for the same weight of larger particles, owing to the tremendously greater surface area exposed. Moreover, if surface-drying itself is perfect, where a great number of fine particles are surface-dried the evaporation of the water absorbed by some particles is likely to proceed while the remainder are being dried.

Where extremely accurate determinations are not required, some of the factors discussed above become negligible as applied to certain types of materials, but in other cases they may prove to be quite important. The necessary degree of accuracy of a determination of the specific gravity is a matter of question, but as such determinations are seldom reported to less than the third significant figure, a single unit of which, applied to road-building materials, may represent more than 0.333 per cent., it is presumed that necessity for determinations accurate to this point are usually desired. This is certainly the case in connection with the use of the specific-gravity determination in ascertaining the voids in pavements constructed of rock, gravel or sand, bound together with a bituminous material.

Conclusions.—As the results of the investigations above described, the following conclusions have been drawn:

1. In the case of rock and slag an appreciable variation may exist between apparent specific gravity and true specific gravity, depending upon the absorption of the material.

2. The displacement method formerly used by the Office of Public Roads and Rural Engineering is not as satisfactory as the Chapman method for determining the apparent specific gravity of single specimens of rock, slag or gravel, unless the difference between apparent specific gravity and true specific gravity is negligible.

3. The Chapman method is satisfactory for determining the apparent specific gravity of single specimens of rock, slag, etc., but is not a safe one to employ in determining the specific gravity of non-homogeneous or apparently homogeneous aggregates, even when the average results of three apparently representative specimens are taken.

4. In the case of non-homogeneous aggregates consisting of fragments of not less than ½ in. in diameter, either the Goldbeck method, the Chapman wire-basket method or the Hubbard-Jackson method are satisfactory, and can ordinarily be depended upon to give check results by different operators working upon the same sample to within 1 in the third significant figure.

5. It is impracticable by any of the methods studied to determine the apparent specific gravity of samples composed of fragments smaller than ½ in.

6. When determining the specific gravity of extremely non-homogeneous aggregates it is recommended that an average of not less than three tests made upon different samples by the Goldbeck, Hubbard-Jackson or Chapman wire-basket method be reported.

7. It has been found that the Bureau of Standards' modification of the Le Chatelier apparatus is more convenient and rapid for determining the specific gravity of aggregates, the individual fragments of which are less than ¼ in. in diameter, than is the Jackson apparatus.

8. When it is desired to obtain as nearly as possible the apparent specific gravity of aggregates consisting of a mixture of coarse and fine particles, it would appear advisable to separate a weighed sample of the material by means of a ½-in. screen and make an apparent-specific-gravity determination upon not less than 1,000 g. of the coarse fraction, and a true-specific-gravity determination upon not less than 50 g. of the finer fraction. The specific gravity of the whole may then be calculated from the following formula, where W equals the percentage by weight of coarse aggregate, W' the percentage by weight of fine aggregate, and G and G' their respective specific gravities:

$$\text{Specific Gravity of Aggregate} = \frac{100}{W/G + W'/G'}.$$

VIBRATION IN STEAM TURBINES.*

By H. A. Fisher.

BEFORE the advent of the steam turbine in the modern power station, vibration was not a serious consideration, in fact was practically unknown. In the reciprocating engine with its low speed any lost motion or misalignment made itself known as a knock or pound, while in the steam turbine with its high speed and delicate balancing the knock and pound becomes vibration. It is the purpose of this article to set forth some of the cases of vibration that are commonly observed.

Revolving parts improperly coming in contact with the stationary parts will cause vibration. While this is not a frequent occurrence, it is one that will do the most damage and therefore, when suspected, no time should be lost in making an examination to see if there is such contact and if so to remedy it at once.

Faulty grouting under the bedplate is another dangerous source of vibration. The proper mixture and mixing of the grout is important, for no matter how much more care is exercised in placing the grout, it will not be satisfactory if it has not been thoroughly mixed in the right proportions; a mixture that is too rich (contains too much cement) will shrink a great deal in setting, while one that is too lean (contains too much sand) will crumble. A grout of equal parts of cement and sand, thoroughly mixed dry and wet down to the consistency of a thin batter and promptly poured, will give good results when care is taken to eliminate the following causes of poor grouting: Freezing, drying out too fast, too little time allowed for the grout to set before starting the machine, grout becoming soaked with oil which will cause it to crumble, and failure to provide for the escape of air from under the bedplate when the grout is being poured. Vibration due to faulty grouting and the movement of the bedplate on the foundation can usually be felt throughout the entire turbine and remains constant at all loads. This vibration can sometimes be stopped or considerably reduced by driving iron wedges under the edge of the bedplate at several points, taking care not to drive them too hard, as the bedplate may be sprung and the alignment of the machine disturbed. The only permanent remedy is to remove the old grout, level the machine up and grout it in again. The top of the foundation should be made rough so that the grout may bind and the foundation should be thoroughly wet down just before the grout is poured.

Turbines supported on I-beams or set on floors supported by I-beams should be grouted with lead, as this will absorb the vibration and prevent its transmission to other machinery and to the building. The final leveling of the bedplate should be done after the turbine and generator have been placed on it and secured.

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*From "Power" of New York.