March 25, 1969 F. V. BROSSEIT 3,434,324

TERMINAL FORMING MACHINE

Filed Dec. 23, 1966 Sheet 1 of 3

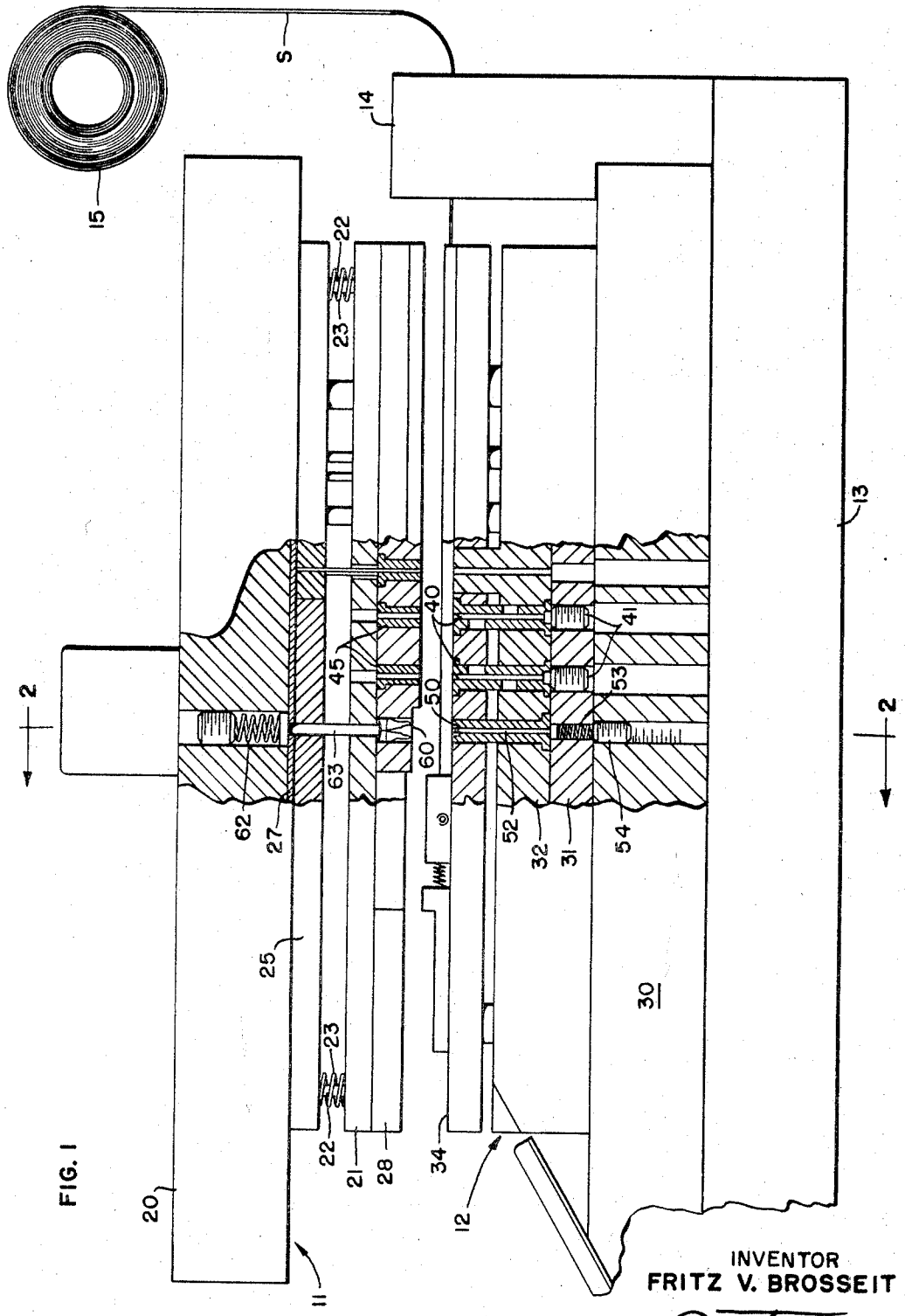

FIG. 1

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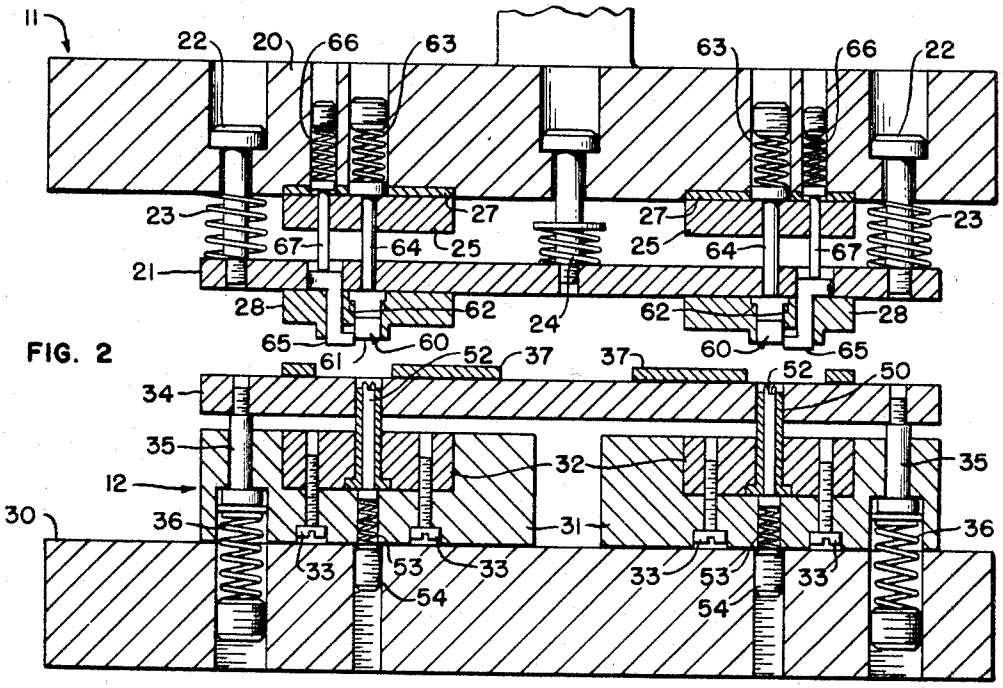

