962,413.

G. H. BENJAMIN.

METHOD OF SOLDERING CHAINS.

APPLICATION FILED MAY 13, 1909.

Patented June 28, 1910.

3 SHEETS—SHEET 1.

FIG.1.

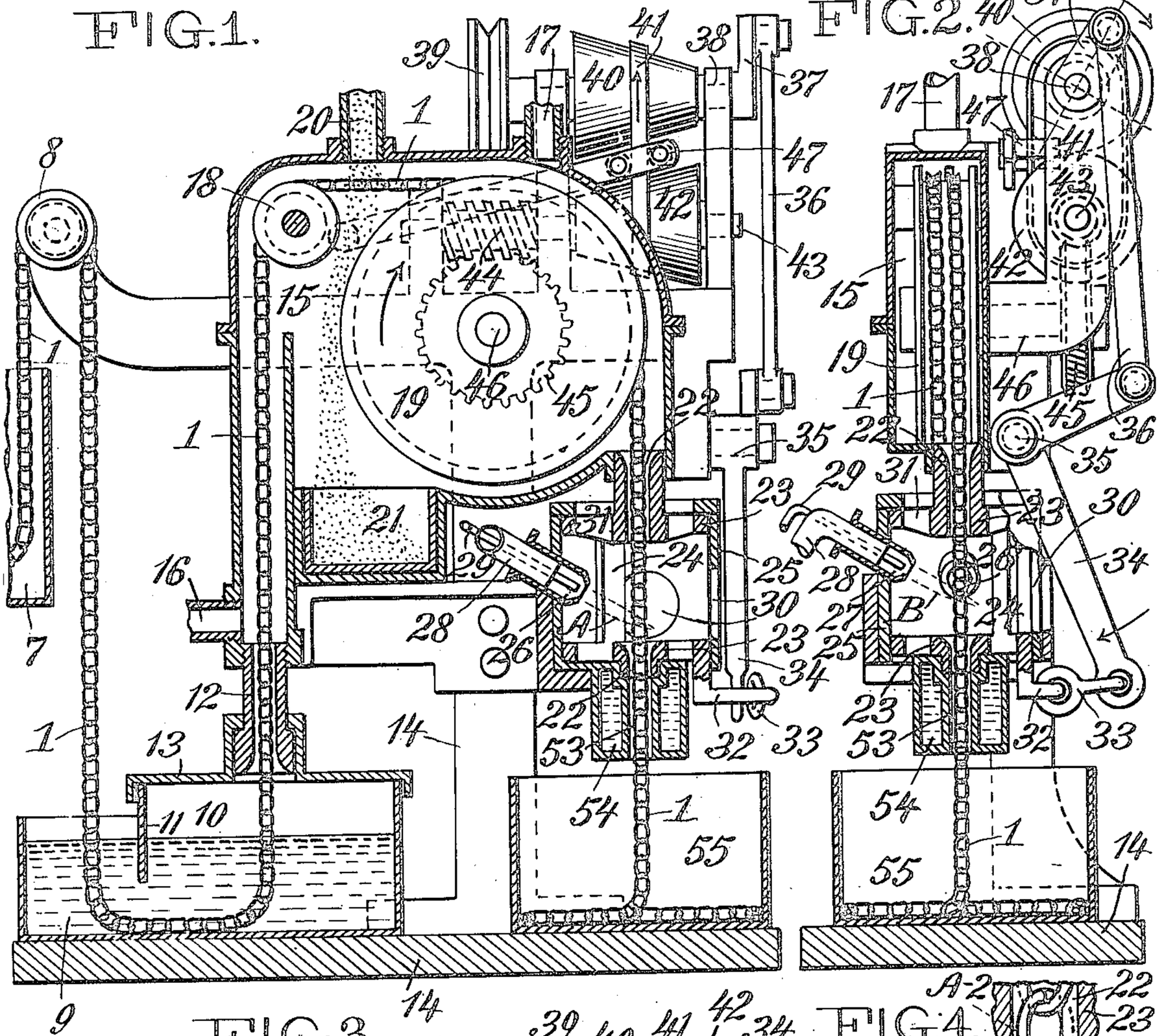

FIG.2.

FIG.3.

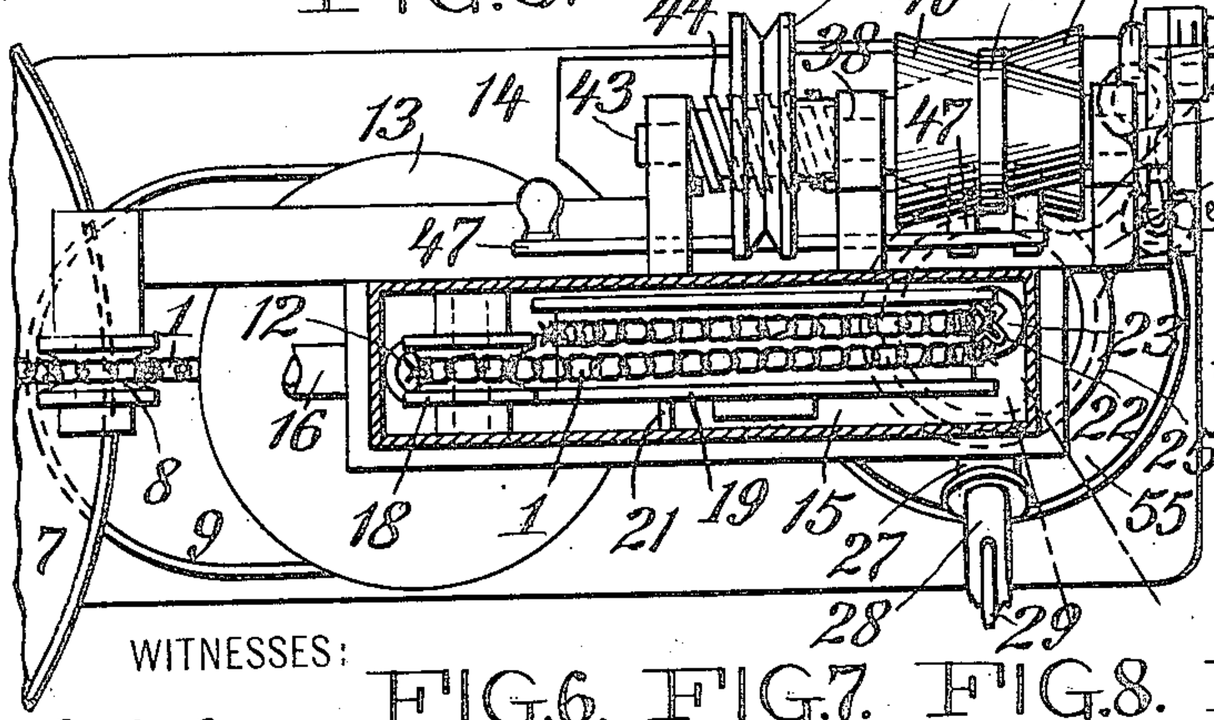

FIG.4.

