Sept. 2, 1958 J. J. SCANLON ET AL 2,850,163

ELECTRICALLY HEATED VIBRATING SCREEN

Filed Feb. 23, 1954 5 Sheets-Sheet 1

Fig. 1.

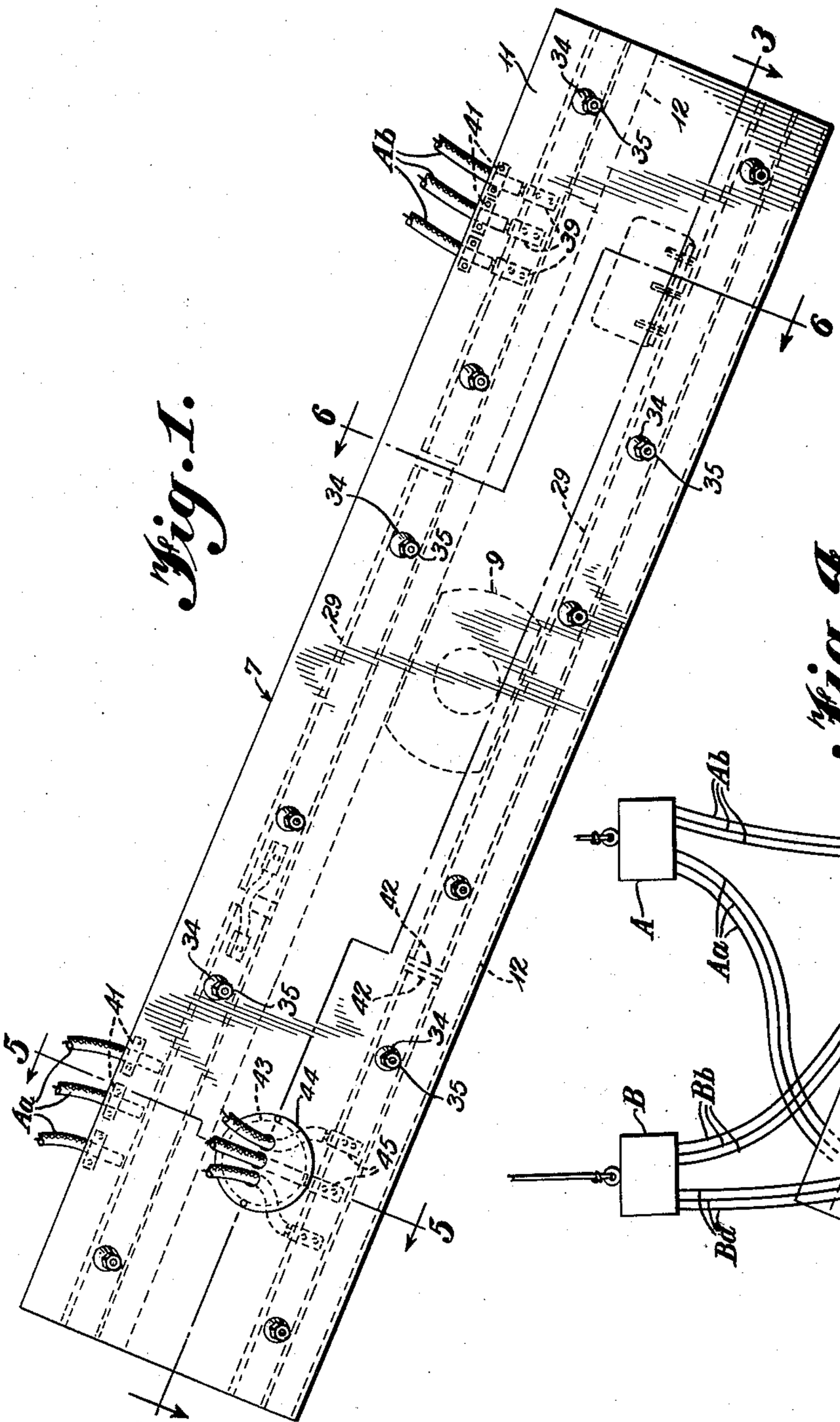

Fig. 4.

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Fig. 2.

