

March 7, 1933.

J. H. CROWE

1,900,804

BRAKE DRUM OR MEMBER

Filed Jan. 16, 1931

2 Sheets-Sheet 1

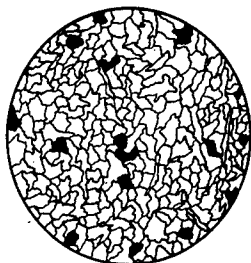


FIG. 1

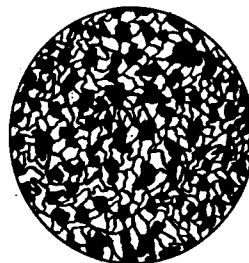


FIG. 2



FIG. 3

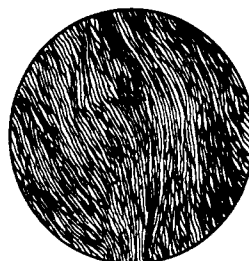


FIG. 4

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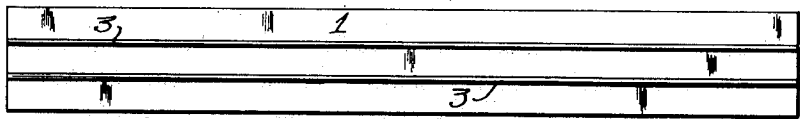


FIG. 5

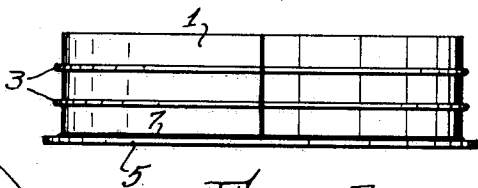


FIG. 7

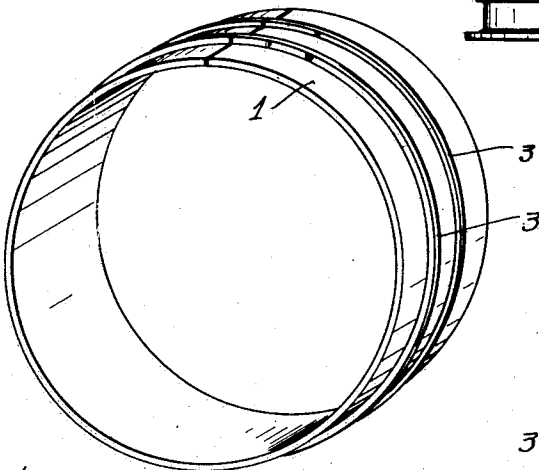


FIG. 6

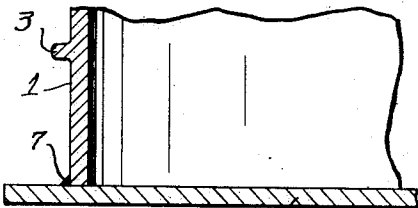


FIG. 8

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UNITED STATES PATENT OFFICE

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BRAKE DRUM OR MEMBER

Application filed January 16, 1931. Serial No. 509,172.

This invention relates to brakes and particularly to brake drums.

The primary object of the invention is to provide a brake member having a contacting surface which will withstand severe usage without scoring or roughening and without loading the lining with particles.

Another object of the invention is to provide a brake drum which may be manufactured economically in numerous sizes and may easily be adapted to meet the varying sizes and requirements of the trade.

Heretofore in the manufacture of brake drums several methods have been employed. One of the older methods consists in casting a drum and subsequently machining or finishing the contact surface. Another method is to press or stamp the drum out of flat sheet metal steel stock. This method provides a cheaper drum which is lighter and as strong and durable as the cast iron drum.

However, due to the deep drawing requirements, certain limitations in the quality of steel which may be used necessarily arise. For instance, the harder steels will not draw efficiently and will tend to tear or crack under pressure of the forming dies. As a result a compromise has been made between steel having proper wearing qualities for service and sufficient ductility for the drawing operation.

The drums formed by these and other methods are all subject to scoring when in use, with the result that it is necessary to replace the drums or to remachine the braking surface thereof if efficient braking action is to be provided.

A disadvantage arising from the scoring of the drums is the wearing and tearing of the shoe lining and the loading of the shoe lining with metal pellets, and slivers. These factors reduce the effective braking areas. To overcome the scoring and resultant excessive wear of the drum and lining, drums of steel which are hardened with various agents to withstand the abrasive action of the shoe have been used. Other attempts to overcome these difficulties have resulted in the manufacture of brake lining which will withstand wear and yet will not tend to score the brake drum.

