Dec. 29, 1936. J. H. YOUNG ET AL 2,065,546

METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

Filed Dec. 16, 1933 6 Sheets-Sheet 1

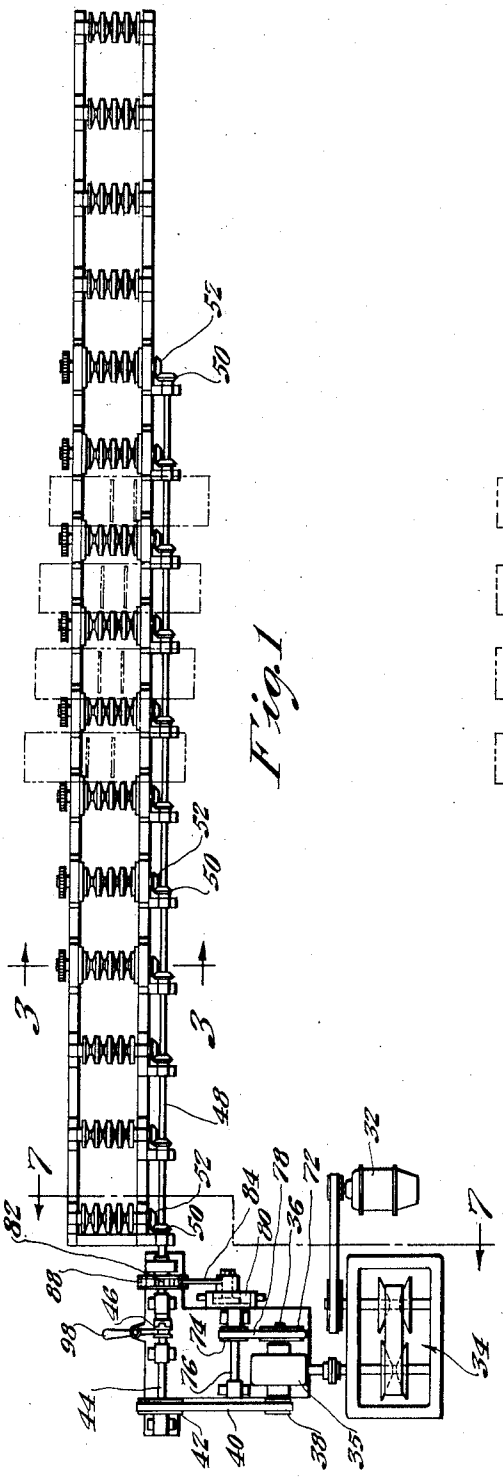



Fig. 1

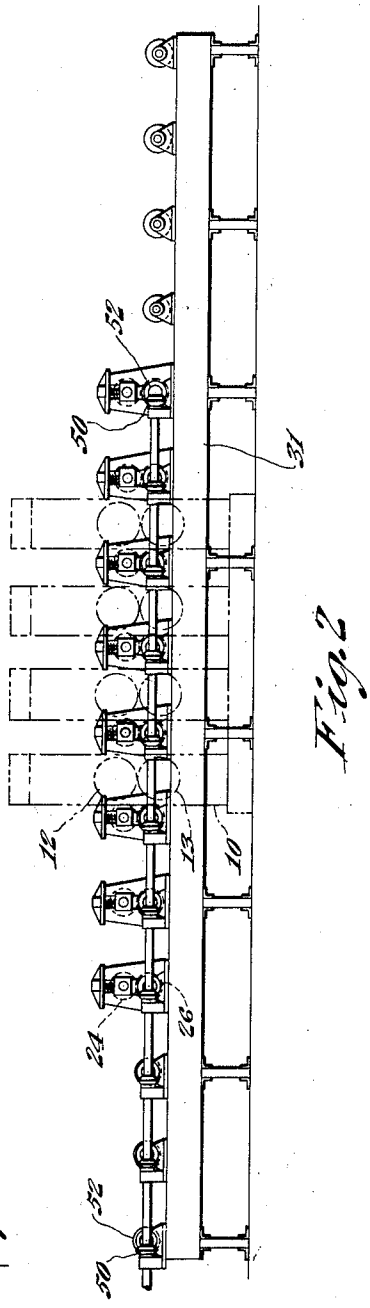



Fig. 2

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METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

