June 22, 1965 A. L. KIMBALL 3,190,041

SUPPORT FOR LARGE MACHINERY

Filed June 28, 1962

Fig. 2.

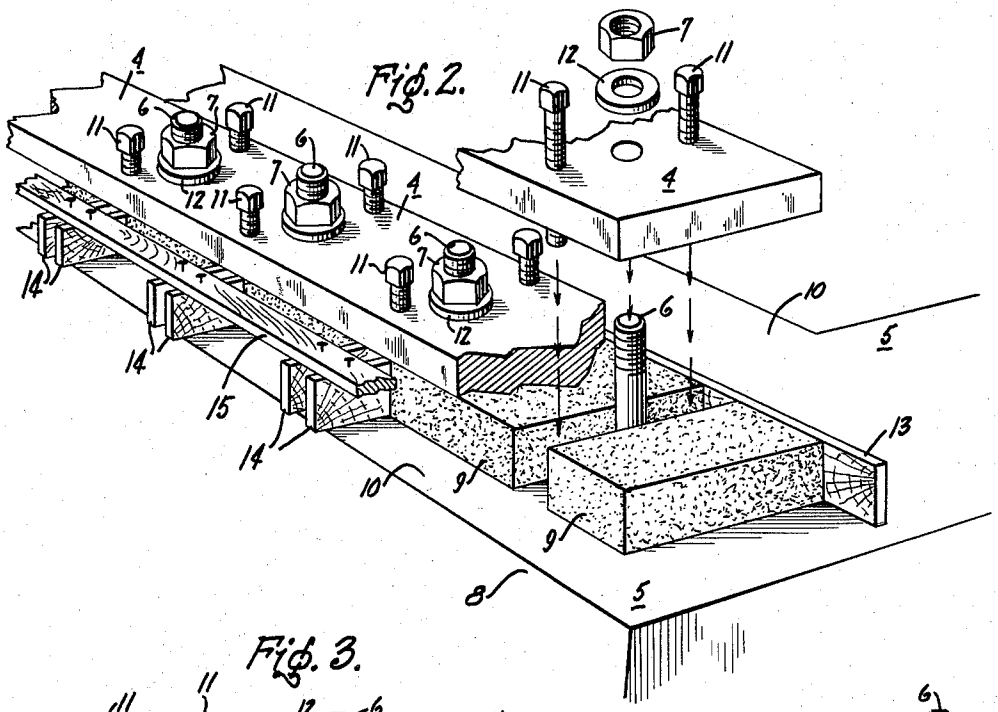
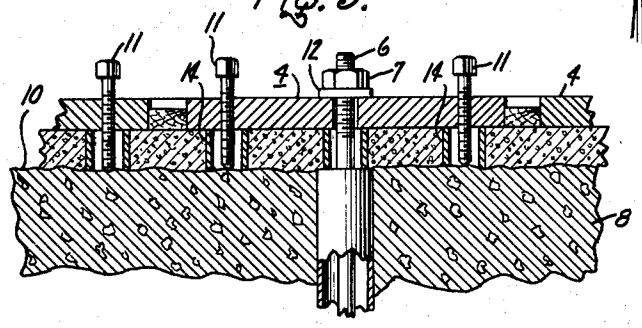


Fig. 3.



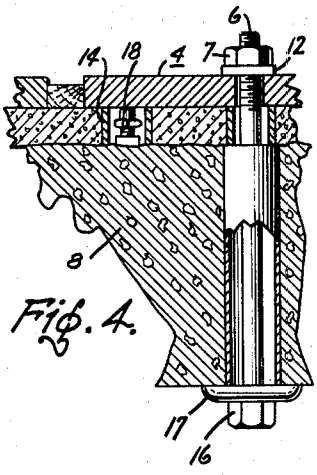


Fig. 4.