While brake drums and linings such as above described are made and used quite generally, they are only partially satisfactory and the scoring of the brake drum and wearing of the shoe lining still present a difficult problem.

The brake drum made in accordance with the teachings of my invention will not score or wear to an appreciable extent, but will present a smooth even braking surface to the shoe throughout the life of the automobile or other apparatus with which associated.

The invention may be better understood by reference to the drawings in which—

Figs. 1 to 4 are representations of the micro-structure of various kinds of steel.

Fig. 5 is an elevation of a blank from which my brake drum may be made.

Fig. 6 illustrates the manner of forming the drum from the blank illustrated in Fig. 5.

Fig. 7 illustrates the assembled brake drum and cover plate.

Fig. 8 is a cross sectional view of part of the drum and cover plates illustrated in Fig. 7.

For the purpose of illustration I shall describe my invention as applied to internal expanding brakes, the application to other forms of brakes being obvious from such description. In order that my invention may be better understood I shall describe my theory as to the cause of scoring of brake drums and the manner in which the drum of my invention overcomes the scoring action. While an investigation of the results of scoring and the comparative tests of my drum with the present forms of drums seems to substantiate the theory herein set out, my theory as to the cause of scoring and the manner of correction thereof is given merely to show the basis upon which I have proceeded and in accordance with which I obtained very satisfactory results.

The scoring of brake drums, I believe, arises from excessive friction applied locally rather than evenly distributed over the drum. Obviously any irregularity on the surface of the brake shoe or drum or any material caught between the brake shoe and the surface of the drum and pressed against the

drum when the brake is applied will cause a highly concentrated localized pressure, with a consequent excessive friction. This friction causes an extremely rapid rise to a very high temperature of the surface of the brake drum, quite often above the critical range of the metal. This fact has been realized and many attempts have been made to make a metal hard enough to withstand this heating action and the concomitant scoring action.

However, it appears that by the present manufacturing methods it is economically impossible to produce a drum of ferrous material of sufficient hardness to withstand the effects of these concentrated pressures.

My invention therefore is based on an entirely different theory, the application of which theory to brake drums or shoes has been proven to a reasonable degree of certainty by very rigid and severe tests.

The present methods of manufacturing brake drums contemplate the use of steel stock having a maximum carbon content of 0.35%. Experience has proven that cold forming of drums from steel plate is limited to these steels containing up to 0.35% carbon, as an increase in carbon produces a steel which will fracture when attempts are made to form it by present methods. Steel of this amount of carbon gives a structural composition of substantially 60% ferrite or carbonless iron and 40% pearlite.

Referring to the drawings, a photo micrograph of a lower carbon steel is shown in Fig. 1, the grains of which are ferrite with a small amount of pearlite between. The white areas represent the ferrite grains and the darker areas the pearlite.

In Fig. 2 is illustrated the micro-structure of steel containing about 0.35% carbon. It should be noted that the number of dark grains is greater and larger in area. In this illustration the white areas represent ferrite or carbonless iron, the heavier dark areas representing pearlite.

By increasing the carbon to 0.85% the metal is saturated and the ferrite and the carbon alloy (Fe_3C) are thoroughly mixed and mechanically united forming a eutectoid pearlite. In this structure the grain boundaries of the ferrite grains are not so clearly defined though lighter and darker areas appear, as illustrated in Fig. 3. This metal composition is a mechanical mixture of ferrite and cementite, the ferrite and cementite usually lying in alternate laminae in proportion of about five parts of cementite to thirty four parts of ferrite. However, this laminated structure does not always occur in pearlitic metal and is not necessary, although I find such a metal very satisfactory. However, a sorbitic structure which results from air cooling rather than slow cooling of metal of such composition would produce an unlaminated pearlite which may be used.

In Fig. 4 the grains of pearlite represented in Fig. 3 have been enlarged to show the laminated structure. For better comparison, the photo micrographs of Figs. 1 to 3 are a magnification 100 diameters and that in Fig. 4 is a magnification of 500 diameters. Since exactly 0.85% carbon is difficult to obtain in practice, I use a metal obtaining from 0.8 to 1.2% combined carbon so as to insure enough carbon to render the metal almost entirely pearlitic and lacking in any substantial amount of free ferrite. In some cases an entirely pearlitic structure may not be necessary and consequently I may use a slightly lower percentage of carbon as the small excess of ferrite would probably not cause serious trouble. If a slight excess of carbon above 0.85% were used, the carbon would form into small needles of cementite interspersing the grains of pearlite and would have no serious deleterious effect.