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Fig. 3

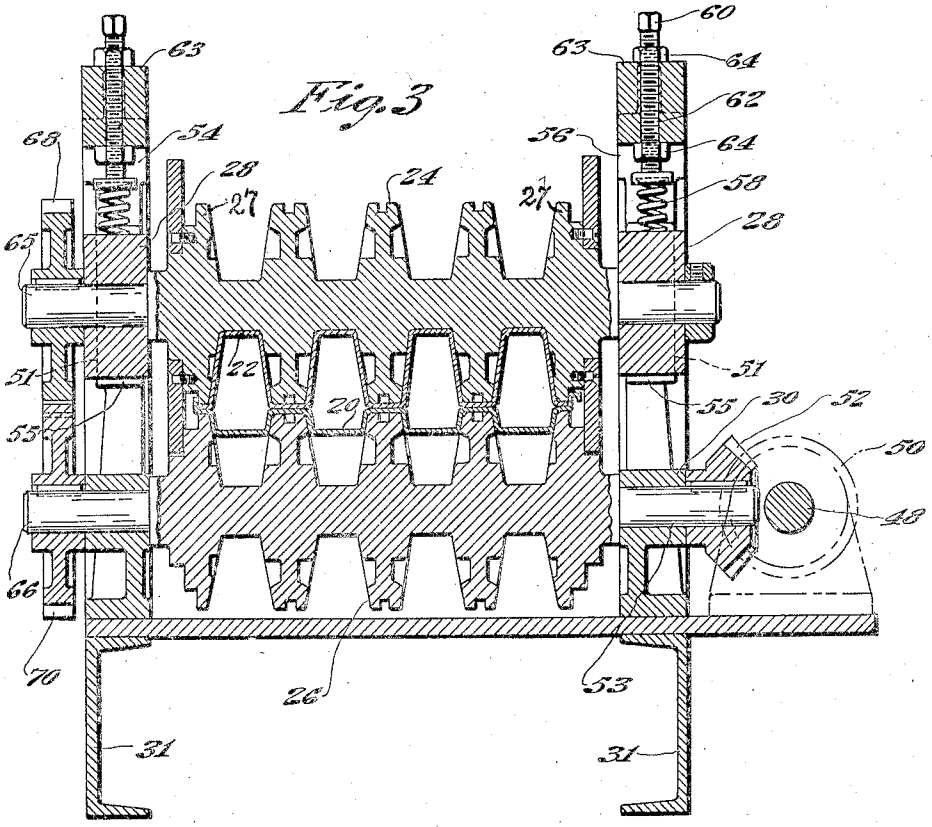
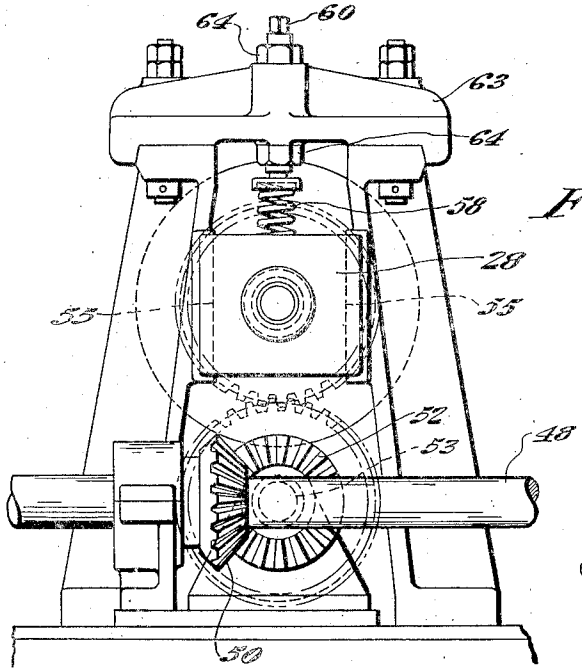



Fig. 4




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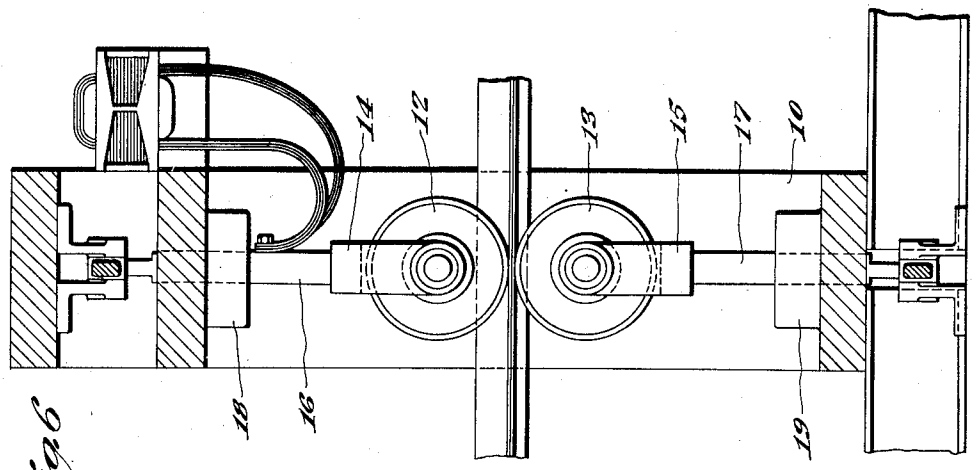



