Model A Brake Drums

BY HOWARD BECKSTEIN

For most of the production of the Model A, the brake drums were made of pressed steel. In about September 1931, cast iron drums were introduced both front and rear. There are a variety of advantages of cast iron over steel that likely contributed to the decision to make the switch. We'll take a look at some of the attributes of these metals to see why grey cast iron is a good choice for brake drums.

Fig 1 shows a steel brake drum with an aftermarket cast iron strengthening band shrink-fitted onto it. We'll talk about why the reinforcing band is helpful later.

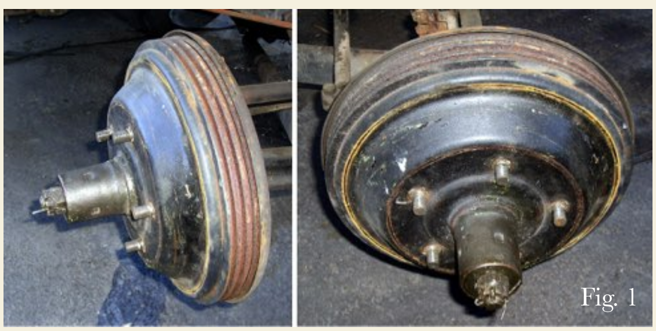

Fig. 1

Fig 2 shows the front cast iron drum introduced in late 1931. Some might confuse it with the 1932 drum, but the Model A drum is 11 inches in diameter and 1932 drums are 12 inches.

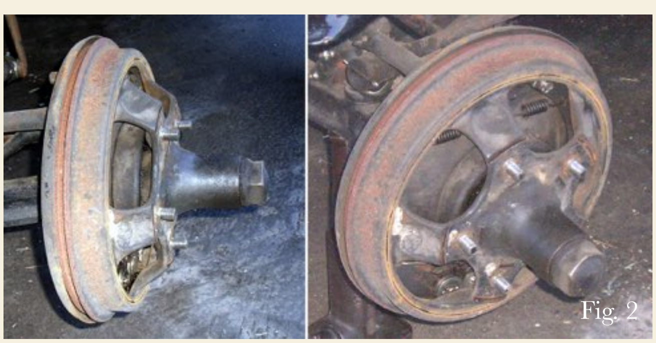

Fig. 2

Notice that a reinforcing band is not installed. One reason is that the rough surface of the cast iron drum will not conduct heat very well to a retaining ring. Another reason is that in order to withdraw a pattern from a mold, the surfaces have to be at a slight angle causing the finished cast to have that same angle; so a retaining ring wouldn't stay on anyway. A single reinforcing ring is cast into the outside of the drum which also acts as a slinger to try to help keep water off of the linings. The wheel mostly seals off the open face. This spider-like face was likely an experiment to reduce brake fade. It would also reduce the amount of metal needed to produce the drum. The design was dropped after a few years in favor of a solid face.

How Cast Iron Drums are Made

Cast iron is a product of the foundry where molten metal is poured into molds. Fig. 3 shows the upper and lower open boxes of a foundry *flask*. The *drag* is the bottom part and the top is called the *cope*. They are keyed together with a pin system that keeps everything including the pattern in the right place as sand is packed in the boxes against the pattern. A specific moisture content is needed for the body of sand to keep its shape once formed.

In the enlargement circle for Fig. 3, the draft angle of the foundry pattern is illustrated. Without this angle, the damp green sand that is packed in hard against the form would break away when the pattern is withdrawn.

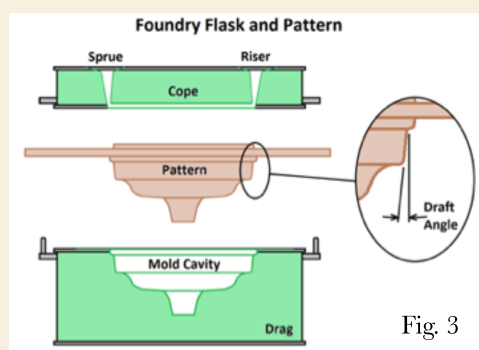

Fig. 3

After the cavity is made and the pattern removed, a core made of packed sand is placed into the cavity to create the internal shape of the brake drum.

