## 8.4 Brakes

# BRAKES AND BRAKING

A. F. Houlberg

*(From "Motor Cycle Repairs and Upkeep" published by Newnes, in weekly instalments, around* 1931)

In the development of the motor-cycle almost every conceivable type of brake has at some time or other been employed. The searching tests imposed by the series of post-war T.T. races have gradually eliminated all designs of doubtful quality, so that the present-day motor-cycle is almost invariably equipped with brakes which are perfectly sound in basic principle. The most casual of surveys of brake equipment at the last Motor Cycle Show will have revealed to the observer the almost universal use of the completely enclosed and well protected internal expanding brake, clearly indicating that the days of such atrocities as wheel rim brakes and belt rim brakes are definitely a thing of the past. It is therefore not proposed to deal with such brakes at length in these pages, but mainly to confine our attention to brakes of current design.

The internal expanding brake used on the modern motor-cycle consists of two shoes of semi-circular formation hinged together at one end and expanded into contact with the interior of the drum at the other. The method generally employed to expand the shoes being a rotating cam of substantially rectangular formation with rounded corners.

## The First Points

A knowledge of the essentials of efficient braking mechanism will prove of great value to the owner in diagnosing the actual cause of any braking trouble he may encounter, and thus enable him to achieve a rectification in the shortest possible time. It is therefore considered that a few words on the fundamentals of brake design will not be amiss.

## The best material for brake linings

In the first place, all brakes rely upon the existence of friction for their action, and it therefore follows that the quality of the friction, or, as it is technically known, the coefficient of friction, existing between the two elements of the brake, namely the stationary element and the rotating element, is of paramount importance. Many substances and combinations of substances have been employed from time to time, but the only material which can be said to give unqualified satisfaction in service is woven asbestos fabric. This asbestos fabric is often reinforced or bonded with brass wires, and highly compressed in the course of manufacture in order to increase its durability. The chief characteristics required of a friction material for brake purposes are that it should be able to resist high temperatures, that it should possess a high coefficient of friction, and that it should be hard wearing. The bonded asbestos brake lining possesses a happy combination of these three features. As a matter of interest, we give herewith a list of materials frequently used for frictional purposes, with their corresponding coefficients of friction:

| Materials in contact | Coefficient of friction |
|---|---|
| Asbestos fabric on cast iron or steel | 0.4 |
| Leather on cast iron | 0.2 |
| Leather on aluminium | 0.22 |
| Cast iron on cast iron (lubricated) | 0.1 |
| Bronze on cast iron (dry) | 0.21 |
| Bronze on bronze (dry) | 0.20 |
| Hardwood on hardwood (dry) | 0.48 |
| Hardwood on hardwood (well lubricated) | 0.16 |
| Cast iron on hardwood (dry) | 0.49 |
| Cast iron on hardwood (slightly lubricated) | 0.19 |
| Cast iron on hardwood (well lubricated) | 0.08 |

## A likely cause of brake failure

From this table it will be seen, as is to be expected, that the question of lubrication between the frictional surface has a very important effect on the coefficient of friction, and thus upon the braking efficiency of the materials. For this reason, sudden ineffectiveness of a motor-cycle brake if not due to an obvious external fault, can often be traced directly to a leakage of lubricant into the brake drum, due to over-zealousness with the oil can or oil gun on the hubs or adjacent components. The remedies for this complaint will be discussed later.

## Examining the brakes

*The Expanding Mechanism*

If, upon examination, the lining is found to be in good condition and free from foreign matter likely to impair efficiency, attention should next be devoted to the expanding mechanism. As we have already indicated. this usually consists of a rectangular cam with rounded corners, which is centrally pivoted and operated through a short shaft by an external lever in connection with the operating mechanism. Irregularities in this cam, due to wear or neglect of lubrication, which would have the effect of stiffening its action, may frequently absorb so much of the energy applied to it that little is left to it for forcing back the brake shoes themselves against the brake drum. The remedy for lack of lubrication is obvious, and consists in cases which are not oo severe, of the liberal application of the oil can to the afflicted parts. In severe cases, dismantling the cam-shaft, thoroughly cleaning the bearings, greasing and reassembling are called for.