FIG. 2

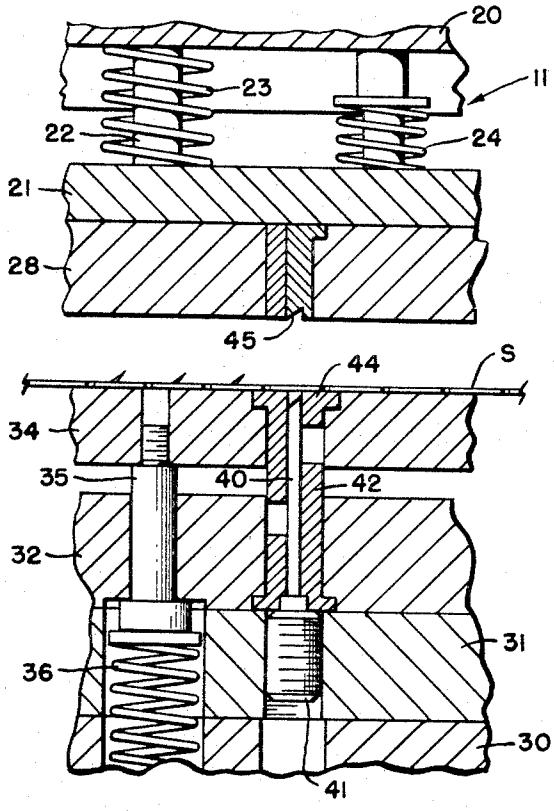

FIG. 3

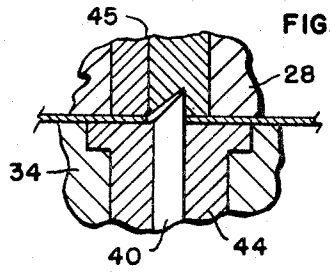

FIG. 3a

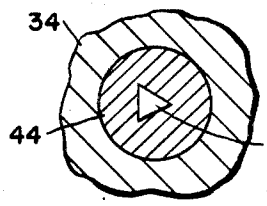

FIG. 3b

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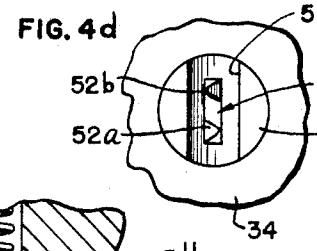

