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Wright et al.

[11] **3,762,206**

[45] **Oct. 2, 1973**

[54] **APPARATUS FOR AND METHOD OF MANUFACTURING CORES FOR IGNITION COILS**

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[52] **U.S. Cl.** **72/382**, 72/384, 72/405, 29/25.42

[51] **Int. Cl.** **B21d 13/02**

[58] **Field of Search** 72/335, 337, 381, 72/382, 384, 385, 396, 397, 403, 404, 405; 29/25.42

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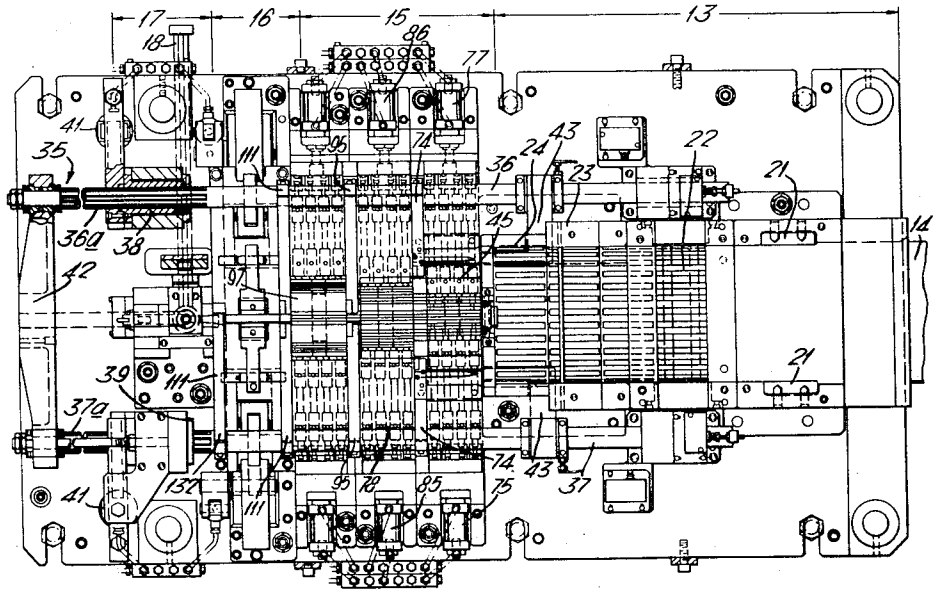
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Primary Examiner—Lowell A. Larson
Attorney—Holman & Stern

[57] **ABSTRACT**

Apparatus for manufacturing laminated cores for spark ignition system ignition coils including a corrugating station which receives sheet metal blanks. Each sheet metal blank has a plurality of parallel slits, which divide the blank into laminae interconnected at their ends. The corrugating station includes a plurality of tools which operate in sequence on the blank to corrugate the blank along the lines of the slits, and the apparatus is such that the undeformed portion of the blank is free to move relative to the tools and the tools sequentially form the corrugations in the blank.

25 Claims, 19 Drawing Figures



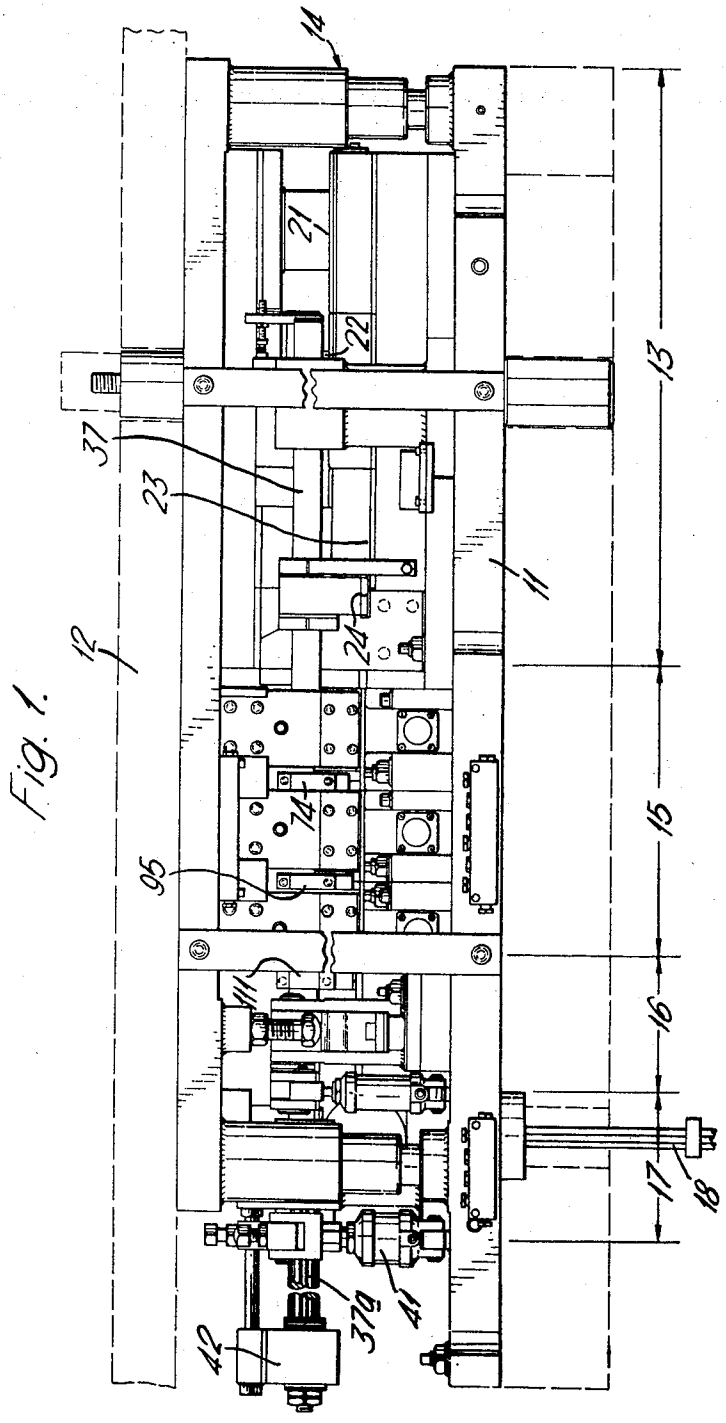


Fig. 1.

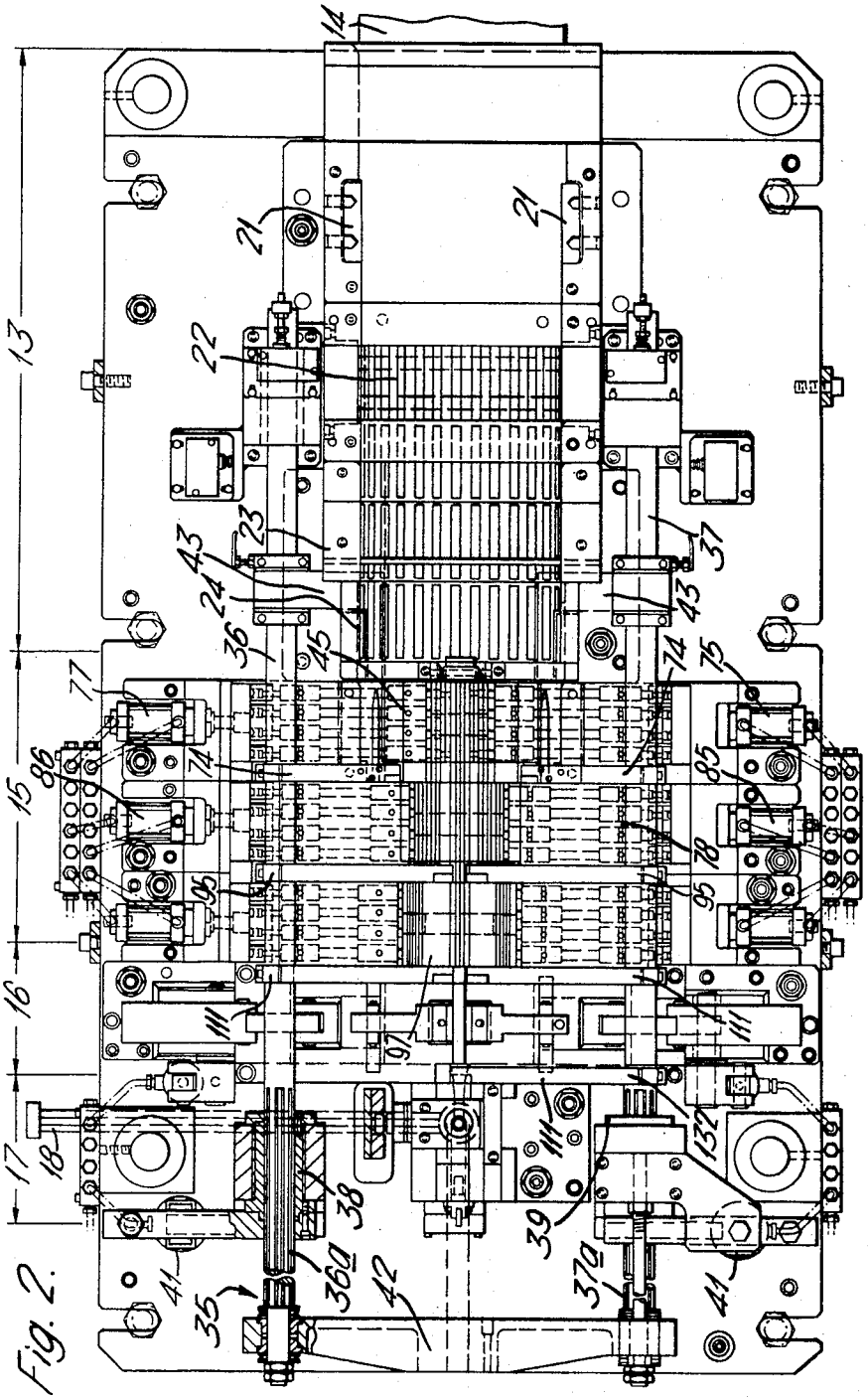

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Fig. 2.

Fig. 3.

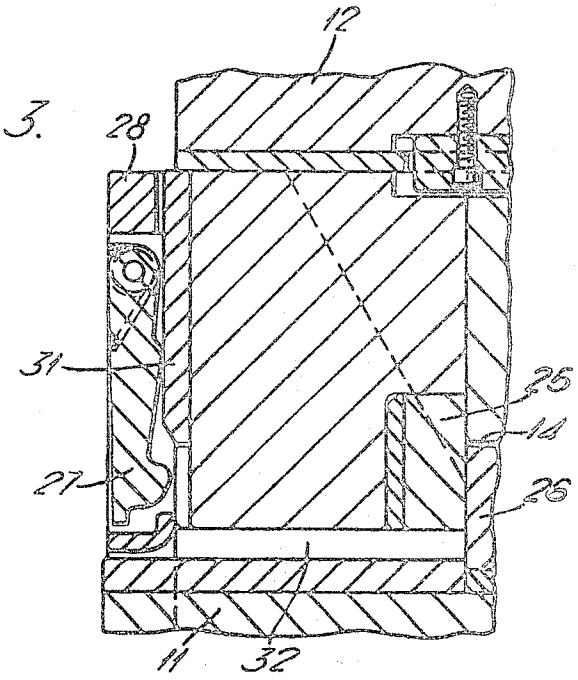


Fig. 4.

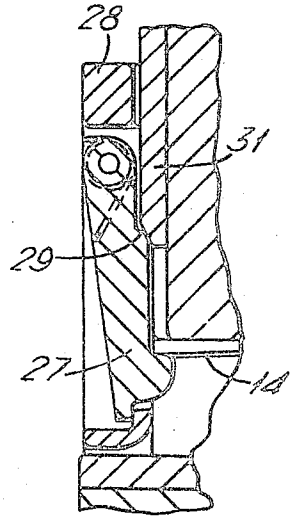


Fig. 5.