*The Brake Cams*

A not uncommon fault, which frequently is not obvious (owing to the enclosed nature of most brake mechanisms) is occasioned by the cam working in an inefficient position. Normally, the cam should lie fairly snug between the two parallel actuating faces forming the ends of the brake shoes. This condition however, is only attained with brake gear which has been particularly accurately made, and with linings that are comparatively unworn. Immediately wear takes place, and the brake actuating mechanism has been taken up accordingly, the cam assumes an angular position in relation to the ends of the brake shoes, and excessive wear or faulty manufacture may enable the cams to assume a position almost at right angles to the fact of the shoes. Obviously in this position, the cam cannot impart additional movement to the shoes and, furthermore, it is in imminent danger of overshooting the 'safe' "maximum" position and becoming locked in the 'fully-on' position, so causing the brake to remain on, completely out of control of the rider. In all fairness to modern designers, it must be pointed out that the possibility of this occurring on present-day brakes is comparatively small. Nevertheless, faulty assembly of the brake or undue neglect may yet produce this condition of affairs. The precise action of the cam and the way in which is can become jammed after passing the dead centre point, will be clearly followed in the accompanying diagram.

## How to check the position of the brake shoes

As we have already indicated, there is some difficulty in observing the exact position of the shoes and expanding mechanism, owing to the fact that they are enclosed within the brake drum and brake back plate. The best way to ascertain the position of the expanding mechanism is to apply the brake moderately hard with everything assembled in the normal position and carefully mark on the back plate or on a suitable piece of metal temporarily attached to it, the exact position of the lever. When the wheel is removed and dismantled, thus revealing the internal mechanism of the brake, it is an easy matter to move the lever into the position marked and to observe the relative position of the expanding cam and shoe ends. If an excessive gap is present between the shoe ends, causing the cam to assume a poor angle, this is generally due to wear of the lining (which should immediately be replaced) or may even be a combination of lining and brake drum wear.

## When and how to pack the ends of the brake shoes

In cases where examination reveals that the brake cam is nearly at the end of its effective travel and the brake shoes shew little sign of wear, the brake may be restored to its original effectiveness by the use of packing at the shoe ends. Suitable packing pieces may be easily formed from mild steel sheets of correct thickness, taking care to see that they are fitted in such a manner that there is no likelihood of them leaving the shoe ends and so upsetting the braking.

The actual shape of these packing pieces will depend upon the design of the shoe, and it will not be outside the ingenuity of the average motor-cyclist to devise a suitable and firmly attacked packing. Two methods of fashioning such packings and attaching them to the end shoes are indicated in the accompanying sketch.

Some manufacturers fit these packings as standard and provide accommodation for shims behind them, so that the cam position is adjustable, in which case it is only a matter of adding a correct number of shims of the correct thickness to bring the brake back to its original efficiency.

**Brake camshaft lever position — how it affects braking power**

The factors controlling the effectiveness of any brake are the frictional area in contact with the brake drum, the coefficient of friction between the shoe and drum the diameter of the drum and the pressure with which the shoe is forced against the drum. In the latter respect, too few riders appreciate the effect and importance of maintaining the correct angle between the brake camshaft lever and the pull rod or cable operating it. A close study of the diagram, showing the loss of effective leverage for different angles between the brake camshaft lever and pull rod, will lead to an appreciation of the energy losses which can occur through neglect of this important point and the resulting loss of braking efficiency. It will be seen that the difference between a correct and incorrect angle may make as much as 13% difference to the force actually applied to the brake shoes and thus to the braking efficiency.

It will be clearly seen from the diagram that the most effective angle between the brake cam lever and its pull rod is 90°. Unfortunately this is an ideal condition which is seldom constantly attainable in a brake, owing to the fact that a certain amount of motion must be permitted in order to apply the brake and a certain allowance must be made for wear. As usual, one has to compromise, and the most effective method is to allow the lever to lay backwards, making a relatively acute angle with the pull rod, so that when all clearances in the operating mechanism have been taken up and the brake shoes have been brought in contact with the drum, the lever and pull rod assume positions approaching the desired 90°. Care must, however be exercised not to overdo the backward positioning camshaft levers, or so much power will be lost that it may become difficult to apply the brake. The limiting angles which the brake camshaft lever can make with the brake pull rod are clearly shewn in the diagram, from which it will be seen that it is unwise to make an angle of less than 60° or more than 120° with the pull rod. The maximum backward slope of the cam is always definitely controlled by the designer, and if the operating rod adjustment is slackened off until the brake camshaft is quite free, it will naturally assume this position under the action of the brake-shoe return springs. There is nothing to be gained by setting the lever beyond this point as it will only expand the shoes slightly in the reverse direction and entail unnecessary lost motion during shoes to droop sufficiently for the heels of the linings to come in contact with the drum (3) the use of the brake lining of the wrong thickness; (4) badly fitted linings.

