

Oct. 27, 1964

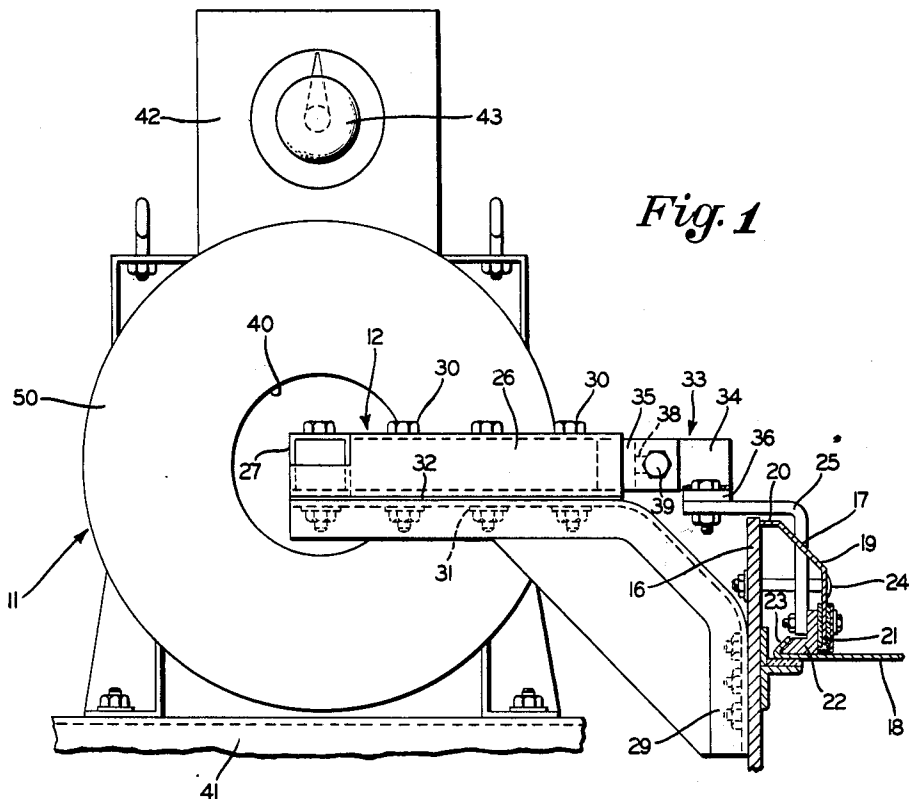
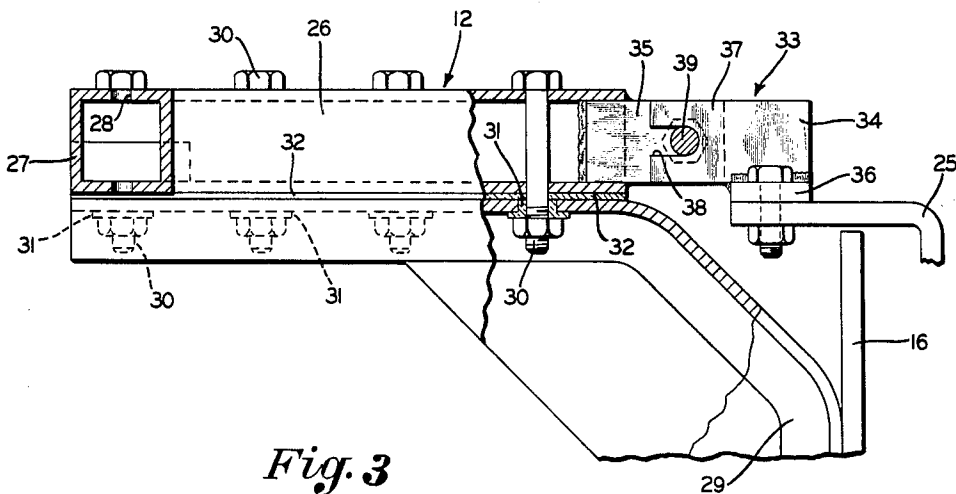
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3,154,757