Fig 6

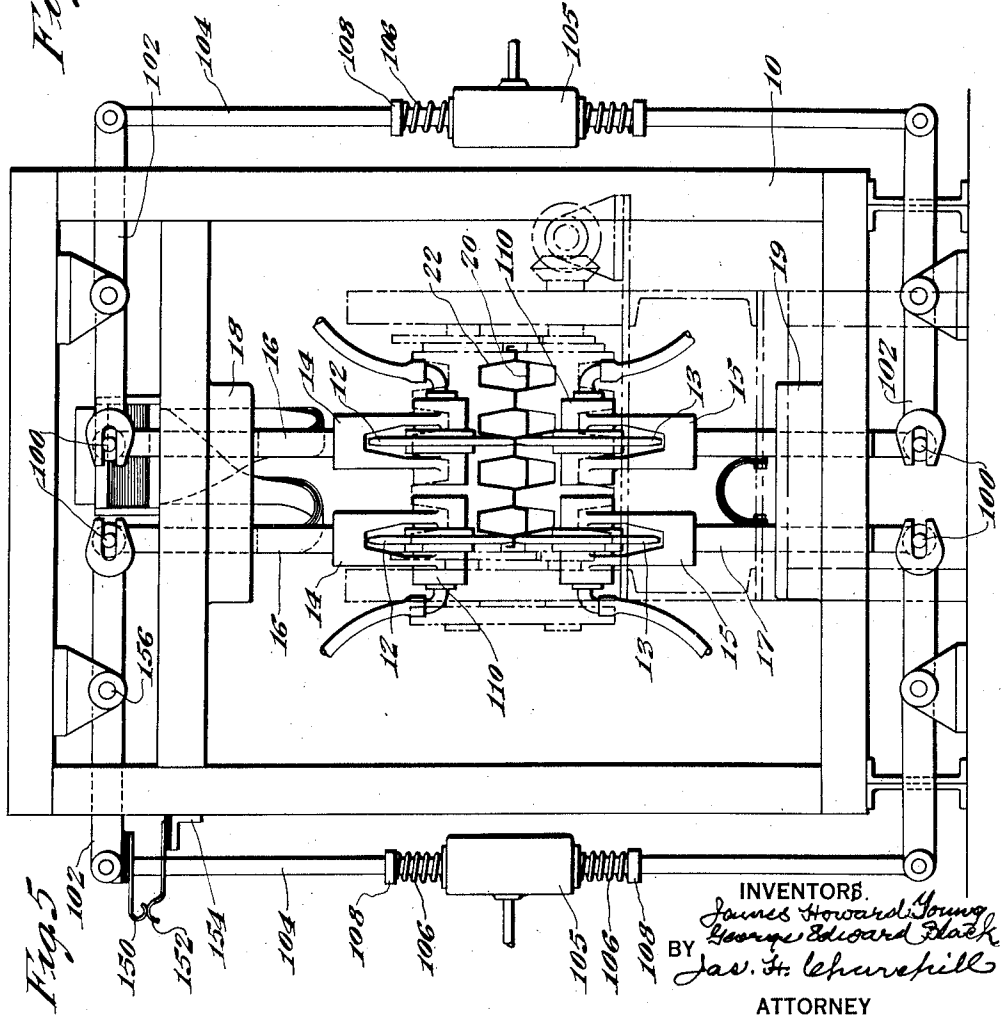



Fig 5




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METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

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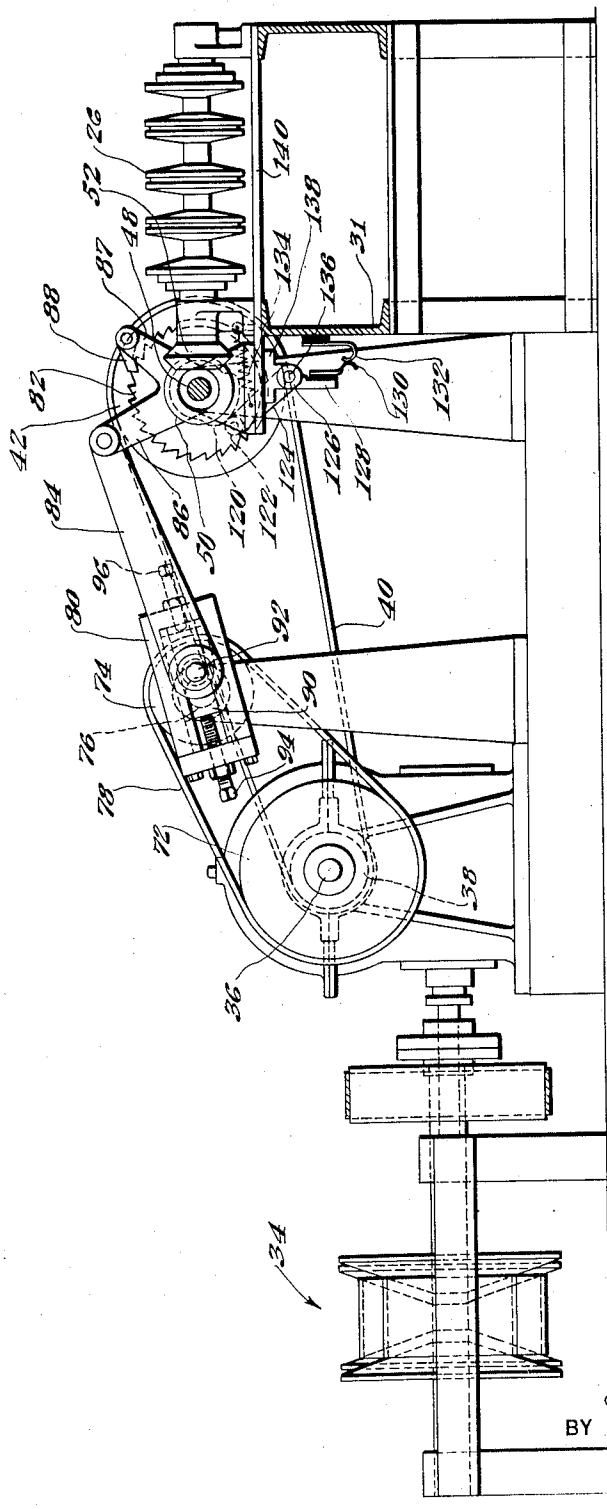



Fig. 7

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METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

