

# PATENT SPECIFICATION (11)

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## (54) A METHOD OF AND A MACHINE FOR SEPARATING AND FITTING INSULATED CONDUCTORS OF MULTI-CONDUCTOR RIBBON CABLES TO CONNECTORS IN HOUSINGS

(71) We, THE BREEDON PRESS LIMITED, a British Company of Leopold Street, Long Eaton, Nottingham, do hereby declare the invention for which we pray

that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—  
This invention relates to a method of and a machine for separating and fitting insulated conductors of multi-conductor ribbon cables to contacts or connectors (referred to hereinafter simply as contacts) in housings and has for its primary object the provision of a method of and a machine for automatically and expeditiously separating integrally formed side-by-side individual insulated conductors of multi-conductor ribbon cables, stripping the insulation from the ends of said conductors and "gang-crimping" the contacts pre-assembled in a housing of an electric fitting, to the bared ends of said conductors.

Broadly, according to the present invention there is provided a method of achieving the object set forth above which consists in passing a multi-conductor ribbon cable end-ways between cutting or tearing elements to separate the individually insulated conductors at the leading end of the cable, passing the separated conductors to collecting and spreading means which presents their leading ends to cropping means which cuts the insulation of each conductor transversely and removes the unwanted insulation to leave the conductors with bared leading ends, holding the cable immovable while performing the foregoing operation, supplying and locating a housing provided with contacts fitted therein in a position for receiving the bared ends of the conductors, "gang-crimping" the contacts about the bared ends of the conductors, and engaging the contacts fully within said housing from

preliminary positions in which they are temporarily located for receiving the bared ends of the conductors.

The invention also provides a machine for performing the above operations which broadly comprises in combination an entry channel for receiving and guiding the multi-conductor ribbon cable, cutting or tearing elements for separating the ribbon length-ways at its leading end into individual insulated conductors, means for feeding the said separated conductors forwardly through a collecting and spreading device, means for moving the cutting or tearing elements out of engagement with the ribbon and simultaneously actuating and causing a gripping device to bear on the separated and spread conductors and hold them stationary while locating them in a cropping and stripping device for baring the leading ends of the conductors, and means for successively feeding housings containing contacts to a position for receiving the bared ends of the conductors, and means for "gang-crimping" the contacts to said bared ends of the conductors, and means for engaging the contacts with the fitted conductors fully in said housings from preliminary positions in which they are initially and temporarily located for receiving the bared ends of the conductors.

To enable the invention to be clearly understood a preferred embodiment thereof will now be described by way of example with reference to the accompanying purely diagrammatic drawings, wherein:—

Figure 1 is a side view of the part of the machine comprising the ribbon entry or guide channel, cutting or tearing elements, spreader mechanism and the insulation crop and strip device shown in an open position, Figure 1A is a plan view of part of Figure 1,

Figure 2 is a view similar to Figure 1 but

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showing elements of the cutting device out of engagement; a conductor-gripping device actuated and the crop and strip device closed,

5 Figure 2A is a view of part of Figure 2 showing the ribbon cable protruding beyond the front face of the spreader mechanism and between the open jaws of the crop and strip device,

10 Figure 2B is a view similar to Figure 2A but showing the ribbon cable cropped to length and its insulation stripped with the crop and strip device in the closed and rearward position,

15 Figure 3 is a view similar to Figure 2 but showing a gang crimping mechanism, for simultaneously crimping a number of contacts to the bared ends of the conductors,

20 Figure 4 is a front view of the transfer mechanism detailing its positioning means and generally including the crop and strip device, the gang crimping mechanism and a supply magazine for holders with contacts fitted therein in preliminary positions,

25 Figure 4A is a view similar to Figure 4 but showing the crop and strip device and gang crimping means in detail,

Figure 5 is a part plan view of Figure 4,

Figure 6 is an end view of Figure 4,

30 Figure 7 is a view showing air springs against the influence of which moves a common base plate supporting the cutting or tearing device and conductor spreader mechanism,

35 Figure 8 is a part view showing the die set carrying the cutting device and its latching and operating means in the closed position,

40 Figure 8A is a view similar to Figure 8 but in its open position,

Figure 9 is a part view showing the cutting or tearing device open to receive the ribbon cable,

45 Figure 9A is a view similar to Figure 9 but showing the cutting or tearing device closed and the conductors of a ribbon cable separated,

50 Figure 10 is a part plan view of the conductor separator device and spreader mechanism, and

Figures 11, 12 and 13 are plan views of the crop and strip mechanism illustrating how a latch release mechanism controlling same is operated.

