United States Patent [19]

Simon

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[45] **Apr. 1, 1975**

[54] **SPRING CONTACT FOR ESTABLISHING ELECTRIC PLUG-IN CONNECTIONS**

[76] Inventor: **Hans Simon,** Bruchhausener Strasse, 5463 Unkel, Rhine, Germany

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[30] **Foreign Application Priority Data**

Apr. 4, 1972 Germany 2216174

[52] **U.S. Cl.** ..... **339/217 S,** 339/258 R

[51] **Int. Cl.** **H01r 9/00**

[58] **Field of Search** ..... 339/217 R, 217 S, 256 R, 339/258 R, 176 MP

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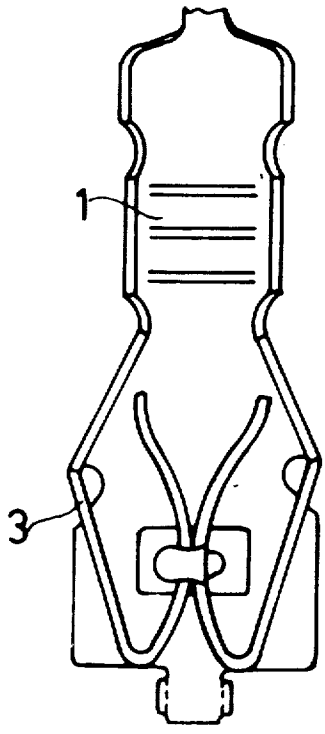
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Primary Examiner—Roy D. Frazier
Assistant Examiner—Robert A. Hafer
Attorney, Agent, or Firm—Steinberg & Blake

[57] **ABSTRACT**

A spring contact for establishing electric plug-in connections which is punched out, as a flat metal portion, from a metal strip and can further be processed by bending of special parts to be shaped into an electric contact for being disposed in a housing made of insulating material. The punched out portion in the punched out state comprises a fastening portion for being bent into the shape of a claw for mechanically fastening and electrically connecting a cable end, an adjoining holding portion for mounting the contact in the insulating housing, and a contact portion for being bent into the shape of a spring contact which can provide an electrical contact with other electric components, the contact portion having two spring arms each extending in the punched out state on two sides of the longitudinal axis and at an angle relative thereto and having such a length that they extend beyond said holding portion. The punched out portion in the punched out state is a single piece, or is connected in a symmetrical manner with an outer punched out portion to form one double piece, the spring arms extending symmetrically into opposite directions, or is linked with further punched out portions to form a chain, being one-piece connected via its holding portion, or if necessary via an intermediate link, with the fastening portion of the following punched out portion.

13 Claims, 47 Drawing Figures



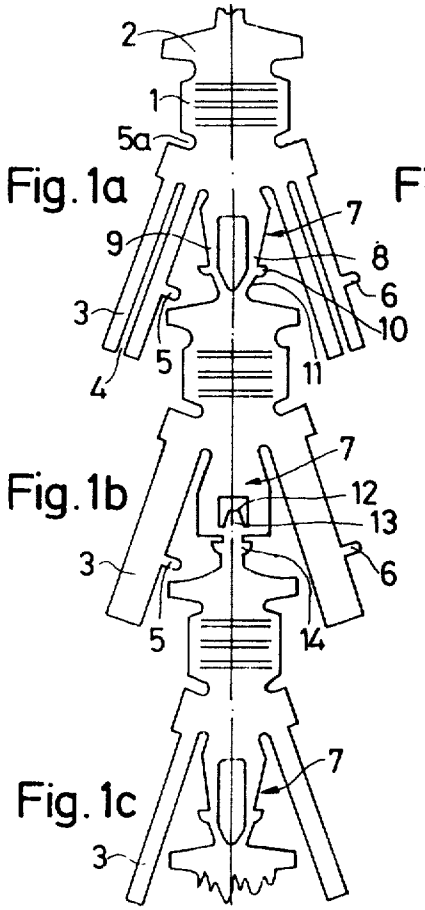


Fig. 1a

Fig. 1b

Fig. 1c

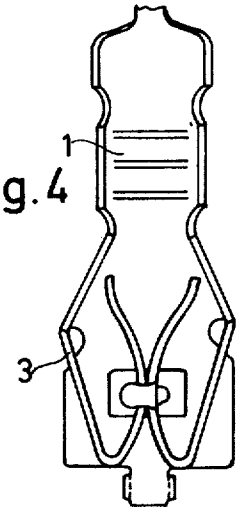


Fig. 4

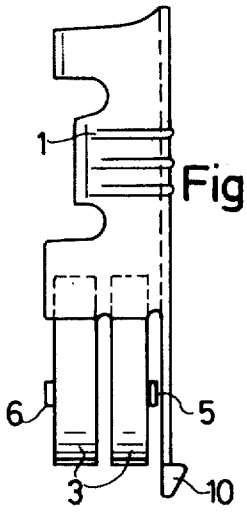


Fig. 5

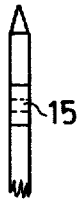


Fig. 6

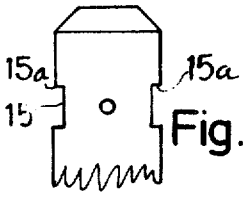


Fig. 7

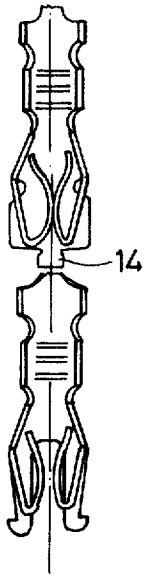


Fig. 2

Fig. 3

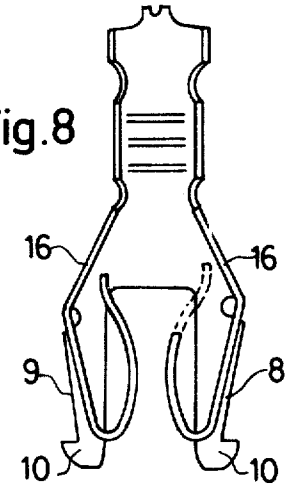


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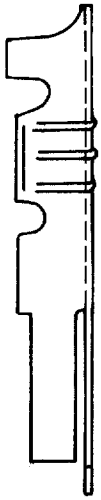