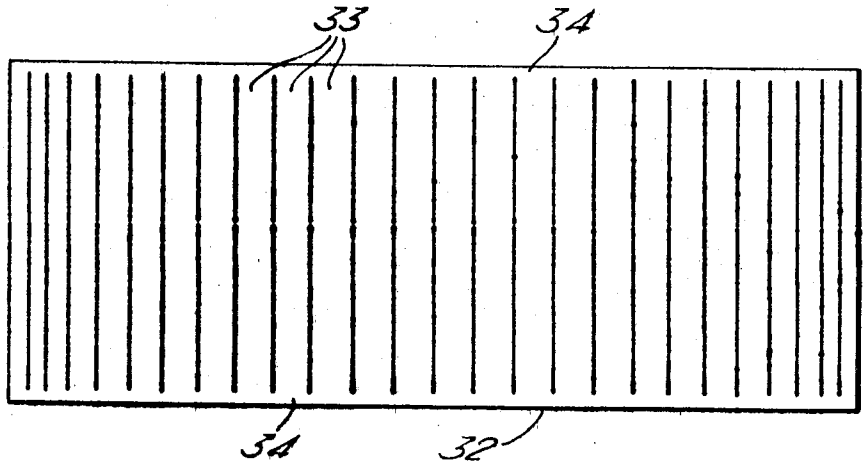


Fig. 15.



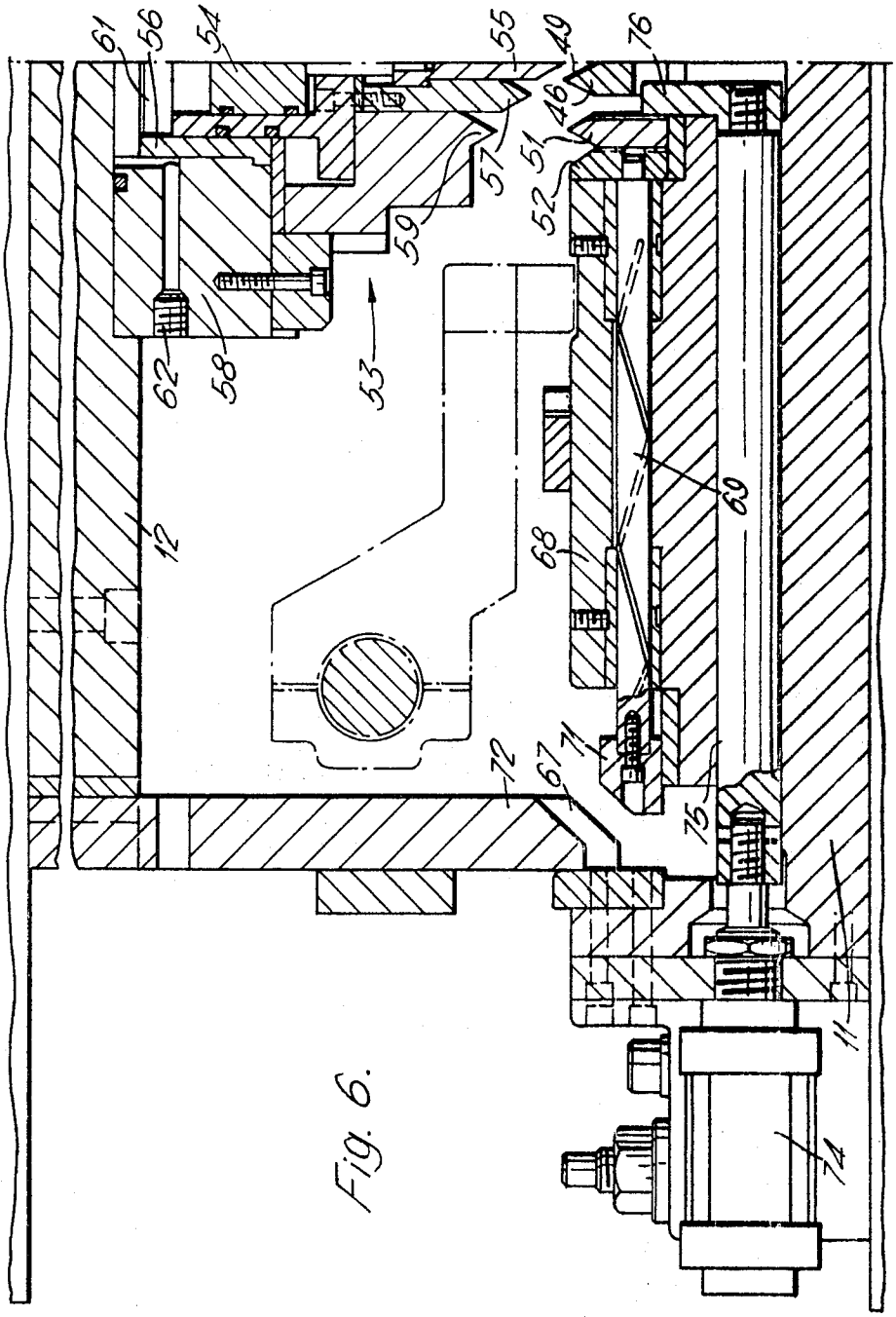


Fig. 6.

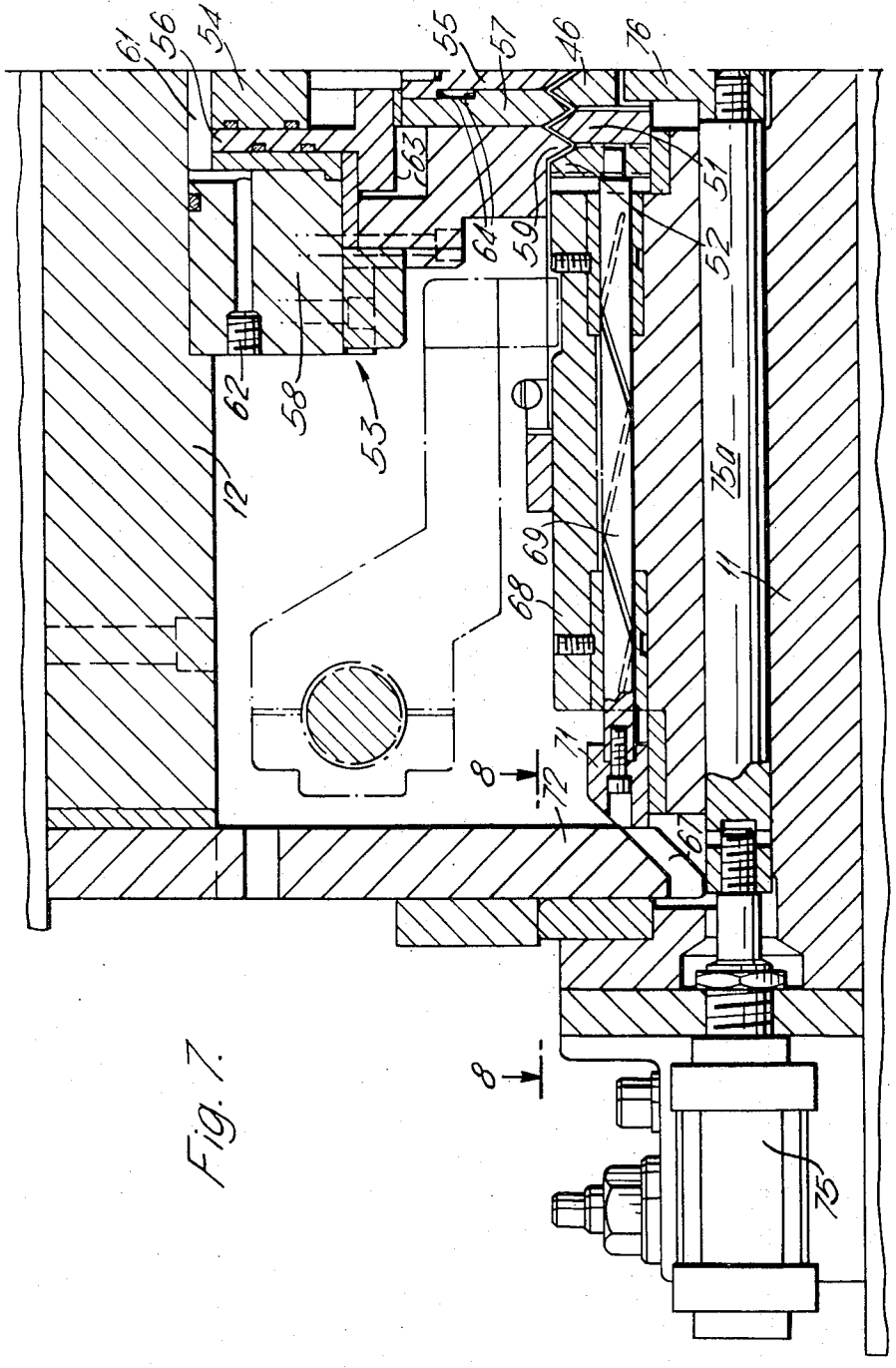

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Fig. 7.

Fig. 8.

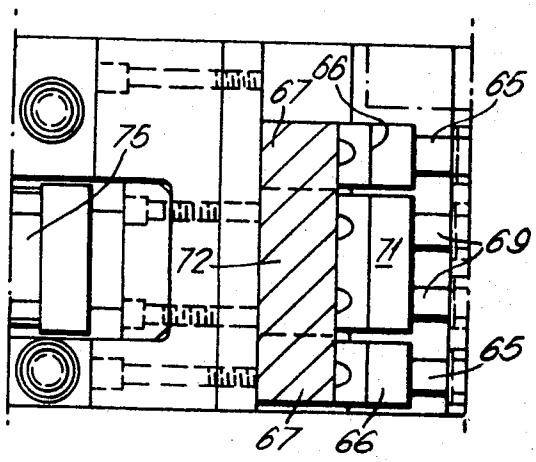


Fig. 9.

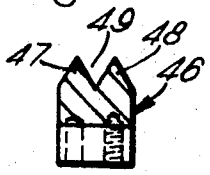
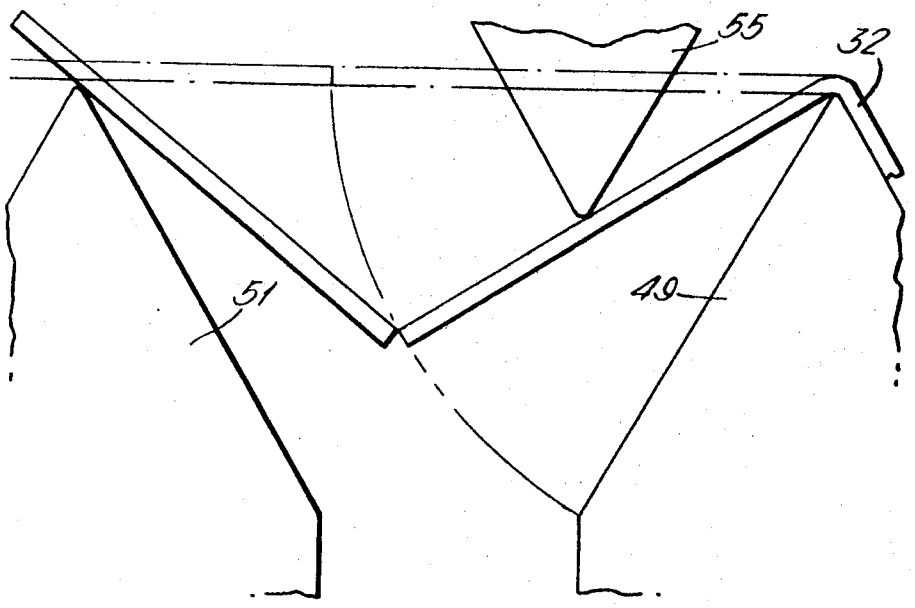


Fig. 10.