55 Referring firstly to Figures 1 to 3 of said drawings, the machine comprises an entry channel or guide 51 for the cable R, a cutting or tearing device comprising a pair of cutting or tearing rollers 1 between which is passed a multi-conductor ribbon cable R introduced into the machine at "E", the rollers 1 acting to separate side-by-side individually insulated conductors of the cable. These rollers 1 are driven by meshing  
65 pinions 1a at their ends and which are driven

by a rack 2a forming part of a ram 2b reciprocated vertically in a fluid power cylinder 2, the stroke of the ram 2b determining the length of ribbon separated lengthways between the individually insulated  
70 conductors.

The longitudinally separated part of the ribbon R passes from between the cutting or tearing rollers 1 to a collector and spreader mechanism comprising diverging channels and indicated generally at 3 which  
75 collects and locates the separated conductors in grooves 3a (Figure 10), still covered by their insulation, in such a manner that the conductors are spread as required and so as to facilitate removal of a short length of the insulation of the conductors to bare the ends thereof when fed between the jaws of a crop and strip mechanism 4 which at  
80 this stage is open to receive the spread apart conductors.

At this position of the leading end of the cable R a pneumatic signal is initialled by the said rack 2a to operate fluid power cylinders 5 and 6 (Figures 1A, 7 and 8) to  
85 open the cutting or tearing rollers 1.

The cutting or tearing device comprises two sets of offset cutting or tearing rollers 1 having peripheral teeth 1b which act to urge adjacent conductors in opposite directions thereby tearing the connection between adjacent connectors. This cutting or tearing device is supported in a die set 70 (Figures 8 and 8A) which is mounted on the common base plate 15. The fluid power  
90 cylinder 5 is mounted by its screwed neck 5a into the base of said die set 70 and the ram 5b is connected to the top of said die set 70 by a column 69. When a signal is initiated by the rack 2a, the cylinder 6, which is mounted on a vertical extension 64a of a latch 64, receives fluid, e.g. air, to the rear of its ram. As a ram 6a working in the cylinder 6 is constrained at its end by a vertical extension 65 of the die set it cannot advance and therefore pushes the cylinder 6 bodily rearwards (see Figure 8A) against the influence of a spring 68 thus releasing a latch 64 from a notch 67 in the pillars 66. This allows the built-up pressure  
95 in the bottom of the cylinder 5 to exert itself and advance the ram 5b thus raising the top half of the die set and opening the top roller assembly to the full stroke of the cylinder 5. As this occurs a cam 10 of this assembly engages a pivoted lever 11 and swings the latter to cause the flat or formed face of a clamping element 12 thereof to bear on and grip the separated and spread insulated conductors which are now positioned in the crop and strip mechanism 4. The ram in the cylinder 2 then retracts to move the rack 2b back to its initial position ready for a subsequent operation and an electrical signal is given which causes a  
100 105 110 115 120 125 130

press 13 to operate one cycle during which the spread ends of the ribbon cable protruding beyond the front face of the spreader arrangement are cropped square to length and their insulation cut prior to stripping.

The cropping and stripping mechanism 4 comprises an upper part 4a which is swingable downwardly against the influence of springs 4b towards a lower part 4c, the springs 4b serving to return the part 4b upwardly when a control latch 19 is released. As illustrated in Figures 2A and 2B the former Figure shows the mechanism in the open position and fingers of the latch 19 are retained by the faces of the columns 20 to keep the latch 19 in the released position. On the downstroke of the press 13 a ram 17 strikes the roller assembly 18 carried by the top half 4a of the crop and strip mechanism and moves this top half downwards causing the latch 19 to engage in notches 20a under the pressure of the spring 20b (Figures 11 and 12).

Figures 11, 12 and 13 illustrate how the latch 19 is released by the latter striking the latch release arm 52 when a transfer slide 26, referred to later, moves to bring the gang crimping tool under the press 13.

This cycle of operation effected by the press 13 is as follows:—

During the downstroke of the press an extension arm 14 on the ram 17 (Figure 2) engages the top of the spreader mechanism 3 and causes both the spreader mechanism 3 and the opened cutting or tearing rollers 1, which are mounted on a common base-plate 15, to lower against the influence of air springs 16 (see also Figure 7) to the down position. The ram 17 simultaneously strikes a roller assembly 18 which is carried on the top half 4a of the crop and strip mechanism 4 and moves this half of the mechanism downwards from an open position (Figures 1 and 2A) to a closed position (Figures 2 and 2B) wherein the blades 63 of the mechanism cut through the insulation and crop the end of the wire square and to the length required.

At this stage of the cycle of operations the latch 19 engages in the notches 20a in pillars 20 and locks the entire crop and strip mechanism in position.