The cope is also rammed with sand against the other side of the pattern and placed on top of the drag.

A *sprue* hole in the cope's sand allows molten metal to be poured into the mold. A similar shape called a *riser* is placed opposite the sprue to vent the mold during pouring. The pour is complete when liquid metal fills the riser.

As the formed drum starts to cool, the extra liquid metal that is in the sprue and riser "feeds the melt" so that as it contracts during cooling, the integrity of the brake drum's shape is maintained.

After the metal has cooled, the sand is broken out of the two parts of the flask and the drum is ready to be cleaned and machined. The sprue and riser are cut off of the rough drum to be recycled and the sand is reused. It is the grains of sand that gives cast iron its rough surface.

Components of Steel and Cast Iron

To better appreciate why grey cast iron is a good choice for making brake drums besides being more economical to produce, we should take a look at some basic metallurgy.

The components of steel and cast iron are essentially the same. Iron is the main part of both alloys. The basic difference between steel and cast iron is the percentage of Carbon that goes into the final product. Steel alloys have a Carbon content of 0.002% to 2.1% by weight. Alloys which contain between 2.5% to 4% Carbon with 1% to 3% Silicon are cast irons.

Some other elements added to iron in small amounts for both steel and cast iron in addition to Carbon are Silicon, Manganese, Phosphorus, Nickel, Colbalt, Chromium, Tungsten, Molybdenum and Vanadium.

The Society of Automotive Engineers (S.A.E.) has set standards for the percentages of these elements in various compositions to meet certain performance criteria for the steels and cast irons used in automotive production. Ford used many different steel and cast iron alloys for the Model A depending on their intended uses.

There is a lot more to the making of steels and cast irons than just the percentage of their component elements. One example is heat treating which changes the molecular structure of steel alloys to control hardness through quenching and tempering as they are worked in rolling mills, forging presses and stamping presses, etc.

Cast iron, on the other hand, can be heat treated to alter its internal structure, but it is not malleable and therefore can't be reshaped after it is cast without fracturing.

Desired Metalurgical Attributes

The various alloys of steel and cast iron have some but not all of the attributes shown in Fig 4.

This table tries to show the broad features of steel and cast iron in general. Of course this chart will change depending on the alloys of each being compared. Green is generally good and red indicates poor performance for that attribute.

Attribute	Description	Steel	Cast Iron
Malleability	Plasticity, the ability to be shaped without breaking.		
Ductility	The ability to deform under tensile stress such as being drawn into a wire.		
Hardness	The resistance to deformation under localized stress.		
Strength	Resistance to fracture under impact.		
Wear Resistance	The ability to withstand abrasion.		
Damping Capacity	The ability to absorb vibrations without transmitting them.		
Heat Transfer	The ability to get rid of heat applied to it.		
Machinability	The ease to which a material can be shaped with conventional cutting tools.		
Corrosion Resistance	The ability to resist oxidation and insolubility to etchants such as salts.		
Weldability	The ease with which metals can be joined by localized melting and filling processes.		

In looking at this table, it would seem that cast iron is not so great. What really matters is its intended use.

1. *Wear Resistance* Is a plus. This is due to the graphite in the alloy.
2. *Damping Capacity* mitigates the chattering and squealing that can occur during braking.
3. *Heat Transfer* can shorten stopping distances and fade recovery times.
4. *Machinability* makes it fast and economical to produce.
5. *Malleability* is not desired. Brake drums should not change their shape
6. *Ductility* really has nothing to offer brake drums where stability of shape is needed.
7. *Hardness* is irrelevant since the brake drums are not subject to localized deformation.
8. *Strength* relates to impact and drums are not subject *to sudden heavy stresses.*
9. *Corrosion Resistance* would be nice, but the abrasion of the linings against the drum keeps the business surface clean of rust. The rest can be painted.
10. *Weldability* is not needed for brake drums.