FIG. 4d

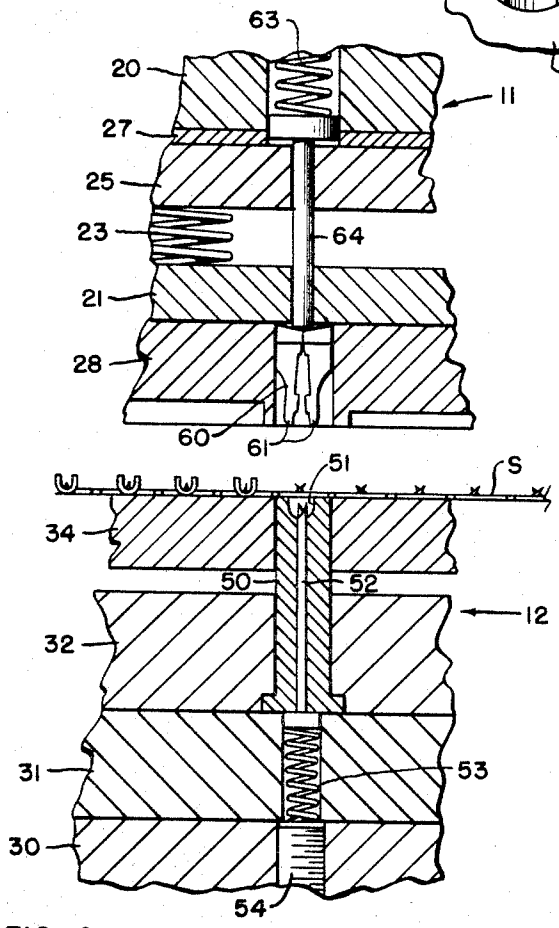

FIG. 4

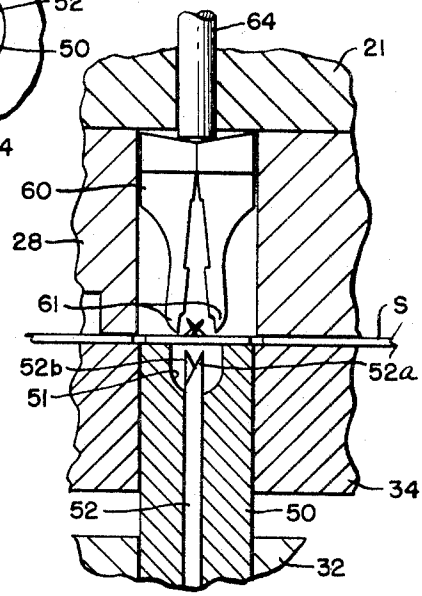

FIG. 4a

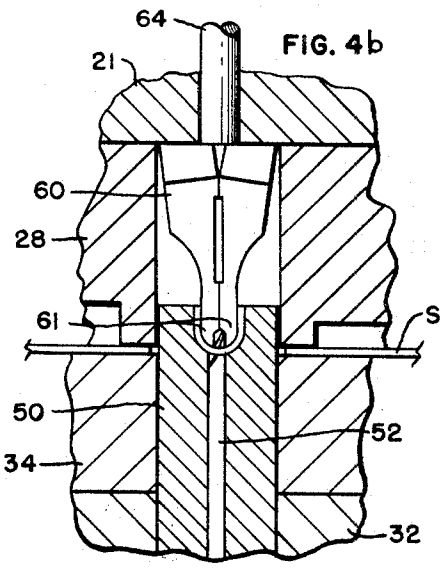

FIG. 4b

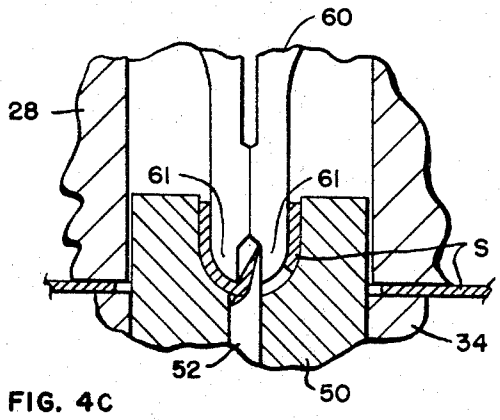

FIG. 4c

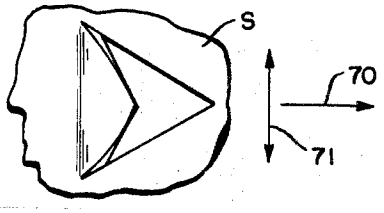

FIG. 5

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Patented Mar. 25, 1969

3,434,324

TERMINAL FORMING MACHINE

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Filed Dec. 23, 1966, Ser. No. 604,265
Int. Cl. B21d 43/28
U.S. Cl. 72—324 14 Claims

ABSTRACT OF THE DISCLOSURE

An insulation piercing terminal forming machine including an insulation piercing tab forming station comprising a punch and a cooperating die for forming an insulation piercing tab from a body of terminal material and for sharpening the tab in a first direction and an insulation piercing tab finishing station comprising a tab bending pin for bending the tab with respect to the body of terminal material, a two part member and a die for squeezing parts of the two part member into engagement with the tab and the tab bending pin to sharpen the tab in a second direction and for cooperation with the two part member to form terminal sides from the body of terminal material.

Insulation piercing terminals for electrical conductors are often fabricated in progressive punch and die mechanisms in which the various component parts of the terminals are cut and formed from a strip of terminal material at individual stations along the length of the machine. In the past the insulation piercing tabs of such terminals have been cut from the strip of terminal material, bent into a steep angle with respect to the strip and sharpened to a point at a single station. It has been found, however, that better insulation piercing tabs result and that the tab-forming portions of the terminal forming machine have a longer life and platform more reliably if the tabs are cut and sharpened in a first direction at a first station and are then bent to a steep angle and sharpened in a second direction at a second station.

Accordingly, an object of this invention is to provide an improved insulation piercing tab forming mechanism.

Another object of this invention is to provide a device for forming insulation piercing tabs which are sharp in two directions.

In accordance with the preferred embodiment of the invention these and other objects are achieved by providing a two station terminal forming mechanism. At the first station, two sides of a triangularly shaped insulation piercing tab are severed from a strip of terminal material and the tab is simultaneously sharpened in a direction perpendicular to the side by which the tab is attached. At the second station a two-part terminal side forming member and a cooperating die form the sides of the terminal while a tab bending member positioned in the die simultaneously bends the tab formed at the first station into a steep angle with respect to the strip. As the two-part forming member bottoms in the die, the two parts of the forming member are cammed together and the tab and the tab bending member are squeezed between the two parts. This sharpens the two unattached sides of the tab so that the tab is sharpened in two directions.