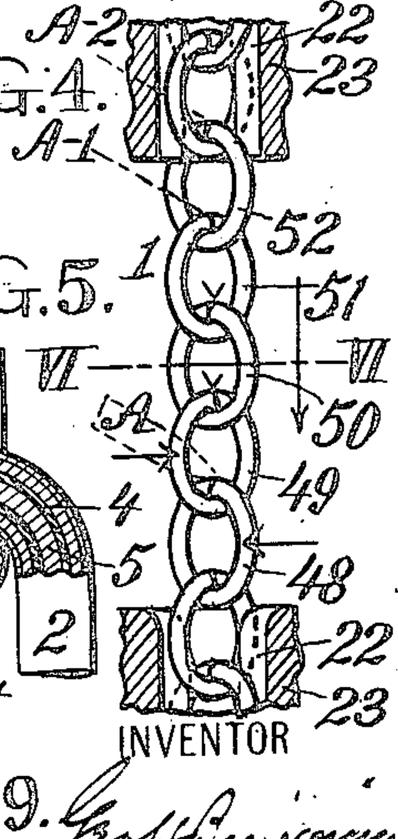

FIG.5.

WITNESSES:

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INVENTOR

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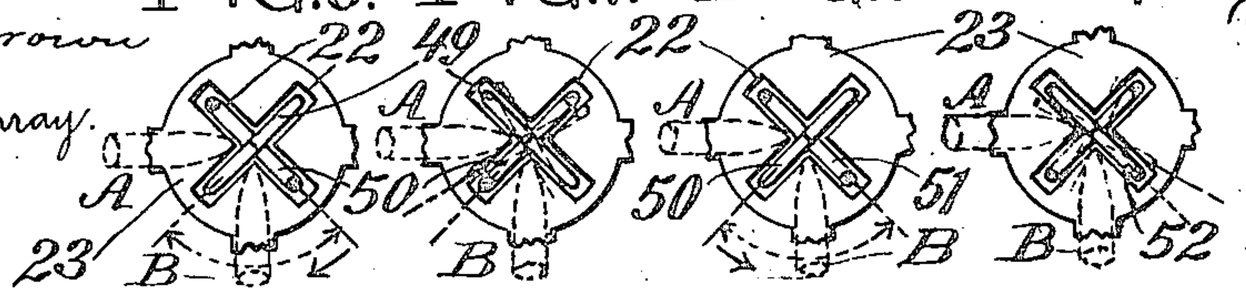
FIG.6. FIG.7. FIG.8. FIG.9.



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3 SHEETS—SHEET 2.

FIG. 10.

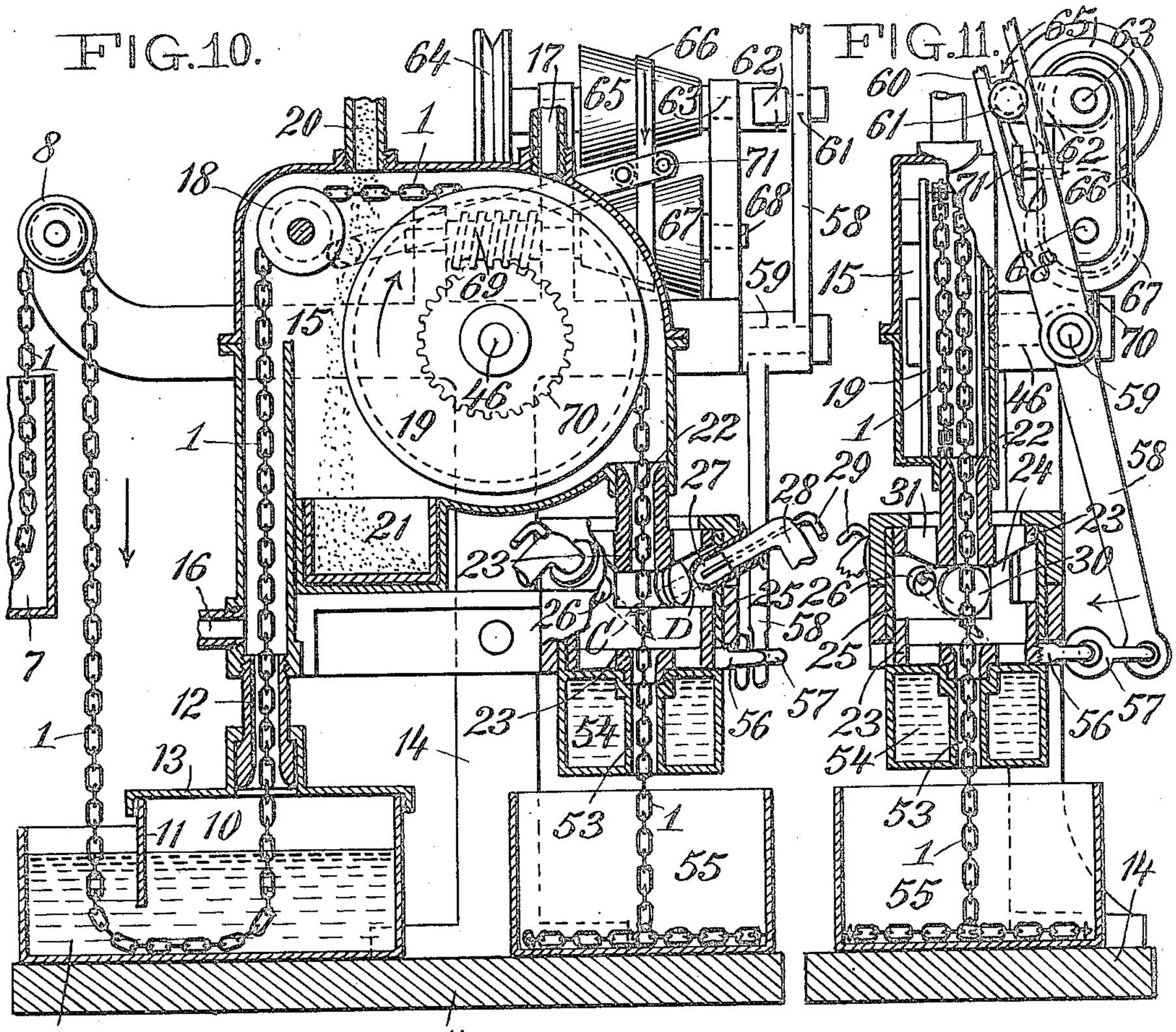

FIG. 11.