The secret to the great performance of grey cast iron for brake drums is the structure of its carbon component. In the cooling process after the brake drum is cast, the carbon turns into graphite flakes and is fairly evenly distributed throughout the metal. Fig 5 is a photomicrograph of grey cast iron showing various components. (Pearlite is a three-dimensional laminate consisting of 88% ferrite and 12% cementite.)

When grey cast iron is fractured, it is the graphite in it that gives it its color and hence its name.

It is this graphite that makes grey cast iron so machinable; it actually helps lubricate the cutting tool. It also helps to resist wear of the braking surface when the linings are pressed against the drum. Graphite gives grey cast iron great damping capacity because it absorbs energy and converts it to heat, which is what brakes are supposed to do.

Switching to Cast Iron Brake Drums

By the end of the 1920's, making brake drums out of pressed steel was an old habit with the automotive industry. For Ford, this habit was finally broken during the last months of Model A production. Pressed steel drums require many stamping steps to properly form them. They are then attached to a steel hub which itself requires many machining steps. Those spider style cast iron drums could be poured into a mold and with a bit of machining for the bearings and the brake surface were ready for stud installation and off to the production line.

One other advantage of cast iron is that different parts of the drums can be made to any thickness desired; thus permitting the resurfacing of their lining surfaces on a lathe. As the braking surfaces wear and get scored, they can be trued up to give them new life. The maximum amount of metal that can be removed from cast iron brake drums is .030" or .060" overall. Any Model A drum that measures more than 11.060" inside diameter must be replaced.

Steel drums must not be resurfaced! In a service bulletin sent to dealers in December 1930, it says: "Under no circumstances must any attempts be made to turn down brake drums on A cars and AA trucks. The brake drums we supply have a rolled braking surface to lessen any possibility of scoring and it is very essential that this surface not be touched with any kind of machining tool." In those days, dealers were to exchange worn drums for their customers at a modest price.

The Causes of Brake Fade

Nothing is more frightening than to be driving down a long hill with your brakes quickly losing their effectiveness. The only safe thing to do is to pull over and let them cool down.

There are two major factors that contribute to brake fade. They are heat-soaking of the linings and drums and expansion of the outer edge of the brake drum. The brakes slow the car by converting kinetic energy to heat energy. This heat has to be rapidly dissipated for the brakes to remain effective.

As brake linings get hotter, they become so saturated with heat that it gets hard for them to generate any more. The same thing happens with the metal drum. It takes time for the heat to dissipate through conduction to heat sinks such as the web of the shoe and the face of the drum and the hub. Heat also dissipates into the air by radiation. This overwhelming of the lining material and metal drum by heating it faster than it can throw off the heat leads to brake fade.

In addition to heat soaking, the drums expand due to the heat generated during braking. The inside of the friction surface of the drum is restrained by the face of the drum. The outside is not restrained from expansion by anything, so it gets larger in diameter as it gets hotter. Fig 6 shows how the drum becomes "bell shaped" as it heats up. Under these conditions, the lining only contacts the inside portion of the drum surface, further contributing to brake fade.

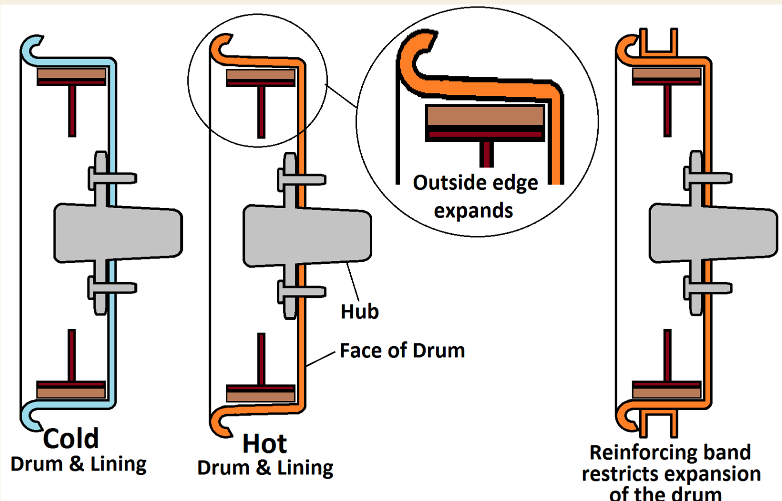

Fig. 6

By installing an aftermarket reinforcing band on a steel drum, it is restrained from expanding too much. The band also acts as a heat sink and as cooling fins; thus creating more surface area for heat dissipation into the air.