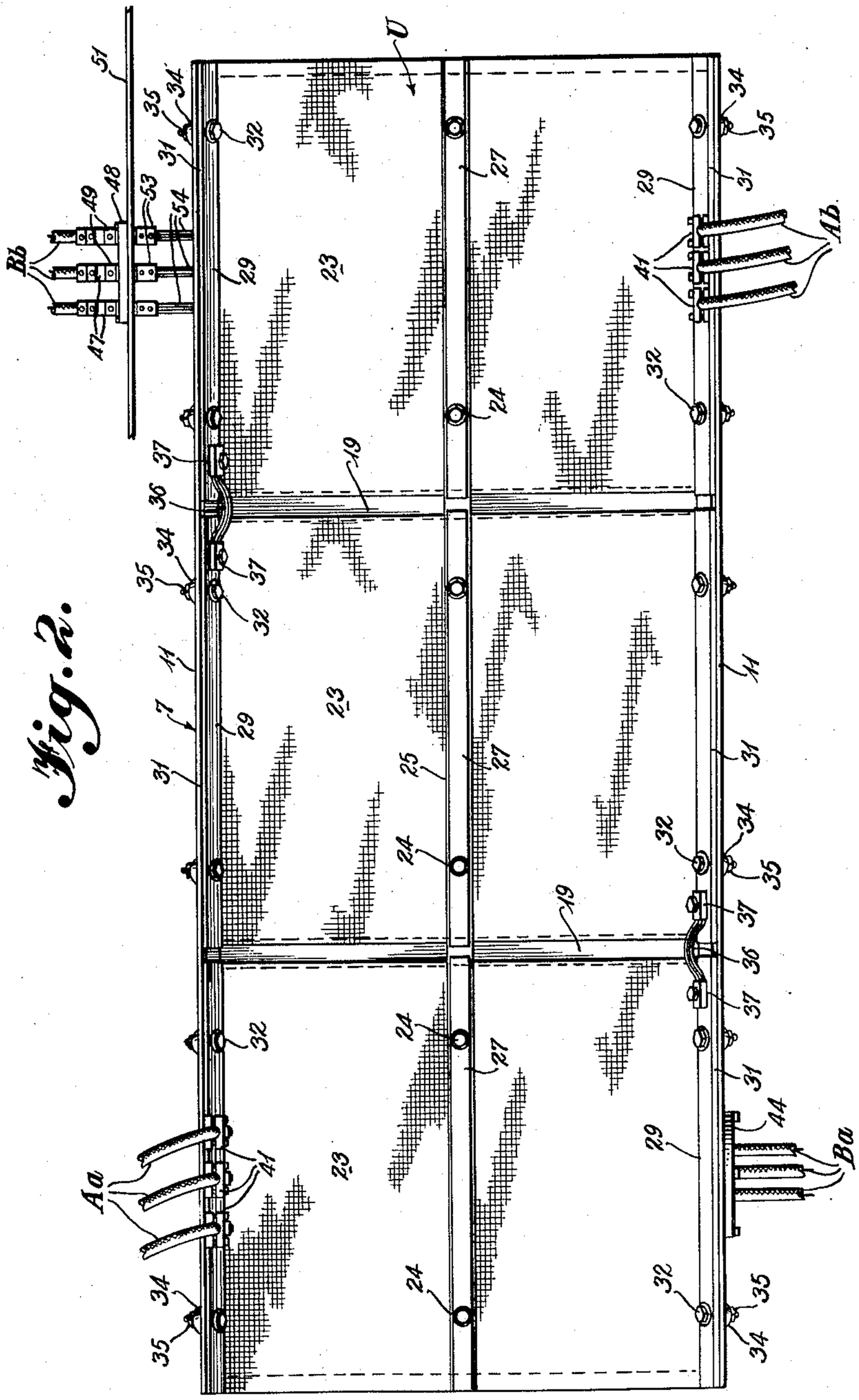

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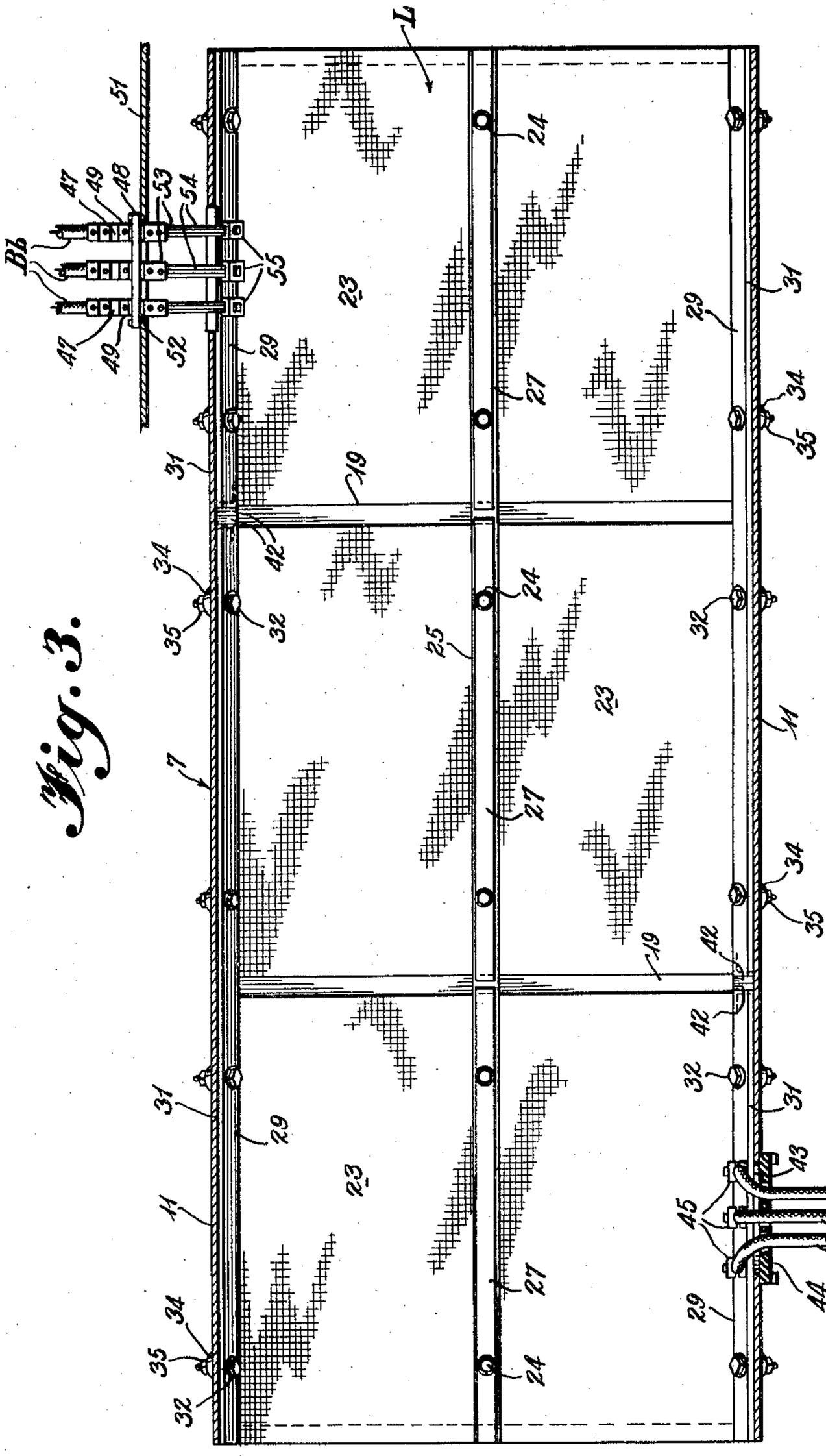
Fig. 3.