The remedy for the first is obvious, and merely entails the proper manipulation of the brake adjustment and the free use of the oilcan.

*(to be continued)*

Fig 3.

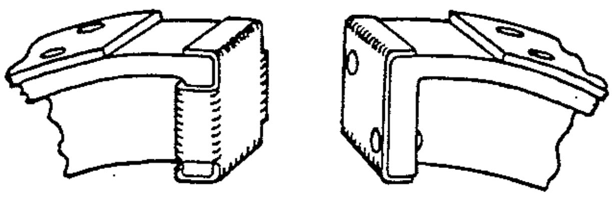


**Fig. 3. Methods of packing shoe-ends. The method shown on the left consists of a cross-shaped piece of steel bent 'round the shoe-end, and can be used when there is plenty of clearance on each side of the shoe. When this clearance is small, the method depicted on the right may be used. In this example the packing is riveted to the shoe face with countersunk rivets finished flush.**

*(Our thanks to member Nick Trahearn of Southminster, Essex for reproducing illustrations for the "Brakes and Braking" article from the originals.)*

Fig 1.

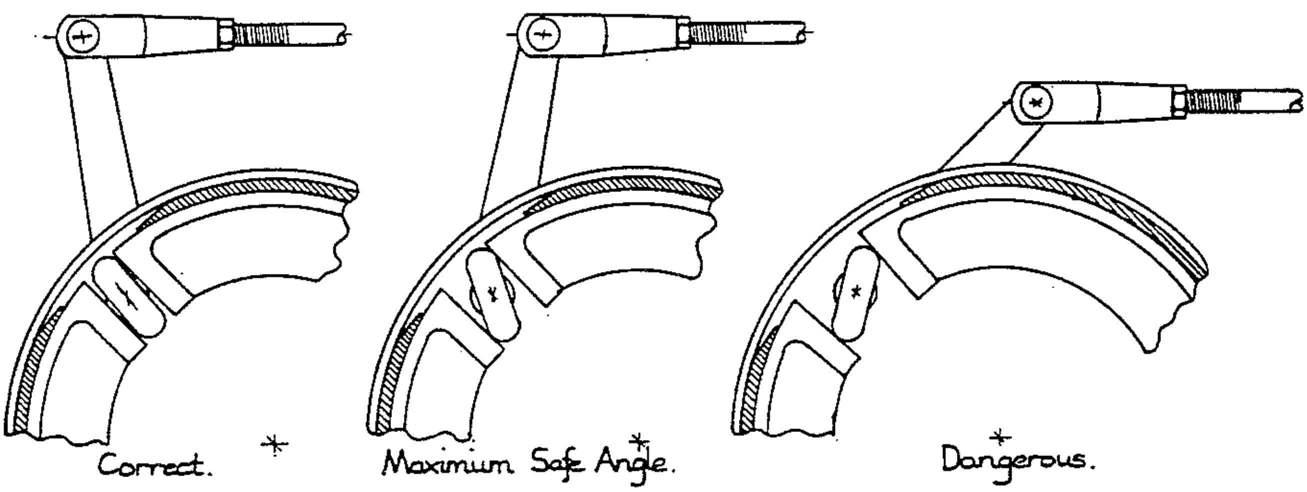



**Fig. 1.** Attention to brake operating gear. The need for careful attention to the position of the brake operating cam, relative to the two ends of the brake shoe, is here clearly shown. It will be seen from the diagram on the extreme right that the cam is in imminent danger of turning right over.

Fig 2.