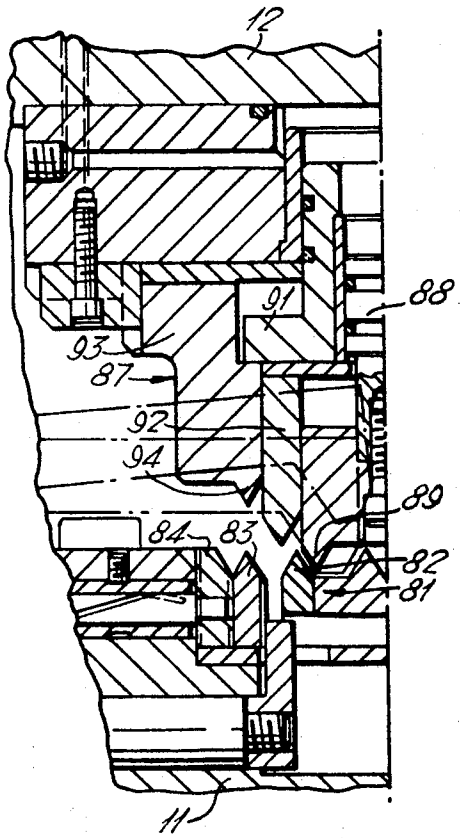


Fig. 11.

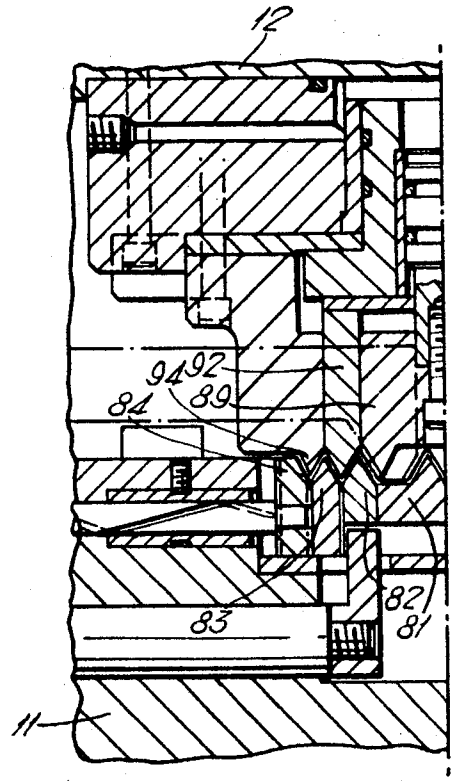


Fig. 12.

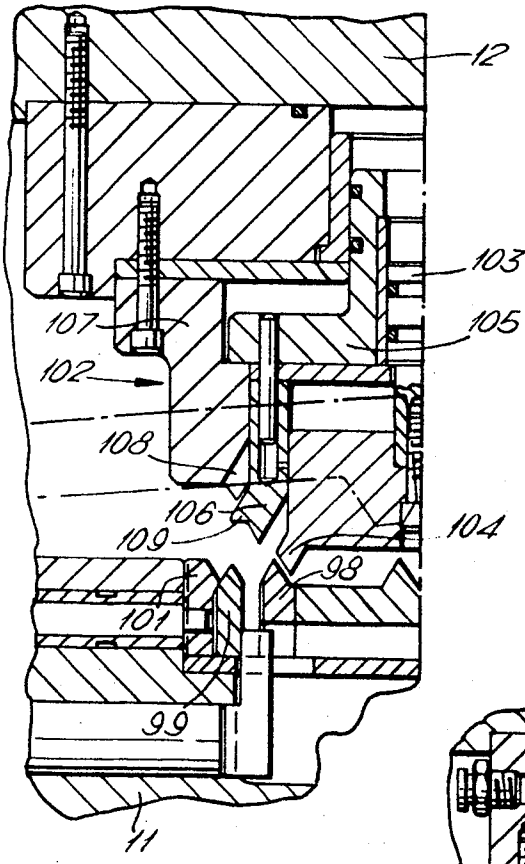

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Fig. 13.

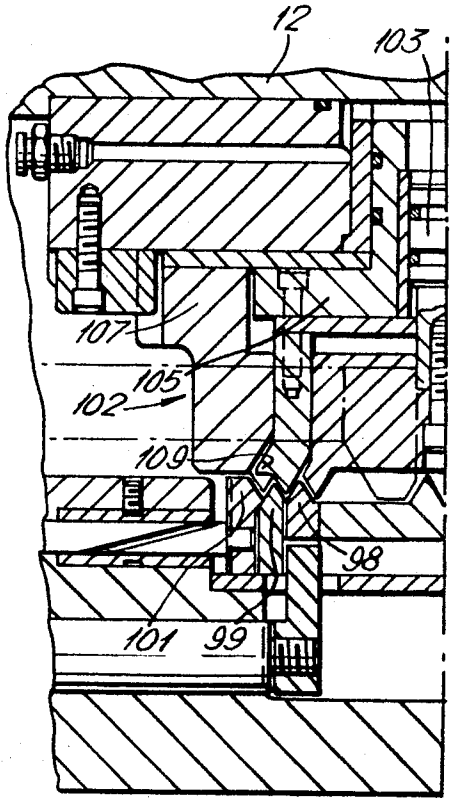

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Fig. 14.

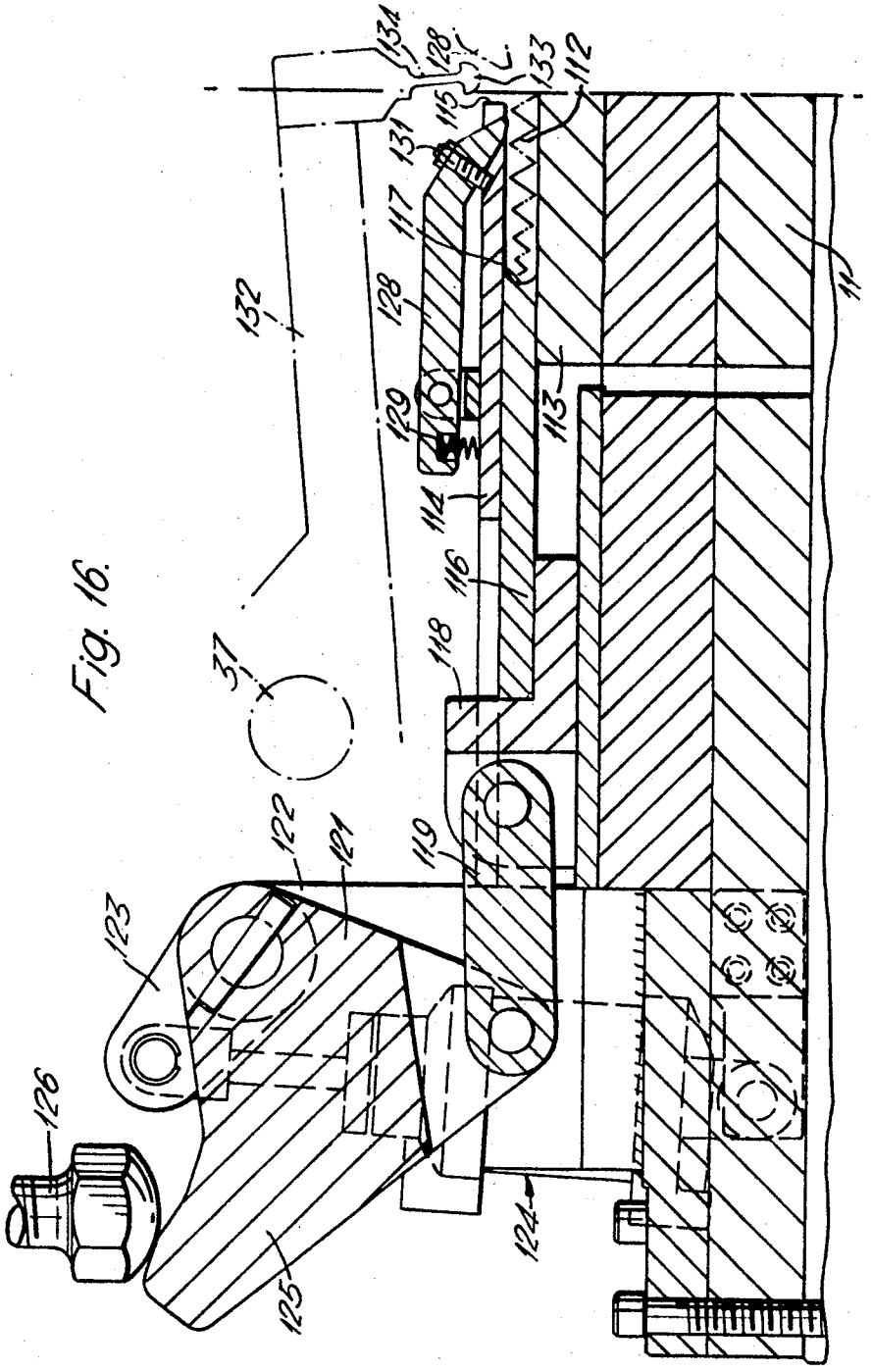

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Fig. 16.

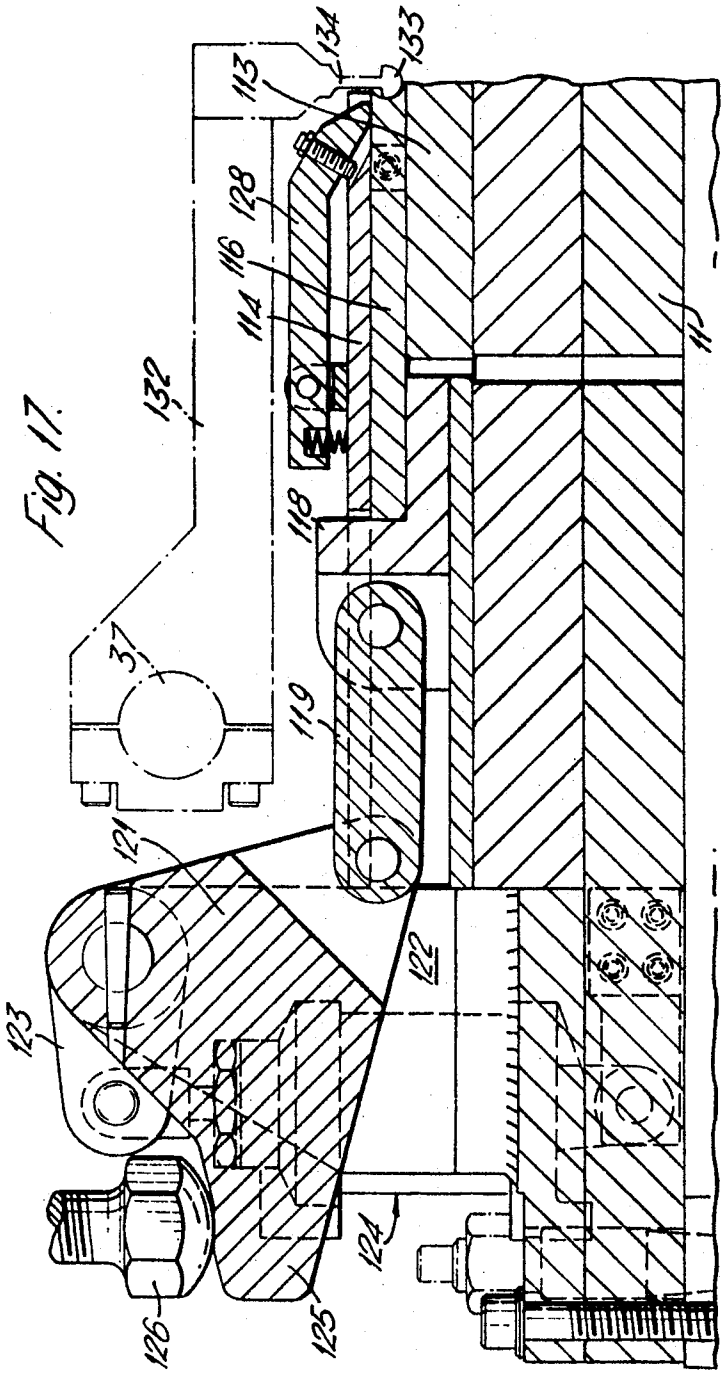

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Fig. 17.