TRANSFORMER WITH SECONDARY WINDING SUSPENDED WITHIN PRIMARY CORE

Original Filed Aug. 2, 1961

2 Sheets-Sheet 1



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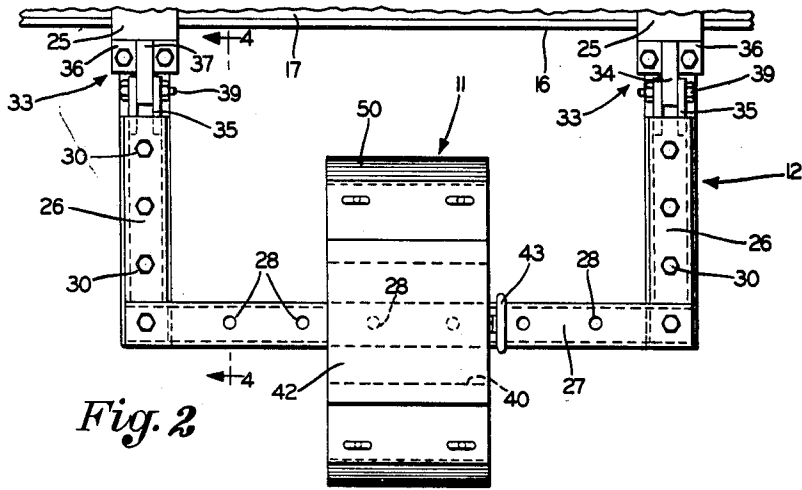


Fig. 2

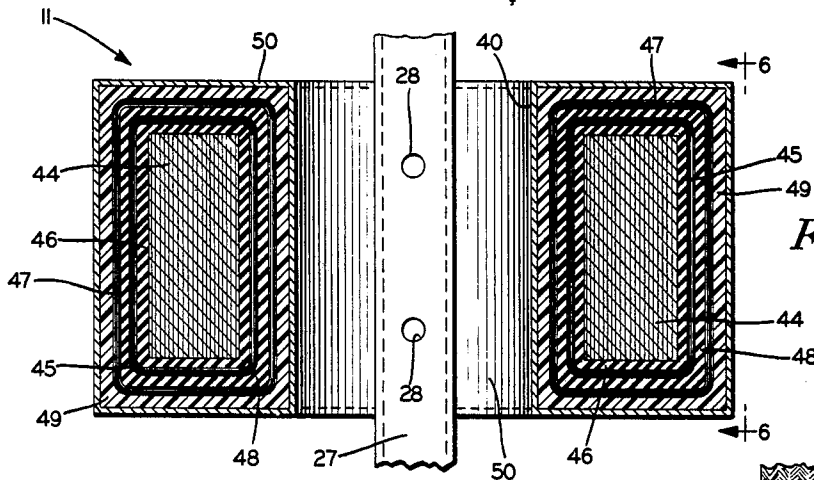


Fig. 4

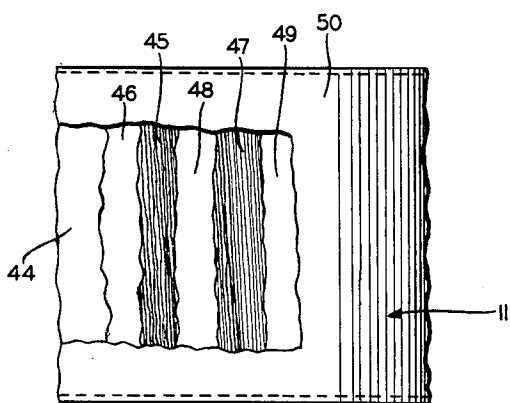


Fig. 5

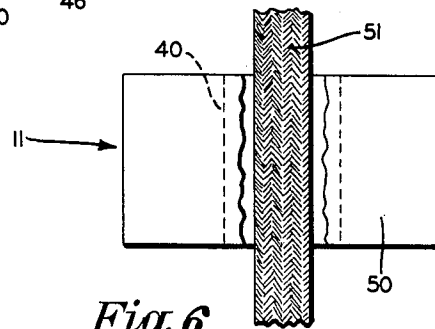


Fig. 6

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1

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TRANSFORMER WITH SECONDARY WINDING SUSPENDED WITHIN PRIMARY CORE

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Original application Aug. 2, 1961, Ser. No. 128,866.
Divided and this application Nov. 13, 1962, Ser. No. 237,235

6 Claims. (Cl. 336—175)

My invention relates to a new and novel transformer construction and the means for electrically connecting the same with units which have limited movement relative to the transformer during operating and use thereof, such as vibrating electrically heated screens. Further, this application is a division of my co-pending application, Serial No. 128,866, filed August 2, 1961.