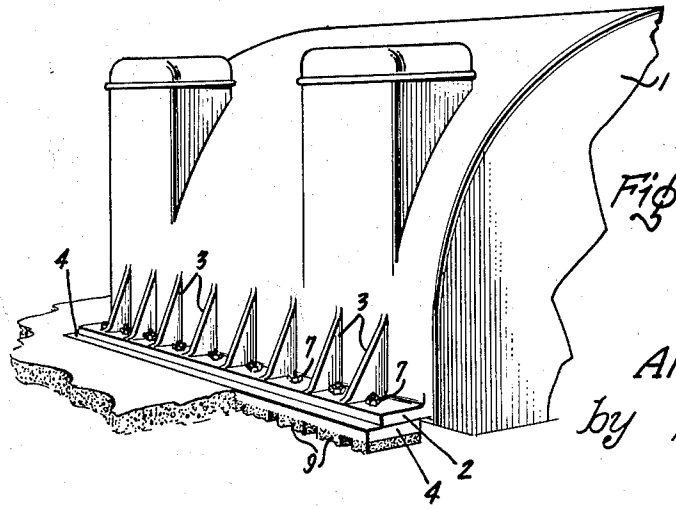


Fig. 1.

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United States Patent Office 3,190,041 Patented June 22, 1965

3,190,041

SUPPORT FOR LARGE MACHINERY

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Filed June 28, 1962, Ser. No. 205,888
6 Claims. (Cl. 50—185)

My invention relates to supports for large machinery and, in particular, to a new and improved support and the method of manufacturing or erecting a support for large machinery which avoids the creation of stresses in the machinery.

In manufacturing large rotating equipment such as, for example, turbine generators, much effort is expended in obtaining the exact size of shafts, bearings, and other components of the machinery and accurately aligning such components. It has been found, however, that all such efforts are for naught if, when the machinery is assembled in position, the foundation or support for that machinery is not accurately leveled so that no portion of the apparatus buckles or is placed under undue stress because of lack of proper leveling of the support. Such lack of leveling may occur at the time of installation or at a later time if the support shifts in position even slightly because of crushing or deterioration of the support. In the past, it has been customary in installing a large piece of rotating machinery to arrange a plurality of accurately level sub-sole plates to support a main sole or foundation plate which is secured to a concrete or base foundation by means of foundation bolts. Accurately leveling the sub-sole plates was a long, tedious, and expensive process and frequently required the use of shims or other adjusting or filler devices. Furthermore, since there were a number of such sub-sole plates which had to be brought to the same leveled position, an inaccuracy in one such sub-sole plate could produce undesired stresses in the frame and other components of the machinery. After a period of use, any shims may produce such stresses through corrosion or similar changes, or through yielding under long sustained stresses.

It is a primary object of my invention to provide a new and improved method for forming a support for rotating machinery which obviates the requirement of leveling a number of sub-sole plates.

It is another object of my invention to provide a new and improved support for large rotating machinery which can be erected or installed rapidly and which provides more accurate leveling of the individual points of support.

It is a further object of my invention to provide a new and improved support for heavy apparatus or structures which maintains a level condition without change over long periods of time.

In its broadest aspect, my invention consists in forming a level support for a heavy rotating machine to be placed on a foundation and to be secured to that foundation by conventional foundation bolts by supporting a foundation plate in a level position spaced above the foundation, securing the plate against vertical movement relative to the foundation, and compacting or ramming into the space between the foundation plate and the foundation a mortar of proper consistency and allowing the mortar to cure in place to form a solid level surface to which the foundation plate and the machine may be securely attached in a leveled condition.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 illustrates a portion of the machine embodying my invention;

FIGURE 2 is a perspective view, partly containing an exploded view, of a support embodying the principles of my invention;

FIGURE 3 is a sectional view illustrating certain priciples of my invention;

FIGURE 4 is a sectional view of a modification of my invention.

FIGURE 1 illustrates a section of a piece of heavy apparatus, in this case illustrated as a portion of a turbine, having a casing 1, from which extends a supporting frame 2 attached to the casing by a plurality of webs 3. The frame 2 is supported on a sole or foundation plate 4, which, in turn, is supported on foundation 5 formed according to my invention. The frame 2 and the foundation plate 4 are secured to the foundation 5 by a plurality of foundation bolts 6 with their associated nuts 7.

The manner of constructing this support for machine 1 is better illustrated in FIGURE 2, which illustrates a portion of foundation 5. The foundation 5 comprises a base portion 8, which is illustrated as being formed of concrete but which may be of metal or other material, and a plurality of grout or mortar pads 9 positioned between base portion 8 and foundation plate 4. In forming the composite support or foundation, foundation plate 4 is first placed in a level spaced position relative to the upper surface 10 of base portion 8 by means of a plurality of leveling screws 11, which threadedly engage foundation plate 4 and whose lower ends engage upper surface 10 of base portion 8. After foundation plate 4 has been accurately leveled by means of leveling screws 11, nuts 7 are screwed on foundation bolts 6 to secure the foundation plate in this leveled position. Metal washers or spacers 12 may be positioned between the respective nuts 7 and the upper surface of plate 4.