Fig. 18.

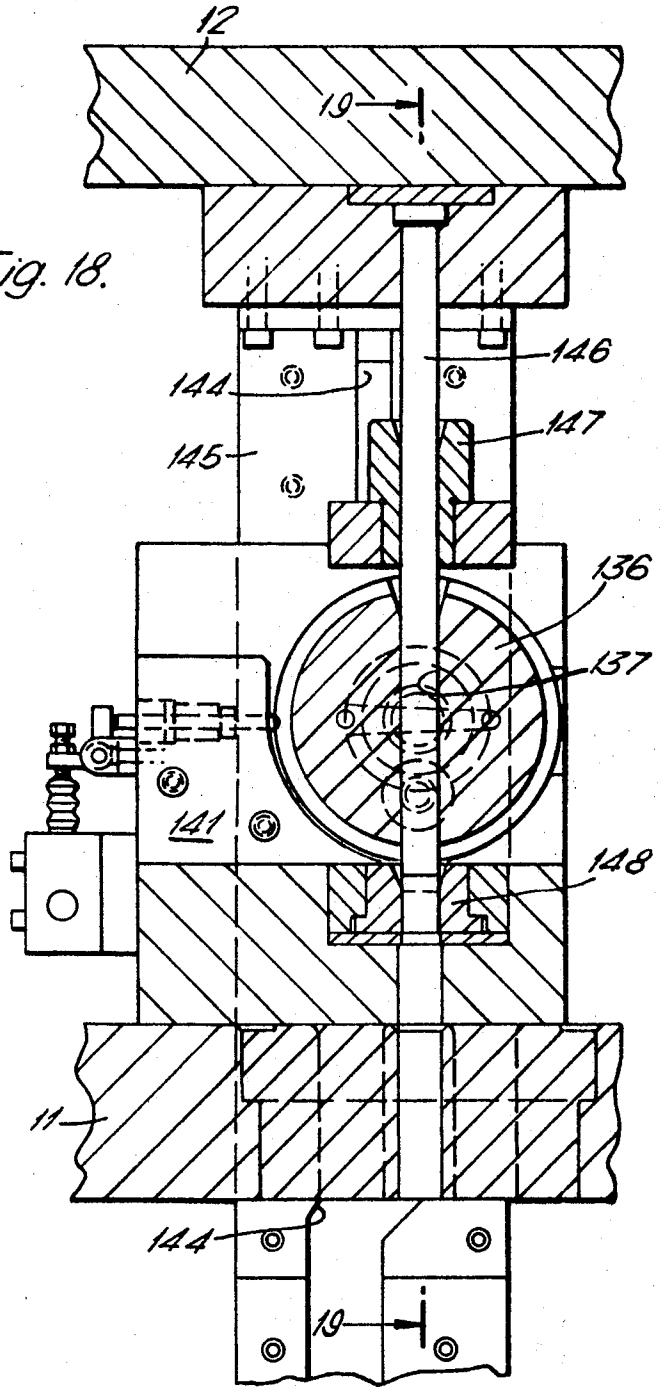
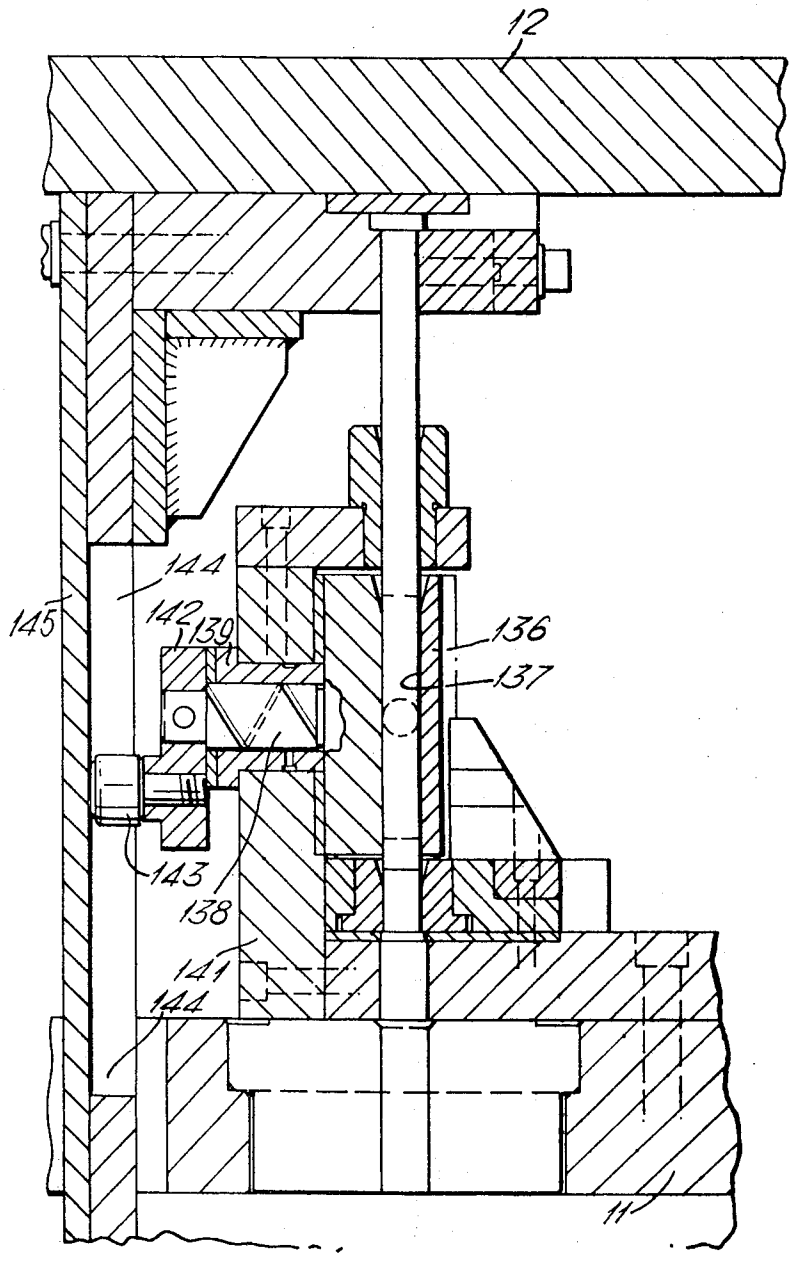


Fig. 19.



APPARATUS FOR AND METHOD OF MANUFACTURING CORES FOR IGNITION COILS

This invention relates to apparatus for and a method of, manufacturing laminated cores for spark ignition system ignition coils.

Apparatus according to the invention includes a corrugating station which receives sheet metal blanks each of which has a plurality of parallel slits dividing the blank into a plurality of laminae interconnedted at their ends, the corrugating station including a plurality of tools which operate sequentially to corrugate a blank along the lines of the slits, the undeformed portion of the blank being free to move relative to the tools as the tools sequentially form the corrugations.

Preferably said tools each include a punch and an anvil, the punches being movable towards and away from the anvils and being movable relative to one another and the anvils being movable relative to one another, the relative movement between the punches and the relative movement between the anvils effecting the sequential formation of the corrugations.

Conveniently the unches are carried by the movable platen of a press and move therewith, the punches being urged to predetermined positions relative to one another by resilient means and collapsing in turn relative to one another against the action of said resilient means during a single power stroke of the press, to provide a sequential action. Preferably the punch of the last tool is fixed relative to the movable platen.

Desirably said resilient means is constituted by compressed air.

Desirably the anvils are carried by the fixed platen of the press and are relatively movable in a direction at right angles to the direction of movement of the punches.

Conveniently the anvil which is utilized first in the sequence is fixed relative to the fixed platen and the remaining anvils are movable towards and away from the fixed anvil.

Preferably the movable anvils are moved towards the fixed anvil to their operative positions in response to movement of the movable platen towards the fixed platen, preferably by cams carried by the movable platen so that the movement of the anvils is timed to occur in relation to the movement of the punches.

Desirably the corrugating station includes at least two stages which operate simultaneously, each stage including a set of said tools and the tools of the first stage producing a first set of corrugations in a blank while the second stage produces a second set of corrugations in a blank previously operated on by the first stage, the apparatus including first transfer means for transferring blanks from the first stage to the second stage.

Preferably a centre corrugation of the blank is formed first and the tools operate sequentially, outwardly from the centre corrugation to produce the remaining corrugations, the ourter undeformed portions of the blank being free to move inwardly as the corrugations are formed.

Desirably the apparatus further includes a coining station operated by the movement of the movable platen of the press, the coining station receiving a corrugated blank from the corrugating station and compressing the corrugated blank laterally, at right angles to the corrugations, to form an unfinished laminated core, the apparatus including second transfer means for transferring corrugated blanks to the coining station.

Preferably the coining station includes a pair of plungers which are slidable towards and away from one another between a pair of fixed parts, and said transfer means delivers the corrugated blank between said fixed parts and between said plungers, said fixed parts resisting bowing of the corrugated blank out of the plane of movement of the plungers as the plunger move toward one another to compress the corrugated blank.

Conveniently the coining station includes stripping means which ensures that the unfinished core disengages from the plungers as the plungers move apart.

Desirably the apparatus further includes a sizing station, and third transfer means for transferring unfinished cores from the coining station to the sizing station where the unfinished cores are subject to a sizing operation.

Conveniently the sizing station includes a sizing die through which the unfinished cores are pushed. Preferably the force required to push the unfinished cores through the sizing die is derived from the movement of the movable platen of the press.

Desirably the sizing station includes indexing means operated by movement of the movable platen of the press for indexing unfinished cores through 90° from a position perpendicular to the direction of movement of the movable platen to a position in line with said direction of movement.

Desirably the apparatus still further includes a blank forming station from which blanks are supplied to the corrugating station.

Conveniently the blank forming station receives a continuous strip of metal said strip being fed to the blank forming station in a step wise manner such that for each complete stroke of the press a length of strip equal in length to the length of the core to be produced is fed into the station.

Desirably the blank forming station includes a slitting tool which for each stroke of the press produces the necessary slits in a length of strip which will constitute a single blank.

More desirably the blank forming station further includes a planishing tool which for ech stroke of the press planishes a previously slitted length of the strip.

Conveniently the blank forming station still further includes a guillotine which cuts previously slitted and planished lengths of strip to form blanks.

Preferably the blank forming station is provided with a cropping tool which crops the edges of the incoming strip prior to the slitting operation, to ensure the width of the strip and therefore the width of the blanks to be formed is the desired width and to ensure that the edges of the strip are correctly orientated relative to the slitting tool.

Advantageously the apparatus includes fourth transfer means for feeding blanks from the blank forming station to the corrugating station.

Desirably said first, second and third, and fourth transfer means are part of a movable carriage and operate simultaneously, said carriage being moved in conjunction with the movable platen of the press and being moved in a direction to feed components by an air spring which is compressed by the drive mechanism of the press to move the carriage in a return direction.

Desirably the core to be produced is cylindrical, the slits in the blank being spaced apart by descreasing

amounts on either side of the centre line of the blank so that the laminae defined between the slits decrease in width progressively from the central laminae towards the outermost laminae, the widths of the laminae decreasing in such a manner that when the corrugated blank is coined then the unfinished core is generally cylindrical, the sizing die through which the unfinished cores are passed rendering the cores more accurately cylindrical.