ELECTRICALLY HEATED VIBRATING SCREEN

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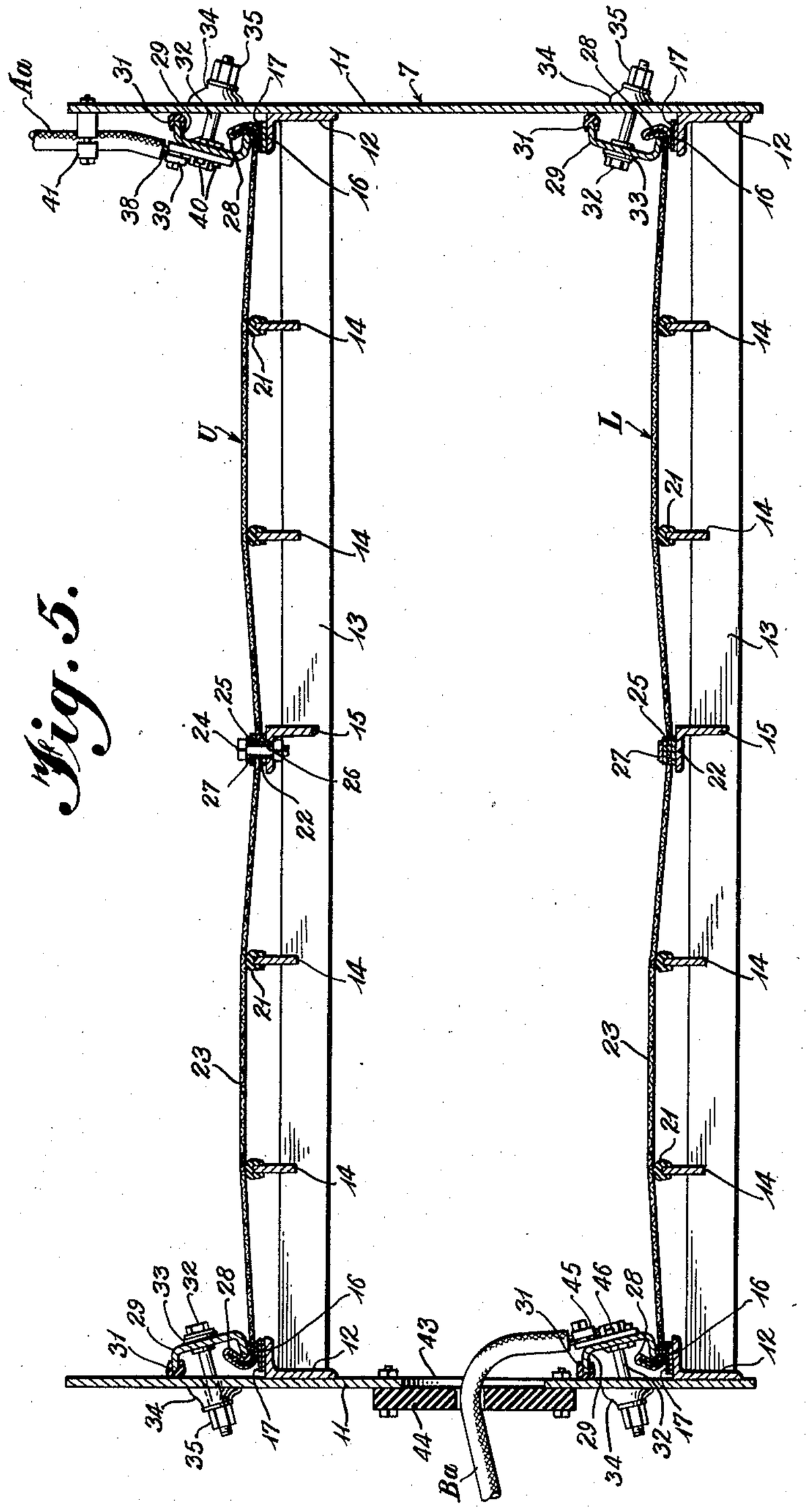
Fig. 5.