FIG. 12.

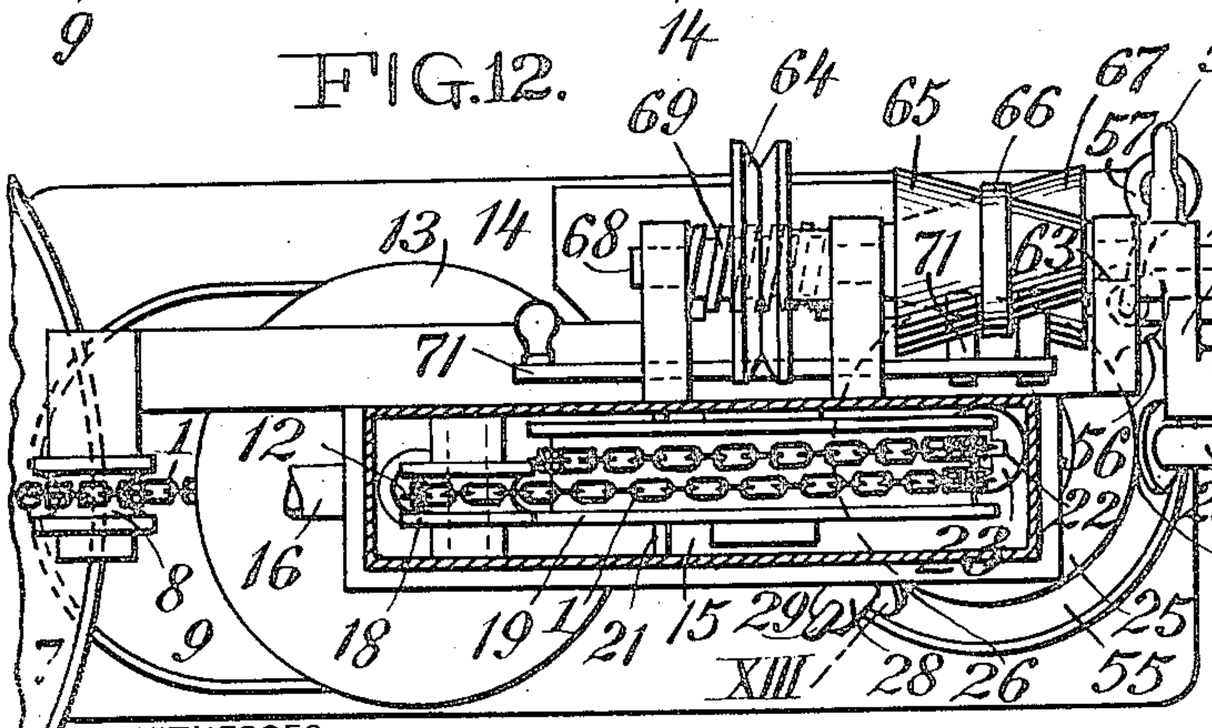

FIG. 13.

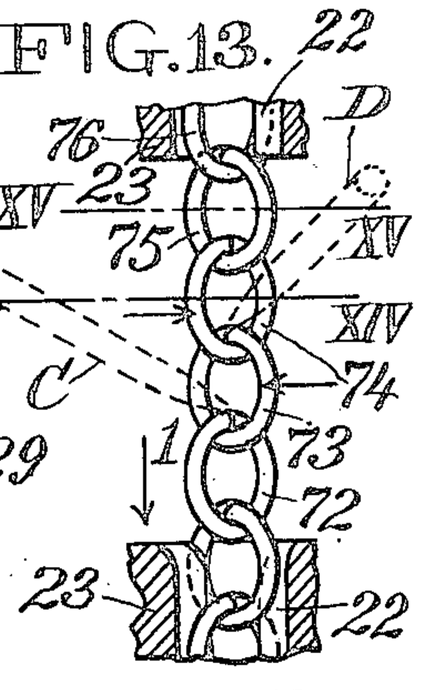

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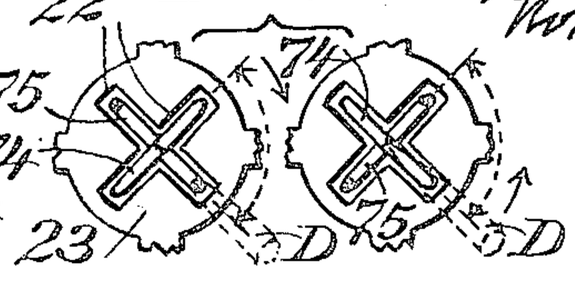
FIG. 14.

FIG. 15.



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3 SHEETS—SHEET 3.

FIG. 16.