A more complete understanding of the invention may be had by referring to the following detailed description when taken in conjunction with the drawings wherein:

FIG. 1 is a front view of a terminal forming machine employing the present invention in which certain parts have been broken away more clearly to illustrate certain features of the invention;

FIG. 2 is a sectional view of the machine shown in

FIG. 1 taken along the line 2—2 in FIG. 1 in the direction of the arrows;

FIG. 3 is an enlarged partial sectional view showing the details of one of the piercing stations of the machine shown in FIG. 1 in which certain components have been relocated more clearly to illustrate certain features of the invention;

FIG. 3*a* is an enlarged view of the piercing station shown in FIG. 3 showing the parts in a closed position;

FIG. 3*b* is an enlarged sectional view of the piercing pin shown in FIG. 3;

FIG. 4 is an enlarged partial sectional view showing the side forming and tab sharpening station of the machine shown in FIG. 1;

FIG. 4*a* is an enlarged view of the device shown in FIG. 4 showing the parts in a partially closed position;

FIG. 4*b* is a view similar to FIG. 4*a* showing the parts in a fully closed position;

FIG. 4*c* is an enlarged view of the parts shown in FIG. 4*b*;

FIG. 4*d* is a top view of the bending and sharpening pin employed in the station shown in FIG. 4; and

FIG. 5 is an enlarged view of an insulation piercing tab formed by the mechanism shown in FIGS. 3 and 4.

Referring now to the drawings, wherein like reference numerals designate like parts throughout the several views, with particular reference being had to FIG. 1, there is shown a terminal forming machine comprised of a punch member **11** and a die member **12**, both of which are suitably formed for mounting in a standard punch press. The die member **12** is positioned on a base plate **13** which also supports a feeder mechanism **14**.

As is more fully described in the copending application of F. V. Brosseit entitled, "Terminal Attaching Machine," Ser. No. 604,350, filed of even date herewith, the feeder **14** advances two strips of stock S in the form of narrow bands of terminal material from a pair of supply rolls **15** (only one of which is shown) through the terminal forming machine along two parallel paths. The terminal forming machine operates on the two strips of stock S in the manner of a progressive punch and die mechanism to form the two strips into terminals. In the portion of the terminal machine to the right of the parts shown in section in FIG. 1, the strips are separated into unitary terminal sections by slits extending transversely partially through the strips. In the portion of the terminal forming machine shown in section the strips are formed into terminal blanks by the mechanism shown in FIGS. 3 and 4. In the portion of the terminal forming machine shown to the left of the parts shown in section in FIG. 1, a wire is fed transversely to the paths of the strips and is cut to length, after which the terminal blanks are attached to the wire by crimping. Finally, the terminals are completed and a finished part comprised of a wire having a finished terminal attached to each of its ends is ejected from the left end (FIG. 1) of the terminal forming machine.

Referring now to FIGS. 1 and 2 the details of the punch member **11** and the die member **12** may be seen. The punch member **11** is comprised of a punch shoe **20** suitably formed for attachment to the ram of an ordinary punch press. An upper stripper **21** is slidably mounted on the ram **20** by upper stripper retaining screws **22** and is urged away from the punch shoe **20** by upper stripper springs **23** which surround the upper stripper retaining screws **22**. Attached to the middle of the punch shoe **20** are heavy backer springs **24** which are normally spaced from the upper stripper **21** and which serve to restrain movement of the upper stripper **21** toward the punch shoe **20**.

The punch member **11** supports a plurality of punch

elements some of which are supported by the punch shoe **20** and others of which are supported by the upper stripper **21**. Those punch elements which are mounted on the punch shoe **20** are secured thereto by a pair of punch holders **25** which are suitably spaced from the punch shoe **20** by a pair of spacer plates **27**. The punch elements which are supported by the upper stripper **21** are retained thereon by a pair of retainer plates **28** which are fixed to the upper stripper **21**.

The die member **12** includes a spacer plate **30** attached to the base plate **13** and a pair of die shoes **31** attached to the spacer plate **30**. A pair of die holders **32** are attached to the die shoes **31** by means of screws **33** and serve to retain a plurality of die elements on the die shoes **31**. A lower stripper **34** is slidably mounted on the die shoes **31** by lower stripper retaining screws **35** and is normally held in a spaced relationship to the die shoes **31** by means of lower stripper springs **36**. Mounted on the upper surface of the lower stripper **34** are stock retainers **37** which serve to define a pair of parallel strip paths through the terminal forming machine.