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ELECTRICALLY HEATED VIBRATING SCREEN

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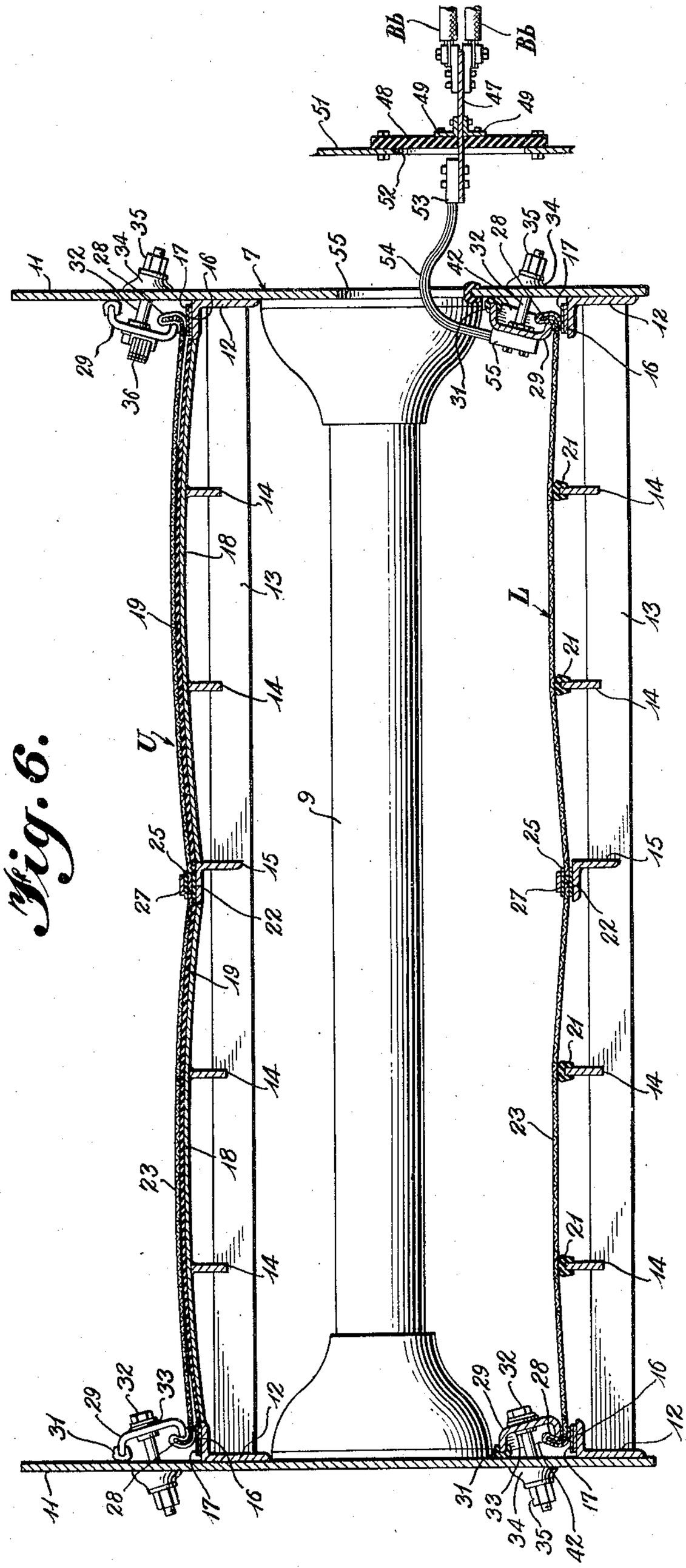
Fig. 6.



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ELECTRICALLY HEATED VIBRATING SCREEN

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Application February 23, 1954, Serial No. 411,707

11 Claims. (Cl. 209—238)

This invention relates to new and useful improvements in vibrating screens and deals more particularly with screen decks that are heated to facilitate handling of wet and sticky materials.

The practice of heating screen decks by the passage of electrical currents therethrough is well known in the art of handling wet or sticky material. Its use, however, has been somewhat limited by the difficulties encountered in preventing shorting of the current through the screen frame with the attendant loss of heating efficiency, and by the difficulties in maintaining a continuous electrical circuit in a device that is vibrated at a relatively high frequency over long periods of time. It will be readily apparent that vibrations of, for example, a frequency of 1,000 per minute and a magnitude of ¼ inch are conducive to the fatigue failure of electrical cables, connectors and the like such as are used in most electrical circuits.

A further difficulty encountered in the electrical heating of vibrating screen decks is the adaptability of the conductor elements for connection with the lower or middle decks of a multiple deck screen. In other words, the insulation of the several decks from the screen frame, and the supplying of electrical energy to the individual decks involves somewhat different problems depending upon their locations.

As examples of these difficulties in connection with bottom and intermediate screen decks, it is noted that the passage of supply cables through the walls of a screen frame may involve the loss of a substantial amount of electrical energy through induction heating of the frame. Further, the inaccessibility of the bottom and intermediate screen decks makes desirable the use of every precaution to prevent wear, or other failure, of the electrical components of such decks.

It is the primary object of this invention to provide a vibrating screen having a screen deck which is so insulated from the screen frame that an electric current may be passed through the deck without loss of electrical energy by shorting of the circuit despite long periods of operation under adverse conditions.

A further important object of the invention is to provide a vibrating screen having a deck including a plurality of screening elements that are electrically insulated from each other and are connected in series in a closed circuit with the elements so mounted as to greatly prolong their life.

A further important object of the invention relates to electrically heating a single screen cloth, and more particularly a plurality of screen cloths connected electrically in series, through improved means of current feeding and distribution, and in the mechanical form of the insulating components.

