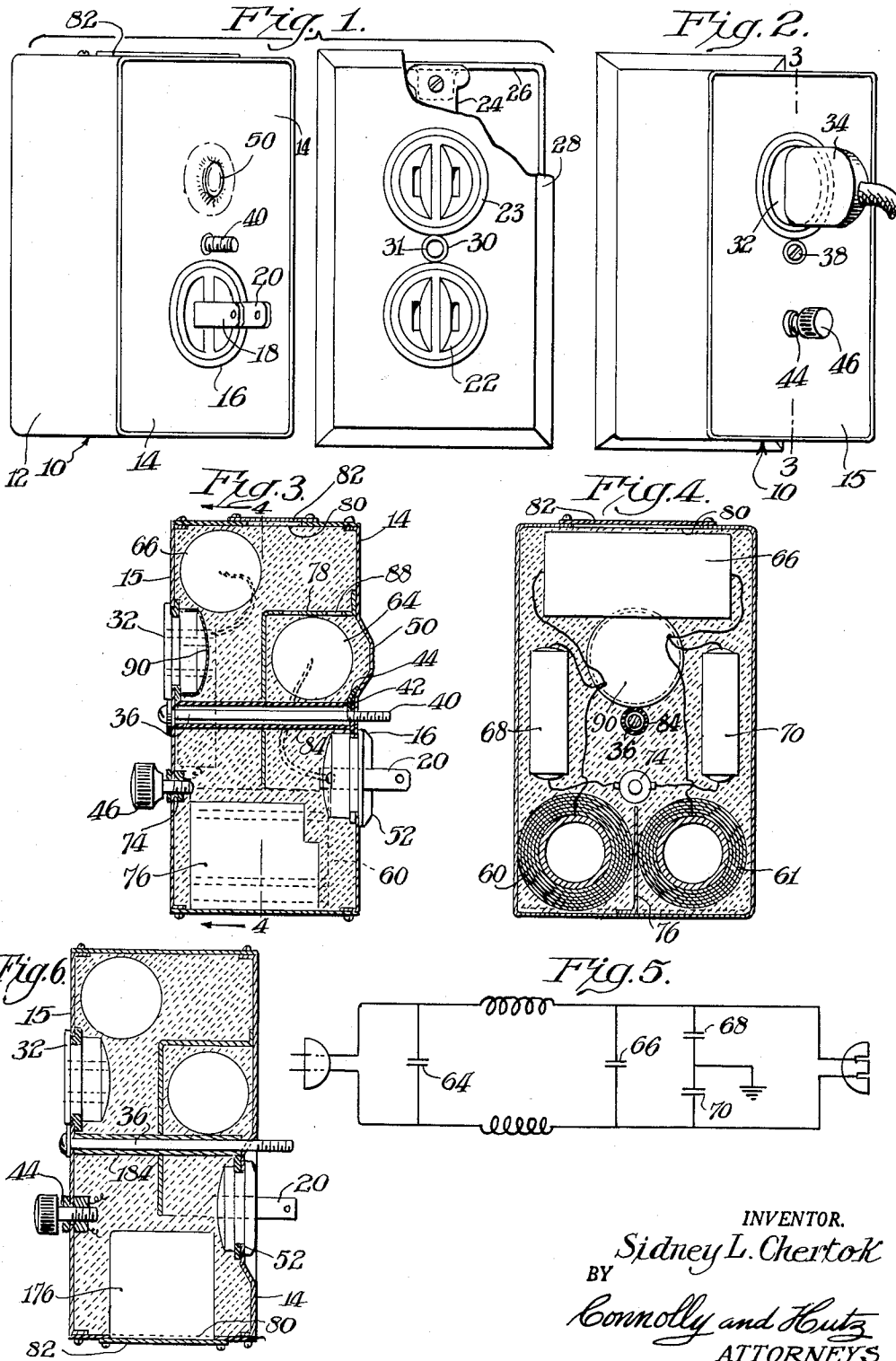
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LINE FILTER

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LINE FILTER

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This invention relates to electrical filters, more particularly to such filters for use with power supply connections to radios and the like.

