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Purdy

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[45] Aug. 27, 1974

[54] METHOD OF MAKING SELECTIVE SWITCH CONTACTS

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[73] Assignee: **AMP Incorporated,** Harrisburg, Pa.

[22] Filed: **Sept. 18, 1973**

[21] Appl. No.: **398,505**

Related U.S. Application Data

[62] Division of Ser. No. 306,113, Nov. 13, 1972, Pat. No. 3,792,206.

[52] **U.S. Cl.** .... **29/630 R,** 29/622, 29/630 B
[51] **Int. Cl.** **H01r 9/00**
[58] **Field of Search** .... 29/630 R, 630 B, 630 E, 29/622; 200/6 B, 6 BA, 6 BB, 6 C, 166 R, 166 B, 166 J; 317/112

[56] **References Cited**

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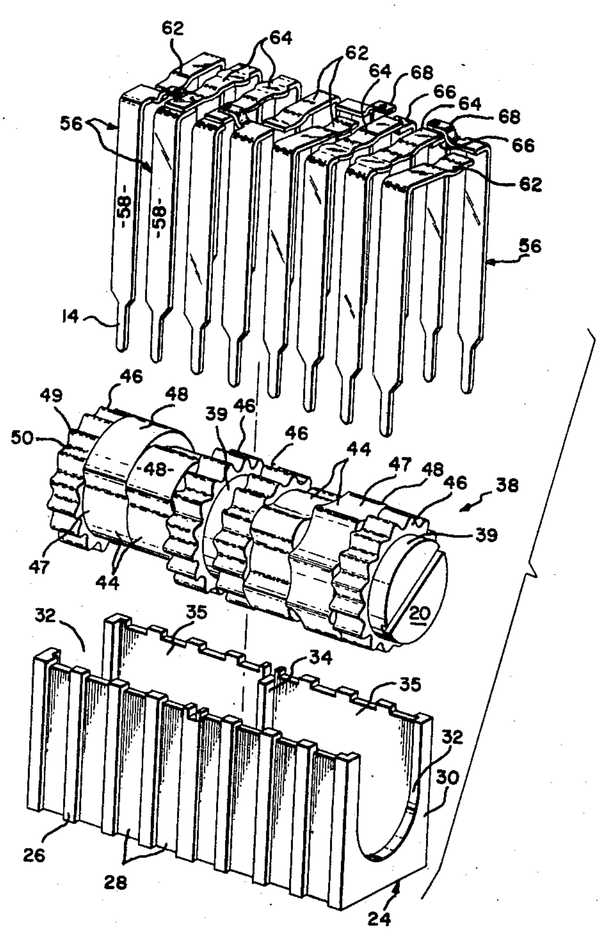
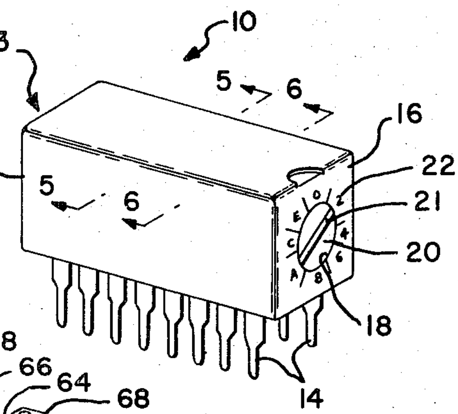
Primary Examiner—Charles W. Lanham
Assistant Examiner—James R. Duzan
Attorney, Agent, or Firm—Allan B. Osborne, Esq.

[57] **ABSTRACT**

This invention relates to a switch having four parts including the housing. More particularly the invention relates to a frame which has 16 positions which can be binary coded. The sixteen positions consist of four single pole-double throw contacts all of which are made by stamping and forming a single sheet of metal. The movable contacts are switched from one fixed contact to another by lobes on a rotatable camshaft.