Various forms of equipment have been provided for the industrial screening of materials, such as iron ore and other similar types of materials. Most of such equipment has included a platform supporting one or more generally horizontally positioned and usually sloping screens which are vibrated in some manner in order to accomplish the screening operation.

Although various attempts have been made to produce vibratory movement of the screen without greatly affecting the supporting frame members thereof, the most practical and satisfactory method is to vibrate virtually the entire screening unit including not only the screens, but also the supporting frame members thereof. This has usually been accomplished by providing a resilient mounting for the supporting frame members on a supporting surface in such a manner as to retain these supporting members in place, and then provide some form of vibrating means which vibrates the supporting frame members and screens relative to these resilient mountings.

It has also been found that not only is vibration of the screens through which the material must pass required, but heating the screens in some manner during the screening operations will add greatly to the functioning thereof, by causing less binding or clogging of the screens during this operation. The simplest manner of accomplishing this heating of the screens is to provide the screen cloth which forms the screens of an electrically conducting material and passing a low voltage electrical current therethrough. In this manner, the screen cloth itself provides a resistance heating unit to supply the necessary heat.

Many problems have been involved in the provisions of these electrically heating and vibrating screen units, certain of which have involved the problem of just exactly how to provide an electrical connection to the screen cloth for properly passing the electrical energy therethrough while still maintaining the screen cloth properly tensioned to support and vibrate the material being screened. Furthermore, the screen cloth must be easily removable and replaceable in view of the relatively short useful life of the screen cloth under the usual abuse and wear encountered.

These electrical connection, support, and replacement problems have been extensively solved according to the principles and constructions set forth in my prior Patents Nos. 2,704,155 and 2,812,062, both entitled "Electrically Heated Screen Construction," and dated March 15, 1955, and November 5, 1957, respectively.

One of the major problems still remaining in electrically heated screen constructions, which problem is also encountered in various other types of electrical installations where it is necessary to supply electrical energy to a unit which has a limited movement or vibratory movement during the operation thereof, is how to supply this elec-

2

trical energy to the vibrating or moving unit from a stationary source and still maintain the necessary electrical connections intact despite the relative movement between the source and the unit being supplied. Prior to the present invention, the attempts to accomplish this have been through the use of various forms of flexible electrical cables which have usually been connected to the secondary of a transformer and to the moving or vibrating unit so as to attempt to provide the flexibility for the relative movement therebetween.

For instance, in screen heating constructions, the screen cloth serving as the screening medium has been connected to the vibrating frame of the screen heating unit through generally hook-shaped, selectively adjustable skirt boards, which are mounted on and adjustable with respect to side rails or frame members. These skirt boards are provided with electrical conducting means contacting and supporting the side edges of the screen, and flexible electrical cables, usually in the form of braided copper cables, have been connected to the conducting means and to a usual transformer mounted in a stationary location adjacent the vibrating screen unit.

These flexible electrical cables have served the purpose of providing for relative movement between the stationary transformer and the moving or vibrating screen unit, but such cables are relatively expensive and are serviceable for only a relatively short period of time, thereby requiring frequent replacement and further adding to the expense thereof through the additional maintenance costs and lost production time for use of a particular unit. For these reasons, it is desirable to provide some means of supplying electrical energy from a transformer unit to a unit required to have limited movement for operation thereof, such as vibrating screen heating units, which eliminates the high expense and frequent maintenance of the usual flexible electrical cables.

It is therefore a primary object of the present invention to provide a transformer construction for electrically heated screen constructions and the like which solves the foregoing problems, the principles of which are applicable not only to vibrating screen heating units, but which are also applicable to constructions where electrical energy must be supplied from a stationary source to a unit which must have limited movement for the operation thereof.

It is a further object of the present invention to provide a unique form of transformer which may be connected to a vibrating screen unit preferably solely by air, yet will properly supply the electrical energy for and to the vibrating screen to be heated.