On the upward return stroke of the press 13, the release of the arm 14 on the spreader mechanism 3 causes air pressure on the air springs 16 to return the opened cutting or tearing rollers 1 and spreader mechanism 3 mounted on the common base plate 15, to the up position and a signal is given to cause a ram 23 in a cylinder 21 (Figures 1, 2A and 2B) to retract and move rearwardly into the cylinder 21 to actuate the insulation stripping mechanism to strip the cut insulation from the conductor ends to bare by means of the blades 63, the cores or wires R1

thereof (see Figure 2B). This is achieved by way of tennoned adapter 22 attached to a protruding end of a ram rod 23, the adaptor 22 being engaged with a complementary tennon slot 24 to the rear of the lower half 4C of the crop and strip mechanism 4.

At this stage of the cycle of operations a further signal is given which results in reverse operation of a ram in a cylinder 25 (Figure 4) and a transfer slide 26 actuated thereby is moved in an opposite direction and the crop and strip mechanism 4 and a crimping tooling 27 (see also Figures 3 and 4A) carried on this slide 26 is moved into a position directly under the press 13, at the same time causing the latch 19 to strike the latch release arm 52 carried on a column 53, thus releasing the latch against spring pressure allowing the crop and strip mechanism to open.

The transfer slide 26 is slidable on two ground rods 29, 30 (Figure 6) by a ram 25a of the cylinder 25 and also slides on a U-shaped prefabricated base 31 the top surface of which is covered with a load taking bearing strip 54. Each rod 29 and 30 is located in a hole 33, said rods each having a flat 32 and being secured in the holes by screws 34. The slide 26 can be adjusted for position by a screwed adjusting bush 56 (Figure 4), and rotation of this bush 56 is constrained linearly by a collar 59 attached to the end of the ram rod 25a of the cylinder 25 and causes the slide 26 to adjust its position. Locking of the slide 26 in its required set position is effected by means of a locking collar 57 and locking screws 58. The cylinder 25 is mounted by its screwed neck 25b directly into the side member of the U-shaped prefabricated base 31 and is secured in position and prevented from rotating by a locking screw 60 and plug 61 (Figure 5).

The other end of the slide 26 is provided with a simple screwed bush 39 fitted with a locking screw 40 and a plug 55 and a spring loaded plunger 41 is fitted in the bush 39 and the end of this plunger 41 projects beyond the stop face of the bush to provide a cushioning effect.

The required number of contacts C for each ribbon cable are fitted in initial and temporary positions in a socket housing H (Figure 6) and the housings with their contained contacts present themselves to a position P (Figures 4 and 5) from a magazine slide S (Figure 6) and are then moved by means of a second slide 43 (constrained within slide cover 49 and its extension 49a) and slidable on a base 43a, operated by a bell crank lever 44 actuated by a ram and cylinder assembly 42 to a locating nest 45 (Figures 3 and 4) and in position on to the lower crimp die 28 (Figure 3). This operation takes place immediately the cycle is

initiated and whilst the ribbon cable *R* is passing through the pair of cutting or tearing rollers 1 and into the spreader mechanism 3.

5 When the transfer slide 26 supports a housing *H* and its contacts or connectors in a crimping position under the press 13, an electrical signal is given to operate the press one cycle to "gang-crimp" the contacts to  
10 the bared ends *R1* of the conductors. On the down stroke of the press 13 the extension arm 14 on the ram 17 (Figure 2) moves the spreader assembly 3 and the open cutting or tearing roller device mounted on said  
15 common base plate 15 downwardly against air spring cylinders 16 and engages the prepared ends *R1* of the ribbon wire beyond the front face of the said spreader assembly in the crimp portions of the connectors or  
20 contacts in a socket housing *H* which has already been positioned at *P* on the lower crimp die 28. At the same time the ram 17 moves the top half of the crimping tool 27, carrying the crimping punch 27*a* downwards to effect "gang-crimping" of the  
25 contacts to the bared ends *R1* of the conductor wires. On the upward return stroke of the press 13 the top half of the crimping tool 27 is raised under spring pressure to a pre-set open height governed by a slotted  
30 arm 62 (Figure 3). On this return stroke of the press 13 a signal is given which charges air to the underside of the built in air cylinder 46 (Figure 3) to lift the socket housing  
35 *H* and the locating nest 45 to a position in readiness for closing the crimped contacts into their housing. At the same time the release of the extension arm 14 on the spreader mechanism 3 causes pressure on  
40 the air springs 16 to return the cutting roller device 1 and spreader mechanism 3 mounted on the common base plate 15 to return to the up position. When both these operations are achieved a further signal results  
45 in operation of the ram 23 in the cylinder 21 and the front face of the tennon adapter 24 engages the spring returned pusher 41*b* through the locating nest housing 62 and forces the socket housing *H* forward until the crimped contacts are pushed completely  
50 into the said housing. The projection 41*a* of the front face of the pusher 41 prevents the socket housing from tilting during this operation. A signal is then given which results in reverse operation of the ram 23  
55 of the cylinder 21, to remove air from the underside of the built in air cylinder 46 which allows compression springs 47 contained within the locating nest assembly, to exert themselves and return the locating nest  
60 downward to the rest position, at the same time operating cylinder 7 which opens the spreader mechanism 3, thus allowing the completed crimped and closed socket housing  
65 *H* assembly to be removed from the