A method according to the invention includes the steps of supporting a sheet metal blank on a fixed anvil which comprises a pair of ribs of triangular cross section defining between them a V-shaped groove, the blank being supported with a slit therein aligned with the apex of the groove, moving a punch of triangular cross section towards the anvil so that the punch engages the blank along the line of said slit and deforms the blank into said groove to form a first corrugation, the uncorrugated portion of the blank being free to move inwardly as the corrugation is formed, moving a second punch of triangular cross section towards the blank along side the first punch and moving a second anvil of triangular cross section towards the first anvil, the second and first anvils when interengaged defining a second V-shaped groove parallel to said first V-shaped groove, the second punch bending the blank along the line of a second slit into said second V-shaped groove, as said second V-shaped groove is formed, to form a second corrugation in the blank, forming the required number of corrugations in the blank in similar manner, and compressing the corrugated blank transversely of the corrugations to collapse the blank so that the corrugations lie in facial contact.

Preferably as the second punch and second anvil are being moved to form the second corrugation, a third punch and a third anvil are moved to form a third corrugation on the opposite side of the first corrugation.

Preferably all of the corrugations with the exception of the first are produced in pairs, the corrugations of each pair being on opposite sides respectively of the central corrugation, and the corrugations being produced sequentially in a direction outwardly from the first corrugation.

One example of the invention is illustrated in the accompanying drawings wherein:

FIG. 1 is a front elevational view of a machine for forming cores for ignition coils,

FIG. 2 is a plan view of the machine shown in FIG. 1, with the upper part of the machine removed for clarity,

FIGS. 3 and 4 are sectional views illustrating two operative positions of a part of the machine shown in FIG. 1,

FIG. 5 is a plan view of a blank,

FIGS. 6 and 7 show respectively two operative positions of a first part of a corrugating stage of the machine shown in FIG. 1, FIGS. 6 and 7 showing only half of the stage, the remaining half being substantially a mirror image of the half shown,

FIG. 8 is a sectional view on the line 8—8 in FIG. 7,

FIG. 9 is a sectional view of a component of the corrugating stage shown in part in FIG. 7,

FIG. 10 is a diagrammatic representation, to an enlarged scale of the operation of part of the corrugating stage shown in FIG. 7,

FIGS. 11 and 12 respectively are views similar to FIGS. 6 and 7, but showing a second stage of the corrugating station of the machine,

FIGS. 13 and 14 respectively are views similar to FIGS. 6 and 7 but showing a third stage of the corrugating station of the machine,

FIG. 15 is a diagrammatic representation of the component produced by the corrugating station of the machine,

FIGS. 16 and 17 respectively are sectional views illustrating two operative positions of a coining station of the machine,

FIG. 18 is a sectional view of a sizing station of the machine, and

FIG. 19 is a sectional view on the line 19—19 in FIG. 18.

Referring to the drawings the machine includes a fixed platen 11 and a movable platen 12 movable towards and away from the fixed platen 11. A crank mechanism (not shown) of a form known in the press art is provided for moving the platen 12 towards and away from the platen 11. The machine includes several operating stations each of which derives its operating power from the movement of the platen 12. At one end of the machine is disposed a blank forming station 13 which receives a continuous strip 14 of mild steel both faces of which are coated with an insulating varnish. Blanks produced by the station 13 are transferred to a corrugating station 15, and blanks corrugated by the station 15 are transferred to a coining station 16. The coining station produces unfinished ignition coil cores, which are then transferred to a sizing station 17. The sizing station finishes the cores, and delivers them into a transfer chute 18 by means of which the finished cores leave the machine.

The blank forming station receives the mild steel strip 14, which is driven into the machine in a stepwise manner from a roll of strip stored at one end of the machine. The mechanism for feeding strip 14 into the machine is operated by the reciprocating movement of the platen 12, and for each complete stroke of the platen 12, that is to say a movement of the platen 12 from its fully raised position, through its fully lowered position and back to its fully raised position, a length of strip equal in length to the core which is to be produced is fed into the machine. The blank forming station includes a cropping tool having a pair of cutters 21 carried by the platen 12, which co-act with corresponding cutters (not shown) on the fixed platen 11. The cutters 21 are spaced apart by a distance equal to the desired width of a blank to be produced, and the length of each of the cutters 21 is equal to the length of the blank to be produced. Thus, the cutters 21 operate on the incoming strip 14 to ensure that the strip 14 is of the desired width, and also to ensure that the lateral edges of the incoming strip are in the desired orientation with respect to succeeding tools of the blank forming station. Assuming that the sequence starts with the platen 12 in its lowermost position, then as the platen 12 is raised a predetermined length of strip 14 is fed between the movable cutters 21 and the fixed cutters of the cropping tool. As the platen 12 reaches its uppermost position, and once again starts to descent towards the platen 11 feeding of the strip 14 ceases, and the predetermined length of strip 14 is cropped by the cutters 21. The platen 12 then starts to move away from the platen 11, and a further length of strip 14 is fed into the crop-

ping tool. As the further lengths of strip 14 is fed into the cropping tool the previously cropped length is fed between the fixed and movable parts of a slitting tool 22. The slitting tool includes a plurality of punches which are of rectangular cross-section, and the lengths of which are slightly less than the length of the core which is to be produced. As will be explained later, the core which is to be produced is cylindrical, and so the punches of the slitting tool are not all of the same width. The punches decrease in width from the longitudinal centre line of the tool, towards the lateral edges of the tool, the widest punches being adjacent the centre line of the tool. Moreover, the spacing between the punches decreases in a similar manner. The punches are carried by the movable platen 12 of the press, and the fixed platen carries a part having recesses aligned with the punches. As the movable platen descends towards the fixed platen the punches perform a shearing operation on the strip, and each punch produces a pair of longitudinally extending slits in the strip 14. As stated above, the punches are slightly shorter in length than the length of the portion of the strip which has been fed into the slitting tool, and so this portion of the strip has an unslitted region at both ends. By virtue of the sizing and spacing of the punches of the slitting tool the spacing between the slits formed in the strip decreases towards the lateral edges of the strip. The action of the slitting tool is essentially a shearing action, and so leaves the strip with alternate regions between the slits deformed downwardly out of the plane of the remainder of the strip. It will be appreciated that as the slitting tool is operating on one length of strip then the cropping tool will be operating on a following length of strip. As the platen 12 once again moves away from the fixed platen 11 the strip 14 is once again fed into the machine, and so the slitted length of the strip 14 is moved out of the slitting tool, and into a planishing tool 23. The planishing tool includes a pair of flat plates one of which is carried by the movable platen and the other of which is carried by the fixed platen. The width of the plates is greater than the width of the strip, and the length of the plates is substantially equal to the length of the core which is to be produced. As the platen 12 once again descends towards the platen 11 the planishing tool flattens the slitted strip to render the slitted strip substantially planar. It will be appreciated that as the slitted length of strip is being planished then further lengths of strip are simultaneously being slitted and cropped by the preceding tools. Subsequent raising of the platen 12 once again feeds a further length of strip into the machine, and thereby moves the planished length of strip to a guillotine 24. The guillotine 24 (FIG. 3) includes a movable blade 25 carried by the platen 12 and a fixed blade 26 carried by the platen 11. The strip 14 is fed beyond the edge of the fixed blade 26 by an amount equal to the length of the core to be produced, and the free end of the strip 14 remote from the tool 26 is supported by a latch 27. The latch 27 is pivotally mounted on an extension 28 of the fixed platen 11, and is spring urged to a position wherein it supports the free end of the strip 14 above the fixed platen. The movable part of the latch 27 is provided with a cam surface 29 engageable by a cam form 31 carried by the movable platen 12. Thus as the movable platen 12 descends, the tool 25 severs the projecting length of strip 14 from the remainder of the strip 14, and at the same time the cam form 31 releases the latch 27 from the strip 14 to permit the severed portion of the strip 14 to drop relative to the blade 26. The severed length of the strip 14 now constitutes a blank to be fed to the corrugating station 15.

The blank 32 (FIG. 5) is of length equal to the length of the core which it is desired to produce, and has a plurality of longitudinally extending slits therein which divide the blank 32 into a plurality of laminae 33 interconnected at each end by unslitted regions 34. The width of the laminae 33 are such that when the blank 32 is subsequently corrugated along the lines of the slits, and then compressed, then the resultant unfinished core will be of substantially cylindrical configuration.

The blank 32, cut form the strip 14, drops onto the fixed platen 11 of the machine, and is transferred by a transfer mechanism to the corrugating station, 15. An air blast ensures that the blank does not adhere to the guillotine blade.

The transfer mechanism which transfers the blank through the three stages of the corrugating station, and subsequently through the coining station consists of a carriage 35 which is reciprocable longitudinally of the fixed platen 11. The carriage consists of a pair of cylindrical rods 36, 37 which are guided for longitudinal sliding movement relative to the platen 11 in bearing carried by the platen 11. At their ends remote from the strip input the rods 36, 37 are provided with splined regions 36*a*, 37*a* passing through respective internally splined sleeves 38, 39. The internally splined sleeves are coupled to a linkage (not shown) whereby the sleeves, and therefore the rods 36, 37 can be caused to rotate through a predetermined angular distance. The sleeves are coupled to respective levers which in turn act on respective air springs 41, the air springs 41 urging the sleeves, and therefore therods 36, 37 to rotate back to their original angular positions. The rotational reciprocatory movement of the rods 36, 37 is controlled by a cam mechanism, which times the rotational reciprocatory movement of the rods in accordance with the position of the platen 12.

The ends 36*a*, 37*a* of the rods 36, 37 are interconnected by a bridge piece 42 within which the ends of the rods 36, 37 are rotatably mounted. The bridge piece 42 is connected by way of a cam operated linkage to the crank mechanism driving the platen 12, in such a manner that for a complete stroke of the platen 12, the carriage 35 goes through a complete reciprocating stroke in a direction longitudinally of the fixed platen 11. Thus as the movable platen 12 performs a single stroke, then the carriage 35 performs a single reciprocating stroke, longitudinally of the machinewhile the rods 36, 37 also perform a rotary reciprocating stroke, the rods 36, 37 being rotated in opposite angular directions.

The cam operated linkage coupling the bridge piece 42 to the crank mechanism of the press includes an air spring, which opposes movement of the linkage in a direction to move the carriage towards the blank forming station. The carriage is moved positively in this direction by a rotatable cam on the drive of the press thereby compressing the air spring. However the movement of the carriage in a feed direction is caused by restoration of the air spring so that in the event that the transfer mechanism becomes jammed, then restoration of the air spring is prevented by the jamming so that the crank mechanism of the press continues to operate,

without moving the transfer mechanism in a direction to feed components through the machine. An electrical counting arrangement is provided in the machine, which senses complete strokes of operation of the transfer mechanism. In the event that the transfer mechanism does not complete a full stroke then the counting system initiates means for switching off the machine. It will be appreciated that in the event of a component jamming within the machine, and preventing operation of the transfer mechanism, then the machine will switch itself off, thereby minimising the risk of damage to the machine.

The transfer mechanism further includes a pair of arms **43** which are located beneath the blank **32** when the blank **32** is severed from the strip **14.** The severed blank **32** falls onto, the arms **43,** and as the platen **12** starts to move away from the platen **11** after severing the blank from the strip, the carriage **35** is moved longitudinally of the machine in a direction towards the strip **14.** The arms **43** move with the carriage, and so slide under the severed blank **32.** The arms **43** clear the rear edge of the blank and permit the blank to fall fully onto the fixed platen with the arms **43** to the rear of the blank. The arms **43** are mounted on the rods **36, 37** in such a manner that the arms move axially but not angularly with the rods. Before the movable platen **12** reaches its limit of movement away from the fixed platen **11,** the carriage **35** is moved in a direction away from the blank forming station under the action of said air spring and so moves the blank into the corrugating station. The movement of the carriage **35** in a feed direction is completed during the initial downward movement of the platen **12** and so the arms **43** are positioned in readiness to receive a further blank guillotined from the strip **14.**

The corrugating station is formed in three longitudinally spaced stages for convenience, the operation of the three stages being substantially identical.