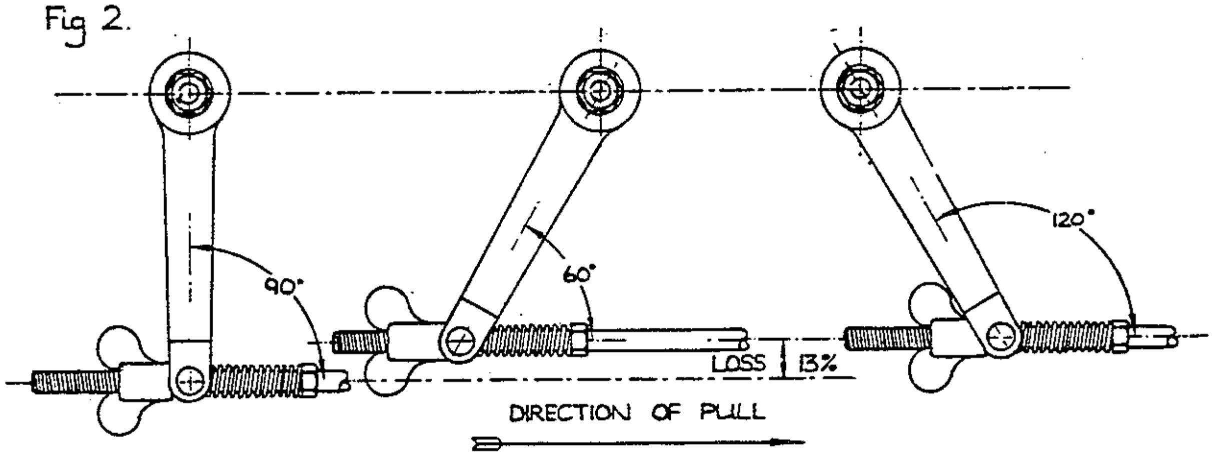



**Fig. 2. Faulty positions of brake levers.** These diagrams demonstrate the loss in effective leverage occasioned by faulty positioning of the brake operating levers relative to the brake pull-rod. Losses of 10 per cent are frequently encountered.

# BRAKES AND BRAKING (2)

A. F. Houlberg

### Wear of shoe pivots

Shoe pivot wear can be remedied by the employment of suitable packing shims between the heel of the shoe and the anchorage pin, or, better still by fitting a new anchorage pin of large diameter and a reasonable fit in the heel of the shoe, so as to correctly reposition the shoe in relation to the brake drum. When fitting anchorage pins of larger diameter it must be remembered that the horns of the shoe ends may have to be opened out to allow the pin to find a seating in the throat portion of the shoe end. There is no remedy for the use of too thick linings other than their replacement. In the course of time they will naturally wear down to the correct thickness, but, in the meantime, ineffective brakes will be the result, and the heat generated by the points of the shoes which remain in constant contact with the drum may be sufficient to raise the temperature of the drum and the adjacent hub to such an extent as to cause the hub grease to become sufficiently fluid to penetrate the grease retaining device and to find its way on to the surface of the drums, thus further reducing braking efficiency.

### Bad fitting of linings

This trouble is frequently encountered immediately after a brake has been relined, due to carelessness on the part of the owner when rivetting up the linings to the shoe. Faulty rivetting of this nature often causes local buckling of the lining, so that hot spots are produced which remain in constant contact with the drum. Such high spots can only be remedied by removing the lining and carefully re-riveting.

High spots due to swelling of the lining around the rivet heads under the action of riveting, are capable of satisfactory treatment if the swollen lining is carefully hammered down on to the brake shoe while it is held in a vice. Undue force should not be employed, particularly with the

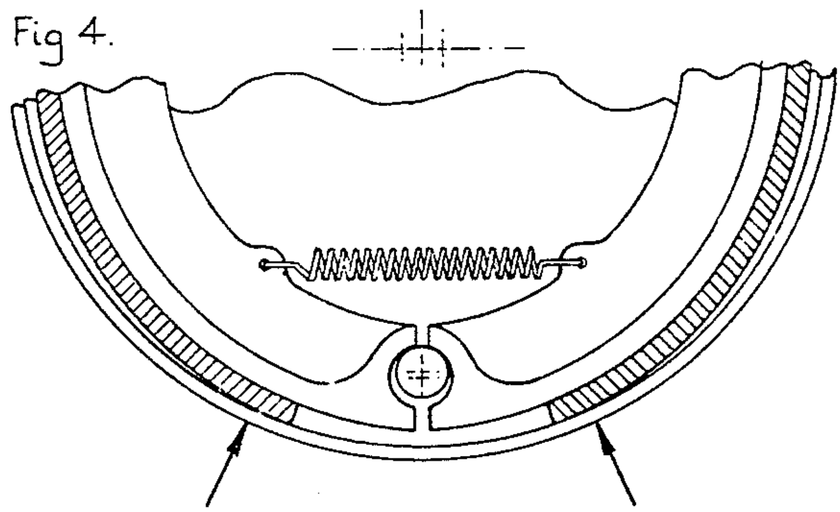



**Fig. 4. Wear at shoe anchorage. When this becomes excessive it may allow the brake shoes to make constant contact with the brake drum.**

modern aluminium shoe, or it will very likely be fractured.