Fig. 9

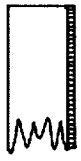


Fig. 10



Fig. 11

Fig. 12

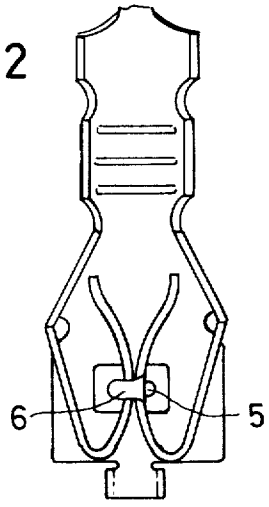


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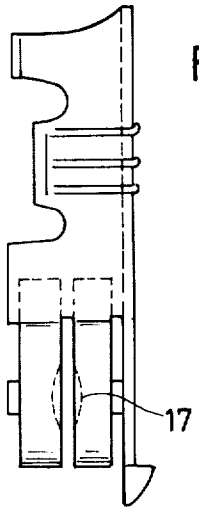


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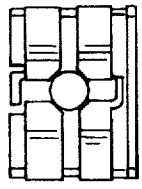


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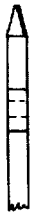


Fig. 14

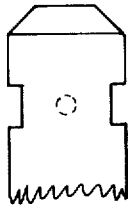


Fig. 19



Fig. 16

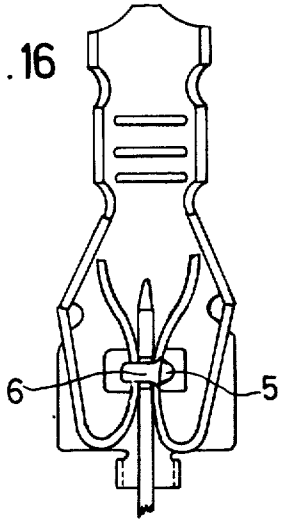


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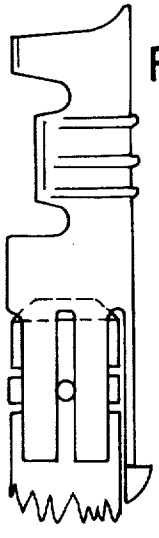


Fig. 20

Fig. 21

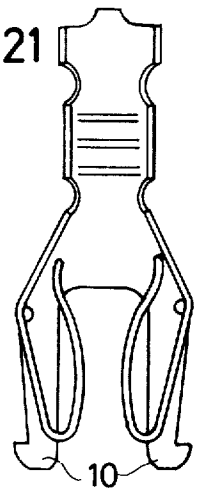


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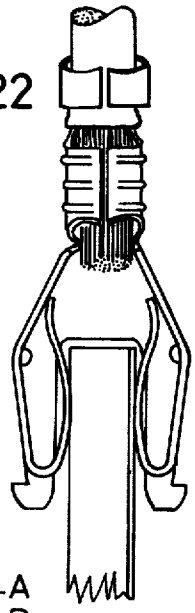
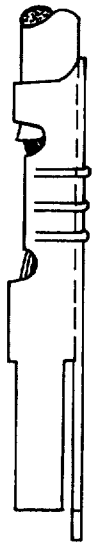


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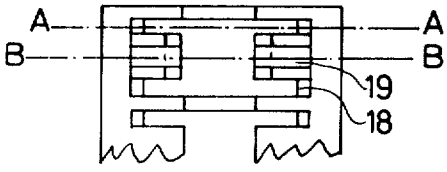


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Fig. 24

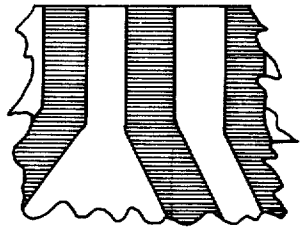


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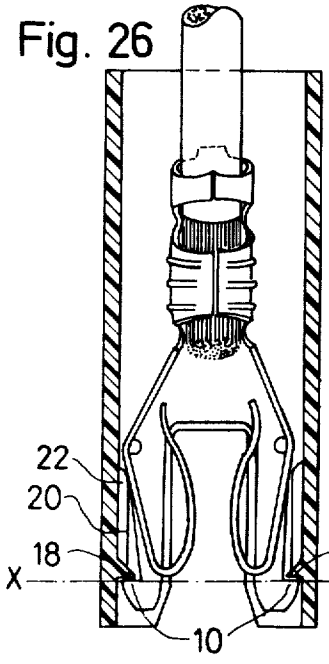
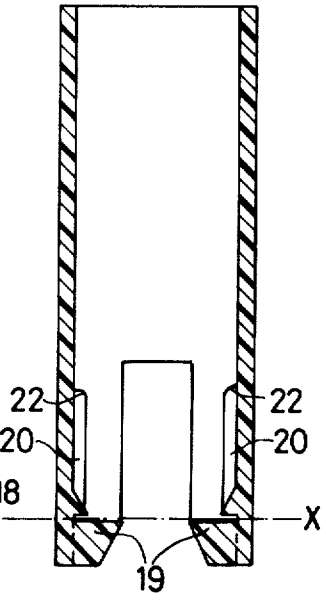


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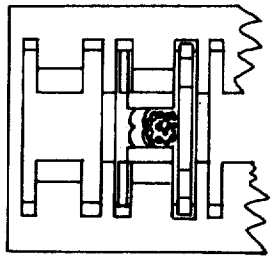


Fig. 28

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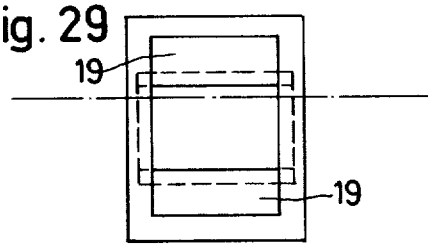