As the strips of stock S are passed through the terminal forming machine shown in FIG. 1, they are initially slit into unitary strip sections which are in turn formed into terminal blanks. The initial operation in the formation of the terminal blanks is the cutting of insulation piercing tabs into the strips of stock S. Two such tabs are cut into each of the strips, however, for the sake of clarity only one of the tab cutting stations will be described.

Referring now to FIG. 3 the details of one of the insulation piercing tab cutting stations is shown. In FIG. 3 an upper stripper retaining screw **22**, an upper stripper spring **23**, a heavy backer spring **24**, a lower stripper retaining screw **35** and a lower stripper spring **36** have been relocated so that their function in the operation of the device may be more readily understood. It should be remembered, however, that the components actually occupy the positions shown in FIGS. 1 and 2.

The insulation piercing tab cutting mechanism is comprised of a tab cutting punch pin **40** mounted in the die holder **32** and positioned with respect thereto by a set screw **41** secured in the die shoe **31**. The tab cutting punch pin **40** is guided and supported in the die holder **32** by a lower cutting pin guide **42** and is guided and supported in the lower stripper **34** by an upper cutting pin guide **44**. Mounted in the retainer plate **28** is a sharpening die **45**.

As the ram of the punch press to which the terminal machine is attached closes, it moves the punch shoe **20** toward the die shoes **31**. This causes the upper stripper **21** to move toward the lower stripper **34** thereby bringing the retainer plate **28** into engagement with the strips of stock S supported on the lower stripper **34**. After this engagement, the upper stripper springs **23** compress thereby reducing the gap between the punch shoe **20** and the upper stripper **21** until the heavy backer spring **24** comes into engagement with the lower surface of the punch shoe **20**. After this engagement, the combined springs **23** and **24** temporarily prevent further narrowing of the gap between the punch shoe **20** and the upper stripper **21**. Therefore, as the punch shoe **20** moves further toward the die shoe **31**, the lower stripper **34** is forced downwardly thereby compressing the lower stripper springs **36**. This action continues until the lower stripper **34** comes into engagement with the die holders **32**.

As the lower stripper **34** moves toward the die holders **32** the stock is lowered into engagement with pin **40** and the cutting of an insulation piercing tab in the strip of stock S begins. As is best seen in FIG. 3*b* the punch pin **40** is triangular in cross-section so that a triangularly shaped tab having one of its sides attached to the strip of stock S and having the other two of its sides free thereof is formed in the strip of stock S.

During the cutting operation, the upper cutting pin guide **44** moves downwardly with the lower stripper **34** toward the lower cutting pin guide **42** mounted in the die holder **32**. The mounting of the guide **44** in the lower stripper **34** assures full support for the cutting pin **40** during the entire cutting operation and allows the relatively small diameter pin **40** to easily cut the strip S in a manner similar to the piercing of a coin by a needle supported in a cork.

After the lower stripper **34** is bottomed on the upper surface of the die holder **32** further downward motion of the punch shoe **20** causes compression of the upper stripper springs **23** and the heavy backer spring **24**. This action causes extreme pressure to be placed on the components of the terminal forming machine and causes the upper pointed end of the insulation piercing tab pin **40** to swage the tab formed in the strip of stock S into a sharp point in a direction extending longitudinally of the strip of stock S. After the swaging operation, the ram which is attached to the punch shoe **20** returns to its initial position during which movement the parts of the terminal forming machine open in a pattern which is exactly the reverse of the closing pattern just described.

Upon completion of the cutting of a first insulation piercing tab in the strips of stock S, the strips are advanced to a second tab cuting station whereat a second insulation piercing tab is formed in the strips of stock S just to the rear of the tab formed at the station shown in FIG. 3. The two tab cutting stations appear to be aligned in FIG. 1 but are actually slightly displaced so that upon completion of the two tab cutting operations each unitary strip section has two tabs formed in it, these tabs being aligned with each other along a line extending transversely of the strips of stock S.