After the foundation plate is thus rigidly secured in a leveled position spaced above upper surface 10 of base 8, mortar forms, comprising a back member 13 and a plurality of transverse members 14, are placed in position. As is well known, it is customary to use wooden forms for this purpose. In accordance with my invention, the mortar form has only three sides for reasons which are pointed out later. These forms may be held in position by transverse boards or planks 15 nailed to transverse members 14. Preferably, transverse members 14 extend over the end of base portion 8 to hold the form in place during the ramming or compacting of the mortar into the form. Preferably, before the mortar which is to form the mortar pads 9 is inserted into the form, the area between foundation plate 4 and upper surface 10 is thoroughly cleaned with compressed air and the surface 10, if concrete, soaked with water to facilitate joining of mortar pads 9 to upper surface 10.

In accordance with my invention, the pads 9 are formed in situ; i.e., in place, between the upper surface 10 and the foundation plate 4. The mortar which forms pads 9 is placed into the form and compacted or ram-packed, each handful being rammed into place before a succeeding handful is placed into the form. The ram-packing process is repeated until all forms are completely packed. In forming the pads, caution should be taken to insure against trying to ram or press too large a quantity of mortar into place at one time, since such action could result in a porous pad structure.

After the formation of the pads is completed under the foundation plate, the level of the plate is checked to insure that its level position has not been altered during the step of compacting the mortar into the form. When the forms are completely filled, preferably the structure is covered with a moist covering such as, for example, wet burlap. Such a covering, as is well known, is main-

tained over the area in a wet condition for sufficient time until the grout or mortar pad is completely cured. In the usual instance, I have found that a minimum of three days is required for such a curing process.

Satisfactory grout or mortar to form pads 9 may be obtained by thoroughly and uniformly mixing with a type 1 Portland cement clean, washed, sharp sand having a good distribution of sizes and a fineness modulus between 2.8 and 3.2. While a finer aggregate of sand may be used, it is preferred that the sand used be no smaller than that normally employed in preparing brick mortar. In mixing the mortar, clean water is used in order to obtain optimum type of grout. The water is added in a quantity just sufficient to maintain the mixture slightly below the bleeding point when ram-packed. Preferably, the consistency of the mortar should be 0" slump, and the water to be added to each bag of cement in a dry sand mix of normal concrete and sand is of the order of two and one-half gallons. The correct amount of water can best be judged by the hand test of pressing a sample within the fist as tightly as possible. Preferably, there should be no excess moisture squeezing out from between the fingers. When the fist is opened, the sample should adhere together, retaining its form without crumbling. Further, the sample should break clean with no powdering or crumbling between the fingers. The palm of the hand should be slightly moist, but not wet. A further check of proper moisture content is provided in accordance with my invention by using a form which contains only three sides. If a fourth side of the mortar slumps off, this indicates that the mortar contains too much moisture.

A satisfactory mortar proportion I have found to be one part cement to two parts of sand by weight. I have found that by using grout or mortar with minimum amount of water, one of the most common grouting defects is eliminated; i.e., the bleeding which occurs immediately under the foundation plate when working the wet mortar in place. By using a relatively dry mortar and eliminating excessive placement water, I obtain a high strength pad in a relatively short time. If the water content is just sufficient to complete hydration, a high strength mortar is acquired in a short period of time. With such a mortar, minimum volume change characteristics or shrinkage is experienced, and high compressive strength results in three days with ultimate strength in approximately seven days.

After the pads have been properly cured in the manner described above, foundation plates 4 are removed and forms 13, 14 stripped from the support. Any excess mortar is then removed from the foundation and sharp corners and feather edges of the pads removed with a file. After the pads have been cured and inspected, the foundation plates are cleaned of any loose mortar, coated with a protective surface such as, for example, oil, lacquer, or the like, and replaced on top of mortar pads 9.

FIGURE 3 illustrates the positions of the leveling screws 11 relative to base portion 8 and foundation plate 4. As is seen in FIGURE 4, foundation bolts 6 have heads 16 which are located well below the upper surface 10 of base portion 8 and which carry washers 17 to distribute the loading of base portion 8 in a well known manner. Obviously, any other suitable type of bolt may be used.