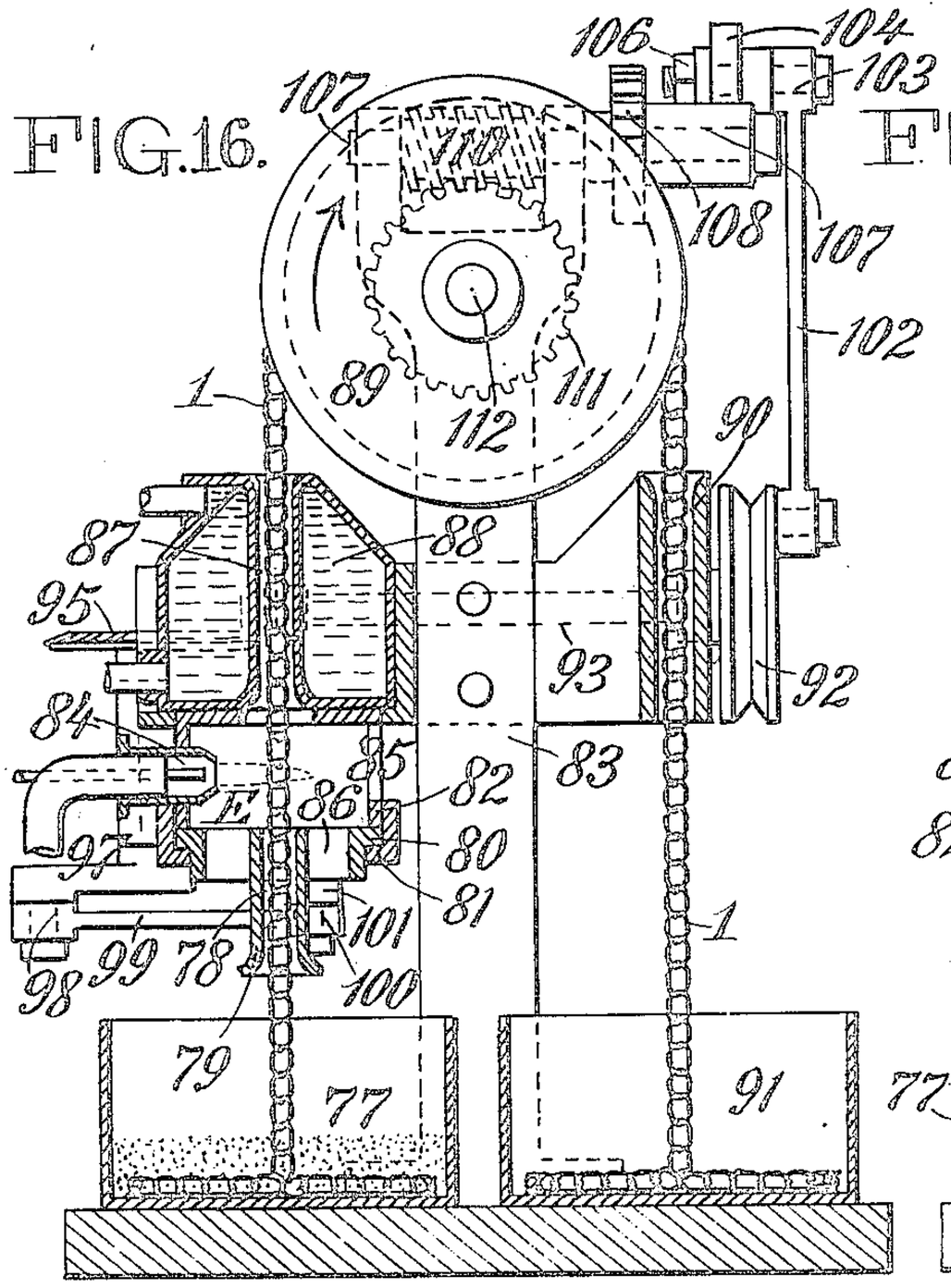


FIG. 17.

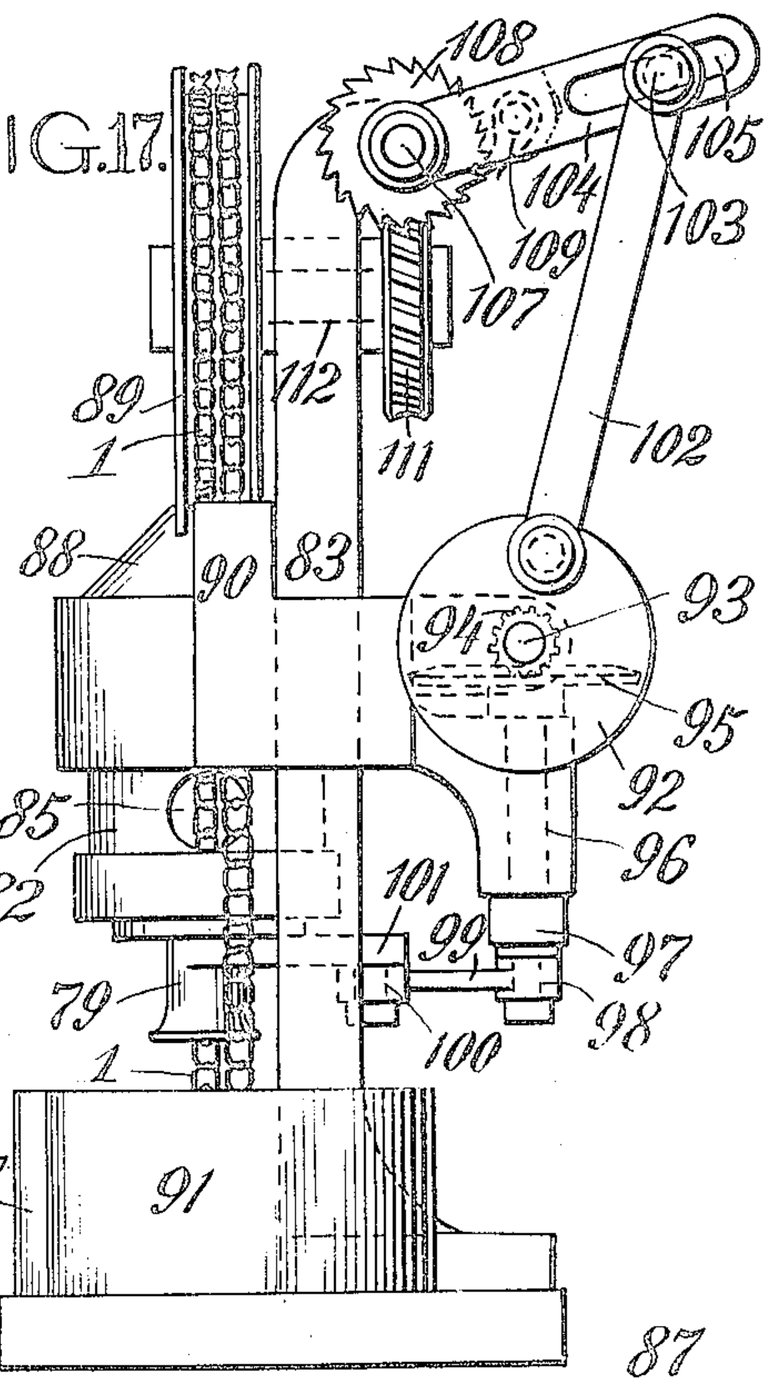


FIG. 18.