After the forming of the second insulation piercing tab the strips of stock S are moved to a terminal forming and tab sharpening station one of which is shown in FIG. 4. At the forming and sharpening station a die **50** having a U-shaped die cavity **51** formed in its upper surface is mounted on the die shoe **31** and is retained thereon by the die holder **32**. The die **50** serves as a guide for a bending and sharpening member **52** which is slidably mounted in the die **50** and which is urged upwardly by a bending and sharpening member spring **53** positioned in the die shoe **31** between the bending and sharpening member **52** and a set screw **54** mounted in the spacer plate **30**. As is best shown in FIG. 4*d* the bending and sharpening member **52** has a pair of tab engaging points **52***a* and **52***b* suitably spaced for engagement with the tabs formed at the tab cutting stations.

In the punch member **11** a two-part forming member **60** having jaws **61** is pivotally mounted in the retainer plate **28** over the die **50** by a pair of trunnions **62** (shown in FIG. 2). The two-part forming member **60** is urged into an open position by a forming member opening spring **63** mounted in the punch shoe **20** which acts upon the two-part forming member **60** by means of a forming member opening pin **64**. Mounted in the punch member **11** adjacent the forming member **60** is a stock retainer **65** which is urged downwardly toward the lower stripper **34** by a spring **66** that acts upon the stock retainer **65** through a pin **67**.

As the punch shoe **20** descends, the punch member **11** moves toward the die member **12** until the retainer plate **28** engages the lower stripper **34**. During this action the stock retainer **64** shown in FIG. 2 engages and grips the strips of stock S against the action of the spring **65**. At the time of engagement of the retainer plate **28** with the lower stripper **34** the components occupy the position shown in FIG. 4*a* wherein the strip S is gripped between the retainer plate **28** and the lower stripper **34** and wherein the two-part forming member **60** is in engagement with the upper surface of the strip.

Further downward movement of the punch shoe **20** causes the retainer plate **28** and the lower stripper **34** to move downwardly carrying the strip of stock S. This movement also drives the two-part forming member **60**

into the die cavity **51** in the upper surface of the die **50**. This action forms one unitary strip section into a U-shaped wire receiving configuration, this action being made possible due to slits formed between the unitary sections at the initial stations of the terminal attaching machine shown in the right-hand portions of FIG. 1.

The movement of the unitary section of stock into the cavity **51** brings the tabs of the section into engagement with bending and sharpening member **52**. The bending and sharpening member **52** bends the insulation piercing tabs formed at the tab cutting stations upwardly so that they stand substantially vertically with respect to the strip of stock S. Upon completion of the bending operation the insulation piercing tabs and the upper portions of the members **52** are positioned between the jaws **61** of the forming member **60**.

The movement of the two-part forming member **60** into the die cavity **51** causes the two parts of the forming member to be cammed together against the action of the forming member opening spring **63**. As the jaws **61** of the two-part forming member **60** come together they squeeze the bending and sharpening member **52** and the tabs formed at the tab cutting stations in the manner shown in FIG. 4*c*. This action swages the sides of the tabs which are not attached to the strip of stock S and causes them to be sharp so that the finished tabs are sharp in two directions, one of which extends longitudinally of the strip of stock S and the other of which extends transversely with respect thereto. The finished tab is shown in FIG. 5 wherein the arrow **70** represents the longitudinal direction of the strip of stock S in which the tab was initially sharpened and wherein the arrow **71** represents the transverse direction of the strip of stock S in which the tab is sharpened by the squeezing action of the two-part forming member **60**.

It should be noted that the terminal blank forming mechanism shown in FIGS. 3 and 4 operates to form insulation piercing tabs in two distinct and separate steps. In the step carried out at the tab cutting stations the tab is cut and sharpened in a first direction. However, no attempt is made to bend the tab to an upright position nor is any attempt made to sharpen the tab in a second direction. At the bending and sharpening station shown the tabs are bent to an upright configuration by the bending and sharpening pin and are sharpened in a second direction by the squeezing action of the two-part forming member. The separation of the cutting and bending steps in the formation of the insulation piercing tabs contributes greatly to the length of life of the cutting pin **40** and the bending and sharpening pin **52** and results in a greatly improved insulation piercing tab.