4 Claims, 7 Drawing Figures

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13
12
5
6
16
22
21
20
18
14
E
C
A
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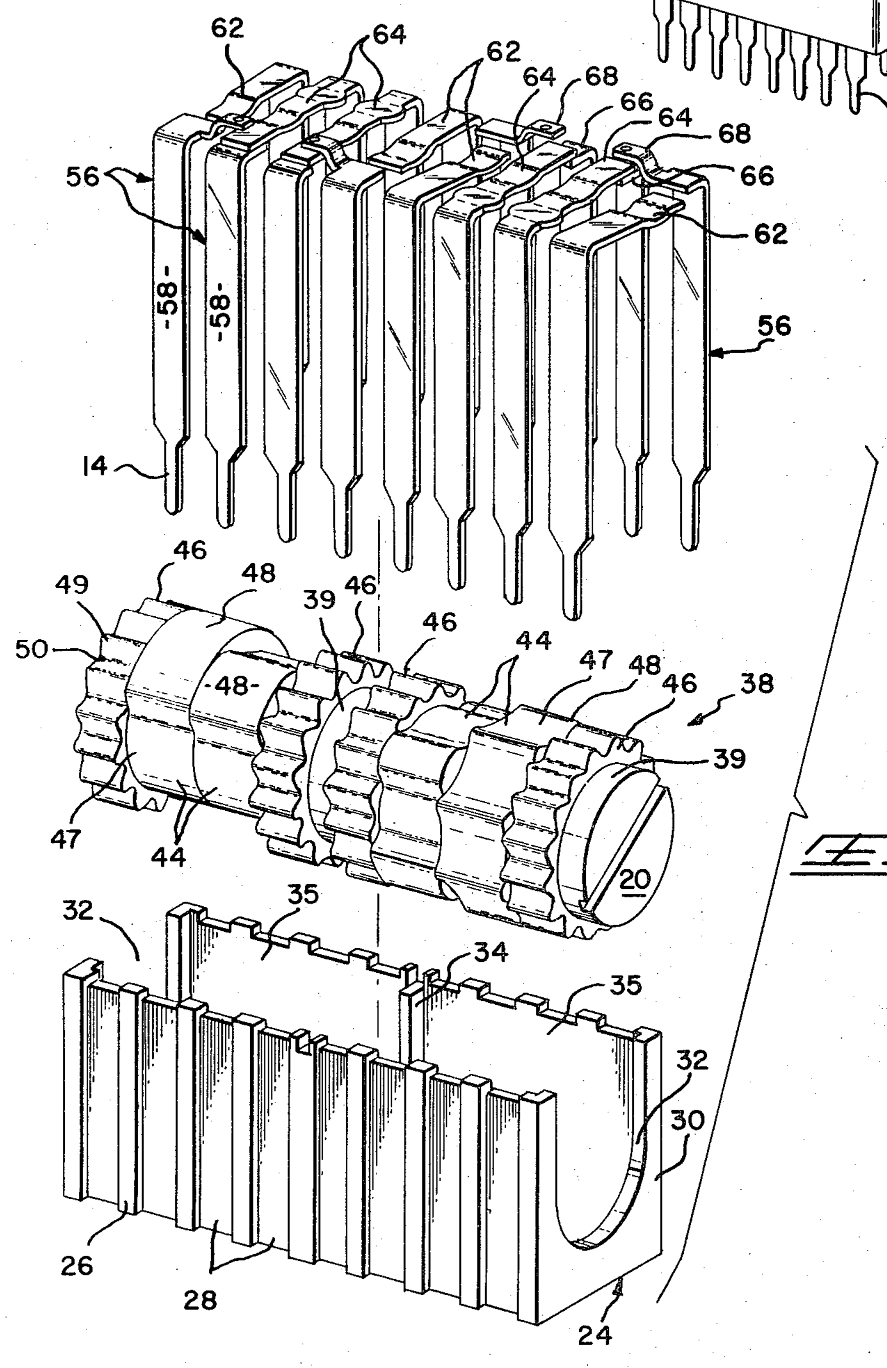
2
4
6
8