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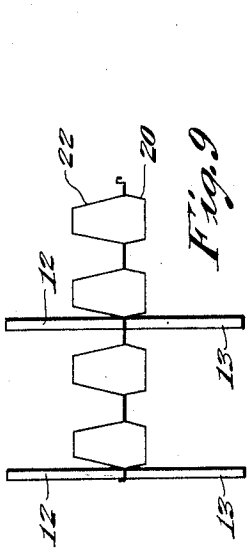



Fig. 9

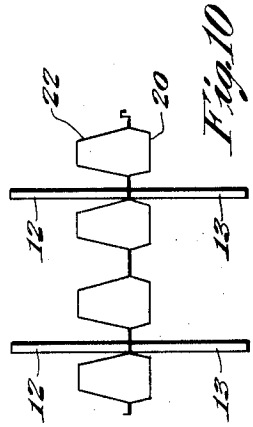



Fig. 10

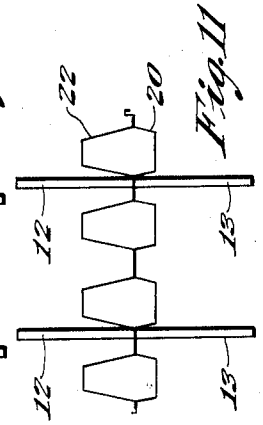



Fig. 11

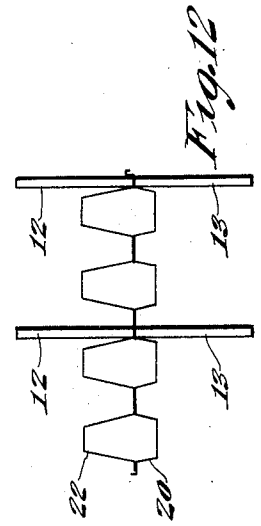



Fig. 12

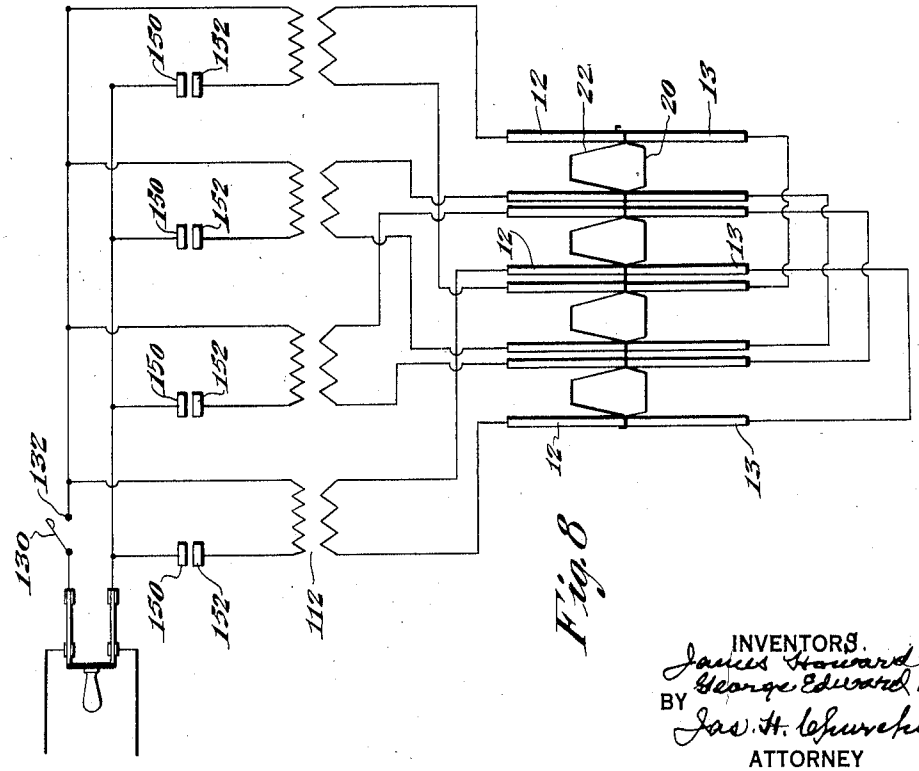



Fig. 8

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METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

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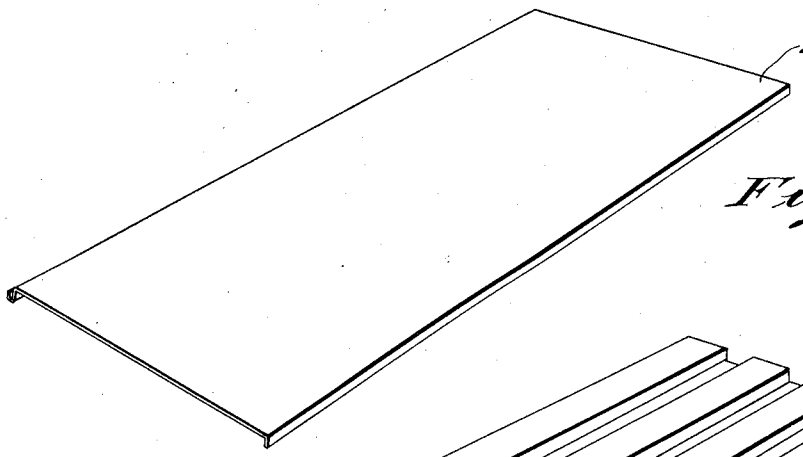