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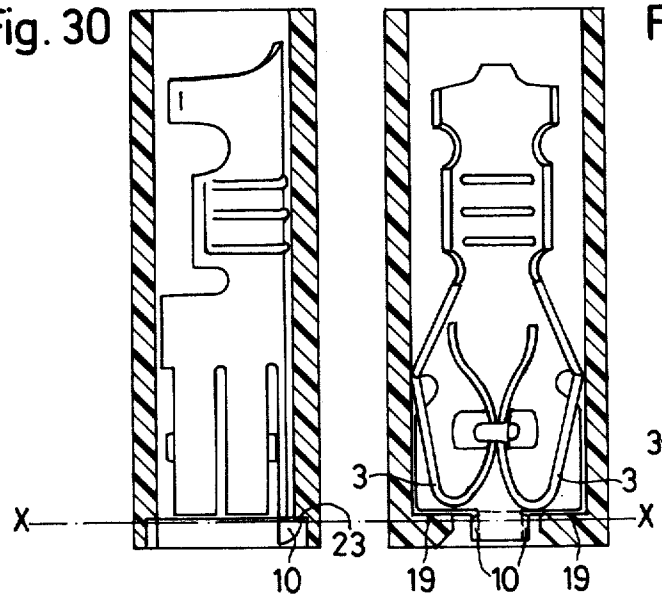


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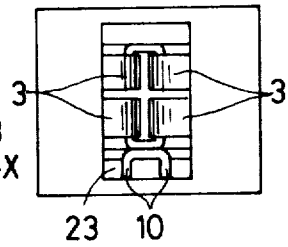


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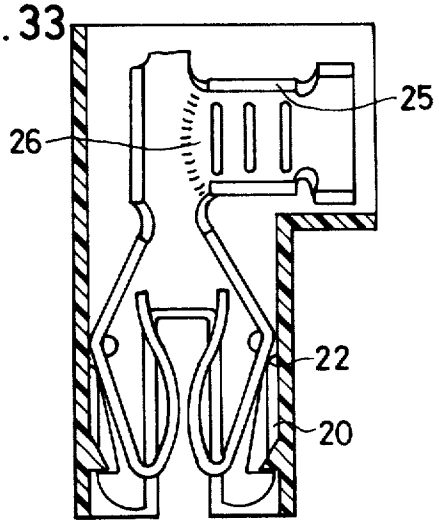


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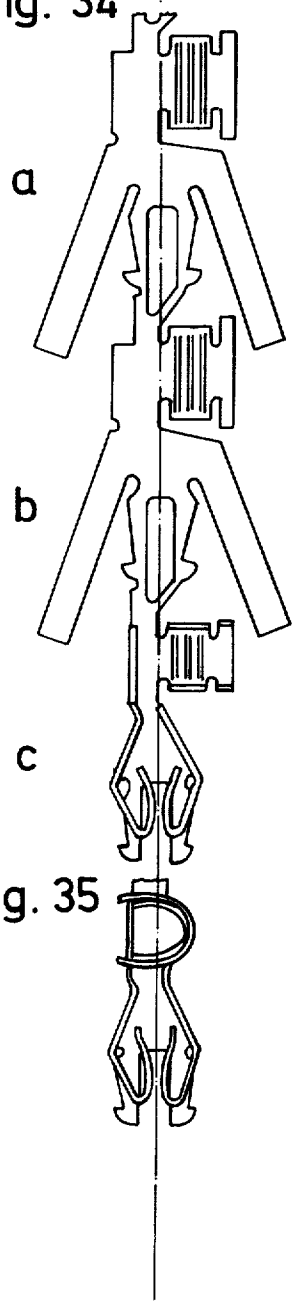


Fig. 35

Fig. 36

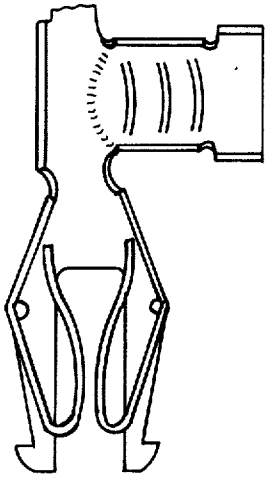
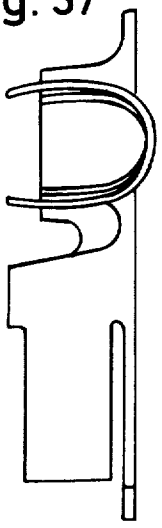


Fig. 37



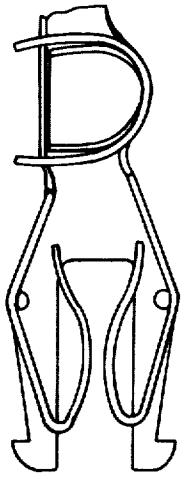


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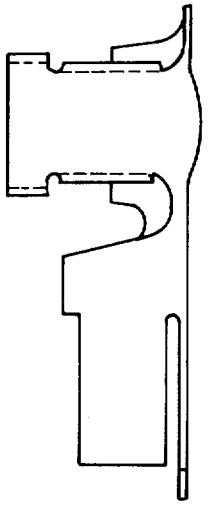