It is still a further object of the present invention to provide a transformer construction for electrically heated screen constructions and the like in which the secondary of the transformer supplying the necessary electrical energy is connected to the transformer primary preferably solely by air, so that the transformer secondary may be secured to the vibrating screen unit and freely vibrate therewith, while the transformer primary may be mounted stationary, thereby solving the problem of a flexible connection between the transformer and vibrating screen unit.

Finally, it is an object of the present invention to provide a transformer construction for electrically heated screen constructions and the like which satisfies the foregoing objects in a simple and efficient manner and at a minimum of expense.

These and other objects are accomplished by the parts, constructions, arrangements, combinations and subcombinations comprising the present invention, the nature of which is set forth in the following general statement, preferred embodiments of which—illustrative of the best modes in which applicant has contemplated applying the principles—are set forth in the following description and

illustrated in the accompanying drawings, and which are particularly and distinctly pointed out and set forth in the appended claims forming a part hereof.

The general principle involved in the transformer construction of the present invention may be broadly stated for application to electrical units generally as including a transformer primary assembly formed with an opening extending longitudinally therethrough and with said primary assembly being adapted for stationary mounting. Further, the unit may include an electrical power consuming unit having electrical connectors thereon and a closed electrical circuit, therethrough between said connectors, with this electrical power consuming unit being mounted for movement within predetermined limits, such as vibrating. Still further, the unit includes transformer secondary means having ends connected secured to the electrical connectors of the electrical power consuming unit for movement of the secondary means with the electrical power consuming unit and with the secondary means extending through the primary assembly opening. Finally, the transformer secondary means in its extension through the primary assembly is mounted free of any connection with the primary assembly which would restrict free movement of the secondary means longitudinally through and laterally within the primary assembly opening.

By way of example, embodiments of the improved transformer construction of the present invention are illustrated in the accompanying drawings forming a part hereof, wherein like numerals indicate similar parts throughout the several views and in which:

FIG. 1 is an enlarged fragmentary end elevation of a transformer constructed according to the principles of the present invention showing the operable connection thereof to a representative screen supporting unit;

FIG. 2, a reduced fragmentary top plan view of the transformer of FIG. 1;

FIG. 3, an enlarged fragmentary sectional view, part in elevation, looking in the direction of the arrows 4—4 in FIG. 2;

FIG. 4, an enlarged horizontal sectional view of the transformer primary with a portion of the secondary being shown extending therethrough in operable position;

FIG. 5, a fragmentary side elevation, with parts broken away, of the transformer primary and looking in the direction of the arrows 6—6 in FIG. 4;

FIG. 6, a fragmentary top plan view, with parts broken away showing the transformer primary with a second embodiment of a portion of a transformer secondary extending therethrough.

Referring to the drawings, the transformer construction according to the principles of the present invention is shown in FIG. 1 connected to a representative vibrating screen unit, the details of which are shown and described in my co-pending application S.N. 128,866, of which this is a division. Furthermore, this transformer construction basically includes the transformer primaries, generally indicated at 11, and transformer secondaries, generally indicated at 12.

As shown in said co-pending application S.N. 128,866 and partially in the present application, the screen supporting frame of the vibrating screen unit is provided with the spaced and opposed side rails 16, which side rails in turn support the usual selectively adjustable, generally hook-shaped skirt boards 17. The skirt boards 17 in turn engage and tension and support the screen cloths 18 which perform the screening function of the unit.

The details of the construction of the skirt boards 17 are set forth in my before mentioned Patent No. 2,812,062, as well as partially in said co-pending application, and are, therefore, considered only briefly here. Each skirt board 17 includes a supporting web portion 19 having an upper end 20 pivotally abutting the particular side rail 16 and a lower end 21 upon which is mounted a generally hook-shaped bus bar 22.

The side edges of the screen cloth 18 positioned at the skirt board 17 are formed with hook-shaped edge portions 23 which are reversely engaged with the skirt board bus bars 22. Thus, when the skirt boards 17 are pivotally adjusted relative to the side rails 16 by manipulation of the tensioning bolts 24, the screen cloths 18 may be tensioned and supported between the opposed skirt boards 17 in proper screening position.