Fig. 13

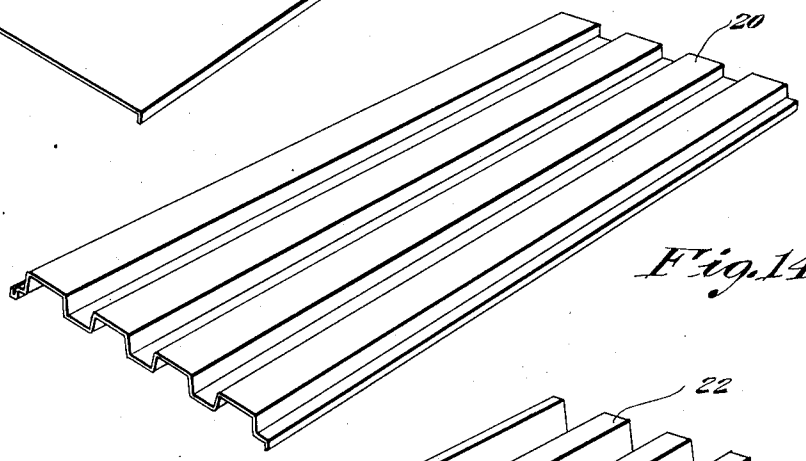



Fig. 14

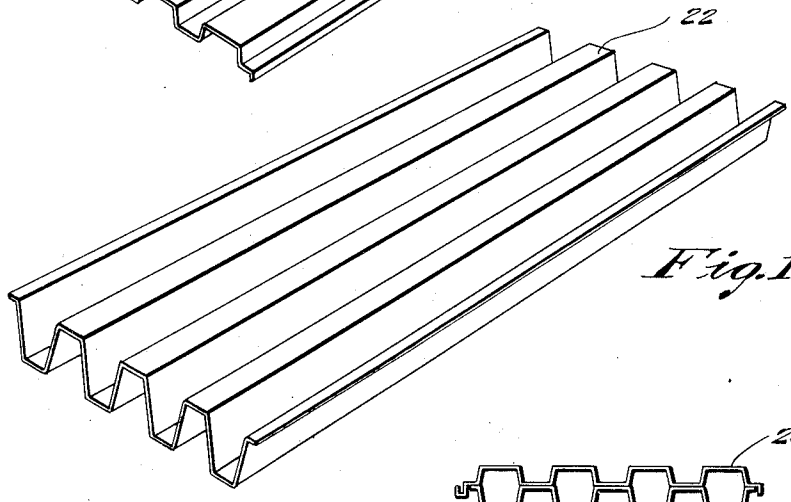



Fig. 15

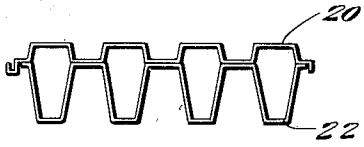



Fig. 16

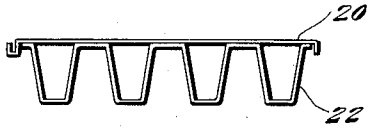



Fig. 17

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# UNITED STATES PATENT OFFICE

2,065,546

## METHOD OF AND APPARATUS FOR PRODUCING CELLULAR METAL BUILDING UNITS

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Application December 16, 1933, Serial No. 702,728

8 Claims. (Cl. 219—4)

This invention relates to a method of and to apparatus for producing cellular metal building units.

One object of the invention is to provide a novel method of and also novel and efficient apparatus for producing a cellular metal building unit by welding together a plurality of metal members, at least one of which is corrugated, in a manner such that successive units may be rapidly and economically produced.

A further object of the invention is to provide a novel and efficient apparatus for producing a cellular steel flooring unit comprising two component steel members, at least one of which is corrugated, and in which provision is made for maintaining and moving the component steel members in predetermined relation to one another, and for performing the welding operations in such manner as to efficiently unite component members into a strong practical unit without liability of injury to the steel.

With these general objects in view, and such others as may hereinafter appear, the invention consists in the method, in the apparatus, and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiments of the invention, Figs. 1 and 2 are views in plan and elevation respectively of the conveying mechanism for feeding the component metal members to and from the welding mechanism; Fig. 3 is a cross-sectional view on the line 3—3 of Fig. 1; Fig. 4 is an end view of Fig. 3 viewed from the right; Figs. 5 and 6 are front and sectional views of the welding mechanism; Fig. 7 is a sectional view taken on the line 7—7 of Fig. 1; Fig. 8 is a wiring diagram for the welding mechanism; Figs. 9, 10, 11 and 12 are views illustrating the sequence of positions of the different welding electrodes with relation to the work; and Figs. 13, 14, 15, 16 and 17 are details in perspective and end elevation of the component metal members from which the present cellular building unit is produced and of two forms of the completed unit.

In general, the invention aims to produce a cellular metal building unit from two component metal members, at least one of which is corrugated. The corrugations are preferably arranged to extend longitudinally of the members and to form a plurality of cells which render the unit exceedingly strong and particularly useful for various commercial purposes. One form of cellular building unit is adapted to be produced by the present method and apparatus comprises the cellular steel flooring illustrated in and forming the subject matter of United States Patent No. 1,867,433. In accordance with the present method, the component members are assembled in superposed and contacting relation, and provision is made for moving the assembled component members as a unit into operative position with relation to welding means. Contact under pressure of the welding means with the external surfaces of the metal members is effected and a welding current caused to flow to cause the welding operation. The unitary assembled metal members are then moved from welding position and with relation to the welding means whereby to prevent adherence of the metal members to the welding means. In the preferred form of apparatus which is particularly designed to produce a cellular steel flooring of Patent No. 1,867,433, the assembled component steel sheets are fed and maintained in predetermined registered relation to one another by feed rolls shaped to fit into corrugations in one and preferably both component members. The feed rolls operate to move the assembled component members between welding electrodes, and provision is made for causing the electrodes to contact with the external surfaces of the component metal members under sufficient pressure so that when a welding current is caused to flow between the electrodes a satisfactory weld will be produced. The welding electrodes may and preferably will be arranged in staggered relationship to afford opportunity for cooling and dissipation of heat, and the movement of the assembled metal members is regulated so that the welded portion or portions thereof are moved from the zone or region immediate the electrodes whereby to prevent adherence of the welds to the electrodes.