Fig. 39

Fig. 42

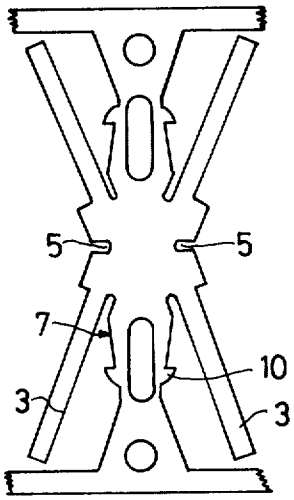


Fig. 43



Fig. 40

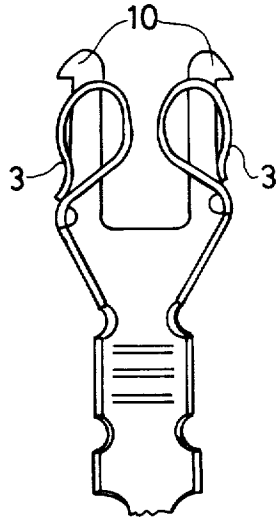


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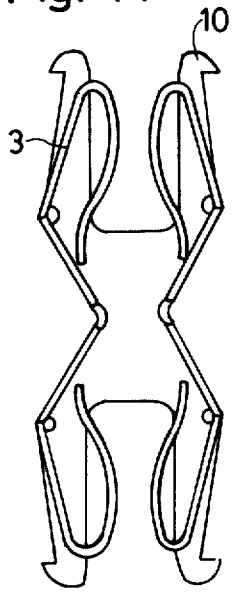


Fig. 45

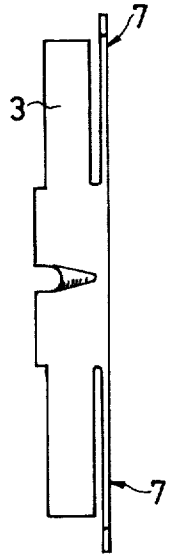
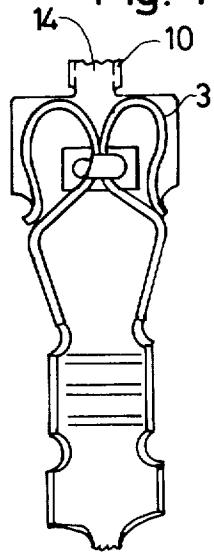


Fig. 41



SPRING CONTACT FOR ESTABLISHING ELECTRIC PLUG-IN CONNECTIONS

The present invention relates to a spring contact for establishing electric plug-in connections which is punched out, as a flat metal portion, from a metal strip, can be shaped to constitute a contact, and can be arranged within a housing of insulating material. The spring contact of the invention can be used very broadly and is particularly suited for connections including flat plug-in tongues, printed wiring boards, printed circuit boards, plug cards, and conductive foils, and can furtheron be used also in connection with round plug-in pins for making electric connections.

For producing electric plug connections, various plug embodiments have been known as for instance flat plug-in tongues and round plug-in bushings, contact springs, and contact forks, etc. Said prior art embodiments have been designed for particular uses and can almost without any exception be used only for such particular aims.

For electric and for electronic uses, i.e. for household devices and machines as well as for automobile electric parts, on one hand, and for the field of measuring, controlling and data processing techniques, on the other, two main constructional principles of the contact materials used are to be distinguished. There are electric flat plug-in connections, among which flat plug-in bushings, fork contacts, and spring contacts are to be understood which are suited to receive more or less thick flat plug-in tongues having in any case a rectangular cross section and a more or less great broadness. On the other hand, there are round plug-in connections, i.e. round plug-in bushings of a tubular construction which include one or several longitudinal slots and whose contact faces are biased in the direction towards the center of said bushing. They are suited to receive round plug-in pins only.

For the production of plug-in contacts, a series of criteria are of importance which have only insufficiently been considered in prior art structures.

The most essential of said criteria can be summarized as follows:

1. Selection of the correct material, i.e. very good conductivity on one hand and a sufficient physical strength and resilient property for the production of the spring parts on the other.

2. Production and construction of the resilient components of the contact material by biasing, bending or deforming of the components punched out from strip or plate material, and avoidance of a decrease of the resilient properties on contact heating.

3. Insulation of said plug-in connections by suitably shaped insulating components which are simply to be produced and simply to be mounted.

4. Possibility of semi or fully automatically processing of said plug materials, for example by using individual contact components in the form of continuous strips on spools.

5. Possibility of adapting the contact pressure to the necessary transmission power of the plug-in contact without the necessity of using a special construction.

It is now the aim of the present invention to provide a spring contact for establishing electric plug-in connections which will essentially fulfil the above sketched criteria and, furtheron, has the advantage of being broadly applicable and yielding an unobjectionable connection when using flat as well as round plug-ins.

The problem of the invention is solved with the aid of a spring contact of the above described kind which is characterized in that the punched out portion includes, in the punched out state, a fastening portion provided with a conductor claw for fastening the cable and an adjacent holding portion and a contact portion having two spring arms each extending on the two sides of the longitudinal axis and at an angle thereto and having such a length that they extend beyond said holding portion.

The inclination of said spring arms and their extended length yield particular advantages. On one hand, it is achieved by said inclination that said great length is obtained without an additional material consumption considering that the spring arms, when punched out, are passed along the fastening portion of the adjacent following contact. By said inclination it is furtheron possible to provide said spring arms with the necessary bendings necessary for obtaining a sufficient spring force which will not essentially be altered when heated.

Further advantageous embodiments of the present invention can best be explained in connection with the flat punched out portion. Thus in a further embodiment of the present invention, the holding portion includes a plate recessed in axial direction whereon holding means are provided making possible a retention of the contact in the housing of insulating material. Said holding means suitably include holding noses arranged at the outer edge of said holding plate. If said plate has been provided with said recess in the axial direction, said holding noses are provided at legs so formed of said holding plate.

In accordance with a further embodiment of the present invention, the two spring arms each are provided with a lateral projection which has been punched out together with said arms and which, on one of said spring arms is provided on the inner side and at the other on the outer side. These lateral projections serve, in the ready and bent contact, as a retaining means for plugged-in flat plug-in tongues. They will be explained again and in greater detail in connection with the fully shaped contact.

In accordance with a still further embodiment of the present invention, the spring arms are, wholly or partly, subdivided by one, or a plurality of, slits provided in the longitudinal direction. Such subdivided spring arms have proved to be of great advantage particularly when used in connection with round plug-ins.