The bus bars 22 are insulated from the respective skirt boards 17 and are connected to the particular transformer secondary 12 by the generally L-shaped, preferably copper, electrical connectors 25. In order to provide the electrical circuit through the bus bars 22 and screen cloths 18, these bars and cloths also must be electrically conducting materials, with the bus bars preferably being copper and the screen cloths being formed of a selected electrical conducting material depending on the particular material to be screened, that is, the various abrasion and other factors to be considered for providing a maximum operable life.

Each transformer secondary 12 is generally U-shaped and is formed by a pair of generally laterally extending side members 26 connected at their ends, spaced from the particular side rail 16, by a generally longitudinally extending connecting member 27. In the particular embodiment shown, the secondary side members 26 and connecting members 27 are preferably hollow and of generally rectangular cross-section and in this case the transformer secondaries 12 would be adapted for high capacity requirements.

Furthermore, as best seen in FIGS. 2, 3 and 4, the connecting members 27 of these transformer secondaries 12 may also be provided with a series of spaced holes 28 formed therethrough and opening into the hollow interiors of the connecting members, which will even more greatly increase the capacity thereof by providing air circulation for minimizing the temperature build-up therein and thereby minimizing the voltage loss in the secondary 12 which would be caused by such temperature build-ups. In the case where capacity is not a problem and low capacity is sufficient, the secondary side and connecting members 26 and 27 may be formed solid and in every case must be formed of an electrical conducting material, preferably copper or aluminum.

The transformer secondaries 12 are supported on the screen supporting frame 13 by the generally L-shaped support brackets 29, which are secured to the particular side rail 16 and preferably mount the secondary side members 26 in generally horizontally extending positions through the fastening bolts 30. Bolts 30 are insulated from the support brackets 29 by the insulating washers 31 and furthermore, the side members 26 are also insulated from the support brackets 29, preferably by the insulating sheets 32 positioned therebetween and formed of an insulating material such as fiber-glass or the like.

A selectively adjustable secondary connector, generally indicated at 33, is provided between each secondary side member 26 and its respective electrical connector 25. These secondary connectors 33 are formed by the slotted, generally T-shaped plates 34 and the flat plates 35, as best seen in FIGS. 1, 2 and 3.

The slotted plates 34 are provided with the flat, generally horizontally extending side flanges 36 which are bolted flatwise on the electrical connectors 25 and these flanges 36 are connected to an upstanding generally laterally extending portion 37 which has a slot 38 opening toward the particular secondary side member 26. The flat plates 35 are mounted in pairs secured to the secondary side members 26 in spaced upstanding positions for receiving the slotted plates 34 therebetween, and these flat plates 35 are selectively releasably secured to the slotted plates 34 by a selectively releasable fastening bolt 39.

Thus, the transformer secondaries 12 are mounted secured on side rail 16 by the support brackets 29 and

5

will vibrate with the remainder of the screen supporting unit, but in order for the skirt boards 17 to be selectively pivotally adjusted with respect to the side rails 16 in order to properly tension the screen cloths 18, these selectively releasable secondary connectors 33 are provided. When the skirt boards 17 have been properly adjusted, the fastening bolts 39 of these secondary connectors 33 are tightened to provide a positive electrical connection from the transformer secondaries 12 through these connectors 33 and through the electrical connectors 25 into the screen cloths 18. In view of the fact that these secondary connectors 33 form an important part of the transformer secondary circuit, they are also formed of an electrical conducting material, preferably copper or aluminum.

The transformer primaries 11 are formed preferably generally cylindrical and are provided with preferably generally cylindrical and longitudinally extending openings 40 therethrough. Furthermore, each transformer primary 11 may be mounted on a stationary supporting surface 41 in usual manner and may be provided with the usual sealed control portion 42 having the selectively movable control knob 43.

The main portion of each transformer primary 11 is formed by a hollow, generally cylindrical, preferably steel core 44 which may be formed annular shape merely by tightly wrapping strip steel, as shown, to form a closed annular core of the desired size which may be stated as being preferably multi-layer due to said wrapping. This annular core 44 is then transversely wrapped preferably completely around the circular extent thereof by a wire coil 45, which wire coil is separated from core 44 by the usual insulating means 46.

A second wire coil 47 may be wrapped in a similar manner about the first coil 45 and likewise separated therefrom by the usual insulating means 48. Finally, the outer coil 47 is covered completely with further insulating means 49 and the entire unit is completely enclosed in a preferably stainless steel case or enclosure 50, so that the case 50, which is completely insulated from the remainder of the transformer primary 11, forms the exposed hollow generally cylindrical shell.