The first stage **45** of the corrugating station (FIGS. **6, 7** and **8**) includes three sequentially operable tools including punches and anvils. A first anvil **46** (FIG. **9**) is affixed to the platen **11,** the first anvil defining a pair of longitudinally extending ribs **47, 48** of triangular cross-section the ribs **47, 48** defining between them a longitudinally extending V-shaped groove **49.** The anvil **46** extends longitudinally of the machine, and the length of the anvil **46** is slightly in excess of the length of the blank **32,** that is to say slightly in excess of the length of the core which it is desired to produce. Positioned on opposite sides of the anvil **46** are a second anvil **51** and a third anvil (not shown) the second and third anvils each define a longitudinally extending rib of triangular cross-section, and the lengths of the second and third anvils are equal to the length of the anvil **46.** The second and third anvils are normally spaced outwardly from the first anvil, but are movable, as will be described later, to engage the first anvil. When engaged with the first anvil, the second and third anvils define respective V-shaped grooves on opposite sides of the V-shaped groove **49.** On opposite sides of the second and third anvils respectively are a fourth anvil **52** and a fifth anvil (not shown). The fourth and fifth anvils are equal in length to the first, second and third anvils, and the fourth and fifth anvils are also movable towards and away from the first anvil. The fourth and fifth anvils do not define triangular ribs, the fourth and fifth anvils having a flat upper surface, and chamfered surface which is presented to the second and third anvils respectively. Thus when the fourth and fifth anvils engage the second and third anvils respectively, then the chamfered surfaces of the fourth and fifth anvils define with the second and third anvils respective V-shaped grooves between the second and fourth anvils and the third and fifth anvils respectively. The first stage **45** further includes a punch assembly **53** carried by the movable platen **12.** The punch assembly is in three sections, a first section **54** carrying a first punch **55,** a second section **56** carrying a second punch **57** and a third punch (not shown) the second and third punches being disposed on opposite sides respectively of the first punch, and a third section **58** carrying a fourth punch **59** and a fifth punch (not shown), the fourth and fifth punches being disposed on opposite respectively of the assembly defined by the first, second and third punches.

The third section **58** is fixedly secured to the platen **12,** and defines a cylinder within which the second section **56** is movable, the second section **56** constituting a piston, and sealing rings being disposed in grooves of the outer surface of the section **56,** and engaging the inner surface of the section **58.** The section **56** also defines a cylinder, within which is movable the section **54.** The section **54** also constitutes a piston, and is provided with sealing rings. Compressed airis admitted to a chamber **61** by way of an inlet passage **62** in the section **58.** The ends of the sections **54** and **56** form one wall of the chamber **61,** and so the sections **54, 56** are urged to move downwardly relative to the platen **12** and the section **58.** Abutment surfaces **63** are provided on the sections **56** and **58** to limit the downward movement of the section **56** relative to the section **58,** and similar abutment surfaces **64** are provided on the sections **56** and **54** to limit the downward movement of the section **54** relative to the section **56.** Thus when the platen **12** is in a raised position then the first punch **55** projects below the second and third punches, and the second and third punches in turn project below the fourth and fifth punches. It will be appreciated that the first punch can collapse relative to the second and third punches, and moreover the first, second and third punches can collapse relative to the fourth and fifth punches, the collapse of the punches taking place in a direction towards the platen **12,** and taking place against the resilient action of the compressed air.

Each of the five punches defines a longitudinally extending triangular rib the length of which is slightly greater than the length of the blank **32,** and the apices of the ribs being presented towards the anvils of the first stage. The apex of the punch **55** is accurately aligned with the apex of the groove **49** in the first anvil **46,** and similarly the apices of the second, third fourth and fifth punches are accurately aligned with the apices of the V-shaped grooves defined by the first, second, third, fourth and fifth anvils, when the anvils are moved into contact with one another.

The blank **32** is delivered to the first stage of the station **15** by the arms **43,** and is guided in its movement intothe first stage so that the blank **32** is positioned accurately between the anvils and the punches. The blank **32** has 25 longitudinally extending slits therein, and the centre first slit is accurately aligned with the apex of the punch **55,** and the apex of the groove **49,** that is to say the apex of the groove **49,** the centre slit of the blank **32,** and the apex of the punch **55,** all lie in a common

plane extending longitudinally of the blank 32, and parallel to the direction of movement of the platen 12. As stated above, the blank 32 is positioned in the first stage as the platen 12 reaches its uppermost position. As the platen 12 starts to descend, the punch 55 is closer to the blank 32 than the remaining punches, and the second, third, fourth and fifth anvils are retracted from the first anvil. The punch 55 engages the blank 32, accurately along the line of the centre slit in the blank, and bends the blank into the groove 49 in the first anvil 46. As the punch 55 pushes the central region of the blank into the groove 49, the blank bends along the line of the central slit therein, and the portions of the blank 32 on opposite sides of the anvil 46 are drawn inwardly. When the central region of the blank 32 is bent completely into the groove 49, the punch 55 is of course arrested. However, the platen 12 at this stage has not reached its lowest position, and so continues to move towards the platen 11. Thus the punch 55 begins to collapse into the punch assembly, against the resilient action of the compressed air in the chamber 61. The dimensions of the anvil 46 and the punch 55 are such that when the central region of the blank 32 has been fully moved into the groove 49, then the slits adjacent to the central slit of the blanks, and on opposite sides thereof, are aligned with the apices of the ribs 47, 48 of the anvil 46.

As the punch 55 begins to collapse into the punch assembly, the second and third punches engage the blank outwardly from the second and third slits,and so commence to bend the blank about the lines of the second and third slits. At this stage, the V-shaped grooves on opposite sides of the groove 49 have not yet been formed, since the second and third anvils are still spaced from the first anvil, on opposite sides thereof. The second and third anvils now commence to move towards the first anvil in the following manner. The second anvil is mounted at one end of a pair of push rods 65 which at their opposite ends carry cam followers 66 engageable by cams 67 carried by the movable platen 12. The rods 65 are mounted for sliding movement in an anvil supporting body 68 fixed to the platen 11, and the cams 67 and cam followers 66 are so arranged that as the second and third punches commence to bend the blank, then the second and third anvils are moved towards the first anvil. The arrangement is such that during this movement both the second and third punches, and the second and third anvils perform a bending action on the regions of the blank between the first and second anvils, and the first and third anvils respectively. The cams 67 and cam followers 66 are so arranged that the second and third anvils engage the first anvil as the second and third punches complete their travel. Thus, the blank is simultaneously bent along the lines of the second and third slits and the fourth and fifth slits. As the bending takes place, the regions of the blank on opposite sides of the region which is being bent are drawn inwardly. The third anvil is moved by cams, cam followers, and a push rod simultaneously and in the same manner as the second anvil.

When the regions of the blank have been bent completely into the grooves defined by the first and second, and first and third anvils, then the second and third punches cannot move any further towards the platen 11. However, the platen 12 has still not reached its lower most position, and continues to move towards the platen 11. Thus the fourth and fifth punches are brought into engagement with the blank, and commence to bend the blank along thelines of the sixth and seventh slits, the sixth and seventh slits being at this time aligned with the apices of the triangular ribs of the second and third anvils. As the fourth and fifth punches commence to bend the blank the fourth and fifth anvils commence to move towards the second and third anvils respectively. The fourth anvil is also mounted at the end of a pair of push rods 69 slidably mounted in the body 68, the opposite ends of the push rods 69 being connected to a cam follower 71 engageable by a cam form 72 carried by the platen 12. It will be appreciated, that the third and fifth anvils are moved in a manner identical to that described with reference to the second and fourth anvils, and simultaneously therewith, the machine including push rods, cam followers and cam forms associated with the third and fifth anvils, and identical in form and operation to that described with reference to the second and fourth anvils. Thus the blank is bent about the sixth and seventh, and eighth and ninth slits simultaneously as the fourth and fifth anvils move towards the second and third anvils, and the fourth and fifth punches move towards the anvils. As stated above, the fourth and fifth anvils do not define triangular ribs, but have flat top surfaces. Similarly, the fourth and fifth punches have flat surface positioned outwardly from their respective triangular ribs. Thus as the fourth and fifth punches complete their movement then the blank is also bent about the tenth and eleventh slits, the blank being bent about the tenth and eleventh slits to a position wherein the outer, uncorrugated regions of the blank are co-planar. The fourth and fifth punches are arrested when the platen 12 achieves its lower most position. Thereafter, the platen 12 starts to move away from the platen 11, thereby lifting the punch assembly 53 away from the anvil assembly. Since the first, second and third punches are urged downwardly by compressed air, as described above, when as the punch assembly 53 retracts from the anvil assembly the fourth and fifth punches will disengage from the blank prior to the second and third punches, and similarly the second and third punches will be disengaged from the blank prior to disengagement of the first punch. The cam forms 67 and 72 disengage from their respective cam followers 66, 71 in a similar manner, but disengagement of the cam forms from the cam followers does not retract the anvils. Thus although the punches disengage from the blank, and return to their original positions relative to one another, the anvils at this stage remain in a closed configuration. Clearly, since the partially corrugated blank is engaged with the anvils, and follows the grooves defined by the anvils, then retracting the anvils to their open configuration would damage the corrugated portion of the blank.

The transfer mechanism is provided with a further pair of transfer arms 74 clamped to the rods 36, 37 respectively. The arms 74 move longitudinally in a manner identical to the arms 43 but also move angularly with the rods 36, 37. The arms 74 are positioned in front of the blank 32 when the blank 32 has been initially moved into the first stage of the corrugating station. As the platen 12 reaches the limit of its movement towards the platen 11, to corrugate the blank the arms 74 start to lift as the rods 36, 37 are rotated. The arms, in a lifted positon, then move towards the blank forming station and before the platen 12 reaches its upward limit the arms are lowered to engage behind the partly

corrugated blank. The arms **74** then are moved in the opposite direction and transfer the partly corrugated blank to the second stage of the corrugating station, while the arms **43** move a further blank into the first stage. Co-extensive with the first anvil, and extending throughout the length of the corrugating station, through all three stages, is a guide rail, the upper surface of which conforms to the shape of the first anvil. As a partly corrugated blank is pushed from the first stage into the second stage, the blank is maintained in the desired orientation relative to the remainder of the machine by the guide rail.

When a partly corrugated blank has been moved out of engagement with the anvils of the first stage, then the anvils can be returned to their original positions in readiness for a further cycle of operation. The second and fourth anvils are returned to their original positions by means of a pneumatically operated ram **75** the piston of which is coupled to a push rod **75***a* mounted for sliding movement in a passage in the anvil support member **68.** At its end remote from the ram **75** the push rod **75***a* carries a finger **76** engageable with the second anvil. Operation of the ram withdraws the piston thereof, thereby pulling the rod **75***a* and consequently the second and fourth anvils towards the ram, thereby returning the second and fourth anvils and their associated cam followers to their original positions in readiness for the further cycle of operation. The third and fifth anvils are returned to their original positions in an identical manner by a second ram **77.** The rams **75, 77** are operated simultaneously, so that both the second and fourth, and the third and fifth anvils are returned at the same time. The operation of the rams **75, 77** is timed by a cam control mechanism which ensures that the anvils are not returned to their original positions until the transfer arms **74** have moved the blank out of engagement with the anvils. After the anvils have been retracted the cam control mechanism causes operation of the rams **75, 77** in the opposite direction, to return the finger **76,** and the finger associated with the ram **77** to their original positions.