Fig. 1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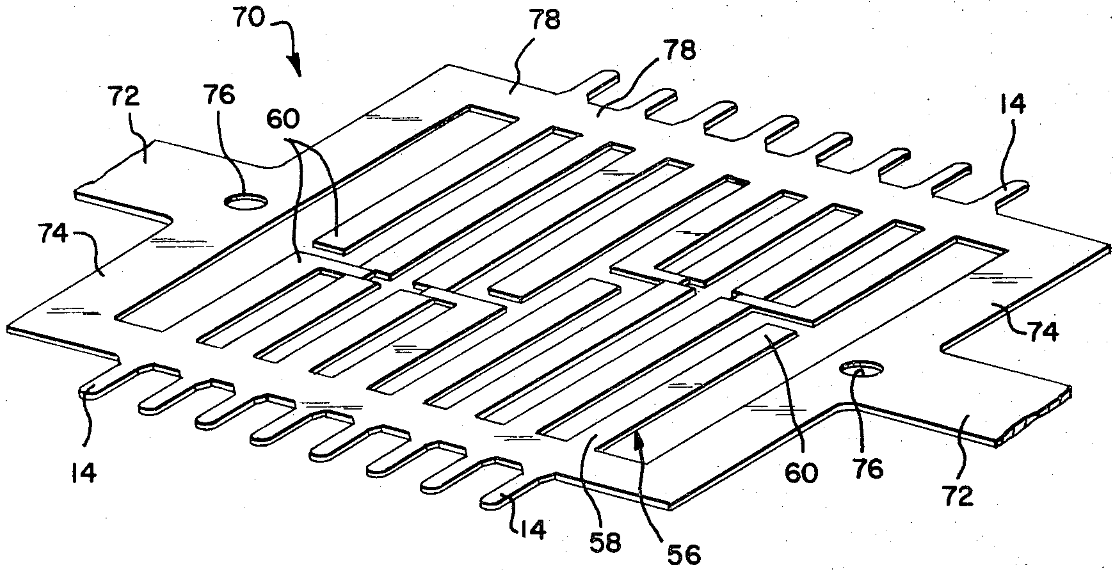
64
62
64
68
66
64
68
66
62
56
-58-
-58-
56
14
46
48
49
50
39
46
46
44
47
48
46
38
39
-48-
47
44
20
32
35
34
35
32
30
26
28
24

Fig. 2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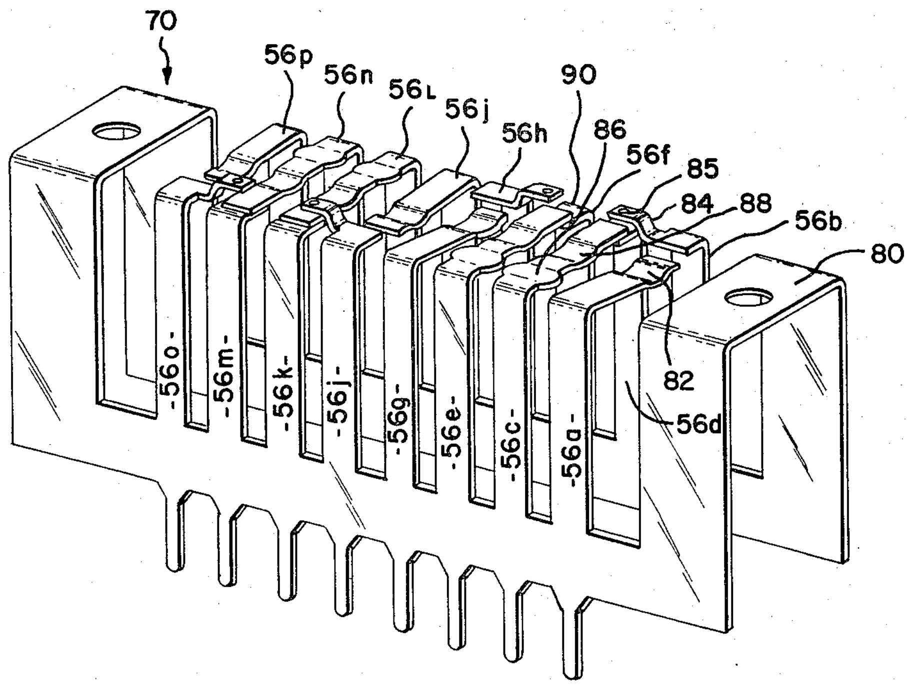
78
78
72
76
60
14
74
74
14
14
58
56
60
76
72