FIGURE 4 also illustrates a modification of the method of forming my machinery support in which a jack bolt 18 is utilized either in place of or in addition to leveling screws 11. In all other respects, the structure of FIGURE 4 is identical with that of FIGURES 2 and 3.

From the foregoing, it may be seen that my invention provides a method of constructing a support for heavy machinery which is not only more rapid than that formerly employed, but which also is less expensive in that it reduces the number of operations and the materials

required. Furthermore, my improved method provides more accurate leveling of large machinery in that by using the large foundation plate 4 as the level surface and compacting a plurality of mortar pads beneath such a plate, I insure that the surface of such pads are all more accurately leveled.

One important advantage of my improved support is that it eliminates the need for additional or filler material conventionally used, such as sub-sole plates, wedges, shims, or other foreign filler supporting pieces.

Another important advantage of my invention is that by satisfying the alignment and leveling of the top or upper supporting surfaces of the foundation plates, the bottom surfaces of such plates need not be accurately machined or finished. Thus, such bottom surfaces may be out of parallelism with the upper surfaces, or roughly machined without affecting the alignment or support of the equipment. Accordingly, my invention provides a support which is more readily and accurately leveled and whose total cost is considerably less than that of previous structures.

While I have shown particular embodiments of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made in the structural arrangements shown and in the instrumentalities employed. I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of forming a permanent, non-corrosive, level support for a heavy machine which comprises
   - supporting a foundation plate in a level spaced relation to the foundation,
   - securing the plate against movement relative to such foundation,
   - positioning between the foundation and the plate a concrete form having one open side,
   - ram-packing a mortar in the form, using a mortar having a moisture content such that it does not slump off on the open side,
   - and allowing the mortar to cure to form a solid level surface to which the foundation plate and a machine may be attached

2. The method of forming a permanent, non-corrosive, level support for a heavy machine of the type which is secured to a foundation by foundation bolts which comprises
   - positioning a foundation plate in spaced relation to the foundation,
   - using leveling screws to maintain the spacing between the foundation and the bottom surface of the plate required to level the upper surface of the plate,
   - using the foundation bolts to prevent vertically upward movement of the plate,
   - positioning between the foundation and the plate a concrete form having one open side,
   - ram-packing a mortar in the form, using a mortar having a moisture content such that it does not slump off on the open side,
   - and allowing the mortar to cure while the plate is restrained against vertical movement thereby to form a firm level surface to which the foundation plate and a machine may be attached by the foundation bolts.

3. The method of forming a permanent, non-corrosive support for a machine of the type adapted to be secured to a foundation by foundation bolts comprising
   - supporting a plurality of foundation plates in spaced level relation above the foundation,
   - restraining the plates against movement vertically relative to the foundation,
   - positioning a plurality of concrete forms, each having one open side, between the foundation plates and the foundation,

compacting mortar within the forms between the plates and the foundation using a mortar having a moisture content such that it does not slump off on the open side, covering the foundation plates, forms, and mortar with a moist material to complete hydration,

and curing the mortar while it is in contact with the foundation and foundation plates to create a plurality of level mortar pads to which the foundation plates and a machine may be attached by the foundation bolts.

4. A permanent, non-corrosive support for a heavy machine comprising

a foundation,

vertically extending foundation bolts having heads secured in said foundation,

a removable foundation plate positioned in spaced relation above said foundation,

screw means threadedly engaging said plate and having ends engaging the upper surface of the foundation for leveling the upper surface of said plate,

and a concrete pad formed in placed by ram-packing mortar between said plate and said foundation,

said bolts being arranged to prevent vertically upward movement of said plate while said pad is formed and to secure a machine to the foundation plate after the formation of said pad.

5. A permanent, non-corrosive support for a heavy machine comprising

a foundation,

a plurality of vertically extending foundation bolts

having their lower ends securely held in said foundation,

a plurality of removable foundation plates positioned in spaced relation above said foundation,

screw means threadedly engaging said plates and having bottom ends engaging the upper surface of said foundation for leveling said plates,

a plurality of nuts engaging said bolts and adjustable to prevent vertical movement of said plates,

and a plurality of mortar pads formed in place by ram-packing mortar between the bottom surface of each of said plates and the upper surface of said foundation.

6. The support of claim **5** in which said bolts and said screw means are spaced from said mortar pads.

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