Among the objects of the present invention is the provision of novel power supply filters that are highly effective, yet simple to make and use.

The above as well as the additional objects of the present invention will be more clearly understood from the following description of several of its exemplifications, reference being made to the accompanying drawings wherein:

Figs. 1 and 2 are pictorial views showing one type of line filter as seen from opposite directions and illustrating its external appearance as well as the manner in which it is mounted for use.

Fig. 3 is a sectional view of the line filter of Figs. 1 and 2, taken along the lines 3—3 in Fig. 2.

Fig. 4 is a sectional view of the filter Figs. 1 and 2, taken along the line 4—4 of Fig. 3.

Fig. 5 is a circuit diagram of the filter assembly in the construction of Figs. 3 and 4, and

Fig. 6 is a view similar to Fig. 3 of a modified form of line filter illustrative of the invention.

According to the present invention, a power line filter has a set of filter components connected together in a metal housing, a plug secured to one wall of the housing with prongs projecting outwardly away from the wall for insertion in a power line outlet, a socket secured to another wall of the housing for receiving a plug-in connector, and a metal mounting screw engaging the housing and having a threaded end projecting out alongside the plug for engagement in a grounded threaded opening of the power line outlet to simultaneously ground the housing and hold it in place.

A highly effective form of filter component assembly includes series inductors connecting the respective prongs with corresponding terminals of the socket, and parallel capacitors bridged between the prongs and between the terminals, a center tap in the socket terminal bridge being grounded to the housing. It is particularly desirable that the inductance in one series connection is shielded from the inductance of the cooperating series connection by an electrically conductive member grounded to the housing. It is also desirable to have the capacitive bridges between the prongs and between the terminals shielded from each other by an electrically conductive member grounded to the housing.

It is also helpful to pot the contents of the housing, preferably without interfering with the operation of the grounding screw. For more universal use, the housing can also be provided with an external connection by which it can be grounded separately from the mounting screw.

Referring now to the drawings, the unit 10 shows an embodiment of the invention having a box-like housing 12 made of sheet metal drawn, or bent and fastened together in the desired shape. The shape illustrated is that of a rectangular prism with one housing wall 14 carrying

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a connector plug 16. This plug has a pair of prongs 18, 20 suitably arranged to plug into the conventional type of electric outlet connector which is shown at 22 in Fig. 1. Standard connectors have socket 23 for receiving the plugs 18 and 20, and also have a metal framework 24 by which they are held in a metal outlet box 26 usually recessed in any convenient wall. Also the open face of the box 26 is covered as by a protective plate 28 secured to the framework 24 by means of a screw (not shown) that engages in an opening 30 provided in the center of the plate and is received in a threaded opening 31 in the framework.

As shown in Fig. 2 the housing wall 15 opposite wall 14, is provided with a socket 32 which can be similar to sockets 23 so that standard forms of line cord plugs, as shown at 34 for example, can be plugged in.

The unit 10 also carries a mounting screw 36, the head of which is shown at 38 just below socket 32. This screw penetrates through the housing and has a threaded end 40 that projects out immediately above plug 16. This end is so located that when plug 16 is received in connector 22, the end will be positioned to pass through opening 30. Also the end 40 has thread that matches the standard thread of framework opening 31.

The mounting screw is rotatably held in the housing, as by threading it through a nut 42 secured to the inner or outer face of wall 14. The nut need not be welded or soldered in place but, if inside the housing, can be merely held by adhesive tape 44 or the like, particularly where the inside of the housing is filled with potting compound. By having the screw so rotatable, it is a simple matter for the unit 10 to be grounded in place as shown in Fig. 2. It is only necessary to remove the plate-holding screw normally provided on the outlet receptacle 22, then plug the prongs 18, 20 into connector 22, and then to rotate the head of screw 36 engaged while pushing it through opening 30 and into contact with the threaded opening 31 in the framework 24. The threading operation is continued until the screw is tightly engaged.