Other important objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this

specification and in which like reference characters are employed to designate like parts throughout the same,

Figure 1 is a side elevational view of a vibrating screen embodying the invention,

Figure 2 is a top plan view of the screen illustrated in Fig. 1,

Figure 3 is a longitudinal sectional view taken on line 3—3 of Fig. 1,

Figure 4 is a diagrammatic view showing the arrangement of the transformers for supplying electrical energy to the screen decks,

Figure 5 is a transverse sectional view taken on line 5—5 of Fig. 1, and

Figure 6 is a transverse sectional view taken on line 6—6 of Fig. 1.

In the drawings, wherein, for the purpose of illustration is shown a preferred embodiment of the invention, and first particularly referring to Figs. 1, 4 and 6, reference character **7** designates a screen frame that is suitably resiliently supported by springs **8**, or the like, as illustrated in Fig. 4. The frame **7** is vibrated by any suitable unbalanced or eccentric shaft, not shown, that is to be passed through the housing **9** and driven by any suitable prime mover, not shown.

Suspended above the screen frame **7** are two transformers A and B, as illustrated in Fig. 4. The transformer A is provided with supply cables A*a* and A*b* which are connected to the upper deck of the screen frame **7**, and the transformer B is provided with cables B*a* and B*b* that are connected to the lower deck of the screen frame **7**, as will be later described.

Referring now to Figs. 1 to 3, inclusive, **5** and **6** for a detail description of the screen frame **7** and its associated elements, it will be noted that the frame includes two spaced side walls **11**. Mounted longitudinally of the opposed, inner faces of the walls **11** are inwardly flanged members **12** that are arranged in opposed pairs at vertically spaced locations. Cross members **13** extend between the upper and lower pairs of members **12** below their inwardly extending flanges and are welded, or otherwise suitably connected, to the members **12** to rigidly connect the side walls **11**. A plurality of longitudinally extending supporting members **14** are mounted at laterally spaced points on the upper and lower cross members **13** and project upwardly therefrom to directly support the screening cloths of the upper and lower screen decks U and L, respectively, at levels above the tops of the cross members **13**. Angle irons **15** are mounted on the cross members **13** of both screen decks at the longitudinal center line of the frame **7** with their top surfaces at the approximate levels of the upper and lower pairs of inwardly extending flanges of the members **12**.

Mounted on and secured to the upper face of the flange of each member **12** is a strip of rubber or other suitable electrical insulating material **16**. Bonded to the upper face of each insulating strip **16** is a second strip **17** of metal or plastic material having adequate mechanical strength to resist piercing due to tensioning of the screen cloth or vibrations.

As illustrated in connection with the upper pair of opposed flange members **12**, in Fig. 6 of the drawings, bridging strips **18** are suitably connected to the inner edge portions of the flanges and extend across the tops of the screen cloth supporting members **14** for connection with the angle irons **15**. As is further illustrated in Figs. 2 and 3, the bridging strips **18** have strips of suitable electrical insulating material **19** bonded to the tops thereof and are spaced longitudinally of the screen frame **7** to divide the interior of the frame into three equal portions. Bonded to the tops of the deck supporting members **14** and the angle irons **15** are strips of

suitable electrical insulating material 21 and 22, respectively.

The upper and lower screen decks U and L, respectively, are each provided with three separate screen cloths 23 that are connected to the angle irons 15 at the center line of the frame 7 by bolts 24. The cloths 23, however, are completely insulated from the bolts 24 and the angle irons 15 by the strips of insulating material 22, the strips of insulating material 25 that are positioned on the top surfaces of the cloths above the strips 22, and insulating collars 26 which surround those portions of the bolts that extend through the strips of insulating material and the screen cloths. Above each strip of insulating material 25 is a strip of metal 27 which is suitably resistant to wear or erosion by the material passing over the screen deck. The metal strips 27 and the previously described strips 17 when made of metal are cut into sections which correspond with the lengths of the screen cloths 23.

Each of the screen cloths 23 extends laterally outwardly in opposite directions from its associated angle iron 15 to a position at which its side edges overlie the strips 17 of the flanged members 12 on opposite sides of the screen frame 7. That portion of each cloth 23 which lies between the angle iron 15 and the side edge of the cloth is supported by the insulation 21 of the supporting members 14 and the transverse edges of the cloths are supported by the insulation 19 of the bridging strips 18. The side edge portions of the screen cloths 23 which overlie the strips 17 are curled upwardly and may be encased in a metal sheath 28 to prevent straightening out or fraying.

Channel shaped tension plates 29, formed or extruded of low resistance metal, such as copper or aluminum, are provided at each side of both decks of the screen for tensioning the screen cloths 23 and for supplying electrical current to the screen cloths to cause heating of the latter. Referring first to Figs. 5 and 6 for a detail description of the plates 29 in connection with their function of tensioning the scren cloths 23, it will be noted that the plates are positioned with their lower edges projecting into the curled edge portions of the cloths 23. The upper edge of each plate 29 is provided with a strip of electrical insulating material 31 which rests against the associated side wall 11. Extending outwardly through each of the tension plates 29 are a number of bolts 32 which are each insulated from its plate by a flanged insulating bushing 33. The threaded outer end portions of the bolts 32 extend through openings in the side walls 11 and lugs 34 on the outer sides of the walls for receiving the nuts 35 by which the lower edges of the tension plates 29 may be drawn toward their associated side walls. This movement of the lower edges of the tension plates 29 will in turn impart the necessary tension to the screen cloths 23 and will insure electrical contact between the tension plates and the sheaths 28 on the curled edges of the cloths.