Fig. 3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56p
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56L
56j
56h
90
86
56f
85
84
88
56b
80
-56o-
-56m-
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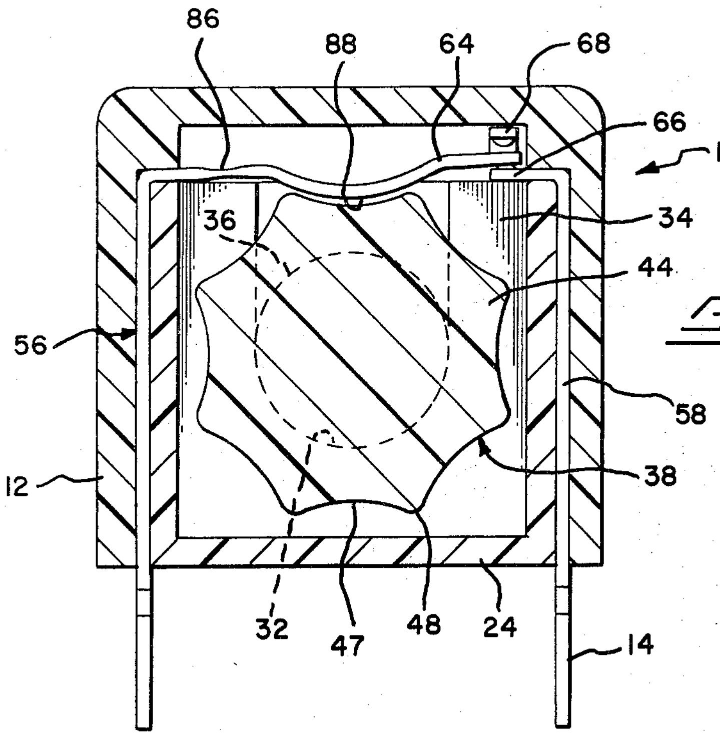
-56j-
-56g-
-56e-
-56c-
-56a-
82
56d

Fig. 4


86
88
64
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66
10
36
34
44
56
58
12
38
32
47
48
24
14