### Brake fierceness or chatter

A properly fitted and adjusted brake should be smooth and progressive in its action when it is applied with increasing force. Occasions arise, however, where brake action is unduly fierce and not under full control of the rider producing a chattering action, which will cause a motor-cycle to come to an abrupt and erratic halt instead of pulling up smoothly. This type of faulty brake action is generally produced by what is very expressively termed 'brake lining pick-up'. What actually occurs is that the toe end of the leading shoe is picked up the rotating drum which tends to carry it round with it until it encounters sufficient resistance from the pivot to cause it to release its grip. The released shoe now springs back to its normal position under the action of the take-off spring, only to be picked up again by the drum and repeat its action.

### The remedy

Since the cause is the picking up of the lining the remedy rests with suitably treating the lining to obviate the possibility of the ends making violent contact with the drum that the shoe will be carried round with such fierceness. The method employed to achieve this is to bevel off the ends of the linings, so that they make gradual contact with the drum when the brake is applied, for a distance of about one inch from the end, by means of an hacksaw, or rough file such as a "Dreadnought" milling file. If bevelling the linings does not effect a cure, make sure that none of the rivets are proud of the lining and making contact with the drum. Also make sure that the take off springs are not too weak, or that there is no undue slackness between the heels of the shoes and the pivot. In addition, the shoe pivots should be examined to ascertain that they are not loose in the back plate.

### Another cause of chatter — worn brake camshaft

Another source of chatter may originate from slackness in the operating mechanism and its bearing. Obviously slackness at this point will enable a periodic motion of the shoes to take place under the action of the brake drum.

### Oil leakage

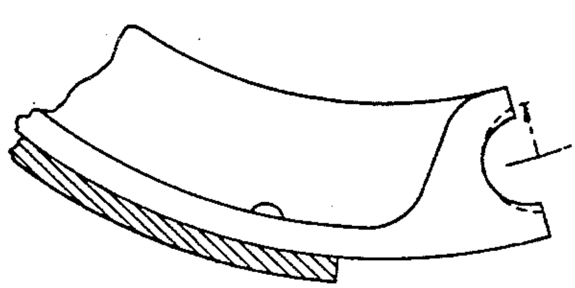
An oil leakage into the brake drum may be the ultimate cause of a certain amount of chatter. When the oil becomes partly burnt off, it frequently reaches a critical stage, where violent brake chatter is produced. The remedy in this instance is either to burn off the oil from the saturated lining with a blowlamp (care being taken not to melt the shoe if it is constructed of aluminium) or to soak the shoe and the lining in petrol until all the oil has worked out.

### Dented brake drum

Brake chatter may again rise from defects in the brake drum itself. A brake drum which has become dented in a minor accident is always prone to picking up the leading shoe and producing chatter. Here the obvious remedy is to get the drum trued up by way of skimming in a lathe if the damage is not too bad, or if the drum is extensively damaged, to replace it by a new one, always remembering that it is inadvisable to take too much metal away from the drum, firstly, because such a procedure would weaken it unduly. and, secondly, it increases the clearance between the shoe and drum, a condition of affairs which is liable to bring the expanding cam into an unfavourable position.

**Fig. 5. When oversize anchorage pins are fitted. This diagram shows how the shoe-ends should be treated. The metal should be removed from the horns of the shoe only, and not from the throat. The metal should also be removed equally from either side.**

Fig 5.



### Brake reaction

See the brake back plate is firmly anchored. The proper absorption of the brake reaction is a matter of no little importance. It must be fully understood that the elementary laws of mechanics as first laid down by Sir Isaac Newton, clearly defined that every action has an equal and opposite reaction. The retarding force, or braking action, applied to the wheel, produces an exactly opposite and equal reaction on the brake shoes which must be resisted by the brake shoe anchorage pin and the brake back plate, to which it is firmly anchored. In turn the back plate must be firmly attached to the frame to resist the reaction, and, furthermore, it should be so attached to the frame that undue bending moments, that is to say, forces tending to bend the frame out of truth — are avoided. The majority of brakes have a torque rod, stud, or link attached to the back plate, whose other end is anchored to a suitable point in the frame so as to absorb the torque reaction due to brake application, and in the cases of persistent chatter, it is essential to make sure that the anchorage for the brake back plate is not loose but firmly tightened up.