In accordance with a still further embodiment of the present invention, the conductor claw of the fastening portion for fastening the cable is preferably arranged at an angle relative to the longitudinal axis which is preferably 90°. This modification will yield a spring contact wherein an angle-shaped fastening of the cable is possible which is very useful particularly when mounting on conductor plates.

For machining it has proved of advantage if the punched out portion of the inventive spring contact is, in the punched out state, connected in a manner known per se, with further punched out portions to constitute a chain, said punched out portion being one-piece connected via its holding portion and, if necessary via an intermediate link with the fastening portion of the following punched out portion. In this way, the otherwise

completely punched out portions are lined up to constitute long strips wound up on spools which can be further processed in automats. Then the cable will be inserted into the conductor claw of the fastening portion provided therefor, and at the same time the intermediate link is disconnected, and the contact is formed out.

For forming out the contact from the punched out portion it has proved particularly useful when in the vicinity of the base of a spring arm there is provided in the holding portion a cut or a recess extending preferably to the assumed extension along the inner edge of the spring arm into the holding portion. Such cut or recess makes possible an easy bending of the spring arm around its inner edge which without said cut would be possible only by a corresponding expansion of the material.

In accordance with a still further modification of the present invention, the punched out portion includes, in the punched out state, two holding portions arranged symmetrically relative to each other and connected via a one-piece connection with one another, as well as two contact portions, the latter including two spring arms each, extending on each side of the longitudinal axis and at an angle relative thereto and having such a length that they project beyond the corresponding holding portions. Such modification of the present invention is particularly suited as a pass-over or a through connection for assembling two printed circuits.

The punched out portion of said inventive modification can also, in a manner known per se, be connected with further punched out portions to constitute a chain, the holding portion if necessary being one-piece connected via an intermediate link to a holding portion of the following punched out portion. In accordance with a further modification, the punched out portion is, in the punched out state, so connected with further punched out portions to constitute a chain that two spring arms are one-piece connected with the corresponding spring arms of the following punched out portion. When processing the punched out strips of this modification, simple separation of the punched out portions is necessary while intermediate links, usually unnecessary, need no longer be removed.

In the fully formed out spring contact according to the present invention, the spring arms are bent around their inner edge at an angle of 90° from the plane of the punched out portions, each on the same side of said plane, and they are furtheron, at about the middle, bent backward in the direction to their base piece. Bending the spring arms back to their base piece, which is preferably so made that a circle is formed provides that the two free ends of the spring arms touch each other and thus constitute the contact portion.

In accordance with a further modification of the present invention, the spring arms are each bent away from the longitudinal axis towards the base piece thus yielding, in connection with the housing of insulating material, into which said spring contact is inserted, an essentially higher contact pressure between the two spring arms, the upper part of which serving as the contact in this case.

In the last mentioned modification wherein the two spring arms are bent back in the direction of the longitudinal axis towards their base piece, the length of the bent back portions of the spring arms is so dimensioned that they are supported with their ends at the corresponding upwardly projected base pieces. In this way, an essential encrease of the contact pressure is obtained.

Each of the lateral projections at the spring arms mentioned above in connection with the punched out portion is, according to a further modification of the present invention, bent at an angle of 90° towards the other spring arm. This provides for particular locking hooks which engage when a flat plug-in tongue is inserted into their lateral recesses. The lateral edges of said recesses in said flat plug-in tongues are preferably shaped oblique so that the force necessary for the withdrawal of the plug-in connection is essentially decreased.

By the particular shape of the inventive spring contact, the contact pressure of the two spring arms provided with said locking hooks is encreased when the flat plug-in tongue is withdrawn. On the other hand, said inventive locking device does not deteriorate, upon inserting the flat plug-in tongue, the contact pressure and is thus more effective than the known stop latches on the flat plug-in bushings or prior art stop or locking means of other contact materials.

In accordance with a further embodiment of the present invention, the holding noses provided at the holding portion are preferably bent away at an angle of 90° from the punched portion plane. These holding noses serving to lock the spring contact within the housing of insulating material may also constitute a lock without said bending away; it has shown however that for reasons of manufacture a simpler locking possibility is obtained in the insulating material housing if said supporting noses are bent away from the punched portion plane at an angle of 90°, preferably in the opposite direction relative to the spring arms which are also bent away from said punched portion plane.

Particularly for a use in connection with round plug pins, it has proved of advantage if in accordance with a further embodiment of the present invention the spring arms are provided, along their facing contact area, with an impression in the longitudinal direction. Such impression may have a rounded-off or an angular cross section. It does not deteriorate the use of the inventive spring contacts in any way, but makes possible, on the other hand, a safe connection also with round plug pins.

When using spring contacts subdivided in the longitudinal direction it is also useful, in order to obtain the same effect, to bend them along their contact areas, which face each other, at their corresponding inner edges up to about 45°. This makes possible also a simple insertion of round plug-in pins and provides for an unobjectionable contact connection.

In accordance with a further embodiment of the present invention the spring contact as described in detail above is arranged in a housing made of insulating material and open on two sides. Said insulating material housing is preferably provided at one of its openings with a support for the bent-off spring arms and with one or a plurality of holding edges for the holding means of the holding portion. As concerns the production method, such a housing is very simple to be made as there are no complicated back tapers.

In accordance with a further advantageous modification of the present invention there are provided, at the inventive spring contact in the insulation material housing, bars which after the insertion of said spring contact react on the outer faces of said spring arms and thus im-

part on them an encreased bias which leads to an encreased contact pressure. In this way, different contact pressures may be obtained with the aid of the inventive spring contact so that the contact pressure can be adapted to the contact load in question. This is done by using one and the same spring contact by only correspondingly shaping the insulating material housing and by forming said pressure bars in correspondence with the contact pressure desired.

This modification proves particularly advantageous if the spring contacts of the invention are arranged in multiple contact plugs.