Fig. 5

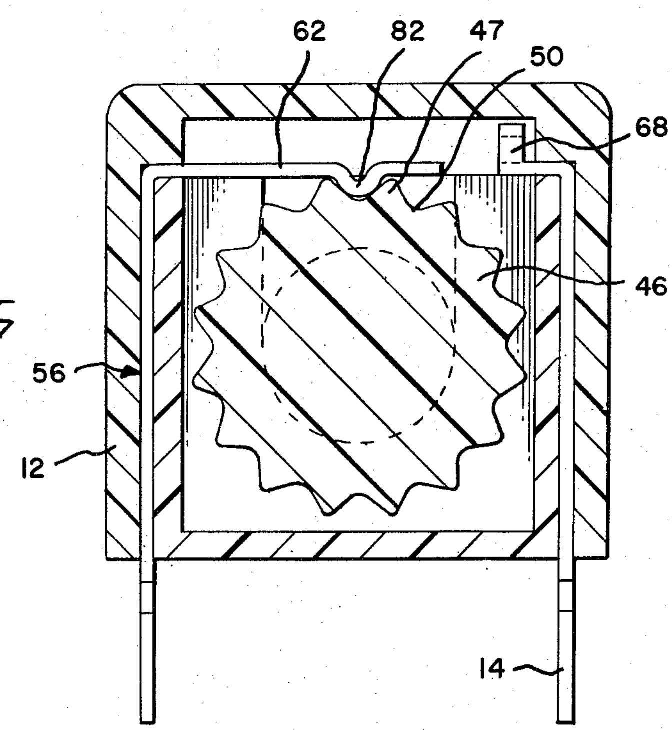
62
82
47
50
68
46
56
12
14

Fig. 6

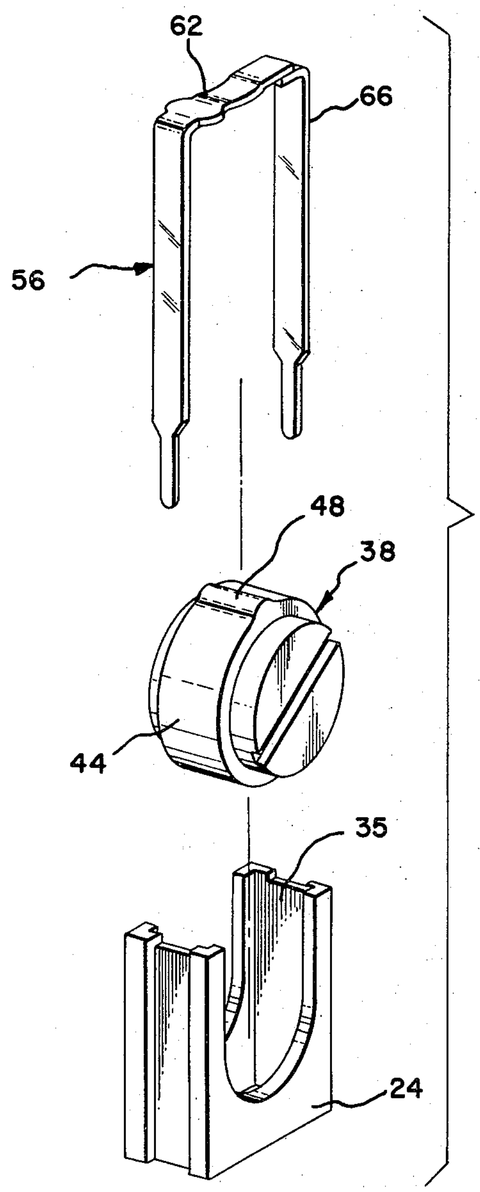

Fig. 7

METHOD OF MAKING SELECTIVE SWITCH CONTACTS

This is a division of application Ser. No. 306,113, filed Nov. 13, 1972 now U.S. Pat. No. 3,792,206.

BACKGROUND OF THE INVENTION

Multi-circuit or selective switches are utilized in many applications. One such application which is becoming extremely important is that of having a means whereby printed circuit boards or an electronic device is capable of accepting or rejecting a message. For example, where one wishes to communicate with a particular circuit board which is only one among many all-electrically connected boards, an addressing signal must be sent preceding the message. A selective switch which is mounted on each board is programmed to "open the door" to its board only when the addressing signal matches a particular code therein. The code will consist of a number of circuits which are opened or closed in a pre-determined combination. An analogy to this electronic switch is the manually operated combination lock.

Selective switches currently available are made from a large number of parts. For example, some contact arms are separately fashioned with a highly conductive contact point being riveted or soldered thereonto. Thus, in a switch having four poles, and with double throw (four movable contacts and eight fixed contacts) there could be a minimum of 28 separate pieces in the contact assembly alone. Added to these 28 pieces, there are detent springs, detent plates and so forth. Obviously, this type of switch is costly to make and further the manufacturing process does not lend itself readily to automation.