The second stage **78** of the corrugating station is extremely similar to the first stage described above. The anvil assembly includes a first anvil **81** which is fixed relative to the platen **11,** and which defines a pair of triangular ribs one of which is shown at **82.** The two triangular ribs are spaced on opposite sides of the longitudinal centre line of the corrugating station, and between the two ribs the first anvil is provided with a pair of triangular ribs which constitute extensions of the first anvil of the first station, and which locate the partly corrugated blanks in the correct position in the second stage. Positioned on one side of the anvil **81** are second and fourth anvils **83, 84** similar to the second and fourth anvils of the first station, although of smaller dimension. The second and fourth anvils **82, 84** are movable towards the anvil **81** through the intermediary of push rods, cam followers, and cam forms exactly in the manner described in the first stage. On the opposite side of the anvil **81** are disposed third and fifth anvils, also movable in the manner described with reference to the first stage. A pair of rams **85, 86** (FIG. 2) are operable simultaneously with the rams **75, 77** to return the anvils to their original positions. The punch assembly **87** of the second stage is similar to the punch assembly **53** of the first stage, and includes a first section **88** carrying a first punch **89** and a second punch (not shown), a second section **91** carrying a third punch **92** and fourth punch (not shown) and a third section **93** fixed to the movable platen **12** and carrying a fifth punch **94** and a sixth punch (not shown). The first and second punches are spaced apart on opposite sides of the longitudinal centre line of the corrugating station, and are collapsible into the third and fourth punches against the resilience of compressed air as described with reference to the first stage. The third and fourth punches are spaced on opposite sides of the first and second punches, and are collapsible relative to the fifth and sixth punches also against the resilience of compressed air.

When the partially corrugated blank is engaged in the second station, then the centre corrugations are engaged on the ribs of the first anvil which constitute extensions of the first anvil, thereby locating the blank in the correct position. In this position, the tenth and eleventh slits of the blank, which it will be recalled where the last slits along which any bending took place in the first stage, should be aligned with the apices of the ribs of the first anvil. The first and second punches of the second station are arranged to engage the laminae defined between the eighth and tenth slits, and between the ninth and eleventh slits respectively, to ensure that the tenth and eleventh slits do coincide with the apices of the ribs of the first anvil. Thus the first and second punches do not necessarily perform any bending action on the blank, assuming that the blank has not stretched or contracted during its transfer from the first station. However, it is desirable to ensure that the tenth and eleventh slits do in fact coincide with the apices of the ribs of the first anvil in order to minimise the effects of tolerance build-up across the width of the blank.

The operation of the second stage of the corrugating station after the first and second punches have ceased to move is identical with that described in relation to the first stage, and after the blank has been bent along the lines of the tenth twelfth, fourteenth, sixteenth, and eighteenth slits by the third and fifth punches and the second and fourth anvils, and along the lines of the eleventh, thirteenth, fifteenth, seventeenth, and ninteenth slits by the fourth and sixth punches, and the third an fifth anvils, the movable platen **12** once again starts to move away from the platen **11.** A further pair of transfer arms **95** clamped to the rods **36, 37** operate simultaneously with the transfer arms **74,** to move the partly corrugated blank from the second corrugating stage, into the third corrugating stage, while the arms **74** transfer a blank partly corrugated in the first stage, to the second stage, and while the arms **43** transfer an uncorrugated blank to the first stage.

The third stage **97** of the corrugating station **15** is similar in its operation to the previous two stages, and includes an anvil assembly having a first anvil fixed relative to the platen **11** and defining a first triangular rib **98** and a second traingular rib (not shown). The two ribs of the first anvil are spaced on opposite sides of the longitudinal centre line of the corrugating station, and the first anvil also defines a centrally disposed pair of triangular ribs which constitute guide rail extensions of the triangular ribs of the first anvil of the first stage. Second and fourth anvils are positioned on one side of the first anvil, adjacent the rib **98,** and are movable towards and away from the rib **98** of the first anvil in a manner identical with that described with reference to the first stage of the corrugating station. Similarly, third

and fifth anvils are positioned adjacent the second triangular rib of the first anvil, and are moved relative to the first anvil in a manner identical to that described with reference to the first stage. Since the third stage is to operate on regions of the blank adjacent the lateral edges of the blank, where the slits are closely spaced, then the dimensions of the anvils of the third stage are smaller than the anvils of the two preceding stages. The punch assembly **102** of the third stage is similar in construction to the punch assemblies of the two preceding stages, and includes three relatively movable sections one of which is fixed relative to the movable platen **12**, and the other two of which are collapsible relative to one another and to the third section against the action of compressedair. The first section **103** carries a first punch **104**, and a second punch (not shown) the first and second punches being spaced on opposite sides of the longitudinal centre line of thestation. The second section **105** carries a third punch **106** and a fourth punch (not shown) and similarly, the fixed section **107** carries a fifth punch **108** and a sixth punch (not shown). The first and second sections are urged to move relative to one another and to the third section, in a direction towards the anvil assembly by compressed air, and the punch assembly **102** operates in a manner similar to that described with reference to the first and second stages of the corrugating station. The punches of the assembly **102** are similar in nature to the punches of the previous stages, in that they each define a longitudinally extending rib of triangular cross section, the length of each rib being slightly greater than the length of the blank. The dimensions of the punches and anvils of the third stage are smaller than the dimensions of the punches and anvils of the preceding stages, since the spacing of the slits of the blank, along which the blank is to be bent by the third stage is smaller than the spacing of the slits closer towards the centre of the blank. The third and fourth punches are each provided with an outwardly extending projection one of which is shown at **109**. The projections **109** are disposed approximately half way along the length of their respectively punches, and serve, as the third and fourth punches operate, to bend the blank along the lines of the twenty-second and twenty-third slits respectively. This bending of the blank along the lines of the twenty-second and twenty-third slits respectively ensures that the fifth and sixth punches engage the blank as the fifth and sixth punches operate. It will be appreciated, that in view of the small dimensions of the laminations towards the edges of the blank then when the blank has been bent about the twentieth and twenty-first slits, then the remaining portions of theblank outwardly from the twentieth and twenty-first slits will be projecting upwardly, generally towards the punches, rather than laterally, at right angles to the direction of movement of the punches. Thus the portions **109** of the third and fourth punches ensure that the desired region of the remainder of the blank can be engaged by the fifth and sixth punches. The projections **109** are short in length, and the fifth and sixth punches are formed with slots in which the projections **109** are received when the second stage **105** collapses into the third stage **107**. The fifth and sixth punches, together with the second, third, fourth and fifth anvils bend the blank about the lines of the twenty-second, twenty-third, twenty-fourth and twenty-fifth slits, to complete the corrugation of the blank.

As the platen **12** is once again moved upwardly, after the blank has been completely corrugated a still further pair of transfer arms **111** also clamped to the rods **36, 37** respectively transfer the completely corrugated blank to the coining station **16**. It will be appreciated that as the completely corrugated blank is transferred to the coining station, the strip **14** is being fed into the blank forming station, a first length of the strip is being positioned in readiness to be cropped, a further cropped length of strip is being positioned in readiness to be slit, a slit length of strip is being positioned in readiness to be planished, a planished length of strip is being positioned ready to be guillotined, a guillotined blank is being transferred into the first stage of the corrugating station, a partly corrrugated blank is being transferred into the second stage of the corrugating station, and a further partly corrugated blank is being transferred into the third stage of the corrugating station.

The coining station receives a completely corrugated blank **112**, and includes a flat base **113** and a flat cover plate **114** both of which are fixed relative to the platen **11**, and which are spaced apart by a distance slightly in excess of the thickness of the completely corrugated blank **112**, that is to say a distance slightly in excess of the height of the centre, largest corrugation of the blank. The base **113** is continuous across the width of the blank **112**, but the cover plate **114** is formed with a centrally disposed, longitudinally extending slot **115**. Slidable between the base **113** and the cover plate **114** are a first jaw member **116** and a second jaw member (not shown). The first and second jaw members are movable simultaneously, towards one another, and are formed at their inner most ends with convex, partly cylindrical surfaces one of which is shown at **117**. The width of each jaw member (measured in a direction parallel to the longitudinal axis of the machine) is slightly greater than the length of the blank **112**, that is to say slightly greater than the length of the core which it is desired to produce. Each jaw member is connected at its outer most end to a saddle **118** which is slidable laterally of the machine, and which is pivotally connected to one end of a link **119**. The other end of the link **119** is pivotally connected to a bell crank member **121** whicn in turn is pivotally mounted on a part **122** fixed in relation to the platen **11**. The bell crank member **121** has a lever arm **123** coupled thereto, in such a manner that the lever arm **123** pivots with the bell crank member **121** relative to the part **122**. The lever arm **123** is pivotally coupled with its end remote from the bell crank member **121** to the ram of an air spring **124**, the cylinder of the air spring **124** being pivotally mounted on the platen **11**. The bell crank member **121** includes a portion **125** which lies in the path of movement of an abutment **126** carried by the movable platen **12**. The air spring **124** urges the bell crank member **121** to pivot in a direction to move the projection **125** towards the movable platen **12**, and in so doing urges its respective jaw member to move transversely away from the centre line of the machine. As the movable platen **12** descends towards the fixed platen **11** the abutment **126** and the corresponding abutment on the opposite side of the machine engage their respective bell crank members, and pivot their respective bell crank members against the action of their respective air springs, thereby moving the respective jaw members towards one another. The stroke of the

jaw members is such that the jaw members do not engage one another and terminate their movement towards one another, adjacent, and on opposite sides respectively of the longitudinal centre line of the machine. When the jaw members are fully retracted, the spacing between thetwo jaw members is sufficient to permit the transfer arms **111** to move a blank **112** between the jaw members, the blank **112** being received between the cover plate **114** and the base **113.** Thus as the platen **12** descends the jaw members are moved towards one another, and the blank **112** is compressed laterally to collapse the corrugations of the blank **112** relative to one another until the individual laminations are substantially in facial contact. The cover **114** and the base **113** prevent the blank bowing as the jaw members compress the blank. By virtue of the spacing of the slits, which controls the width of the laminations, the collapsed blank, which defines an unfinished core, isof generally cylindrical cross section. A pair of strippers **128** are pivotally mounted on the cover plate **114** on opposite sides of the slot **115** respectively. Each stripper is pivotable relative to the cover plate **114,** and is urged by a respective spring **129** in such a direction that one end of each of the strippers projects downwardly through a transversely extending slot in the cover plate **114,** and into the space defined between the cover plate **114** and the base **113.** The amount by which the ends of the strippers **128** project into this space is controlled by respective adjustable stops **131.** As the jaw members of the coining station compress the blank **112** the jaw members engage the strippers **128,** and pivot the stripper against the action of their respective springs. However, as the jaw members retract then the strippers are returned to their original positions by their respective springs, and prevent the unfinished core being drawn with either jaw member, as the jaw members retract. It will be appreciated that in the absence of the strippers **128,** it will be possible, in the event that the unfinished core adheres to one or both jaw members, for the unfinished core to be moved with one or other jaw member, away from the longitudinal centre line of the machine, or to be expanded again, in the event that the unfinished core adheres to both jaw members.