Although a particular embodiment of the invention is shown in the drawings and described in the foregoing specification it will be understood that the invention is not limited to that specific embodiment, but is capable of modification and rearrangement, and substitution of parts and elements without departing from the scope of the invention.

What is claimed is:

1. A device for forming terminals comprising:
- a first station including a punch and a cooperating die for forming an insulation piercing tab and for sharpening the tab in a first direction; and
- a second station including:
  - means for bending the tab formed at the first station into an upstanding configuration;
  - a two-part forming member;
  - a die for cooperation with the two-part forming member to form the sides of the terminal; and
  - means for squeezing the bending means and the tab between the two parts of the forming member to sharpen the tab in a second direction.

2. The terminal forming device according to claim **1** wherein the first station also includes guide means for supporting the punch during the forming and sharpening of the tab.

3. The terminal forming device according to claim **1** wherein the two-part forming member is a pair of spring loaded jaws which push the sides of the terminal into engagement with the cooperating die and which are cammed together by the die to squeeze the bending means and the tab together to sharpen the tab in the second direction.

4. The terminal forming device according to claim **1** wherein the insulation piercing tab has a triangular cross-section and is attached to the terminal by one of its sides, wherein the punch and die of the first station sharpen the tab to a point in a direction perpendicular to the side by which the terminal is attached and wherein the squeezing of the bending means and the tab by the two-part forming member sharpens the two unattached sides of the tab.

5. A device for making terminals for wires including:
- means for cutting an insulation piercing tab from a terminal blank and for sharpening the tab in a first direction;
- means for bending the tab into an upright position with respect to the blank, and
- means for sharpening the upright tab in a second direction.

6. The device according to claim **5** wherein the means for sharpening the upright tab in a second direction is a two-part squeezing member which squeezes the tab and the bending means between its two parts to sharpen the tab.

7. The device according to claim **5** wherein the insulation piercing tab has at least three sides and is attached to the terminal blank by one of its sides; wherein the cutting means sharpens the tab in a direction perpendicular to the side by which the tab is attached, and wherein the means for sharpening the tab in a second direction sharpens two unattached sides of the tab.

8. A mechanism for forming terminals from strips of terminal material in which the sides of the terminals have been severed one from the other and in which insulation piercing tabs have been previously cut including:
- a die member;
- forming means for cooperation with the die member to form the side walls of the terminal; and
- means on the forming member for sharpening the tabs of the terminals.

9. The mechanism according to claim **8** further including means for bending the tabs into a substantially right-angle with respect to the strip prior to the sharpening of the tab by the forming member.

10. The punch and die set according to claim **9** wherein the forming member is comprised of two parts and wherein the die member squeezes the two parts of the forming member together with the bending means and the tab between the parts to sharpen the tab.

11. An insulation piercing terminal forming mechanism including:
- an insulation piercing tab forming station comprising a punch and a cooperating die for cutting an insulation piercing tab from a body of terminal material and for sharpening the tab in a first direction, and
- an insulation piercing tab finishing station comprising a punch and a cooperating die for bending the tab with respect to the body of terminal material and for sharpening the tab in a second direction.

12. The mechanism according to claim **11** wherein the die of the insulation tab finishing station is comprised of two parts and further including means for squeezing the tab between the two parts of the die to sharpen the tab in the second direction.

13. The mechanism according to claim **11** wherein the tab finishing station further includes a second punch having the tab bending and forming die formed in it and a second die having the tab bending and forming punch mounted in it positioned for cooperation with the second

punch to form terminal sides from the body of terminal material.

14. The mechanism according to claim 11 wherein the punch and die of the tab forming station cuts a triangularly shaped tab from the body of terminal material that is attached to the body of material along one of its sides and sharpens the tab in a direction extending perpendicularly to the attached side and wherein the punch and die of the tab finishing station sharpens the tab in a direction extending parallel to the attached side.

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U.S. Cl. X.R.

29—630; 113—119