Since a metal having so high a carbon content cannot be formed efficiently by stamping, I prefer to form a band or strip 1 of required length of such a metal by bending it normal to its width into an annulus or band, as illustrated in Fig. 6. This band should have circumferential ribs as indicated at 3 in Fig. 5, for reinforcing the drum and more particularly to assist in cooling the drum and in providing a large heat radiating surface. The ends of the strip or band are welded together to form a brake drum and a backing plate 5 is welded or otherwise secured thereto to form the completed drum. In some cases, a lining of such metal may be incorporated in the drum in any suitable manner, or in the entire drum may be composed of such metal, cast or otherwise formed. Again, I may form the shoe of such metal and secure the brake lining to the drum.

Referring to Fig. 8, the drum 3 is placed in proper position on the plate 5 and welded along a circumferential weld indicated at 7.

The reasons for forming a drum of ferrous metal of higher carbon content are as follows:

When the brake is applied the uneven surfaces of the brake shoe or drum tend to concentrate the pressure at certain points and cause excessive friction therebetween which results in localized heat areas. Due to the kinetic energy of the moving apparatus the temperature at these points or along these lines rises rapidly and the drum heats to a temperature considerably above the temperature to which an evenly applied brake shoe would heat the drum. A metal containing ferritic grains bound together by pearlite does not harden uniformly and evenly under heat, but on the contrary there is a relative change in the hardness of the ferrite and pearlite.

Consequently small grains, or groups of grains of the harder material start tearing

loose from the drum. Quite often the small pellet of material thus started will roll between the drum and along the shoe due to movement of the drum and will wind up on itself, thus rolling out a considerable thread of metal and forming a groove. Again, the grains will break loose immediately and be pressed into the brake shoe lining. In both cases the material thus torn loose is imbedded in the shoe and remains therein and cuts the drum surface. Furthermore, such pellets or slivers as are torn loose have a tendency to protrude slightly above the shoe and thus concentrate the friction and form substantially a cutting tool. This action continues until many such portions have been torn loose from the drum and have left cavities and have imbedded in the shoe lining and scored the drum by contact therewith under pressure. At the same time these pellets are hardened due to cold work strains set up by rolling them under pressure between the drum and shoe.

It is difficult to say with certainty whether the pearlite tends to soften more rapidly under a given change in temperature than the ferrite and thus permits the ferrite or groups of grains of ferrite to tear loose or whether the ferrite tends to soften more rapidly, thus permitting the pearlite to become detached and imbedded in the drum. However, I believe that at the temperatures under which brake drums operate that the ferrite tends to harden under heat up to a certain temperature more rapidly than the pearlite, and that as a result the ferrite grains tend to tear loose. In either event it is apparent that this tearing and cutting effect results from a relative change in hardness of the components of the material and cannot be overcome merely by using metals, steels or alloys of greater hardness.

However, I have learned that it can be overcome by the use of any ferrous metal of substantially eutectoid or hyper-eutectoid composition, the relative hardness of the various components of which remains the same throughout a wide range of temperatures.

The amounts of carbon specified produce a eutectoid metal having a substantially pearlitic or sorbitic micro structure. In a metal having such structures the relative hardness of the component remains substantially the same throughout a wide range of temperatures and in fact up to the critical range of about 1350° F.

In practical use the temperature is never very high except where raised by concentrated or localized pressure as described, and since the entire band of pearlitic metal maintains a uniform hardness under heat and there is no relative softening or hardening of the pearlite or ferrite grains themselves, neither the grains nor cement become dislodged

and imbedded in the shoe with resultant scoring of the drum.

While generally I have described a pearlitic steel or metal in which the iron and cementite lie in alternate lamina, I may use a sorbitic pearlite which differs from the metal described in that the same laminated structure is not apparent as above mentioned. Although in my description I have referred for examples to carbon steels of the eutectoid or hyper-eutectoid composition, I do not mean to limit the invention only to carbon steels, but also to include steel alloys and other metals having a eutectoid ratio and the term "eutectoid" is used in its broader sense and not merely as a description of a function of carbon content. For instance, while .80 to 1.2% of carbon is desirable in plain carbon steel and will give substantially eutectoid composition, in alloys or other metals the carbon may be lower, the alloy or other constituents being of sufficient amounts to prevent the existence of any substantial amount of free ferrite.