Another problem which workers in this field are faced with is the spacing between printed circuit boards in installations such as computers, telephone exchanges, airplanes and the like. As space is generally at a premium in such installations, the circuit boards are stacked as close together as possible. The pluggable components such as the selective switches must have as low a profile as possible. The miniaturization of a large number of discrete parts obviously increases manufacturing costs as well as decreases operating life and reliability.

Accordingly, it is an object of the present invention to provide a complex sixteen position binary codable selective switch having four discrete parts including the housing and which can be mass-produced using high speed automation.

Another object of the present invention is to produce a switch adapted to control electric circuits on a selective basis.

Other objects and features of the invention will become apparent from the following description of the preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of a completely assembled binary codable selective switch;

FIG. 2 is an exploded view of a preferred embodiment of the switch in FIG. 1 less the cover;

FIG. 3 is the contact frame of FIG. 2 after stamping operations;

FIG. 4 is the contact frame of FIG. 3 after forming operations;

FIGS. 5 and 6 are cross-sectional views taken along lines 5—5 and 6—6 respectively of FIG. 1; and

FIG. 7 is another preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a completely assembled binary codable dual in-line package switch **10** ready for use in a printed circuit board (not shown) or the like. The components of switch **10** include the upper cover member **12** of housing **13**. Depending from the housing are pins or connecting posts **14** which are adapted to be received in female receptacles, sockets, or holes in a printed circuit board (not shown). The end wall **16** of cover member **12** has an opening **18** in which is positioned the slotted end **20** of camshaft **38** (FIG. 2). Encircling opening **18** are position indicators **22.**

FIG. 2 is an exploded perspective view of the components within switch **10.** The lower half of housing **13** is base member **24** having sidewalls **26** on which are contained on its outer surface, vertical grooves **28.** End walls **30** have elongated, U-shaped slots **32** opening upwardly. Intermediate to end walls **30** is a dividing wall **34** which sections the interior of base member **24** into two compartments **35.** As with walls **30,** dividing wall **34** also has a U-shaped upwardly opening slot **32.**

Immediately above base member **24** is the aforementioned camshaft **38.** The camshaft has three annular bearing surfaces **39,** one on either end (only the right sided one can be seen) and a third one in the middle which separates camshaft **38** into two halves. Both halves contain two distinct, side by side cams **44** positioned between two detent surfaces **46.** The positioning of the flanks **47** and lobes **48** on cams **44** have been pre-determined to yield specific results as will be discussed below. The detent surfaces **46** contain a plurality of hills **49** and valleys **50.** In the assembled switch camshaft **38** is positioned within base member **24** with annular bearing surfaces **39** rotatably positioned in slots **32** and each half of the camshaft in one of the two compartments **35.**

Positioned above camshaft **38** are a plurality of contact members **56.** The members each have a shank or intermediate portion **58,** the aforementioned posts **14** at the outer ends, and on the other end inner portions **60** which have been bent normal to the intermediate portion **58.** As these contact members form an important part of the instant invention, they will be considered in detail below. Suffice it to say that there are four detent springs **62** and four movable contact arms **64** each of which are engageable with two fixed contacts **66–68.**

In the assembly of switch **10,** the contact members **56** fit down over the camshaft **38** positioned in base member **24** with the inner portions **60** extending across the openings of compartments **35** with each of the movable contact arms **64** in registration with one of the four cams **44.** Each of the four detent srpings **62** are loaded against one of the four detent surfaces **46** so that a firm intentional effort is required to rotate camshaft **38** and so that the camshaft is protected against unintentional movement induced by vibrations. To this end, the detent springs may be designed to response to different resonant frequencies.

FIGS. 3 and 4 show the development of contact members **56** by stamping and forming operations performed on a strip roll of metal (not shown) having suitable dimensions. Although several different metals can be used, phosphor bronze has been found to work quite satisfactorily.