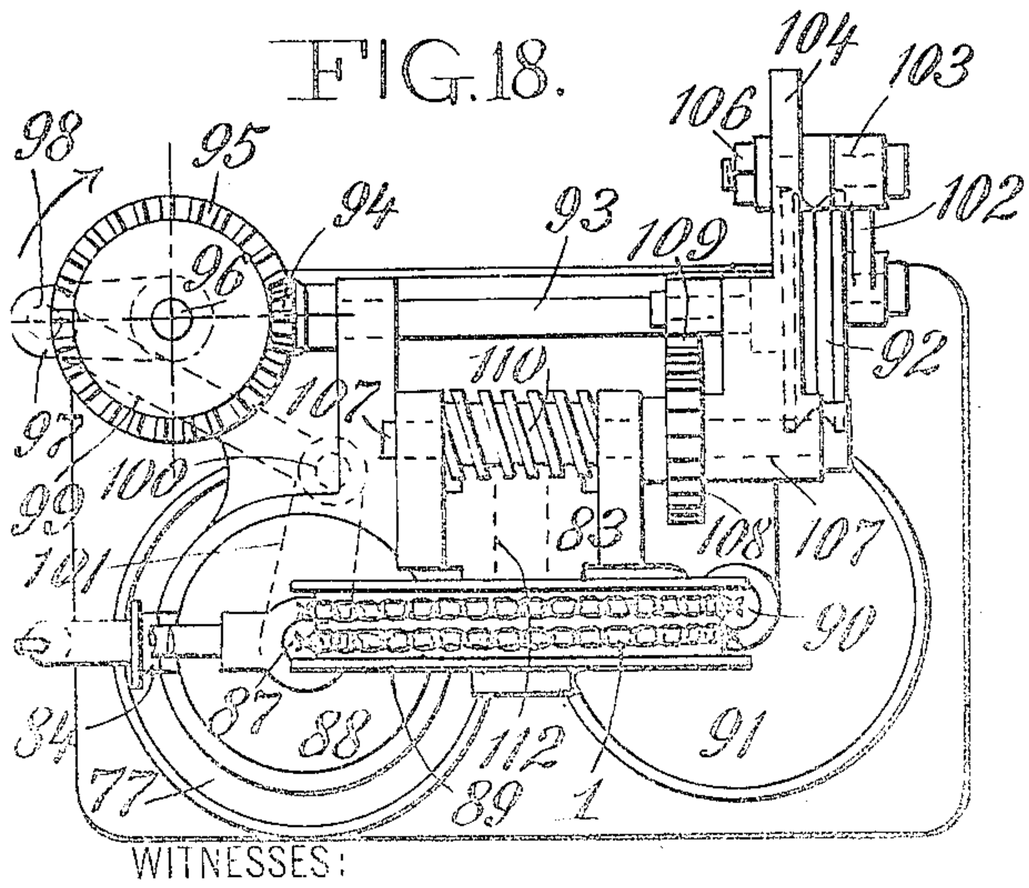


FIG. 19.

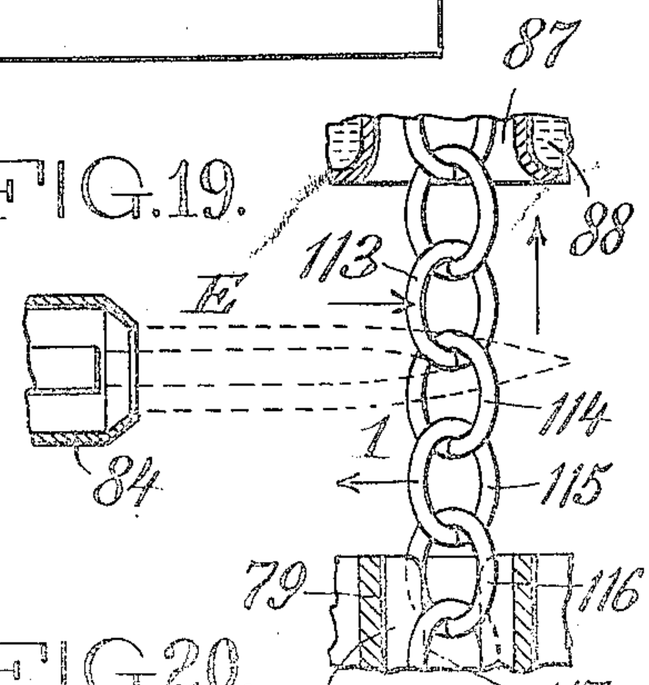
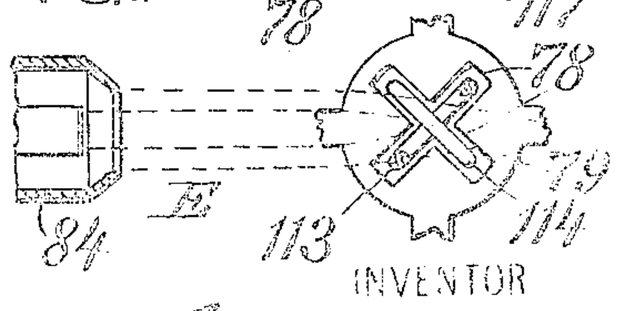


FIG. 20.



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UNITED STATES PATENT OFFICE.

GEORGE HILLARD BENJAMIN, OF NEW YORK, N. Y.

METHOD OF SOLDERING CHAINS.

962,413. Specification of Letters Patent. Patented June 28, 1910.

Application filed May 13, 1909. Serial No. 495,617.

To all whom it may concern:

Be it known that I, GEORGE HILLARD BENJAMIN, a citizen of the United States, residing at the city, county, and State of New York, have invented certain new and useful Improvements in Methods of Soldering Chains, of which the following is a specification.

This invention relates to chain making and is especially applicable to the making of chains of the finer type such as watch chains, etc., and is particularly directed to machines for automatically soldering the link ends while the links are connected.

Previous to this time great difficulty has been experienced in the completion of chains of this type owing to the fact that the excessive heat required to heat the link ends tends to distort the links themselves and in other ways injure the same. My invention is intended to obviate difficulties of this nature and to render feasible the soldering of the link joints without material distortion of the links.

My further aim is to devise a method of treating the chain before subjecting it to the flame and then rendering the flame effective in such a manner that the spreading of solder from the joints and on plated metal will be effectually avoided and serious injury to the chain prevented.