Referring now to the drawings, in the machine illustrated therein for welding the two component members of the illustrated cellular metal flooring unit, 10 represents the frame of the machine which is arranged to support a plurality of pairs of welding elements or electrodes 12, 13. In one form of the invention the welding electrodes preferably take the form of wheels rotatably mounted in yokes 14, 15 upon supporting rods 16, 17, slidably supported in suitable bearings 18, 19, and provision is made for effecting movement of the electrodes 12, 13 toward and from one another during the operation of the machine as will be described, in order to exert pressure upon the two component sheets to be welded and to thereby enable the requisite weld to be obtained by the passage of the welding current through the electrodes and through the portion of the sheet pressed between the same, as will be described.

The machine is further preferably provided with means for supporting, positioning and moving a pair of superposed sheet metal members 20, 22

through the machine, and as herein shown the machine is provided with a series of sets of positioning and feeding rollers, as shown in Figs. 1, 2 and 3. Each set of rollers **24**, **26** is journalled in suitable bearings **28** and **30** in brackets **54** and **56** supported on longitudinally extended supporting members **31** forming a part of the frame, and provision is made for driving a plurality of the sets of rollers in order to positively feed the superposed sheet metal members **20**, **22** after they have been once positioned and without disturbing their predetermined relation to one another, so that the web portions between adjacent corrugations pass between the welding electrodes or wheels **12**, **13** in the manner illustrated. As illustrated in Fig. 3, the positioning and feeding rollers **24**, **26** are preferably shaped to snugly fit the corrugations in both component members and the end rollers **27** to snugly fit into the recess formed by the marginal lips at the side of the preferred form of building unit, so as to definitely maintain the component members in predetermined relation to one another during their movement through the machine. When one of the members of the building unit is uncorrugated, as shown in Figs. 13 and 17, one set of the rollers **24**, **26** serve as feed rollers only, and the desired positioning is effected by the reception of the end rollers **27** in the marginal recesses **29** of the unit.

The plurality of sets of feed rollers **24**, **26** are driven either continuously or intermittently, as will be described, depending upon the character of welding operation to be performed and when such rollers are to be continuously driven the rotations of a motor **32** are transferred through a variable speed drive, indicated generally at **34** and which may comprise any usual or preferred form of such drive now upon the market and thence through a worm and worm wheel speed reducing unit **35**. The worm wheel shaft **36** is provided with a pulley **38** around which a belt **40** runs and the rotations of the worm shaft are transmitted through the pulley belt and a second pulley **42** upon a counter shaft **44** to and through a clutch **46** to a driving shaft **48** extending lengthwise of the machine frame. The driving shaft is provided with a series of bevel gears **50** which are arranged to cooperate with bevel gears **52** upon the extended end of the shafts **53** of the lower sets of feed rolls, as illustrated in Fig. 3. Provision is made for gearing together the upper and lower sets of rolls **24**, **26** comprising each pair of feed rolls, and as illustrated in Fig. 3, the extended shafts **65**, **66** of the upper and lower feed rolls **24** and **26** are provided with cooperating spur gears **68** and **70**. In order that the machine may accommodate different thicknesses of material forming the component floor members, provision is made for yieldably mounting the upper feed rolls **24** and, as illustrated in Figs. 3 and 4, the bearings **28** for the opposite ends of the upper feed roll shaft are provided with grooves **51** and arranged to slide upon slides **55** in the standards **54** and **56**, and the bearings are yieldingly held downwardly by heavy coiled springs **58** and pressed by adjusting screws **60** screwed through threaded holes **62** in the cross members **63** forming the top of the standards and having lock nuts **64** for maintaining the parts in their adjusted positions.

For some purposes it may be desirable to effect the intermittent movement of two component sheets to be welded together to form the building unit, and suitable driving connections are provided for effecting this result, as clearly shown in Figs. **1** and **7**.

A pulley **72** on the worm wheel shaft **36** is belted to a pulley **74** on a counter shaft **76** by a belt **78**. An adjustable crank **80** fast on the end of the counter shaft **76** transmits its motion to a ratchet **82** fast on the driving shaft **48** through the connecting link **84** connected to one arm **86** of a bell crank lever loosely mounted on the shaft **48**. The other arm **87** carries a pawl **88** which cooperates with the ratchet **82** to turn the shaft **48** and, consequently, the feed rolls **24** and **26** through the cooperating bevel gears **50** and **52**. In order to change the length of travel of the component members **20** and **22**, carried between the feed rolls, from one setting to another as desired, the length of stroke of the crank arm **80** can be adjusted to vary the stroke of the pawl arm **87** and thereby change the number of teeth in the ratchet **82** which the pawl can push forward during one cycle of the intermittent movement of the machine. A block **90**, which carries a stud **92** to which the link **84** is attached, is slidably and adjustably mounted between set screws **94** and **96** in the crank arm **80**. This arm which is securedly fixed to the counter shaft **76** as described above is provided with a T slot into which the block **90** fits.