As shown, the connecting member 27 of the particular transformer secondary 12 is supported extending longitudinally through the particular primary opening 40 and is preferably maintained spaced laterally from the case 50 so that none of the vibratory movement of the secondary 12 is imparted to the primary 11. Thus, the only connection between the transformer primaries 11 and secondaries 12 is an air connection and absolutely no wear can take place between these primaries and secondaries. Furthermore, since the secondaries are rigidly secured to the vibrating screen unit for vibration there-with, virtually all possibility of wear is eliminated.

As illustrated in a second embodiment in FIG. 6, in the case where the particular application permits, the connecting member 27 of the transformer secondary 12 may be a braided cable 51 of copper or aluminum. In this case, the cable 51 may either be supported spaced totally from the transformer primary 11 and extending through the opening 40 thereof, or where conditions permit and limited wear can be tolerated, this cable may lay on the case 50 of the primary and extending through the opening.

In view of the fact that case 50 is completely insulated from the electrically conducting portions of the transformer primary 11, the construction will still operate satisfactorily even though the cable is laying on the case. There is in this case, however, going to be limited wear of the cable 51 due to the vibratory motion thereof relative to case 50, but in certain cases, this can be tolerated and it would not be of a magnitude to present the problems of a flexible cable secured to a stationary transformer and secured to a vibrating screen unit.

In use of the first embodiment construction of the present invention, the screen cloths 18 formed of elec-

6

trically conducting material are properly positioned with the edge portions 23 thereof engaged with the bus bars 22 of the skirt boards 17, and for this purpose, these skirt boards may be pivoted away from the respective side rails 16 by loosening the tensioning bolts 24. In order to permit this pivotal movement of the skirt board relative to the side rail 16, however, where the bus bars 22 are connected to the electrical connectors 25 of the transformer secondaries 12, it is necessary to also loosen the fastening bolts 39 of the secondary connectors 33, permitting relative movement between the T-shaped slotted plates 34 and their respective connecting plates 35.

After the cloths 18 have been engaged by the skirt board 17, the tensioning bolts are tightened to properly tension the screen cloths for performing the supporting and screening functions thereof. Once these screen cloths 18 are properly tensioned, the fastening bolts 39 of the transformer secondaries 12 may be tightened to provide virtually a solid connection between plates 34 and 35 of the secondary connectors 33 and, therefore, virtually a rigid or solid connection between the electrical connectors 25 and the secondary side and connecting members 26 and 27.

Again, in the preferred embodiment shown in FIGS. 1 through 5, with the transformer secondaries 12 formed by the rigid side members 26 and connecting members 27, and with side members 26 rigidly supported on the side rails 16 of the screen supporting frame 13, the connecting members 26 will be positioned extending through the longitudinal openings 40 of the transformer primaries 11 spaced laterally from all portions of the primary case 50. Thus, when the vibrating unit of the screen supporting frame is operated to vibrate the entire screen supporting frame, these vibrations will be carried completely through the transformer secondaries 15, but in view of the fact that the only connection between the transformer primaries 11 and the transformer secondaries 12 is air, these vibrations will not be transmitted to the transformer primaries.

With this first embodiment construction, therefore, the need for a direct flexible connection between the screen supporting frame, which is vibrating, and a transformer unit, which is stationary, is completely eliminated. By mounting the transformer secondary 12 rigidly connected to the screen supporting frame for vibration with this screen supporting frame, and by providing merely an air connection between the transformer secondary and the transformer primary 11, all possibility of wear of the electrical connections for supplying electrical energy through the screen cloths 18 is eliminated.

In the case of the second embodiment construction, where the flexible cable 15 is positioned merely extending through the transformer primary 11 but resting against the case 50 thereof, there will be some slight frictional wear between this cable 51 and the case 50, but under certain conditions this can be tolerated and the wear will still not approach the wear incurred from a direct flexible cable connection as previously used with transformers of standard construction.