In FIG. **3** a frame **70** has been stamped from a strip roll of metal (not shown). On either end are connecting straps **72** which lead to and from other like frames (not shown). Running transverse to and integral with straps **72** are two end strips **74**, each of which contain a positioning hole **76** located on the frame's longitudinal axis. Between the end strips and parallel thereto are the two rows of eight contact members **56** each. The posts **14** extend outwardly and the contact portions **60** project inwardly with respect to the frame's longitudinal axis.

Web portions **78** connect contact members **56** with end strips **74**. These web portions are located adjacent to posts **14**. Although this location for the web portions is preferred because it adds stability to the contact members **56** both during the forming operation and assembly of switch **10**, it has been found that the removal of the web portions subsequent to assembly is facilitated if such portions were located at or near the free ends of posts **14**.

FIG. **4** shows frame **70** ater the forming operation. The midsections of end strips **74**, hereinafter designated generally at **80**, and inner portions **60** have been bent to form the bight on the U-shaped configuration while the ends of end strips **74**, posts **14**, intermediate portions **58** and web portions **78** form the legs.

Each contact member **56** is separately identified by a small letter beginning with "*a*," attached to the reference numeral **56** for the purpose of describing the structure of the inner portions **60**.

The contact portion of member **56*a*** is biased or loaded downwardly relative to midsection **80** and further a section designated at **82** and adjacent the free end of the inner portion, has been dimpled to form detent spring **62** (FIG. **2**).

The contact portions of contact member **56*b***, contains a laterally extending tab **84** which has been bent so that its contact area **85** is in a higher horizontal plane than for example the midsection **80** of end strip **74**. Tab **82** so formed is the fixed contact **68** (FIG. **2**).

The inner portion **60** of contact member **56*c*** (adjacent to **56*a***) has been swaged as seen at **86**. The swaging has extruded the contact portion further toward and overlaps its opposing contact member (**56*d***) and extends beneath lateral tab **84**; i.e. fixed contacts **66** and **68**. Further, the swaging has increased the flexibility of the inner portion **60** and has hardened the material allowing higher stress levels. The contact portions of **56*c*** have also been dimpled between the free end and the swaged area to create a convex surface **88** which is dimensioned to rest conformably in a flank **47** on cam **44** (see FIG. **5**). The inner portion **60** on contact member **56*c*** formed as described above constitutes movable contact arm **64** (FIG. **2**).

The inner portion **60** of contact member **56*d***, positioned adjacent member **56*b*** and oppose member **56*c***, is generally rectangular platform **90** which constitutes the fixed contact **66** (FIG. **2**). As the platform on contact member **56*d*** has been obscured in FIG. **2** by movable contact arm **64**, reference is made to contact member **56*f*** which clearly show the platform and as will be seen is identical thereto.

Contact members **56*a***, *b*, *c* and *d* form one set consisting of a detent spring **62**, movable contact arm **64** and fixed contacts **66–68**. This set has a mirror image in all respects in members **56*e***, *f*, *g*, and *h*. These two sets form a first group having double pole-double throw characteristics. A second group but orientated **180** degrees therefrom, consists of contact members **56*i***, *j*, *k*, *l*, *m*, *n*, *o*, and *p*. The two groups together, along with the particular cam **44** configurations, operate in **8-4-2-1** binary sequence. As is apparent, the cam **44** configuration and contacts can be varied to produce any sequence as desired.

FIG. **5** clearly shows the relationship between the several components in switch **10**. Camshaft **38** is seen rotatably positioned in base member **24** of housing **13** with annular bearing surfaces **36** seen in phantom positioned in openings **32**. The figure also clearly shows the swaged area **86** on movable contact arm **64** as well as the positioning of its free end in between the two, vertically spaced-apart, fixed contacts **66–68**. Contact arm **64**, biased against fixed contact **66**, is moved into engagement with fixed contact **68** by rotating camshaft **38** to where a lobe **48** elevates the arm.

FIG. **5** also shows the general construction of cover member **12** and its relation to contact members **56** and base member **24**. As is well understood in the art, the housing members are bonded together to make an environmentally sealed package.