Referring now to Fig. 2 for a detail description of the tension plates 29 associated with the screen cloths 23 of the upper deck U of the screen, it will be noted that a separate tension plate is provided for each curled edge of each of the three screen cloths employed and that sufficient space is provided between adjacent ends of the tension plates to prevent the flow of electrical current therebetween. A braided electrical connector or jumper 36 is connected by lugs 37 to the adjacent end portions of the middle and one end tension plate 29 on one side of the screen frame 7 and a similar connection is provided between the middle and the opposite end tension plate at the other side of the screen frame. In other words, the tension plates 29 are so electrically connected to each other as to provide longitudinally staggered pairs with a separate tension plate opposing the end plate of each of such pairs. The supply cables A*a* and A*b* from the transformer A are connected to the separate tension plates 29 at opposite ends of the screen frame 7 so that the three screen cloths 23 and their associated tension plates are connected in series between these cables.

The connection between the cables A*a* and their associated tension plate is best illustrated in Fig. 5 and will be described as follows:

Each of the cables A*a* is fully insulated except at its end portion 38 which is rigidly connected to the cable fitting 39. The fitting 39 is in turn rigidly connected to the tension plate 29 by bolts 40, or the like. At a point adjacent the end portion 38 of each cable A*a*, the insulated portion is secured to the side plate 11 by a split clamp 41 to prevent flexure of the cable at its point of connection with the cable fitting 33. This clamping of the cables A*a* to the side plate 11 will cause the flexure of the cables, due to vibration of the screen, to be absorbed throughout the entire lengths of the cables and will substantially prevent the breaking of the cables by repeated bending at the points of connection to the fittings 39 attached to the tension plate 29.

The connections between the cable A*b* and their associated tension plate 29 are identical to those described above and will not be repeated.

Referring now to Fig. 3 for a detail description of the arrangement of the tension plates 29 associated with the screen cloths 23 of the lower deck L, it will be noted that two of the tension plates are each of sufficient length to fully engage the curled edge portions of two adjacent screen cloths 23. These two tension plates are staggered longitudinally on opposite sides of the screen frame 7. Additional tension plates 29, each having a length equal to only one cloth, are arranged in the diagonal corners of the frame 7 to occupy the spaces not filled by the double length tension plates. This arrangement of tension plates 29, therefore, gives the same effect as that of the upper deck U of the screen but without the need for employing jumpers 36 to provide the electrical continuity between two of the tension plates for each side of the frame 7.

Mounted on the adjacent ends of the longitudinally aligned tension plates 29 of the lower deck L are insulating blocks 42 which maintain the proper spacing between the tension plates and positively insulate the single length tension plates from the double length plates.

As is best illustrated in Figs. 1, 3 and 5, the cables B*a* are introduced through a relatively large opening 43 formed in one side wall 11 to prevent inductive heating of the screen frame 7 by the flow of current through the cables. The cables B*a* are supported in the opening 43 by a plate 44 of insulating material having three relatively small openings through which the separate cables pass. The inner ends of the cables B*a* are uninsulated and are rigidly connected to fittings 45 which are in turn rigidly connected by bolts 46 to the single length tension plate 29 at one end of the screen.

As is best illustrated in Figs. 2, 3 and 6, the cables B*b*, are rigidly connected to the buses 47 that extend through the plate of insulating material 48 and are fastened thereto by brackets 49. The plate 48 is, in turn, mounted on a stationary member 51 having a relatively large opening 52 therethrough for receiving the inner ends of the buses 47. The stationary member 51 is intended to represent a portion of a supporting frame for the screen, an enclosure or housing for the screen, or any similar structure which may be provided in certain installations.

Connected to the inner end of each bus 47 by a cable lug 53 is a flexible braided cable 54 which extends through the enlarged opening 55 in the side wall 11 and is clamped by a cable lug 55 to the single length tension plate 29 at the opposite end and side of the screen frame 7 from the cables B*a*.

The operation of the screen embodying the invention

permits the handling of wet and sticky material by heating the screen decks as follows:

Electrical energy is supplied to the screen cloths 23 of the upper deck U by the transformer A through the cables A*a* and A*b* and to the screen cloths 23 of the lower deck by the transformer B through the cables B*a* and B*b*. In this connection it will be noted that the cables on the transformer A are so connected to their associated plates 29 as to prevent fatigue failure of the cables or deterioration of the insulation on the cables. The cables from the transformer B are so connected to their associated tension plates 29 as to prevent fatigue failure of the cables or destruction of the insulation and additionally are so introduced through the side walls 11 of the screen frame as to substantially prevent the loss of electrical energy by induction heating of the side walls. The three screen cloths of each deck are connected in series by their associated tension plates 29 and both the tension plates and screen cloths are completely insulated from any other components of the screen in such a manner as to prevent deterioration of the insulation and the consequent loss of electrical energy by shorting of the circuits through the decks.

It is to be understood that the form of this invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described the invention, we claim:

1. In a vibrating screen, a screen frame having laterally spaced side walls, each of said side walls having an opening therethrough with the openings located at opposite ends of said frame, an inwardly extending flange mounted on each of said side walls at a level below said openings, tension plate means operatively associated with the side walls and supported by their flanges against vertical movement, means for electrically insulating said tension plate means from the side walls and their flanges, a plurality of screen cloths electrically connected at their sides to said tension plate means, a plurality of tensioning members connecting said tension plate means to their associated side walls for tensioning the screen cloths between the side walls, means for electrically insulating said tensioning members from said tension plate means, a stationary plate positioned in spaced relationship with one of said side walls and having an opening in alignment with the opening in said one wall, an electrical insulating member mounted on said stationary plate to bridge its opening, conducting bars mounted on and extending through said insulating member to be insulated from the stationary plate, a set of flexible cables each electrically connected to the inner end of a conducting bar and extending through the aligned side wall opening in spaced relationship with the wall, means for electrically connecting said flexible cables to the tension plate means adjacent said aligned side wall opening, a second set of cables extending through the opening in the other side wall, means electrically connecting the supply cables to the tension plate means adjacent the last mentioned opening, electrical insulating means bridging the last mentioned opening for supporting said cables in spaced relationship with the wall, and means for electrically connecting all of the tension plate means and the screen cloths in a single series circuit with the two sets of cables.