The rod **37** of the transfer carriage **35** has clamped thereto and carries a transfer arm **132** which does not have a counterpart carried by the rod **36.** The arm **132** of course moves in synchronism with the previously mentioned transfer arms. The end of the arm **132** remote from the rod **37** is shaped to define a head **133** spaced from the remainder of the arm **132** by a narrow neck **134.** The thickness of the neck **134** is slightly less than the width of the slot **115** in the cover plate **114,** but the width of the head **133** is greater than the width of the slot **115.** Thus as a corrugated blank is coined the arm **132** is at the end of the coining station remote from the corrugating station and is lifted by rotation of the rod **37.** As the platen **12** lifts the arm **132** is moved to the entrance of the coining station and is lowered. The arm **132** is then moved longitudinally from the corrugating station and as the arm **132** is moved longitudinally, with the arm in the lowered position, the head **133** passes between the cover plate **114** and the base **113,** and the neck **134** passes along the slot **115.** The head **133** engages the unfinished core, and transfers the unfinished core from the coining station to the sizing station **17.**

The sizing station **17** includes an indexing disc **136** which is rotatable through 90°, and which is formed with a diametrically extending bore **137** the diameter of which is substantially equal to the diameter of an unfinished core. One end of the bore **137** is relieved to permit easy insertion of an unfinished core. As an unfinished core is being transferred from the coining station to the sizing station, the disc **136** is in a position rotated through 90° in a clockwise direction from the position shown in FIG. **17,** and the arm **132** transfers the unfinished core into the bore **137.** The disc **136** is mounted for rotational movement by a shaft **138** running in a bearing **139** carried by a bracket **141** fixed relative to the platen **11.** The end of the shaft **138** remote from the disc **136** carries a crank arm **142** which in turn carries a roller **143** mounted for rolling movement about an axis parallel to but spaced from the axis of the shaft **138.** The roller **143** engages in a slot **144** in a member **145** carried by the platen **12.** The shape of the slot **144** in the member **145** is such that as the platen **12** moves downwardly the shaft **138,** and therefore the disc **136** is indexed through 90° in a counter-clockwise direction (as considered in FIG. **18**). Similarly, as the platen **12** moves upwardly away from the platen **11** the disc **136** is indexed through 90° in a clockwise direction. A push rod **146** extends downwardly from the platen **12,** and is guided by a bearing **147** carried by the bracket **141.** The push rod **146** is so positioned that as the platen **12** moves downwardly, then the rod **146** can pass through the passage **137** in the disc **136,** and into a sizing die **148** also carried by the bracket **141.** Thus as the platen **12** ascends an unfinished core is transferred by the arm **132** into the passage **137** of the disc **136.** As the platen **12** then starts to descent, the disc **136** is indexed through 90°, to move the unfinished core from a horizontal position to a vertical position, and thereafter, the push rod **146** pushes the unfinished core from the passage **137** and into the sizing die **148.** The stroke of the push rod **146** is of course identical to the stroke of the platen **12,** and is such that the push rod **146** does not push the unfinished core completely through the sizing die **148,** but merely ensures that the unfinished core is completely clear of the passage **137.** The platen **12** then ascends, and when the push rod **146** is completely withdrawn from the passage **137** the disc **136** is indexed back through 90° to receive a further unfinished core. Subsequent downward movement of the platen pushes the subsequent unfinished core from the passage **137** in the disc **136,** and the subsequent unfinished core engages the first mentioned unfinished core, and pushes the first mentioned unfinished core completely through the sizing die **148.** At the exit end of the sizing die **148** there is positioned a transfer tube along which the now finished core is transferred to a storage bin, or into a conveyor mechanism which conveys finished cores, for example to an ignition coil assembly plant.

The sizing die **148** merely ensures that cores produced by the machine are of a standard diameter, and standard cross section, and the term unfinished core is to be construed accordingly. Some cores leaving the coining station may well be in a suitable condition for use.

It will be appreciated that the stations of the machine operate simultaneously, each station preparing a component which is subsequently transferred to the following station. Thus a finished core is produced for each

complete stroke of the press. The tools of each station of the apparatus are detachable from their respective platens for servicing and the tools of each station, both movable and fixed tools can be removed independently of the tools of the other stations.

The apparatus includes a safety system which checks that the transfer arms have performed a complete downward movement at a predetermined point in the operating cycle, that the carriage 35 has performed a complete longitudinal stroke at a predetermined point in the operating cycle, and that an unfinished core has been inserted into the indexing disc at a predetermined point in the operating cycle. If any one of these three conditions is not fulfilled then operation of the apparatus is stopped. The air springs of the transfer mechanism and the movable punches of the corrugating station are supplied with compressed air from a common source continuously while theapparatus is operative.

We claim:

1. Apparatus for use in the manufacture of laminated cores for spark ignition system ignition coils, including a corrugating station which receives sheet metal blanks each of which has a plurality of parallel slits spaced apart by different distances dividing the blank into a plurality of laminae of different widths interconnected at their ends, the corrugating station including a movable platen movable relatively towards and away from a fixed platen, a plurality of punches carried by the movable platen and moving therewith, resilient means urging the punches to predetermined positions relative to one another and to the movable platen, the punches being mounted for collapsing movement in the direction of the stroke of the movable platen in turn relative to one another and to the movable platen against the action of said resilient means during a single operating stroke of the movable platen so that the punches can collapse relative to one another in sequence during said single operating stroke, a plurality of anvils associated with said punches and carried by the fixed platen, the anvil associated with the first punch of said plurality of punches being fixed, and the remaining anvils being movable laterally with respect to the direction of movement of the movable platen, relative to one another, in sequence, towards and away from the fixed anvil and, means operated by the movement of the movable platen causing movement of the movable anvils towards the fixed anvil in a sequential manner determined by the movement of the movable platen towards the fixed platen, so that the movement of the anvils is timed in a predetermined relation to the movement of the punches, the relative movement between the punches and the relative movement between the anvils, together with the relative movement of the punches with respect to the anvils effecting a sequential formation of corrugations in said blank, with said slits at the apices of the corrugations.

2. Apparatus as claimed in claim 1 wherein said resilient means is constituted by compressed air.

3. Apparatus as claimed in claim 1 wherein said movement of the movable anvils is effected by cams carried by the movable platen.

4. Apparatus as claimed in claim 1 wherein the corrugating station includes at least two stages which operate simultaneously, each stage including punches and anvils and the punches and anvils of the first stage producing a first set of corrugations in a blank while the second stage produces a second set of corrugations in a blank previously operated on by the first stage, the apparatus including first transfer means for transferring blanks from the first stage to the second stage.

5. Apparatus as claimed in claim 1 wherein a centre corrugation of the blank is formed first and the tools operate sequentially, outwardly from the centre corrugations to produce the remaining corrugations, the outer undeformed portions of the blank being free to move inwardly as the corrugations are formed.

6. Apparatus as claimed in claim 1 further including a coining station operated by the movement of the movable platen of the press, the coining station receiving a corrugated blank from the corrugating station and compressing the corrugated blank laterally, at right angles to the corrugations, to form an unfinished laminated core, the apparatus including second transfer means for transferring corrugated blanks to the coining station.

7. Apparatus as claimed in claim 6 wherein the coining station includes a pair of plungers which are slidable towards and away from one another between a pair of fixed parts, and said transfer means delivers the corrugated blank between said fixed parts and between said plungers, siad fixed parts resisting bowing of the corrugated blank out of the plane of the plungers as the plunger move toward one another to compress the corrugated blank.

8. Apparatus as claimed in claim 7 wherein the coining station further includes stripping means which ensures that the unfinished core disengages from the plungers as the plungers move apart.

9. Apparatus as claimed in claim 6, further including a sizing station, and third transfer means for transferring unfinished cores from the coining station to the sizing station where the unfinished cores are subject to sizing operation.

10. Apparatus as claimed in claim 9 wherein the sizing station includes a sizing die through which the unfinished cores are passed.

11. Apparatus as claimed in claim 10 wherein the force required to pass the cores through the sizing die is derived from the movement of the movable platen of the press.

12. Apparatus as claimed in claim 9 wherein the sizing station includes indexing means operated by movement of the movable platen of the press for indexing unfinished cores through 90° from a position perpendicular to the direction of movement of the movable platen to a position in line with said direction of movement.

13. Apparatus as claimed in claim 1 further including a blank forming station from which blanks are supplied to the corrugating station.

14. Apparatus as claimed in claim 13 wherein the blank forming station receives a continuous strip of metal said strip being fed to the blank forming station in a step wise manner such that for each complete stroke of the press a length of strip equal in length to the length of the core to be produced is fed into the station.

15. Apparatus as claimed in claim 13 wherein the blank forming station includes a slitting tool which for each stroke of the press produces the necessary slits in a length of strip which will constitute a single blank.

16. Apparatus as claimed in claim 15 wherein the blank forming station further includes a planishing tool

which for each stroke of the press planishes a previously slitted length of the strip.

17. Apparatus as claimed in claim 16 wherein the blank forming station still further includes a guillotine which cuts previously slitted and planished lengths of strip to form blanks.

18. Apparatus as claimed in claim 15 wherein the blank forming station includes a cropping tool which crops the edges of the incoming strip prior to the slitting operation, to ensure the width of the strip and therefore the width of the blanks to be formed is the desired width and to ensure that the edges of the strip are correctly orientated relative to the slitting tool.

19. Apparatus as claimed in claim 13 including fourth transfer means for feeding blanks from the blank forming station to the corrugating station.

20. Apparatus as claimed in claim 19 wherein said first, second and third, and fourth transfer means are part ofa movable carriage and operate simultaneously, said carriage being moved in conjunction with the movable platen of the press and being moved in a direction to feed components by an air spring which is compressed by the drive mechanism of the press to move the carriage in a return direction.

21. Apparatus as claimed in claim 17 including fourth transfer means for feeding blanks from the blank forming station to the corrugating station.

22. A method of manufacturing a laminated core, including the steps of supporting a sheet metal blank on a fixed anvil which comprises a pair of ribs of triangular cross section defining between them a V-shaped groove, the blank being supported with a slit therein aligned with the apex of the groove, moving a punch of triangular cross section towards the anvil so that the punch engages the blank along the line of said slit and deforms the blank into said groove to form a first corrugation, the uncorrugated portion of the blank being free to move inwardly as the corrugation is formed, moving a second punch of triangular cross section towards the blank along side the first punch and moving a second anvil of triangular cross section towards the first anvil, the second and first anvils when interengaged defining a second V-shaped groove parallel to said first V-shaped groove, the second punch bending the blank along the line of a second slit into said second V-shaped groove, as said second V-shaped groove is formed, to form a second corrugation in the blank, forming the required number of corrugations in the blank in similar manner, and compressing the corrugated blank transversely of the corrugations to collapse the blank so that the corrugations lie in facial contact.

23. A method as claimed in claim 22 wherein as the second punch and second anvil are being moved to form the second corrugation, a third punch and a third anvil are moved to form a third corrugation on the opposite side of the first corrugation.

24. A method as claimed in claim 22 wherein all of the corrugations with the exception of the first are produced in pairs, the corrugations of each pair being on opposite sides respectively of the central corrugation, and the corrugations being produced sequentially in a direction outwardly from the first corrugation.

25. Apparatus for use in the manufacture of laminated cores for spark ignition system ignition coils, including a corrugating station which receives sheet metal blanks each of which has a plurality of parallel slits spaced apart by different distances dividing the blank into a plurality of laminae of different widths interconnected at their ends, the corrugating station including a movable platen movable relatively towards and away from a fixed platen, a plurality of punches of triangular cross section carried by the movable platen and moving therewith, resilient means urging the punches to predetermined positions relative to one another and to the movable platen, the punches being mounted for collapsing movement in the direction of the stroke of the movable platen in turn relative to one another and to the movable platen against the action of said resilient means during a single operating stroke of the movable platen so that the punches can collapse relative to one another in sequence during said single operating stroke, a plurality of anvils associated with said punches, and carried by the fixed platen, the anvil associated with the first punch of said plurality of punches being fixed, and comprising a pair of ribs of triangular cross section defining between them a V-shaped groove with which the first punch co-operates, and, the remaining anvils being of triangular cross-section, and being movable sequentially laterally with respect to the direction of movement of the movable platen towards the fixed anvil, to define further V-shaped grooves parallel to said first V-shaped groove and associated respectively with the remaining punches and, means operated by the movement of the movable platen causing movement of the movable anvils towards the fixed anvil in a sequential manner determined by the movement of the movable platen towards the fixed platen, so that the movement of the anvils is timed in a predetermined relation to the movement of the punches, the relative movement between the punches and the relative movement between the anvils, together with the relative movement of the punches with respect to the anvils causing a sequential formation of corrugations in said blank, with said slits of the blank at the apices of the corrugations.

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