As the inventive spring contacts, as has already been mentioned in the beginning, are also advantageously used for mounting on printed wiring boards, the holding plate is, in accordance with a particularly advantageous modification, recessed in the axial direction. Said recess has the same dimension as a printed wiring board.

The invention will now be explained in detail with reference to the enclosed drawings.

In the drawings,

FIGS. **1***a*, **1***b*, and **1***c* illustrate side projections obtained in the manufacture of spring contacts from metal strips;

FIGS. **2** and **3** respectively show in elevation spring contacts formed from the above structure;

FIG. **4** shows at an enlarged scale a spring contact according to the invention;

FIG. **5** is a side view of the contact of FIG. **4**;

FIGS. **6** and **7** are respectively fragmentary side and front views of a plug-in spring tongue for use with the structure of FIGS. **4** and **5**;

FIG. **8** is an elevation of a spring contact for use with a printed wiring board;

FIG. **9** is a side view of a spring contact for use on printed wiring boards;

FIGS. **10** and **11** are fragmentary side and plan views of a printed wiring board;

FIGS. **12–17** show how projections of spring arms cooperate with flat plug-in tongues;

FIG. **18** shows the front side of a spring contact with a round contact pin inserted;

FIG. **19** is a side view of the contact pin of FIG. **18**;

FIG. **20** is a front view of the contact pin as seen from the plug-in end thereof;

FIGS. **21–23** illustrate how the spring contacts operate when mounted on printed wiring boards;

FIG. **24** is a fragmentary plan view of such a printed wiring board;

FIGS. **25–28** illustrate the mode operation of fastening hooks of the spring contact when used on printed wiring boards, FIGS. **26** and **27** respectively being sectional view taken along lines A—A and B—B of FIG. **25**, and FIG. **28** showing a partial view of an insulated housing;

FIGS. **29—32** illustrate the operation of holding noses at a link, FIG. **29** showing a single pole housing as seen from the plug-in side of the spring contact, while FIG. **30** is a longitudinal section through an insulated housing and FIG. **31** is a section perpendicular to that of FIG. **30**;

FIG. **33** shows a housing of the invention with a spring contact inserted;

FIG. **34** shows at parts *a,b,c*, the punched out spring contact of FIG. **33**;

FIG. **35** shows a completely shaped spring contact;

FIGS. **36–39** are respectively different vies of the contact of FIG. **35** at an enlarged scale;

FIGS. **40** and **41** are plan views of two further spring contacts of the invention;

FIGS. **42–45** show a double-sided spring contact punched out perpendicularly with respect to the length of the strip, FIGS. **43** and **44** showing the double-sided spring contact in plan while FIG. **45** is a side view thereof.

FIGS. **1***a*, **1***b*, and **1***c* illustrate side projections as are obtained in the manufacture of spring contacts from metal strips. For a better explanation, different modifications of said side projections have been shown, although on the other hand, though not necessarily, always the same profiles are arranged on such a profile strip which can be processed in an automat.

In FIG. **1***a*, **1** is the socalled conductor claw the two sides of which are later, during the deforming step, bent upward whereby it becomes the conductor claw into which the end of the copper wire of the electric lead is inserted, and by deforming the tightening of said conductor claw is connected with the spring contact. Said conductor claw **1** is linked, in one direction, to a so-called insulation claw **2** which upon tightening grips the insulation of the electric wire and holds it in a manner known per se.

As concerns the other direction, there are provided outwardly directed relatively long spring arms **3**, shaped in FIG. **1***a* as double spring arms by recess **4** arranged in longitudinal direction. Between conductor claw and spring arm, there is provided a cut, or a recess, **5***a* serving to facilitate the bending from the punched portion plane. Spring arms **3** are provided with lateral projections **5** and **6** which, when rectangularly bent, serve for locking the flat plug-in tongues. In view of the oblique position of the spring arms it is possible to locate them along the holding portion (conductor claw and insulation claw) of the following spring contact so that no essential additional material consumption for the shaping of the relatively long spring arms is necessary.

Holding portion **7** is subdivided by a recess in the axial direction into two legs **8** and **9** provided at their ends with a support nose **10** each. At the same time, said holding portion **7** serves as a connection to the following spring contact, where an intermediate link **11**, not necessary for the spring contact itself, is provided. By so linking the individual spring contacts it is possible to roll them up in the form of strips which can then be passed on to automats for further processing. Upon further processing, the linking bars which are not necessary for the contacts are cut away or punched out when the electric wire is pressed in.

The punched out portion shown in FIG. **1***b* shows spring arms **3** having no recess in the longitudinal direction. Furtheron, holding portion **7**, too, is not subdivided in the axial direction so that there are no legs **8**, **9**. Instead, there is either a free cut **12** forming the known blocking zone **13**, and/or there is provided a projection **14** showing on both sides outwardly directed support noses which are bent downwardly at right angles. In FIG. **1***c*, there is shown a further modification of said spring contact wherein spring arms **3** are shaped small so that a relatively flat spring contact can be obtained therewith. Holding portion **7** is again provided with an axial recess, and at the ends of the legs so formed support noses are provided.

All the modifications of the inventive spring contacts have been linked with one another and hence can, when processed, be passed to the tightening tool in the same way, can be separated with one and the same cutting tool, and can be pressed in with one and the same tool.

As has already been mentioned, spring arms **3** are bent from the punched portion plane around their inner longitudinal edge and bent upwardly at an angle of 90° relative to the punched portion plane. Before or thereafter, the spring arms are bent in the direction to their base piece, or to the conductor claw, respectively, so that a spring contact as illustrated in FIGS. **2** and **3** is obtained. In the modifications according to FIGS. **1***b* and **2** there are two fastening hooks **14** each in front of the head or plug-in side of the spring contact. They do not interfere with the contact arms and they are expressively provided outside the conductive cross section. By the arrangement of the holding hooks as shown, the production of insulated housings for this kind of inventive spring contacts has essentially been simplified and reduced in costs.