The plugging in of the unit serves to align the end 40 of screw 36 with the opening 31, and the tightening of the screw establishes an electrical contact or ground path from the housing through the framework 24, to the box 26. In standard installations of the modern type, box 26 is connected by a suitably provided electrical conductor to a good ground site such as a cold water line or the like. This ground conductor is usually carried along with the conductors that supply the electrical power to the terminals in the sockets of connector 22. In this way modern electrical power installations automatically provide good ground connections for each of the boxes 26 and frameworks 24 at every electrical supply outlet. The mounting of the filter unit in place will therefore enable the mounting screw to establish a very good ground return for the housing 12. This good ground return does not require the nut 42 threaded on this mounting screw to be soldered, welded or otherwise in good electrical contact with the housing. However, if it is not firmly grounded, it is advisable to have a lock washer fitted under the head 38 of screw 36 so as to have a sharp edge that penetrates any non-conductive coating such as paint, on the housing surface, when the unit is mounted in place.

In older electric power installations the outlet box 26 may not have adequate grounding. For this purpose the unit 10 is shown as provided with an external binding post 44 welded, staked, or securely bolted in an accessible place to the housing 12. The post 44 can be provided with a securing nut 46 preferably of the type that cannot be removed although it can be threaded with one's fingers in and out an amount sufficient to permit

its clamping against a lug or wire or other suitable lead wrapped around the post. The post can also be transversely drilled to more readily receive such a wire.

For a neater fit against standard forms of outlet receptacles, housing wall 14 is shown in Figs. 1 and 3 as having a dome-like protuberance 50 pressed out. This provides an abutment projecting out from this wall by approximately the same distance by which the outer face or base 52 of plug 16 projects. The protuberance 50 in this way takes the place of a second plug 16 that would otherwise be needed to obtain symmetry, and the unit when securely tightened in place will not be cocked or tilted, but will present a good appearance.

The internal construction of the line filter of Figs. 1 and 2 is more clearly shown in Figs. 3 and 4. From each of the prongs 18, 20 of plug 16 an inductor 60, 61 establishes a separate connection to one of the terminals of socket 32. At the same time, the prongs 18, 20 are bridged by capacitor 64, and the terminals of socket 32 are also bridged by capacitor 66. These terminals have an additional bridge made by a chain of two series-connected capacitors 68, 70. The junction of the two capacitors 68, 70 is grounded to the housing as by being soldered to a nut 74 that holds the binding post 44 in place. This circuit is diagrammatically illustrated in Fig. 5. For radio receivers operating in the 500 to 1700 kilocycle per second signal frequency band, very effective results are obtained with each inductor made of a three bank winding of copper wire having 20 turns per bank, around a core having an outside diameter of $\frac{7}{8}$ inch. These inductors should have wire heavy enough to carry the desired current, No. 14 for example, are bridged by capacitors 64, 66 each of 0.33 microfarad. All the capacitors are preferably of the so-called non-inductive type.

For best results, the inductors 60, 61 are arranged so that they are not mutually coupled, as by fitting between them a shielding wall 76 of metal, which may be conveniently spot welded to the housing.

Furthermore, the bridges on the opposite sides of the inductors are also desirably shielded from each other, and in the illustrated construction this is accomplished by a pocket-forming wall 78 which can be screwed or spot welded to housing wall 14 to form with it a substantially complete compartment confining capacitor 64 as well as its leads.

For long life, particularly under adverse humidity conditions, it is also helpful to pot the inside of the housing as by filling it with pitch. For this purpose an opening 80 can be provided to one end of the housing and after it is completely assembled, the potting compound can be poured in through this opening. After the potting is completed the opening is conveniently covered by a plate 82 which can also be used to carry a label or other indicia. The plate and opening can be provided at either end wall, or for that matter either side wall of the housing. If desired, a front or back wall can even be used for this purpose.