2. In a vibrating screen, a screen frame having laterally spaced side walls, a pair of inwardly extending flanges mounted in vertical spaced relationship on each of said side walls and each pair being in laterally aligned relationship with the pair of flanges on the other wall, each of said walls having an opening therethrough between its upper and lower flanges, a plurality of tension plates operatively associated with and supported by each one of said flanges, means for electrically insulating said

tension plates from their side walls and flanges, upper and lower screen decks each formed of a plurality of screen cloths spaced relative to each other longitudinally of its deck, each screen cloth being electrically connected at its sides to tension plates associated with opposite side walls of the frame, means electrically insulating said screen cloths of each deck from each other, a plurality of tensioning members connecting said tension plates to their associated side walls for tensioning the screen cloths between the side walls, means for electrically insulating said tensioning members from said tension plates, two sets of supply cables electrically connected to the diagonally arranged end tension plates of the upper deck, means electrically connecting the tension plates and cloths of said upper deck in a single series circuit with the aforesaid two sets of supply cables, means for rigidly connecting each cable of said two sets to and insulating it from the side wall associated with its connected tension plate, two additional sets of supply cables extending through the openings in said side walls and electrically connected to the diagonally arranged end tension plates of the lower deck, means electrically connecting the tension plates and cloths of said lower deck in a single series circuit with the two additional sets of cables, and means supporting each cable of said two additional sets in its opening in spaced relationship with the side wall associated with its connected tension plate.

3. In a vibrating screen, a screen frame having laterally spaced side walls, an inwardly extending flange mounted on each of said side walls, a strip of electrical insulating material attached to the top of each flange, a protective strip attached to the top of each strip of insulating material, a plurality of tension plates having their lower longitudinal edge portions resting upon said protective strips and their upper longitudinal edge portions inclined outwardly toward the side walls, a strip of electrical insulating material attached to the upper longitudinal edge portion of each tension plate and engaging the adjacent side wall, a screen deck formed of a plurality of longitudinally spaced screen cloths electrically connected at the sides of the box to the lower edge portions of said tension plates, a plurality of bridging members extending transversely between said flanges below the spaced edges of adjacent cloths, a strip of insulating material attached to the top of each bridging member for supporting the spaced edges of said cloths, a plurality of deck supporting members extending longitudinally of said box below said cloths, a strip of insulating material attached to the top of each deck supporting member for supporting said cloths, a plurality of tensioning members connecting said tension plates to their associated side walls for tensioning the screen cloths between the side wals, an electrical insulating member positioned between each of said tensioning members and its associated tension plate, supply cables electrically connected to the diagonally arranged end tension plates, an electrical connector between each one of said diagonally arranged end tension plates and the next adjacent one of the remaining tension plates to provide a single series circuit through said tension plates and screen cloths, and a clamp ragidly connecting each cable to and insulating it from the side wall associated with its connected tension plate.

4. In a vibrating screen, a screen frame having transversely spaced side walls, a plurality of pairs of transversely opposed tension plates operatively associated with said side walls, means for supporting said tension plates against vertical movement, mean for electrically insulating said tension plates from their side walls and supporting means, a screen deck formed of a plurality of longitudinally spaced screen cloths with each screen cloth electrically connected at its side edges to one of said pairs of opposed tension plates, respectively, means for electrically insulating said screen cloths from each other, a plurality of tensioning members cooperating with said

tension plates for tensioning the screen cloths between the side walls, means for supplying electricity to said screen deck including one set of supply cables connected directly to a tension plate at the feed end of said screen deck and another set of supply cables connected directly to another tension plate at the discharge end of said screen deck, and means for connecting the remaining tension plates to form a single series electrical circuit through all of said tension plates and screen cloths, said means including a plurality of jumpers electrically connecting pairs of adjacent tension plates and spanning the gaps between adjacent screens, one only of said jumpers being associated with each gap in said screen deck and successive gaps having their jumpers disposed on opposite sides of said deck.

5. In a vibrating screen, the combination as defined in claim 4 further characterized by a clamp for each of said cables mounted on a side wall in spaced relation to and above said tension plates, each of said clamps securely engaging its associated cable so as to cause that portion of the cable between said connecting means and said clamp to partake of the motion of said vibrating screen and to thereby prevent flexure of the cable at its point of connection to the tension plate.