The punched out portion shown in FIG. **1***c* and the spring contact according to FIG. **3** appertaining thereto are characterized in a very flat construction of said spring contact and are therefore particularly suited for mounting on printed wiring boards, printed circuits, card foils or conductor foils, respectively. The axial recess in the holding portion by which legs **8, 9** are formed provides for the space for the mounting or the plug-in side, for instance of a printed wiring board, to be inserted when using the completed spring contact. At the same time, said legs **8, 9** limit the play of the board inserted and thus prevent the contact springs from too high a mechanical load.

FIG. **4** constitutes an enlarged topview of a spring contact according to the invention.

FIG. **5** shows a side view of the same spring contact. It includes four spring contact pairs **3** and corresponds to the punched out portion according to FIG. **1***a*. This spring contact is meant for the use in flat plug-in tongues. With the aid of said spring contact, also individual trailing plug-in connections can be obtained. Lateral projections **5** and **6** at the spring arms serve for arresting the plugged-in spring tongue according to FIGS. **6** and **7**. The two spring clips **3** are pulled apart by the bevelled flat plug-in tongue and the bent projections of the spring arms engage with the recesseses **15** of the flat plug-in tongue. By beveling edge **15***a* in recesses **15** of the flat plug-in tongue, it is possible to essentially simplify the withdrawal of the flat plug-in tongue.

FIG. **8** shows a plan view of a spring contact for the use in printed wiring boards. Deformation of spring arms **3** is so performed that they are bent, at the beginning of the solid legs **16** of spring arms **3**, at an angle of about 15 to 45° towards the axis of said spring contact and then, a short distance from holding hook **10**, are re-bent at an angle of about 130° towards the conductor claw. They follow a depressed arc in the direction towards the solid leg **16** against which the spring arms can be supported forming an arc in the opposite direction. As springs, when bent, have a tendency to move, through release, towards their original position, the shape according to the invention provides that a loss in contact pressure by heating and an increase of the electric contact resistance connected therewith is avoided. The shortened right spring arm depicted in FIG. **8** shows a different shape yielding a smaller contact pressure as the free end of said spring arm is not supported against solid leg **16**. In the case of the left spring arm of FIG. **8**, on the other hand, the end of the spring arm is supported by leg **16** when mounting the printed wiring board whereby the contact pressure is increased.

FIG. **9** shows a side view of a spring contact for use on printed wiring boards. FIG. **10** shows a side view of a printed wiring board. FIG. **11** shows a plan view of a portion of a printed wiring board.

In FIGS. **12** to **17**, the mode of operation of projections **5, 6**, provided in the spring arms as the stopping hooks for flat plug-in tongues is again illustrated in plan and lateral views, respectively.

In order to receive round contact pins, it can be suitable to tilt the slotted spring arms, at a level with the contact area, at their inner side with part of their breadth up to an angle of about 45°, as shown for example in FIG. **13** at **17**. The front side of such a spring contact is illustrated in FIG. **18** showing a round contact pin inserted. A lateral view of said contact pin is again shown in FIG. **19** and a front view thereof as seen from the plug-in side is shown in FIG. **20**.

FIGS. **21** to **23** show again the mode of operation of spring contacts when mounted on printed wiring boards. FIG. **24** shows a portion of a plan view of said printed wiring board.

The mode of operation of fastening hooks **10** of the spring contact according to the invention if used on printed wiring boards is shown in FIGS. **25** to **28**. FIG. **25** shows a partial view of an insulated housing for the reception of a spring contact as seen from the plug-in side for the spring contact. At the same time, FIG. **25** shows cutting lines AA and BB. FIG. **26** corresponds to sectional view AA, FIG. **27** corresponds to sectional view BB through such insulated housing. FIG. **28** shows a partial view of an insulated housing having two receiving openings to receive spring contacts for use in connection with printed wiring boards, one of said receiving openings showing a spring contact inserted. Illustration is given from the plug-in side for the printed wiring board. In the production of the housings according to the invention, no back tapers are necessary which would have to be made by advancing and interlocking pins of the production tool. There are only two sawtooth-like holding edges **18** and two supports **19** necessary which are arranged in the mold separation plane and do not yield any difficulties in production. The mold separation line is drawn in FIGS. **26** and **27** and is identified by an X. FIG. **26** shows how holding hooks **10** of the spring contact engage behind holding hooks **18** of the housing. By support **19** the spring contact is prevented from being pushed through the housing. Rather the flection in the front of spring arms **3** press against support **19**. This does not impede spring arms **3** as concerns their spring action, as the spring contact is pushed back when the printed wiring board is slid in.

The contact pressure of spring arms **3** can be encreased by providing, in the insulated housing, one or two pins **20**. Upon inserting the spring contact into the insulated housing, spring arms **3** touch head **22** of pins **20** and the spring arms are now conducted further by pins **20** which after hooking into hooking noses **10** tightly press against the spring arms. Thereby the spring

movement of spring arms **3** is limited, and the pressure of the contact areas onto the conductive path or the flat plug-in tongue, respectively, is increased. By varying the height of pins **20** in the openings of the insulated housing, the contact pressure of certain contact springs can be adapted to the transfer power in question.

In FIGS. **29** to **32** the mode of operation of holding noses **10** at link **14** is illustrated in connection with the insulated housings, with particular reference to flat plug-in tongues. The insulated housing as used does not show any edges or undercuts in the receiving opening for the spring contact which can be produced with difficulty only. FIG. **29** shows a single pole housing as seen from the plug-in side of the spring contact. The recess is rectangular and smooth up to tool separation plane X. Only supports **19** are to be seen which can be manufactured without any difficulties.

FIG. **30** shows a longitudinal section through an insulated housing according to the invention including a spring contact, in a lateral view. The spring contact is held back by holding nose **10** at holding edge **23** of the insulated housing. FIG. **31** shows the sectional view appertaining thereto as a plan view. The spring contact inserted presses with the front flections of spring arms **3** against support **19** thus avoiding that the spring contact is slid through the housing.