It is apparent therefore, regardless of the theory, which appears to be substantiated, that an important characteristic of the metal I use must be that it is a homogeneous and not a heterogeneous mass, the various components of which maintain their same relative and substantially equal hardness or softness throughout a wide range of temperatures. In the metals of eutectoid and hyper-eutectoid composition uneven hardening and softening under changes in temperature and resultant fractures and separation of the components is minimized to the utmost and by using such a metal I eliminate entirely or reduce to a minimum the scoring of the drum and make possible the use of shoe lining of ordinary material. Again, the high carbon content tends to act as dry lubricator.

By the use of higher carbon metals I not only obtain a harder material to withstand the abrasion and cutting and scoring effects described, but I am using material in which the cause of scoring and the agency from which the scoring results is eliminated. An important feature of my invention therefore is the use for brake drums, shoes or the like of a steel or ferrous materials or ferrous alloys having a homogeneous pearlitic or sorbitic structure, the component parts of which will maintain their same relative and substantially equal hardness under heat.

While I have referred to steel in some of the examples given, it is to be understood that the invention is not to be limited to steel as the desirable characteristics can be imparted to other ferrous metals with equally good results.

I claim:

1. In a brake comprising a drum and a shoe adapted to be placed in engagement with said drum under pressure, a contact surface

on said drum, said surface being comprised of eutectoid steel having substantially a completely pearlitic micro-structure.

2. A brake drum having a shoe contacting surface composed of substantially eutectoid steel.

3. A brake drum having a shoe contacting surface composed of substantially hyper-eutectoid steel.

4. A brake comprising a drum and a shoe engageable therewith, the contacting surface of one of said elements being comprised of metal having a eutectoid composition.

5. A brake comprising a drum and a shoe engageable therewith, the contacting surface of one of said elements being comprised of ferrous metal having a eutectoid composition.

6. A brake comprising a drum and a shoe engageable therewith, the contacting surface of one of said elements being comprised of metal having a hyper-eutectoid composition.

7. A brake comprising a drum and a shoe engageable therewith, the contacting surface of one of said elements being comprised of ferrous metal having a hyper-eutectoid composition.

8. A brake comprising a drum and a brake-shoe engageable therewith, the contacting surface of one of said members being comprised of a steel alloy having a eutectoid composition.

9. A brake comprising a drum and a brake shoe engageable therewith, the contacting surface of one of said members being comprised of a steel alloy having a hypereutectoid composition.

10. A brake comprising a drum and shoe engageable therewith, the contact surface of one of said elements composed of steel containing carbon up to substantially 1.8% and having a pearlitic micro-structure.

11. A brake having a drum and brake shoe contractible with said drum under pressure, the contact surface of one of said members being of eutectoid steel having a pearlitic structure.

12. A brake comprising a drum and shoe contactable therewith, the contact surface on one of said elements being comprised of a ferrous eutectoid metal having no substantial amount of free ferrite and having a pearlitic micro-structure.

13. A brake drum comprised of eutectoid ferrous metal having a homogeneous structure, the component parts of said metal structure being capable of maintaining their same relative and substantially equal hardness throughout changes in temperature below the critical range.

14. A friction generating brake element having its contact surface composed of ferrous metal containing combined carbon in a range up to substantially 1.8% and having substantially no free ferrite.

15. A friction generating brake element having its contact surface composed of ferrous metal having a carbon content within the eutectoid range.

16. A friction generating brake element having its contact surface composed of ferrous metal having a combined carbon content within the eutectoid range and possessing a pearlitic microstructure with substantially no free ferrite.

17. A brake element having its friction contact surface composed of ferrous metal possessing a substantially pearlitic micro structure.

18. A brake element having its contact surface composed of eutectoid ferrous metal containing substantially no free ferrite.

19. A brake member having a contact surface comprised of ferrous metal composed of substantially complete pearlite containing substantially no free ferrite.

20. A brake member having its contact surface composed of ferrous metal containing ferrite, carbon and alloying elements which react with the ferrite to form a eutectoid structure.

In testimony whereof, I hereunto affix my signature.

JAMES H. CROWE.