One problem incidental to the design of the torque member arises from the necessity of chain adjustment in the case of the rear wheel, and the demand for simple wheel removal in the case of both whels. For this reason many manufacturers employ a form of torque anchorage consisting of a slotted member attached to the brake plate engaging a fixed pin attached to the frame or a reversal of this scheme. When the parts are new, and a good fit exists between the brake anchorage stop pin and the slot, so that little or no backlash exists between them, the production of chatter, due to looseness of the back plate, is unlikely.

In the case of machines that have seen some wear, however, there may be sufficient play between these parts to cause trouble of this nature, although it must be remembered that in all cases the tightening up of the spindle nuts will have a clamping effect on the back plate, and that provided these are kept done up dead tight (an important point for many other reasons) little trouble is likely to be encountered from this source.

### Faulty hub bearings may cause erratic braking

Another cause of erratic brake action of the chattering variety is occasioned by faulty adjustment of the hub bearings, permitting the brake drums to possess an unnecessarily excessive degree of movement in relation to the brake shoes. The remedy here is obviously careful adjustment of the hub bearings. While attending to bearings, it is as well, in the case of front wheel brake chatter to check over the bearings of the steering head and make sure that excessive play has not developed in these.

### Worn shoe pivot

Yet another cause of brake chatter is wear at the brake pivot pin, permitting the two shoes to make contact with each other without making firm contact with the anchor pin, thus permitting the shoes to have a certain amount of play at the anchorage. *(to be continued)*

## BRAKES AND BRAKING (3)

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### Cable operated brakes

Cable operated brakes, in spite of the increase in size of the operating cables which has taken place in recent years, are still prone to a certain amount of stretch, particularly in the case where a rider drives on his brakes, instead of employing the more gentle and economical method of driving by correct manipulation of the throttle. Cable operated brakes, therefore, need much more frequent attention in the matter of adjustment than rod operated brakes.

Every maker provides ample and simple adjustment to meet all but exceptional eventualities, and the rider who permits his brakes to reach the stage where an excessive amount of lost motion takes place before the brake comes into action, has only himself to blame.

### General adjustment

The simplest way to carry out braking adjustments is to put both front and rear wheels on the stand clear of the ground. Slacking the locking devices of the brake adjustment, it is then a fairly easy matter to tighten up the adjustments until the brakes are heard just rubbing, always taking care of course, that the brake lever is hard up against its stop. It is then advisable to slack back the adjustments one complete turn to make sure that the brakes are completely clear of the drum when in the "off" position. A test of the brakes should then be carried out by depressing the brake or operating lever and turning the wheel by hand in order to obtain a rough idea of its effectiveness. The brakes should then be released and the wheel spun by hand to make certain that the shoes still clear the drum in the "off" position. If they do not, examine the brake mechanism for stiffness in the manner indicated elsewhere.

### Rear wheel brake adjustment

In the case of rear wheel brakes the need for chain adjustment produces additional complications. The method of adjusting the chain invariably consists in sliding the rear wheel backwards and forwards between the slotted fork ends, and it is not difficult to realise that this will make a complete readjustment of the brake necessary. Whenever chain adjustments are carried out, it is therefore essential to make a brake test and readjust the brake accordingly. When adjusting the chain, it is also of importance to remember that if the torque member is of the rigidly clamped type, it should be firmly tightened up again after the chain adjustment has been completed. A certain amount of brake chatter may be produced if this point is neglected.

The Rudge Whitworth concern have developed a form of coupled front and rear brakes which gives a high degree of braking efficiency if properly adjusted. The basis of this coupled brake scheme is the fact that a percentage of the total weight of the motor-cycle carried by the front wheel is increased on brake application, the extent of this additional load being of course dependent upon the violence of the brake application. In cases of very violent braking, the larger percentage of the total weight of the machine is thrown on to the front wheel, due to momentum possessed by the cycle and rider, and it therefore becomes of some importance to have high braking power available on the front wheel. The Rudge device provides for equal brake application on both front and rear wheels under normal circumstances, but ensures that a greater percentage of the braking effort is provided on the front wheel when the brakes are heavily applied. The scheme is extremely simple, and consists of a partly compressed spring interposed in the rear brake pull rod, the strength of this spring being sufficient to overcome normal pressures applied to the brake pedal; in fact the rear brake pull rod functions as though it were solid, the spring remaining in the extended position. Under these conditions pressure on the rear brake pedal applies both front and rear brakes equally. As increased pressure is applied to the brake pedal however, the resistance of the coupling spring is overcome and it is further compressed. When this occurs little additional braking load is applied to the rear brake, but the majority of the additional braking effort is applied to the front wheel, thus enabling full use to be made of the increased load which the front wheel has now been called upon to bear.