In the forms shown in the accompanying drawings I have devised a method of manipulating chains so that the joints of the links are more subject to the heat of the flame or flames in their passage through the heating zone than are the body portions of the links. That portion of the chain which is in the heating zone of the flame is subjected to substantially continuous oscillation during its forward movement. This oscillation is so governed with relation to the movement of the chain through the flame or flames that it operates to bring each link joint into the correct position to receive a maximum of heat from the flame when directly in the path thereof and to immediately withdraw the link proper to a position wherein the body of the link passing through the flame will receive a minimum of heat. The advantages of this treatment of the chain are further enhanced by subjecting the chain to an acid cleaning solution and then passing it through magnesia or a similar material. In the form of chain shown, the solder for the joints is contained within the body of the chain, although it may be applied otherwise. Upon being coated with magnesia as described, the chain is passed through the flames with an oscillatory movement and the magnesia prevents the tendency of the solder to flow, although, as previously stated, this tendency will be considerably less than hitherto, owing to the manner in which it is subjected to the action of the flame.

It is to be understod that my invention is not limited to the continuous oscillation of the chain during its forward movement through the flames, nor to the special method of applying the solder, the machines shown in the accompanying drawings being intended merely to illustrate certain methods which I may employ to continuously pass the unsoldered links in chain form through a flame or flames and synchronously manipulate the chain in such a manner that the joints of the links and the solder carried thereby are subjected to a maximum degree of heat while the body of the chain is subjected to a minimum degree of heat.

In the arrangements illustrated in the drawings, the chain is first passed through a cleansing solution, then passed through a protective non-oxidizing gas and finally coated with magnesia previous to its passage through the flames. These operations preferably all take place during the continuous forward movement of the chain.

In the accompanying drawing, Figure 1 is a sectional elevation of a machine for carrying out this invention. Fig. 2 is an end elevation, partly in section. Fig. 3 is a plan view, partly in section. Fig. 4 is an enlarged sectional view showing a series of links and the operation of treating the joints. Fig. 5 is a very much enlarged view of the links, partly in section, showing the contained fusible solder, and two abutting ends of the wire which are to be united. Figs. 6, 7, 8, and 9 are sectional plan views of parts shown in Fig. 4, and showing successive stages in the operation. Fig. 10 is a sectional elevation of a modification of the machine shown in Figs. 1, 2, and 3. Fig. 11 is an end view, partly in section, and Fig. 12 is a sectional plan view, of the machine shown in Fig. 10. Fig. 13 is an enlarged sectional view on the line XIII—XIII of Fig. 12, showing a series of links and the operation of heating the joints. Figs. 14 and 15 are sectional plan views, on corresponding lines of Fig. 13, showing successive stages through

which the chain passes. Fig. 16 is a sectional view of a modified machine. Fig. 17 is an end elevation, and Fig. 18 is a plan view of the machine shown in Fig. 16. Figs. 19 and 20 are enlarged views of a series of links showing the operation of heating the joints by means of the machine shown in Figs. 16, 17, and 18.

The chain 1 as it comes from a chain-making machine is composed of a series of links each of which comprises a bent wire 2, having abutting ends as shown in Figs. 4 and 5.

As shown in Fig. 5, the wire 2 of which the links are made, is composed of a tube of plater's metal 3, having an outer metallic coating which may be of gold, and a central wire core 5 of plater's metal with an intermediate annular filling or tube of solder 4.

When heat is applied to the abutting ends of wire made as just described, the solder melts and flows into the space 6 between the abutting ends, and, owing to the fact that the solder is distributed between the central wire 5 and the outer tube 3, it lodges between the abutting ends of the core and also between the abutting ends of the outer tube, whereas if the solder were contained only in the center of a tube, it would run too freely in consequence of there being too small a proportion of the infusible metal in the path of the flowing solder.

In the machine illustrated in Figs. 1, 2, and 3, the chain which has been formed in a chain-making machine is led from the receptacle 7, over a pulley 8, through an acid cleaning solution in the vessel 9, to prepare the surfaces of the abutting link ends for the soldering operation, and into the chamber 15, which is filled with a non-oxidizing gas, through pipes 16 and 17. The chamber 15 is connected through the tube or nipple 12 with the chamber 10, having a partition 11 sealed in the acid cleaning solution, and a cover 13, vertically slidable on the nipple 12, in order that the vessel 9 may be removed or changed when necessary. Inasmuch as the chamber 15 is filled with a non-oxidizing gas, oxidation of the chain is prevented, and as it passes the orifice of pipe 20, moving over the roller 18 to the drain 19, magnesia is deposited thereon to protect the outer surface of the links from amalgamating with the solder, the surplus of magnesia falling into a box or drawer 21.

The chain is fed forward by the rotation of the drum 19, and moves downward between the guides 22 carried by the oscillator which comprises upper and lower members 23 and connecting bar 24, mounted in the cylinder 25, constituting the soldering chamber and secured to the standard or frame 14.

The blow-pipe burners 26, 27, mounted in the cylinder 25, are connected with gas and air supply pipes 28 and 29, respectively, and project flames A and B upon the chain as it passes through the oscillator. Vents 30 and 31, in the cylinder 25, permit the escape of the hot products of combustion and prevent the undesirable heating of the chain.

For the purpose of rotating the oscillator, an arm 32 is connected by a link 33 to a bell-crank lever 34, pivoted at 35, and connected by means of rod 36, to a crank 37, on the shaft 38, which is connected to a source of power through pulley 39. One revolution of the crank 37 causes the oscillator 23, to make an oscillation of one-third of a revolution in each direction.

In order that the chain shall be moved forward a distance of one link for each quarter revolution of the crank shaft 38, the chain driving drum 19, is connected therewith through the worm and gear 44, 45, and the belt 41, passing over the cone-pulleys 40, 42, the relative movement being determined by the position of the belt-shifter 47 which is regulated to suit the length of links composing the chain. In this manner the shaft 43 may move more or less rapidly than the shaft 38, which actuates the oscillator, whereby the proper length of chain fed forward during each oscillation may be adjusted to suit the particular length of links.