6. In a vibrating screen, a screen frame having transversely spaced side walls, an inwardly extending flange mounted on each of said side walls, a plurality of longitudinally extending supporting members arranged at spaced intervals across said frame, a screen deck formed of a plurality of screen cloths spaced relative to each other longitudinally of said deck and supported by said longitudinal supporting members, a plurality of spaced tension plates, one of said tension plates being associated with and electrically connected to each side edge of each screen cloth, respectively, said tension plates being operatively associated with the side walls and supported by said flanges against vertical movement, means for electrically insulating said tension plates from said side walls and said flanges, means for electrically insulating said cloths from said supporting members and from each other, a plurality of tensioning members connecting said tension plates to their associated side walls for tensioning the screen cloth between the side walls, means for supplying electricity to said screen deck including one set of supply cables connected directly to a tension plate at the feed end of said screen deck and another set of supply cables connected directly to another tension plate at the discharge end of said screen deck, and means for electrically connecting the remaining tensioning plates to form a series electrical circuit through said tension plates and cloths, said means including a plurality of jumpers electrically connecting pairs of adjacent tension plates and spanning the gaps between adjacent screens, one only of said jumpers being associated with each screen gap, and successive gaps having their jumpers disposed on opposite sides of the screen deck.

7. In a vibrating screen, a screen frame having transversely spaced side walls, one of said side walls having an opening therethrough, tension plate means associated with each of said side walls, means for supporting said tension plate means at a level below the opening in said one wall, means for electrically insulating said tension plate means from said side walls and said supporting means, a screen cloth electrically connected at its side edges to said tension plate means, a plurality of tensioning members cooperating with said tension plate means to tension said screen cloths between said side walls, supply cables extending through the opening in said one side wall, a plate of insulating material covering said opening and having holes therethrough for receiving said supply cables and holding them away from the edges of the said opening, and cable clamps for fastening the ends of said supply cables directly to said tension plate means.

8. In a vibrating screen, a screen frame having transversely spaced side walls, one of said side walls having an opening therethrough, a stationary plate positioned in spaced relationship with said one side wall and having an opening in alignment with the opening in the latter, tension plate means associated with each of said side walls, means for supporting said tension plate means at a level below the opening in said one side wall, means for electrically insulating said tension plate means from said side walls and said supporting means, a screen cloth electrically connected at its side edges to said tension plate means, a plurality of tensioning members cooperating with said tension plate means to tension said screen cloth between said side walls, an electrical insulating member mounted on said stationary plate to bridge the opening therethrough, conducting bars mounted on and extending through said insulating member to be insulated from said stationary plate, a set of flexible cables each electrically connected to the inner end of a conducting bar and extending through the aligned side wall opening in spaced relationship with the wall, and means for electrically connecting said flexible cables directly to the tension plate means adjacent said aligned side wall opening.

9. In a vibrating screen, a screen frame having transversely spaced side walls, a screen deck disposed intermediate said spaced side walls formed of a plurality of longitudinally spaced screen cloths, means for electrically insulating said screen cloths from each other, means associated with each of said side walls for tensioning and for forming a series electrical circuit through said screen cloths, said means including a first tension plate associated and coincident with one side edge of the screen cloth constituting the feed end of said screen deck, a second tension plate associated and coincident with one side edge of the screen cloth constituting the discharge end of said screen deck, and a plurality of tension plates associated with the remaining side edges of screen cloths in said screen deck, said last mentioned tension plates being of sufficient length to fully engage the side edge portions of two adjacent screen cloths and to span the gap therebetween and being arranged in overlapped relationship so that one only of said tension plates spans each gap in said screen deck with successive gaps being spanned on opposite sides of the latter, means for supporting said tension plates against vertical movement, and means for supplying electricity to said first and second tension plates.

10. In a vibrating screen, a screen frame having transversely spaced side walls, an inwardly extending flange mounted on each of said side walls, a plurality of longitudinally extending supporting members arranged at spaced intervals across said frame, a screen deck formed of a plurality of screen cloths spaced relative to each other longitudinally of said deck and supported by said longitudinal members, a plurality of spaced tension plates associated with and electrically connected to the side edges of said screen cloths, said tension plates being operatively associated with said side walls and supported by said flanges against vertical movement, means for electrically insulating said tension plates from said side walls and said flanges, means associated with each of said side walls for retaining and for forming a series electrical circuit through said screen cloths, said means including a first tension plate associated and coincident with one side edge of the screen cloth constituting the feed end of said screen deck, a second tension plate associated and coincident with one side edge of the screen constituting the discharge end of said screen deck, and a plurality of tension plates associated with each of the remaining side edges of screen cloths in said screen deck, said last mentioned tension plates being of sufficient length to fully engage the side edge portions of two adjacent screen cloths and to span the gap therebetween and being arranged in overlapped relationship so that one only of the tension plates spans each gap in said screen deck with

successive gaps being spanned on opposite sides of the latter, means for electrically insulating said cloths from said supporting members and from each other, a plurality of tensioning members connecting said tension plates to their associated side walls for tensioning the screen cloths between the latter, and means for supplying electricity to said tension plates, said last mentioned means including one set of supply cables connected to said first tension plate and another set of supply cables connected to said second tension plate.

11. In a vibrating screen, a screen frame having transversely spaced side walls, a screen deck comprised of a plurality of longitudinally spaced screen cloths supported between said side walls, means for electrically insulating said screen cloths from each other and from said side walls, means for distributing electricity along each side edge of each screen cloth, means to bridge the gap and to provide an electrical connection between adjacent screen cloth side edges, one only of said means being provided for each gap and said means being staggered so that successive gaps are bridged on opposite sides of said screen deck leaving a first side edge and a second side edge at the feed and discharge ends of said screen deck, respectively, each without an electrical connection to any other side edge, and means for supplying electricity to said screen deck including one set of supply conductors connected to said first side edge at the feed end of said screen deck and another set of supply conductors connected to said second side edge at the discharge end of said screen deck.

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