FIG. **6** illustrates the relation of detent spring **62** to detent surface **46**. The view shows the interaction between dimple **82** and the hills **49** and valleys **50** on surface **46**. The angles thereon are steep to require some force to rotate camshaft **38** and also to provide a "snap" action as detent springs **62** cam over a hill into a valley.

FIG. **6** also includes an end view of fixed contact **68** showing the vertical offset thereof.

FIG. **7** illustrates the adaption of the switch disclosed herein to a single pole (one movable contact arm **62**) and a single throw (fixed contact **66**). It is clear that fixed contact **68** could be used in lieu of contact **66**. Camshaft **38** incorporates a single cam **44** having a single lobe **48**. Base member **24** has but a single and shorter compartment **35** and of course cover member **12** would also be proportionately smaller.

It is apparent that cam **48** in FIG. **7** could have a single flank **47** instead of a single lobe **48**.

With the exception of contact members **56** the other three components of switch **10**; i.e., cover and base members **12–24** and camshaft **38**, are made of plastic or other insulating material.

In summary the present invention discloses a switch consisting of a limited number of easily available components with the contact members being made from a single strip of material by stamping and forming without adding another single discrete element. However, as is well known in the industry, the contact members may be plated with gold, tin or the like to enhance the metal's electrical characteristics but this is a matter of choice rather than need.

The present invention is ideally suited for use as an address to a printed circuit board such that access to the board is gained only by a select signal. It is apparent to one skilled in the art that a board having thereon the switches herein disclosed can be given a new address at any time without removing the switches from the board and with the only required tool being a screwdriver.

It is further apparent that the switch disclosed herein, having a total of four parts, is readily adaptable to manufacturing via automation.

The present invention is not limited to a single pole, single throw or a dual double pole, double throw embodiments. It will be clear to those skilled in the art that any number of combinations can be made.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as some modifications will be obvious to those skilled in the art.

What is claimed is:

1. A method of making selective switch contacts comprising the steps of:

a. providing a planar sheet of conductive material;

b. stamping said sheet to provide a frame comprising two parallel rows of one contact member each, said contact members each having an intermediate portion, connecting posts at one end thereof and an inner portion at another end, said inner portion of one contact member projecting towards said inner portion of the other contact member;

c. forming said stamped frame into a U-shaped form to where said inner portions form the bight thereof;

d. shaping one of said inner portions to form a first fixed contact; and

e. shaping the inner portion opposite said first fixed contact to form a movable contact arm; and

f. shaping the inner ends positioned on a row opposite said second fixed contacts to form detent springs.

2. The method of claim **1** further characterized by the additional step of swaging said movable contact

arm to extrude the free end thereof into an overlapping relation with said first fixed contact.

3. A method of making contacts useful in electromagnetic relay assemblies comprising the steps of:

a. stamping planar sheet of conductive material to form a frame comprising two parallel rows of parallel contact members, said contact members being in two groups one group being identical to the other with each group having four contact members in one row and the four contact members in the opposite row in opposing relation, said contact members each having an intermediate portion, a connection post on one end of said intermediate portion and an inner portions on another end of said intermediate portion, said inner portions of said members on one row facing said inner portions of other said members on another row;

b. bending said frame into a U-shape where said inner portions form the bight thereof; and

c. forming said inner portions to provide in each group two sets of contacts comprising two first and two second fixed contacts formed from four adjacent inner portions on the same row where each of said first fixed contacts are spaced above one of said second fixed contacts, and two movable contact arms formed from two adjacent inner portions on the opposing row, and two detent springs formed from inner portions positioned on the same row as and on either side of said movable contact arms.

4. The method of claim **3** further characterized by the additional step of swaging said movable contact arms to extrude the free ends thereof into the space between said first and second fixed contacts.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,831,272 Dated August 27, 1974

Inventor(s) HAROLD LAWRENCE PURDY

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 5, after the word "stamping" insert the word --a--.

Signed and sealed this 29th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

AMP 2884