Provision is made for disengaging the continuous driving mechanism, when intermittent motion is desired, by means of the clutch **46** which is provided with an operating handle **98** to control the operation thereof. Conversely when continuous motion is desired, it is necessary to disengage the pawl **88** from its ratchet **82**, and engage the clutch **46** into its operative position.

From the description thus far, it will be observed that mechanism is provided whereby two component members, at least one of which is corrugated, forming a cellular metal building unit, may be positioned in predetermined relationship and maintained in predetermined relationship as they are moved through the machine, and that provision is also made for moving the said unit through the machine either intermittently or continuouly, as desired.

In order that the requisite welding pressure may be applied by the electrodes during the welding operation without causing the work to become bent or distorted and thereby avoiding any permanent bowing or distortion of the work, provision is made for applying to the work pressure by each of the coperating pairs of electrodes in such a manner that the welding pressure does not distort the work. Accordingly, as shown in Figs. 5 and 6, the electrodes are mounted in floating relationship and provision is made for effecting movement of the electrodes **12**, **13** toward each other under equal pressures. As shown in Fig. 5, the upper portions of the supporting rods **16** of said electrodes are provided with pins **100** adapted to be received in the slotted ends of levers **102** which are pivotally mounted on the frame and connected at the opposite ends to the plunger rods **104** of the hydraulic cylinders **105**. The hydraulic cylinders may be connected with any well known means for supplying pressure thereto. In order to insure that the cooperating electrodes will be actuated to quickly close the weld, springs **106** are provided between ends of the hydraulic cylinders **105** and collars **108** fast on the rods **104** thereof. Provision is made for cooling the welding electrodes and, as shown in Fig. 5, each electrode is formed with an internal cooling space in a hollow hub **110** which may be connected with any suitable supply of cooling water.

From the above description, it will be observed that by mounting the electrodes in floating relationship as described and by continuously applying equal amounts of pressure by each cooperating pair of electrodes, no bending or distortion of the work can take place while it is being welded since the electrodes are automatically moved into engagement with the opposite sides of the work and thereafter exert equal pressures on the work, thus insuring that the work remains in an undistorted condition during welding.

In commercial operation the electrodes have a tendency to flatten out by reason of the heating effects and the pressure used for welding so that in operating the present machine, if the floating arrangement of electrodes above described was not used, the level of the lower electrode would not be in the plane between the guide and positioning rolls **24**, **26** and, as a result, the welding pressure of the upper electrode would force the work downwardly into contact with the lower electrode and the work would be welded in this arched or bowed position. In addition, in the machine embodied in a plurality of pairs of welding electrodes, different electrodes wear and squash down at different rates and, as a result, if the aforesaid floating arrangement was not used, one part of the work would be bowed with respect to another part, while by the use of the floating arrangement of welding electrodes the welding pressure is prevented from forcing the sheet from its normal position irrespective of the flattening of either the top or bottom electrodes.

From the description thus far, it will also be observed that in accordance with the present invention the work is mounted in absolute alignment both vertically, laterally and longitudinally, and the electrodes function merely to pinch together the component metal members during the welding operation.

Provision is made for supplying a current through the electric welding rolls, as diagrammatically illustrated in Fig. 8. The current is taken from a suitable source of power and passed through a transformer **112**, thence through upper and lower welding rolls **12** and **13**, and then through the cooperating welding rolls of the same set, as clearly illustrated in the drawings.

Provision is made for making and breaking the current at proper intervals, as when intermittent movement of the work is desired, and, as herein shown in Fig. 7, this may be accomplished by means of a cam **120** fixed on the main driving shaft **48** and adapted to make and break the circuit at predetermined intervals during the operation of the machine. A cam roller **122** which cooperates with the cam **120** is mounted on the end of one arm **124** of a bell crank lever **126**. The other arm **128** carries a contact member **130** which is adapted to come in contact with a second contact member **132** mounted on and properly insulated from the supporting member **31**. The cam roller **122** is yieldingly held in cooperating relation with the cam **120** by means of a spring **134**. The bell crank lever **126** is pivotally mounted on a stud **136** secured in a bracket **138** which in turn is fastened to the underside of a plate **140** forming part of the machine frame.

Provision is also made for breaking the circuit when the sheets pass from between the welding rolls and, accordingly, each welding unit as shown in Fig. 5 is provided with a pair of contact members **150** and **152** properly insulated from the machine frame. The contact member **150**, mounted on the end of lever **102**, is arranged to come in contact with the stationary member **152**. The stationary contact member **152** is mounted on a supporting piece **154** secured to the machine frame. When a pair of sheets to be welded is passed between the welding rolls or electrodes **12** and **13**, the roll **12** will be raised upward and thereby cause the lever **102** to pivot on its fulcrum **156**, bringing the contact member **150** down in contact with the member **152**. This contact will close the circuit to allow the current to flow through the welding rolls as illustrated in the wiring diagram in Fig. 8. When the sheets have passed from between the welding rolls, the roll **12** will drop down and cause the circuit to be opened at the contacts **150** and **152**.