machine, leaving the machine ready for the next cycle.

According to modifications not illustrated the ribbon cable may be moved and conveyed to the connectors and socket housing  
70 in any other suitable manner.

#### WHAT WE CLAIM IS:—

1. A method of fitting insulated conductors of multi-conductor ribbon electric cables with contacts or connectors which consists in passing a multi-conductor ribbon cable endways between cutting or tearing elements to separate the individually insulated conductors at the leading end of the cable, passing the separated conductors to collecting and spreading means which presents their leading ends to cropping means which cuts the insulation of each conductor transversely and removes the unwanted insulation to leave the conductors with bared leading ends, holding the cable immovable while performing the foregoing operation, supplying and locating a housing provided with contacts fitted therein in a position for receiving the bared ends of the conductors, "gang-crimping" the contacts about the bared ends of the conductors, and engaging the contacts fully within said housing from preliminary positions in which they are temporarily located for receiving the bared ends of the conductors.

2. A machine for carrying out the method claimed in Claim 1 which comprises in combination an entry channel for receiving and guiding the multi-conductor ribbon cable, cutting or tearing elements for separating the ribbon lengthways at its leading end into individual insulated conductors, means for feeding the said separated conductors forwardly through a collecting and spreading device, means for moving the cutting or tearing elements out of engagement with the ribbon and simultaneously actuating and causing a gripping device to bear on the separated and spread conductors and hold them stationary while locating them in a cropping and stripping device for baring the leading ends of the conductors, and means for successively feeding housings containing contacts to a position for receiving the bared ends of the conductors, and means for "gang-crimping" the contacts to said bared ends of the conductors, and means for engaging the contacts with the fitted conductors fully in said housings from preliminary positions in which they are initially and temporarily located for receiving the bared ends of the conductors.

3. A machine as claimed in Claim 2, wherein said ribbon-separating elements comprises upper and lower rollers between which the ribbon is fed and which act to tear or cut the side-by-side individually insulated conductors, said rollers being adapted



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initiated and whilst the ribbon cable *R* is passing through the pair of cutting or tearing rollers 1 and into the spreader mechanism 3.

5 When the transfer slide 26 supports a housing *H* and its contacts or connectors in a crimping position under the press 13, an electrical signal is given to operate the press one cycle to "gang-crimp" the contacts to the bared ends *R1* of the conductors. On the down stroke of the press 13 the extension arm 14 on the ram 17 (Figure 2) moves the spreader assembly 3 and the open cutting or tearing roller device mounted on said common base plate 15 downwardly against air spring cylinders 16 and engages the prepared ends *R1* of the ribbon wire beyond the front face of the said spreader assembly in the crimp portions of the connectors or contacts in a socket housing *H* which has already been positioned at *P* on the lower crimp die 28. At the same time the ram 17 moves the top half of the crimping tool 27, carrying the crimping punch 27*a* downwards to effect "gang-crimping" of the contacts to the bared ends *R1* of the conductor wires. On the upward return stroke of the press 13 the top half of the crimping tool 27 is raised under spring pressure to a pre-set open height governed by a slotted arm 62 (Figure 3). On this return stroke of the press 13 a signal is given which charges air to the underside of the built in air cylinder 46 (Figure 3) to lift the socket housing *H* and the locating nest 45 to a position in readiness for closing the crimped contacts into their housing. At the same time the release of the extension arm 14 on the spreader mechanism 3 causes pressure on the air springs 16 to return the cutting roller device 1 and spreader mechanism 3 mounted on the common base plate 15 to return to the up position. When both these operations are achieved a further signal results in operation of the ram 23 in the cylinder 21 and the front face of the tennon adapter 24 engages the spring returned pusher 41*b* through the locating nest housing 62 and forces the socket housing *H* forward until the crimped contacts are pushed completely into the said housing. The projection 41*a* of the front face of the pusher 41 prevents the socket housing from tilting during this operation. A signal is then given which results in reverse operation of the ram 23 of the cylinder 21, to remove air from the underside of the built in air cylinder 46 which allows compression springs 47 contained within the locating nest assembly, to exert themselves and return the locating nest downward to the rest position, at the same time operating cylinder 7 which opens the spreader mechanism 3, thus allowing the completed crimped and closed socket housing *H* assembly to be removed from the

machine, leaving the machine ready for the next cycle.