To unlock of holding noses **10** is very simple as both noses are arranged at link **14.** It is therefore sufficient to introduce the blade of a screw driver and, by a short lever movement, release the hook.

In FIG. **33** there is shown the inventive housing with the spring contact inserted, where conductor claw **25** of fastening portion **26** is arranged under an angle of 90° to the longitudinal axis. This spring contact is shaped to be used on printed wiring boards. Hooking of the spring contact within the housing is performed in the same way as in the case of spring contacts having a normally arranged conductor claw. In this connection, it has proved particularly advantageous to provide the housing with an additional opening so that it may be used both for normally angled spring contacts and for spring contacts as described above having a rectangularly angled conductor claw. In the same way housing and spring contacts for use in connection with flat plug-in tongues can be produced.

In FIGS. **34***a*, *b*, and *c*, the punched out spring contact shown in FIG. **33** is still linked with the neighbouring punched out spring contact portion. In FIG. **34***c*, the spring arms have already been bent to constitute the contact portions. In FIG. **35** there is shown a completely shaped spring contact having however a rectangularly bent, but upright, conductor claw. In FIGS. **36, 37, 38,** and **39** these modifications are illustrated once more in an enlarged form as a plan view and as a lateral view.

In FIGS. **40** and **41** there are shown the plan views of two spring contacts according to the invention whose spring arms are not, as hitherto, bent inwardly but rather outwardly. This leads to a still higher contact pressure because of the shorter path between the contact point and the pressure point in the housing wall and there is therefore a smaller contact resistance for the electric conductor. As for the rest, this modification corresponds, particularly as concerns the profil, to the spring contacts of the invention described above in detail.

In FIGs. **42** to **45** there is illustrated a double-sided spring contact punched out at right angles relative to the direction of the strip. In FIG. **42,** the punched out portion is shown together with the edges of the strip showing also the round holes for the search pins. It is further-on possible to arrange the profiles in a staggered way one after the other, i.e. not at right angles but rather inclined relative to the direction of the strip. In FIGS. **43** and **44** such a double-sided spring contact according to the invention is shown in a plan view, FIG. **45** shows the same device in a lateral view.

In the form as shown, said double-sided spring contact serves for assembling printed wiring boards. It can however also be used for assembling flat plug-in tongues and, when considering the above described changes, for assembling round plug-in pins.

I claim:

1. For use in establishing electrical connections, an electrically conductive body of unitary sheet material having a substantially flat base portion terminating at one end in a hook means for engaging a shoulder or the like of an insulating member, said body of sheet material having a pair of springy contact arms both of which have elongated fixed free end regions distant from said hook means, said fixed free end regions of said contact arms being integral with said base portion and bent at substantially right angles thereto, and said fixed free end regions of said contact arms diverging away from each other in a direction toward said hook means situating said fixed free end regions closest to each other at their extremities which are most distant from said hook means, and said springy contact arms respectively having elongated flexible portions separate from said base portion and extending from and beyond said fixed free end regions, said flexible portions having next to said fixed free end regions converging regions which are inclined toward each other in a direction opposite to the direction of inclination of said fixed free end regions of said contact arms, and said flexible portions having beyond said converging regions thereof elongated movable free end regions bent toward each other backwardly with respect to said converging regions.

2. The combination of claim **1** and wherein said movable free end regions of said contact arms are situated between said converging regions thereof.

3. The combination of claim **1** and wherein said converging regions of said contact arms are situated between said movable free end regions thereof.

4. The combination of claim **1** and wherein said elongated base portion has a transverse line of symmetry extending across said base portion substantially at said extremities of said fixed free end regions of said contact arms where said fixed free end regions are located closest to each other, and the structure on one side of said line of symmetry forming a mirror image of structure on the other side thereof so that said base portion has opposed ends respectively provided with a pair of said hook means and is connected with two pairs of said contact arms.

5. The combination of claim **1** and wherein said base portion has beyond said fixed free end regions of said contact arms a conductor claw means for engaging a conductor and beyond said conductor claw means an insulation claw means for engaging insulation which surrounds the conductor.

6. The combination of claim **1** and wherein said movable free end regions of said flexible portions of said

springy contact arms are situated between said converging regions thereof and terminate inwardly beyond said converging regions closely adjacent to the fixed free end regions of said contact arms which are integral with said base portion.

7. The combination of claim **1** and wherein each of said flexible portions of each springy contact arm is formed with a longitudinal slit dividing each flexible portion into a pair of flexible sections extending from said fixed free end region which is integral with said base portion.

8. The combination of claim **1** and wherein said movable free end regions of said flexible portions of said springy contact arms are situated between said converging regions thereof and respectively have lateral projections to be received in notches formed in opposed side edges of a contact blade which is received between the movable free end regions of said flexible portions.

9. The combination of claim **1** and wherein an insulating means receives said body of sheet material and has a pair of cam means for engaging said flexible portions of said springy contact arms and camming them toward each other.

10. The combination of claim **9** and wherein said camming means engages said converging regions of said flexible portions of said springy contact arms.

11. The combination of claim **9** and wherein said insulating means includes a pair of stop portions for engaging parts of said flexible portions of said springy contact arms where they are bent backwardly to limit axial movement of the sheet material in said insulating means.

12. The combination of claim **1** and wherein said body of sheet material has in line with said hook means but distant therefrom, beyond said free end regions of said arms which are integral with said base portion, a conductor claw means for engaging a conductor and beyond said conductor claw means an insulation claw means for engaging insulation which surrounds the conductor.

13. The combination of claim **1** and wherein said base portion has beyond said extremities of said free end regions of said arms which are integral with said base portion a conductor claw means for engaging a conductor and an insulation claw means situated beyond said conductor claw means for engaging insulation which surrounds a conductor, said conductor claw means and insulation claw means being in line with each other and being arranged perpendicularly with respect to a line passing midway between said springy contact arms.

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