In order to prevent overheating of the metal of the component members of the building unit during the welding thereof, the machine is preferably provided, as above stated, with a plurality of sets of cooperating pairs of welding electrodes **12**, **13** and successive pairs thereof are spaced lengthwise of the machine sufficiently to prevent overheating of the metal between the portions of the unit which are being welded at one time. As illustrated in Figs. 9 through 12, successive pairs of the welding electrodes are disposed in different lateral positions, thus further assisting in the dissipation of the heating during the welding operation. It will therefore be observed that this spaced disposition, as illustrated, of the plurality of pairs of electrodes with the simultaneous welding of the component metal members together at a plurality of points spaced laterally and longitudinally of the unit insures rapid production and at the same time guards against overheating of the metal.

From the description thus far, it will be observed that the present cellular building unit is in accordance with the present method, as practiced in the machine illustrated and described herein, adapted for the commercial production of the cellular metal building units in a rapid, economical and practical manner, and an important feature of the present method resides in the movement of the component members of the unit with relation to the welding means both into and from welding position whereby adherence of the molten metal forming the weld to the welding electrodes is prevented. In performing the welding operation upon the thicknesses of sheet steel of which it is desirable to produce building units suitable for use as flooring units and the like, the relative movement of the component members of the unit being welded into welding electrodes before adherence of the weld to the electrodes has taken place is important, and in accordance with the present invention the feed or movement of the building unit through the machine is so regulated as to prevent adherence of the material of the welds to the electrodes.

While the preferred form of apparatus has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:—

1. A machine for making a cellular metal building unit such as a flooring unit from component metal members at least one of which is corrugated having, in combination, a plurality of pairs of welding electrodes, conveying means for supporting and moving the assembled component metal members, said welding electrodes being spaced with relation to each other and to the

component metal members being moved through the machine to cause the electrodes to successively engage the members at points between laterally spaced corrugations, electrode supporting means having provision for permitting movement of the electrodes into engagement with the opposite surfaces of the metal members irrespective of the exact position of the metal members, and fluid operated means for effecting heavy pressure between the electrodes, and means for stopping and starting the welding operation.

2. The method of making a cellular metal building unit which comprises in assembling component metal members, at least one of which has longitudinally extended corrugations having substantially flat bottom walls, so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, and welding the web portions of said members along paths disposed so closely adjacent the side walls of said cells and lengthwise thereof as to structurally close said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity.

3. The method of making a cellular metal building unit which comprises in assembling component metal members, at least one of which has longitudinally extended corrugations having substantially flat bottom walls, so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, moving the component metal members thus assembled in the direction of the length of said cells, maintaining the component metal members in their assembled relation during said movement, and welding the web portions of said members along paths disposed so closely adjacent the side walls of said cells and lengthwise thereof as to structurally close said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity.

4. The method of making a cellular metal building unit such as a floor unit, which comprises in assembling component metal members, at least one of which has longitudinally extended corrugations having substantially flat bottom walls, so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, moving the component metal members thus assembled in the direction of the length of said cells, maintaining the component metal members in their assembled relation during said movement, and progressively welding selected spaced apart web portions and successively welding other selected spaced apart web portions simultaneously with the first selected web portions along paths disposed so closely adjacent the side walls of said cells and lengthwise thereof as to structurally close said cells and form thereby a plurality of beams of maximum load-carrying capacity without overheating the component members of said building unit.

5. The method of making a cellular metal building unit which comprises assembling two metal members both of which are provided with longitudinally extended corrugations and at least one of which with corrugations having substantially flat bottom walls, and with the corrugations in one member opposed to the corrugations in the other member so as to form a plurality of cells having substantially flat bottom walls and contacting web portions intermediate said cells, and welding said web portions along paths disposed so closely adjacent the side walls of said cells and lengthwise thereof as to structurally close said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity.

6. A machine for making a cellular metal building unit such as a floor unit from component metal members, at least one of which is corrugated so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, said machine having, in combination, a plurality of pairs of welding electrodes, conveying means for supporting and moving the assembled component metal members, said welding electrodes being spaced with relation to each other and arranged with relation to said web portions to cause the electrodes to weld the said web portions along paths so closely adjacent the side walls of said cells as to structurally close the said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity, electrode supporting means having provision for permitting movement of the electrodes into engagement with the opposite surfaces of said metal members irrespective of the exact position of the metal members, fluid-operated means for effecting heavy pressure between the electrodes, and means for stopping and starting the welding operation.

7. A machine for making a cellular metal building unit such as a floor unit from component metal members, at least one of which is corrugated so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, said machine having, in combination, a plurality of pairs of welding electrodes, conveying means for supporting and moving the assembled component metal members, said welding electrodes being spaced with relation to each other and arranged with relation to said web portions to cause the electrodes to weld the said web portions along paths so closely adjacent the side walls of said cells as to structurally close the said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity, and electrode supporting means having provision for permitting movement of the electrodes into engagement with the opposite surfaces of said metal members irrespective of the exact position of the metal members.

8. A machine for making a cellular metal building unit such as a floor unit from component metal members, at least one of which is corrugated so as to form a plurality of cells having substantially flat bottom walls and web portions contacting intermediate said cells, said machine having, in combination, a plurality of pairs of welding electrodes, conveying means for supporting and moving the assembled component metal members, said welding electrodes being spaced with relation to each other and arranged with relation to said web portions to cause the electrodes to weld the said web portions along paths so closely adjacent the side walls of said cells as to structurally close the said cells and form thereby a plurality of parallel beams of maximum load-carrying capacity, and electrode supporting means.

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