According to modifications not illustrated the ribbon cable may be moved and conveyed to the connectors and socket housing in any other suitable manner.

#### WHAT WE CLAIM IS:—

1. A method of fitting insulated conductors of multi-conductor ribbon electric cables with contacts or connectors which consists in passing a multi-conductor ribbon cable endways between cutting or tearing elements to separate the individually insulated conductors at the leading end of the cable, passing the separated conductors to collecting and spreading means which presents their leading ends to cropping means which cuts the insulation of each conductor transversely and removes the unwanted insulation to leave the conductors with bared leading ends, holding the cable immovable while performing the foregoing operation, supplying and locating a housing provided with contacts fitted therein in a position for receiving the bared ends of the conductors, "gang-crimping" the contacts about the bared ends of the conductors, and engaging the contacts fully within said housing from preliminary positions in which they are temporarily located for receiving the bared ends of the conductors.

2. A machine for carrying out the method claimed in Claim 1 which comprises in combination an entry channel for receiving and guiding the multi-conductor ribbon cable, cutting or tearing elements for separating the ribbon lengthways at its leading end into individual insulated conductors, means for feeding the said separated conductors forwardly through a collecting and spreading device, means for moving the cutting or tearing elements out of engagement with the ribbon and simultaneously actuating and causing a gripping device to bear on the separated and spread conductors and hold them stationary while locating them in a cropping and stripping device for baring the leading ends of the conductors, and means for successively feeding housings containing contacts to a position for receiving the bared ends of the conductors, and means for "gang-crimping" the contacts to said bared ends of the conductors, and means for engaging the contacts with the fitted conductors fully in said housings from preliminary positions in which they are initially and temporarily located for receiving the bared ends of the conductors.

3. A machine as claimed in Claim 2, wherein said ribbon-separating elements comprises upper and lower rollers between which the ribbon is fed and which act to tear or cut the side-by-side individually insulated conductors, said rollers being adapted



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to move, one set relatively to the other to combine to effect a tearing or cutting operation during the period a ribbon passes between them, and then to move apart after a separating action has been carried out.

4. A machine as claimed in Claim 3, wherein said rollers are driven by meshing pinions at their ends that are rotated by a rack by means of a ram, the stroke of the ram determining the length of ribbon separated lengthways between the individually insulated conductors.

5. A machine as claimed in Claim 4, wherein the separated and insulated conductors are fed to a spreading device comprising diverging channels in which the conductors are clamped with their leading ends disposed in juxtaposition to a mechanism that crops said ends and also removes a portion of the insulation thereof to bare each conductor for the reception of a contact.

6. A machine as claimed in Claim 5, wherein the conductors are simultaneously clamped by a clamping member actuated by cam means upon opening part of the cutting or tearing rollers.

7. A machine as claimed in Claims 5 and 6, wherein the cropping and stripping mechanism comprises a lower part in which the leading ends of the splayed apart conductors are located, and an upper part that is movable towards the lower part and provided with cutting blades that act to strip the insulation from the leading ends of the conductors and to bare the latter.

8. A machine as claimed in Claim 5, 6 or 7, including means for feeding connector housings provided with contacts, to positions in which the bared ends of the

conductors can be engaged with said contacts and the latter crimped to the conductors by a gang-crimping operation.

9. A machine as claimed in Claim 8, wherein said contacts are temporarily located in preliminary positions in the housings and pusher means provided for closing the crimped contacts into their housings.

10. A machine as claimed in any of the preceding claims 2 to 9, wherein said operations are carried out in a controlled predetermined sequence by electrically controlled pneumatic or hydraulic means responsive to electric signals initiated by the various mechanisms.

11. A machine as claimed in Claim 10, wherein the crop and strip mechanism and the crimping mechanism is actuated by a ram, or a projection thereof, of a press responsive to electric signals initiated by said mechanisms.

12. A method of fitting insulated conductors of multi-conductor ribbon electric cables with contacts or connectors substantially as hereinbefore described.

13. A machine for carrying out the method claimed in Claims 1 or 12, constructed substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

14. Conductors formed from multi-conductor ribbon electric cables and fitted with contacts in accordance with and by the method and machine claimed in any of the preceding Claims.

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