The manner of directing the flame principally upon the joints while the chain is passing through the soldering chamber will be clearly understood by reference to Figs. 4 to 9, inclusive. It will be observed that in passing through the upper and lower members of the oscillator, the right-angled slots of the guides 22, cause the alternate links to assume positions in quadrature. The flames A and B of the blow-pipes 26, 27, are directed upon the joints when the links are in planes displaced 45° therefrom. The effect of the oscillatory movement of the chain as it is moved through the flames may be traced as follows:—Starting with the chain in the position shown in Fig. 4, if the chain is fed downward and at the same time oscillated in the direction of the arrow pointing to the left, the lower end of link 50 will pass the flame A, and during the last part of the quarter revolution the flame will be directed upon the joint of link 49, indicated at the lower V in Fig. 4. The links will have swung from the position shown in Fig. 6 to that in Fig. 7, the crank moving through one quarter revolution and the chain moving downward the distance equal to the length of one link. While the crank 37 is making the next quarter revolution across the lower arc, the chain will be oscillated slightly to the position shown in dotted lines in Fig. 7, and back to the position shown in full lines, the chain moving downward the length of a link, causing the flame A to be directed toward the upper part of link 50 as shown in Fig. 8, and at V in Fig. 4. During the next quarter revolution of the crank 37, the

chain will be oscillated in the direction of the arrow pointing to the right in Figs. 4 and 8, the chain will have moved downward the length of a link, causing the flame A to move past the lower end of link 52 and then to impinge upon the joint of link 51 as indicated by the line A^1 in Fig. 4. While the crank is making the next quarter revolution across the upper arc, the chain will be oscillated slightly to the position shown in dotted lines in Fig. 9, and back to the position shown in full lines, the chain meantime moving downward the length of a link, causing the flame A to impinge upon the joint of link 52 as shown in dotted lines at A^2 in Fig. 4. It will be seen that the flame A impinges upon the joints of the links during the greater portion of the time.

The flame B is spaced a distance equal to the length of a link from the flame A, and accordingly will operate upon the links of the chain in the manner described with regard to flame A. It will be observed that during the oscillatory downward movement of the chain, each of the flames will operate upon successive contiguous links. Due to the movement described, the chain as a whole will not be greatly heated, thereby preventing the distortion of the links and the separation of the abutting ends, while only a sufficient amount of solder will flow to fill the joint, any escaping solder being prevented by the magnesia from adhering to the outer surface. As the finished chain leaves the oscillator, it is immediately cooled by passing through a tube 53 surrounded by a water-cooled jacket 54, and is deposited in a receptacle 55.

In Figs. 10 to 15, inclusive, I have shown a machine which operates in substantially the same manner as that previously described, but differs in certain particulars, as hereinafter indicated.

The oscillator 23 is connected by means of radial arm 56 and link 57 to the lever 58, which is centrally pivoted at 59, and is provided with a slot 60 in its upper end, for the crank-pin 61, the crank 62 being secured to the driving shaft 63, which is connected to a source of power by means of pulley 64. One revolution of the shaft 63 causes the oscillator to make a quarter turn in each direction.

Secured to shaft 63 is a cone pulley 65, over which passes a belt 66 riding over another pulley 67 secured to a shaft 68. Also secured to the shaft 68 is a worm 69 in mesh with a worm wheel 70 secured to a shaft 46 to which is secured the driving drum 19. Rotation of the worm 69 by means of the belt and cone pulleys causes forward movement of the chain equal to the length of one link for each revolution of crank 62. In order to adjust the forward movement of the chain to suit different lengths of links, the belt 66 is shifted by means of the belt shifter 71, so that the shaft carrying the worm will move more or less than the shaft which actuates the oscillator, whereby the oscillator will continue to make one quarter turn in each direction for each revolution of the shaft 63, although the shaft 68 carrying the worm may make more or less than a revolution for one of shaft 63, and thereby cause different lengths of forward movement of the chain during an oscillatory movement.

As shown in Figs. 13 and 14, the flame C from burner 26 at the end of each reciprocation is directed toward the chain on a line between the two series of links placed at right angles to each other, similar to flame A in Fig. 1, whereas, as shown in Figs. 13 and 15, the flame D from burner 27 at the end of each reciprocation is directed toward the chain on a line parallel with a series of the links.

With the chain moving continuously downward the action of flame C on the chain as shown in Figs. 13 and 14, will be as follows:—Starting with flame C striking the joint of link 72, when the downwardly moving chain is oscillated in the direction indicated by the arrow pointing to the left, flame C will be momentarily intercepted by the lower end of link 74 and it will only be at the last part of the oscillation in that direction that flame C will strike the joint of link 73 as shown to the right of Fig. 14. Then while the chain, still moving downwardly, is oscillated in the direction of the arrow pointing to the right, the lower end of link 75 will be moving past flame C and at the last part of the oscillation in that direction, flame C will strike the joint of link 74. During the next oscillation, the flame C will heat the lower end of link 76 during the first part of the oscillation in one direction, heating the joint of link 75 at the last, and during the oscillation in the opposite direction, the flame C will heat the upper end of link 76 during the oscillation in that direction. Starting again, with flame D striking the joint of link 73, (and on a line with the link), if the chain is oscillated in the direction indicated by the arrow pointing to the left in Fig. 13, while the chain is moving continuously downward, the lower end of link 75 will be moving past flame D and at the last part of the oscillation in that direction, flame D will strike the joint of link 74 as shown to the right of Fig. 15. Then if the chain is oscillated in the direction indicated by the arrow pointing to the right in Fig. 13, flame D will be moving past the lower end of link 76, and at the last part of the oscillation in that direction, will strike the joint of link 75. It will thus be seen that flame D heats the jointed ends of the links during the oscillation in either direction, whereas flame C

heats the jointed end of a link during oscillation in one direction, and has the one imperfection of heating the body of a link during the first part of an oscillation in the other direction. To overcome said imperfection, the oscillator is caused to move at a greater speed while the flame C is moving past the lower ends of the links. This is acomplished by means of the crank riding in the slot 60 of lever 58. As the crank pin 61, moving in the direction indicated by the arrow and riding in the slot 60, nears the pivot 59 of lever 58, it causes a much faster movement of the end of the lever to which the oscillator is connected.

In the machine shown by Figs. 16 to 20, inclusive, the unfinished chain 1, after being etched by a suitable solution, is placed in a receptacle 77 containing magnesia. The chain is then moved upwardly through guides 78 in an oscillator 79, which is provided with a flange 80 riding in a groove 81 at the lower end of a cylinder 82 attached to the frame 83. A blow-pipe burner 84 causes a flame E to be thrown horizontally across the path of the chain during its upward travel. Suitable vents 85 and 86 are provided for escape of hot products of combustion to prevent undesirable heating of the chain. The chain is then passed up through a tube 87, provided with a cooling jacket 88, and is looped around a rotating wheel 89, by which it is intermittently fed forward, guides 90 serving to keep the chain in engagement with the wheel as it descends into a receptacle 91.