The most important broad principle involved in the present invention is the freedom of movement of the transformer secondary 12 relative to the transformer primary 11, so that the transformer secondary can be secured directly to the vibrating screen supporting frame with the transformer primary being mounted stationary, and no excessive wear will take place between vibrating and stationary members. Furthermore, in the first embodiment construction shown in FIGS. 1 through 5, the entire connection between transformer primary 11 and transformer secondary 12 is air, so that here there can be absolutely no wear.

It should be understood that in the first embodiment form of the present invention shown in FIGS. 1 through 5, wherein the connecting member 27 of the transformer

secondary 12 is supported by the side members 26 completely free of any contact with the transformer primary 11, this connecting member 27 could be a braided flexible cable such as indicated at 51 in the second embodiment shown in FIG. 6, or could take on other forms as conditions demand. Furthermore, in the preferred form this connecting member 27 can be solid for relatively low capacities and hollow with the possible addition of the holes 28 for higher capacities as conditions demand. The important thing for higher capacities is to maintain the temperature at a minimum in order to maintain voltage drops to a minimum.

In the foregoing description, certain terms have been used for brevity, clearness and understanding but no unnecessary limitations are to be implied therefrom, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of example and the scope of the present invention is not limited to the exact details of construction shown.

Having now described the invention, the construction, operation and use of preferred embodiments thereof, and the advantageous new and useful results obtained thereby, the new and useful construction and reasonable mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claims.

I claim:

1. Transformer construction including a closed annular metal primary core having an opening longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, insulation means between the core and coil means, hollow annular case means surrounding and totally enclosing the core and coil means and outwardly insulating the core and coil means at all sides forming an opening longitudinally through said case means, a movable conducting secondary member extending longitudinally through the case means opening and being free of any physical connection with said case means which would restrict free movement of the secondary member longitudinally through and laterally within the case means opening, the secondary member having ends outward of the case means and case means opening, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

2. Transformer construction including a closed annular metal primary core having an opening longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, a hollow annular metal case surrounding and substantially totally enclosing the core and coil means at all sides forming an opening longitudinally through the case, insulation means between the core and coil means and coil means and case, a movable conducting secondary member extending longitudinally through the case opening and being free of any physical connection with said case which would restrict free movement of the secondary member longitudinally through and laterally within the case opening, the secondary member having ends outward of the case and case opening, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

3. Transformer construction including an annular wrapped multi-layer strip metal primary core having an opening longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, a hollow annular metal case surrounding and substantially totally enclosing the core and coil means at all sides forming an opening longitudinally through the case, insulation means between the core and coil means and coil

means and case, a movable conducting secondary member extending longitudinally through the case opening and being free of any physical connection with said case which would restrict free movement of the secondary member longitudinally through and laterally within the case opening, the secondary member having ends outward of the case and case opening, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

4. Transformer construction including a closed annular metal primary core having an opening formed longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, a hollow annular metal case surrounding and substantially totally enclosing the core and coil means at all sides forming an opening longitudinally through the case, insulation means between the core and coil means and coil means and case, a movable conducting secondary bar member extending rigidly longitudinally through the case opening and being suspended free of any physical contact with said case, the secondary member having ends outward of the case and case opening, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

5. Transformer construction including a closed annular metal primary core having an opening formed longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, a hollow annular metal case surrounding and substantially totally enclosing the core and coil means at all sides forming an opening longitudinally through the case, insulation means between the core and coil means and coil means and case, a movable conducting secondary bar member extending rigidly longitudinally through the case opening and being suspended free of any physical contact with said case, the secondary member having ends outward of the case and case opening, the secondary member being hollow substantially totally between said ends, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

6. Transformer construction including a closed annular metal primary core having an opening formed longitudinally therethrough, coil means wrapped longitudinally through the core opening and about the core, a hollow annular metal case surrounding and substantially totally enclosing the core and coil means at all sides forming an opening longitudinally through the case, insulation means between the core and coil means and coil means and case, a movable conducting secondary bar member extending rigidly longitudinally through the case opening and being suspended free of any physical contact with said case, the secondary member having ends outward of the case and case opening, the secondary member being hollow substantially totally between said ends and having a series of spaced holes formed therein opening into an interior thereof at least in the portion thereof extending through the case opening, and electrical connection means on the secondary member ends adapted for electrical connection of the secondary member to an electrical power consuming unit in a closed electrical circuit through the secondary member.

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