surface with the object of obtaining a more uniform distribution of the old bituminous material, and, after rolling to the proper shape, by applying a surface treatment of a cold bituminous material that will enliven the existing material and seal the surface. This treatment is covered with stone chips in the manner prescribed for regular bituminous surface treatment work.

In the last case we have a properly constructed bituminous penetration pavement, but the bituminous material is starting to deteriorate. This can be enlivened or revived by cleaning the surface and applying a seal coat of material in quantities, depending upon the degree of disintegration. Caution should be exercised to avoid applying an excess amount, which results in a slippery condition, and is very objectionable to horse-drawn traffic. Generally, one-tenth to one-sixth of a gallon is used and brushed into the surface with hand-brooms. The surface is then covered with chips or gravel approximating twenty pounds to the square yard. In the use of certain slow-drying, cold bituminous materials it will be observed that this new material softens up the old bitumen somewhat, giving the appearance at first of an excess application, and, having a hard surface underneath, the road becomes quite slippery, but this condition obtains for only a short period of time.

To insure the best results, one-half of the road should be treated at a time in order that the traffic may use the other portion while the bituminous material is setting up. This method has become quite effective, and results in increased life to the pavement.

In the repairs of breaks, depressions and local defects, which may occur under any one of the general conditions previously outlined, it is more satisfactory to use hot bituminous binders, and if replacements are necessary, they can be made after the fashion of the original construction. This work can be done very efficiently in this manner with little equipment and the average class of labor. There are a number of instances where cold bituminous compounds can and are being used successfully in certain seasons of the year on pavements of this kind, but in cold weather there is usually difficulty with some of this material, owing to its composition. As an example, the emulsified products break down or separate, and their adhesiveness is destroyed at low temperatures. Materials that are cut back with natural solvents can be used later and give very good results. The mixtures can be prepared at some point, not exposed to the weather, but convenient to the work, hauled to the site of the repairs and deposited. This is an effective method in case of emergency.

Bituminous Concrete Pavements

The various mixed bituminous pavements, with the exception of sheet asphalt, are included in the class of bituminous concretes.

Careful observation in locations where there is considerable bituminous paving shows that different streets, in spite of the fact that they have been constructed of the same material, present different appearances. Cracking of the surface is one of the greatest, as well as one of the earliest, defects that may develop in bituminous pavements. This may be due to one cause or a combination of several causes. Frequent cases are noted in bituminous wearing surfaces, which, although apparently satisfactory mixtures in all other respects, contract as the base contracts, and crack open at exactly the same point as the foundation. Again, cases are noticed of otherwise satisfactory pavements which crack because of their failure to receive the amount of traffic necessary to give the pavement its full compression, or to iron out and close up the surface after low temperatures have tended to open it up by stretching the bituminous binder.

A condition of the sort last described, however, may have been hastened considerably, or even caused directly, by what might be called improper design of the pavement in the first place.

The bituminous surface mixtures expected to receive heavy traffic should be tough and fairly hard in order to resist displacement. Those designed for light traffic should be softer and more yielding, and this is accomplished by using a softer bitumen, that is, one of a higher penetration. Failure to do so means that as the pieces of mineral aggregate contract or shrink in volume during cold weather, they exert a spreading force in the surrounding bitumen, which it cannot withstand because of its lack of light fluxing oils and corresponding ductility or ability to stretch; in other words, pavements containing hard or non-ductile bituminous material will have a greater tendency to crack in cold weather. Similar results, and even general disintegration of the wearing surface, may have been produced by too little bitumen in the mixture, since this is largely a measure of the life and elasticity of the pavement; and, similarly, overheated mixtures suffer a hardening and reduction of bonding power of the bitumen, with consequent tendency to crack. and wear. Aside from faulty drainage, poorly proportioned mixtures and unsuitable ingredients contribute largely to the failures in this type of pavement.

A bituminous concrete pavement which is satisfactory in all other respects may show surface indications of slight disintegration. The material in all probability has been attacked by the elements and evidence of wear is shown as the gloss is gone and the discoloration of the surface, which approaches a light brownish hue, is noticeable. This is speedily followed by a general porous condition and, if not promptly attended to, will allow the surface to retain moisture, which will eventually break the bond of the material and result in ravelling and failure of the pavement.

The wavy condition of the surface found in the bituminous macadam roads is also common to the bituminous concrete types. This condition is usually found on welltravelled streets, especially on grades, and is caused mostly by the bituminous mixture being too soft, which gives it a tendency to push under traffic. A wavy surface may be attributable to the methods used in the construction of the pavement for, if in the building the material was not at a temperature suitable for raking to a uniformly loose condition, or crept under the roller as a result of careless handling or being rolled while too hot, an irregular surface would result. Pushing or waving in local spots may often be traced to the laying of the mixture on a dusty or dirty surface.

The wearing and deterioration along the edges of bituminous pavements where there is no header, is responsible for one of the most troublesome and expensive forms of repairs to roads of this type. The traffic continually irons out the surface along the edges and this spreading or flattening out produces a feather edge along the sides. The moisture and foreign material tracked on from the shoulders soon attack the bituminous material and result in the crumbling or breaking away of the surface which occasions extensive repairs. This condition is more pronounced when the material in the shoulders is of a nonporous nature or is poorly drained.

In the repairs to the bituminous concrete pavements, special care is required in determining the methods and materials to be used Taking the several conditions