A shaft 93, carrying pulley 92, connected to a source of power, is geared to the vertical shaft 96 by means of bevel pinion 94 and bevel gear 95. For the purpose of operating the oscillator, a crank 97 on the lower end of shaft 93, is connected by means of crank pin 98 and link 99 to the pin 100 on the crank 101, forming a part of the oscillator. Each revolution of the crank 101 causes the oscillator to make a quarter turn in each direction.

The drum 89 which feeds the chain forward is given an intermittent movement by means of a pawl and a ratchet. The drive pulley 92 is connected by means of link 102, pin 103, and lever 104, carrying ratchet 109, with ratchet wheel 108 carried by the shaft 107, which operates the drum 89 through worm 110 and worm-wheel 111. By this construction, an intermittent movement is imparted to the drum 89, and by the adjustment of the pin 103 in the slot 105 by means of a nut and screw 106, the amount of such intermittent movement may be regulated to correspond with the length of a link of the chain. Inasmuch as a rotary movement of the drum shaft 112 is caused by the movement of the lever 104 in one direction but not in the other, an intermittent forward motion will be imparted to the drum 89 and chain.

The bevel pinion 94 on the shaft 93 to which the drive pulley 92 is secured, is one-quarter of the diameter of the bevel gear wheel 94 which it drives, consequently the drive pulley will make four revolutions while the crank 97 is making one revolution, thereby causing a quarter revolution of the crank to one of the drive pulley.

The flame E at the end of an oscillatory movement of the chain in each direction, is directed toward the chain at an angle of 45° from each series of links.

The successive steps in the soldering operation of this modification are illustrated in Figs. 19 and 20. The joints are at the lower ends of the links and the chain is moved intermittently upward. During the intervals of rest, the flame E impinges upon a joint, as for instance, the link 113, and at this time the chain is oscillated as indicated by the arrow pointing to the right.

Fig. 19 represents link 113 as having just completed such an upward movement, followed by an oscillation to the right as above referred to. It will be seen that during this oscillation the flame E is heating the jointed end of link 113 to a greater extent than any other part of the link. The crank 97 will then be in the position shown in Fig. 18, and lever 104 will have returned to a position in readiness to cause another upward movement of the chain, as shown by Fig. 17. Crank 97, rotating in the direction indicated by the arrow, will then be moving over the "dead center", causing a very slight oscillation of the chain. During this time, drive pulley 92 will have made one complete revolution, causing the chain to move upward during the first part of the revolution, and to rest during the last part with the flame impinging against the joint of link 114. During the next quarter revolution of crank 97, the chain will be oscillated as indicated by the arrow pointing to the left, nearly a quarter turn, during which time drive pulley 92 will have made another complete revolution, causing the chain to move upward during the first part of the revolution, and to rest during the last part, with the flame impinging against the joint of link 115. As crank 97 moves forward, it will then move across the "dead center", causing a very slight oscillation of the chain, during which drive pulley 92 will have made another complete revolution, causing the chain to move upward during the first part of the revolution, and to rest during the last part, the flame then impinging against the joint of link 116. Continued movement of crank 97 will cause the chain to be oscillated in the direction indicated by the arrow pointing to the right, nearly a quarter turn, during which time drive pulley 92 will have made

another complete revolution, causing the chain to move upward during the first part of the revolution and to rest during the last part, the flame then impinging against the joint of link 117.

I have described several arrangements by which my invention may be carried out, but it is evident that changes may be made without departing from the spirit of the invention.

I claim:—

1. The method of fusing solder between the abutting ends of interconnected links which consists in passing said links successively through a heating flame, and in oscillating said links during their travel through the flame, whereby the body of each link is exposed to a minimum temperature, and the abutting ends exposed to a maximum temperature.

2. The method of fusing solder between the abutting ends of interconnected links which consists in moving said interconnected links through a heating flame and synchronously oscillating the portion passing through the flame.

3. The method of uniting solder-filled link-ends of a chain, which consists in passing the chain through a cleansing agent, coating the surface with a non-fluxing powder, passing the chain through a heating flame, guiding said link-ends in the center of the path of travel and oscillating the body of the links partially away from the flame, whereby said link ends are exposed to a greater degree of heat than the other portions of the chain.

4. The method of uniting the abutting ends of interconnected links having cores of solder, which consists in passing said links at a predetermined rate through a heating flame guiding said abutting ends in the center of the path of travel and simultaneously oscillating said links, whereby the body of each link is moved partially away from the flame and the abutting ends travel in range therewith.

5. The method of uniting the abutting ends of interconnected links having cores of solder which consists in passing said links successively through a heating flame, guiding said abutting ends in the center of the path of travel and oscillating the body of each of said links away from the flame in time with the successive travel of said bodies of said links through the flame, whereby said abutting ends are maintained in the path of the flame for a greater time than the body of the link.

6. The method of uniting the abutting ends of interconnected links of a chain which consists in treating the chain with a cleansing fluid, subjecting it to a protective non-oxidizing gas, coating the surface with a non-fluxing substance, passing the links successively through a heating zone, and simultaneously vibrating the portion within the heating zone.

7. The method of uniting the abutting ends of interconnected links having cores of solder, which consists in passing said links successively through a heating flame and oscillating said links in time with their travel through the flame, thereby maintaining said abutting ends in the path of the flame for a greater time than the body of the link; and in cooling the links as they emerge from the flame.

8. The method of uniting the abutting ends of interconnected links having cores of solder which consists in passing said links successively through a heating flame, and causing said abutting ends to come to rest in the path of said flame at the end of travel of each link through the flame; and in oscillating said links during the travel from one resting place to another.

9. The method of uniting the abutting ends of interconnected links having cores of solder, which consists in passing said links successively and intermittently through a heating flame and causing said abutting ends to come to rest in the path of said flame; and in oscillating said links during the travel from one resting place to another.

In testimony whereof, I affix my signature, in the presence of two witnesses.

GEORGE HILLARD BENJAMIN.

Witnesses:
ERNEST D. CONDIT,
ELIZABETH BARNETT.