When potting is utilized it is desirable to keep the potting compound from interfering with the operation of screw 36. As more fully shown in Figs. 3 and 4, the screw can be sheathed by a sleeve 84 of cardboard or the like that extends substantially the entire distance between walls 14 and 15. Cardboard is sufficiently impervious to the penetration by molten pitch so that the pitch will be kept away from the mounting screw. The assembly will be made somewhat simpler to manipulate during manufacture if the sleeve 84 is fitted through an opening in pocket-forming wall 78, so that it can be held in place by that wall. When the potting is poured in from the end in such a way that the pocket-forming wall holds capacitor 64 in a blind pocket which traps air and which would thereby tend to keep the potting compound from fully enveloping capacitor 64, the top of the pocket is preferably perforated as by leaving slots 88 in its

upper corners. This is conveniently done by making the pocket forming wall from a flat metal sheet that is notched to provide the slots 88 and then bent into shape.

Some sockets 32 are perforated and will permit the potting compound to leak through. This can be guarded against by covering the internal face of the socket as by means of a cardboard cap 90. The cap can have perforations through which the socket terminals project.

Fig. 6 shows a modified form of the invention in which the protuberance 50 is not used. Instead wall 14 is recessed at the site where plug 52 is connected. This will give a symmetrical mounting even though the base of the plug projects beyond its anchorage site. Alternatively a plug of the flush mounting kind can be used.

Fig. 6 also has a shielding wall 176 struck or punched from the end wall of the housing. The opening provided by the punching out of the shielding is suitable for use as a potting opening. The sheath 184 is also made as a tight fit around screw 36 so that it holds the screw in place and no nut (42 in Fig. 3) is needed.

If the maximum performance is not desired, the filter circuit can be simplified. For example, the capacitor 66 can be omitted, and capacitors 68, 70 compensated somewhat by increasing their capacitance values. On the other hand, capacitor 64 or if desired both capacitors 64 and 66 can be omitted.

The inductors can also be provided with high permeability cores of compacted iron powder or silicon steel. The use of such cores makes it possible to reduce the size of the inductors.

At different signal frequencies somewhat different inductance and capacitance values give best results. For example, smaller inductances and capacitance are suitable for frequencies above 1700 kilocycles per second. However, a substantially identical filtering effect can be obtained by reciprocal changes in the bridging capacitors and series inductors. Thus, doubling the inductance of each inductor will be compensated for by halving the capacitance of each bridging capacitor. However, the filtering is not too critical in these respects and a doubling or halving can be effected without compensation.

The grounding capacitors can also be bridged across the socket terminals instead of the prongs, or can be bridged across both places. Where one side of the power line is grounded, one of the grounding capacitors serves no purpose and can be eliminated. This is the one connected between the ground connector and the grounded line. The function of the other grounding capacitor is then accomplished by the adjacent bridging capacitor so that one of them is also not needed. The inductor in the grounded line is also unnecessary.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A power line filter comprising a conductive housing, a plug secured to one wall of the housing with two prongs projecting outwardly away from the wall for insertion in a power line double convenience outlet, a dome shaped projection on said one wall and spaced with respect to said plug so as to nest in one outlet of said double convenience outlet when said plug is engaged in the other outlet, a two terminal socket secured to another wall of the housing for receiving a plug-in connector, filter components positioned within the housing and including series inductors connecting the respective prongs with corresponding terminals of the socket, an electrically conductive shield grounded to the housing located between the inductance in one series connection and the inductance of the cooperating series connection, a capacitor bridged between the prongs, two series connected capacitors bridged between the terminals, a center tap between the capacitors in the terminal bridge being grounded to

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the housing, and a metal mounting screw conductively engaging the housing and having a threaded end projecting out between the plug and projection for engagement in a grounded, threaded opening of the power line convenience outlet to simultaneously ground the housing and hold it in place.

2. The combination of claim 1 in which the screw extends completely through the housing, a sleeve substantially impervious to plotting compound surrounds the portion of the screw within the housing, and the components around the sleeve are potted within the housing.

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