Counter Measures to Brake Fade

Good driving habits involve using the compression of the engine and lower gears to slow the car down in conjunction with the brakes. The rule of thumb is to go down a hill in the same gear used to go up. Shifting the car into neutral in regular traffic and using the brakes to do all the work to bring the car to a stop will require longer stopping distances, possibly induce brake fade sooner and wear the linings down more quickly.

Brake adjustments are to be made when the drums are cold. If adjusted when hot, the drums have expanded and the adjustment will be too tight when the drum cools and contracts, thus causing binding and quick overheating of the drum and linings leading to fade.

Inspect the brakes at least annually to be sure the linings are not worn down to the rivets. Although often made of soft brass, the rivets are hard enough to cause scoring in a brake drum.

Cast Iron Drums are not Indestructible

Fig 7 shows a cast iron rear drum with a nasty crack through it. This was found on the author's car after a rear wheel locked up while rolling out of a parking lot driveway under light brake pressure. The cause of this fracture is unknown. In thinking back, the only thing that comes to mind was a hard hit to the chassis when driving too fast over a deep storm gutter that crossed the road in a neighborhood unfamiliar to the driver about a week or so before. It seems that Model As should be driven with a little more care when gouges in the pavement are a clue to the hazard

One word of wisdom about installing replacement drums on your hubs. Don't try to do it yourself; have them installed professionally. You'll be glad you did.

In Conclusion

So well suited is cast iron for brakes that the material is used today for drums and rotors. In the interest of safety, MAFCA and MARC fine point judging allows cast iron drums in lieu of steel and the installation of reinforcing bands on steel drums for only a slight point deduction.

If you want the original steel or late 1931 cast iron drums, go to the swap meets; but take a precision measuring tool with you. Otherwise the only new brake drums in the catalogs are solid-faced cast iron. As far as safety is concerned, they're a good

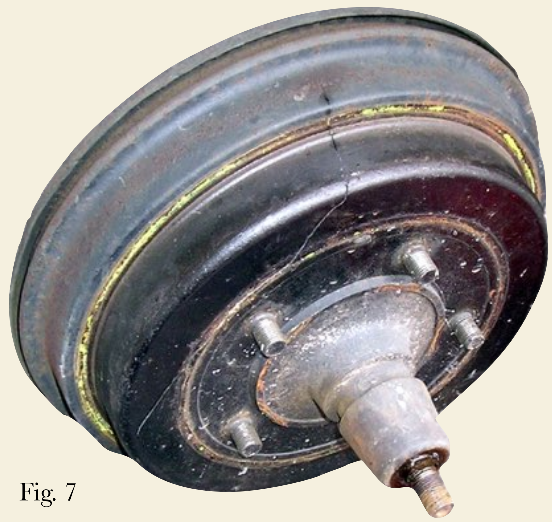

Fig. 7

Classified Ads

•Karl Pope knows of a 28/29 chassis with hydraulic brakes, rebuilt motor and tranny for $3,500; (801) 374-8083

•Six 5.25/5.50-17 wheels and one 19" wheel with new Sears tire $100.00 Call Tony (801)796-0396.

• Clark Christensen is selling 2 Chevy barn finds. Clark's got all the info you need (801) 362-0210

If you would like to have an item included in the Classified Ads, call Robert at (801) 489-9808 .

MAFCA Pattern Project

The Pattern Project video is now available via the MAFCA YouTube channel. The video highlights the enormous work spearheaded by Helen Christensen of the Santa Clara Valley A's in San Jose, California. Ladies, go check it out!