### Excessive brake pedal or brake lever movement

If an excessive movement of the brake lever or pedal is called for in order to bring the brakes into action, despite the fact that the clearance between the drums and the shoes has been accurately set, it indicates the existence of faulty adjustment or excessive wear in the operating mechanism. A certain amount of clearance or lost motion is of course necessary, but the discriminating rider will cut this down to the smallest possible amount, so that he has the brake under full control immediately he applies his foot to the pedal or hand to lever, without the necessity for making an excessive movement in order to bring the brake into action. The modern motor-cycle brake has so few articulated joints in its make-up that the possibility of sufficient backlash or wear taking place in these appreciably to affect brake application is remote. In nearly every case it will be found that this fault is entirely due to incorrect adjustment on the part of the owner.

### Straight pull rods should not require frequent adjustment

Brakes operated by pull rods which are practically inextensible should maintain their adjustment for a considerable time, since the only modification which takes place is that due to wear of the friction linings, and modern linings are capable of giving many thousands of miles' service before appreciable wear takes place.

### A note on cranked pull rods

In a well designed brake gear of the rod type, the pull rods will be arranged to be dead straight and to give as direct pull as possible on the brake camshaft lever. There are however, numerous examples in use where the rod is cranked in order to dodge a projecting portion of the motor-cycle's anatomy, in which case there is always present the tendency to straighten out the kinks. This will have the result of increasing the effective length of the pull rod, in which frequent attention to the brake adjustment is advisable.

This method of braking has many commendable points, and certainly goes far towards providing maximum possible braking under all circumstances.

## BRAKE REPAIRS

### How to reline the brake shoes

The most frequent repair which the owner is called upon to carry out is relining the shoes with fresh friction linings.

### Getting at the shoes

Removal of the rear wheel will in some cases give access to the brake shoes. In other cases it may be necessary to withdraw the brake back plate from the hub. In nearly all front wheel brakes withdrawal of the wheel and removal of the back plate is necessary. The method of dismantling varies with different makes, and this question is dealt with in detail elsewhere.

Examination of the brake shoes will in nearly every case reveal that they are held in position against the cam and pivot pin by means of short coil springs in tension which are generally known as take off springs.

### Mark before removal

Before removing the shoes it is wise to mark them in such a manner that you will replace them in the same position. Shoes have a way of bedding down during use and, if they are reversed, may not work so sweetly as if retained in their original positions.

### How to release them

To release the shoes it is necessary to extend the springs until one shoe is pulled sufficiently far away from the cam and anchorage pin to clear any retaining disc, or disc, which maintain it in position, so that it may be moved sideways clear of the cam and pivot pin, thus releasing the other shoe. The retaining springs are never so strong that appreciable difficulty is likely to be encountered in separating the brake shoes in this way by hand, and it is a very much simpler way than trying to unhook the springs by means of a metal rod or screw-driver.

### In cases of special difficulty

In cases where difficulty is encountered in withdrawing the brake shoes in this manner, recourse may have to be made to releasing the shoes by removing the springs, in which case a piece of stout string threaded through the eye of the spring will be found much the simplest method. Protecting the hand with a suitable quantity of rag padding, sufficient pull can be imparted to the string to extend the spring until the eye is clear of its anchorage on the brake shoe. When both springs are loosened in this manner the shoes are completely free.

### Removing the old lining

The old lining can now easily be removed by gripping the shoe in a vice and inserting a cold chisel under one end, shearing the brake lining rivets in sequence, taking care to hold the chisel at such an angle that the shoe will not be cut into, and remembering that it is necessary for the rivets to be sheared off close to the shoe or unnecessary difficulty may be experienced in withdrawing them. Once started the remainder of the lining is easily torn away from the rivets whose projecting portion can now easily be cut off with the chisel. With the lining removed and the

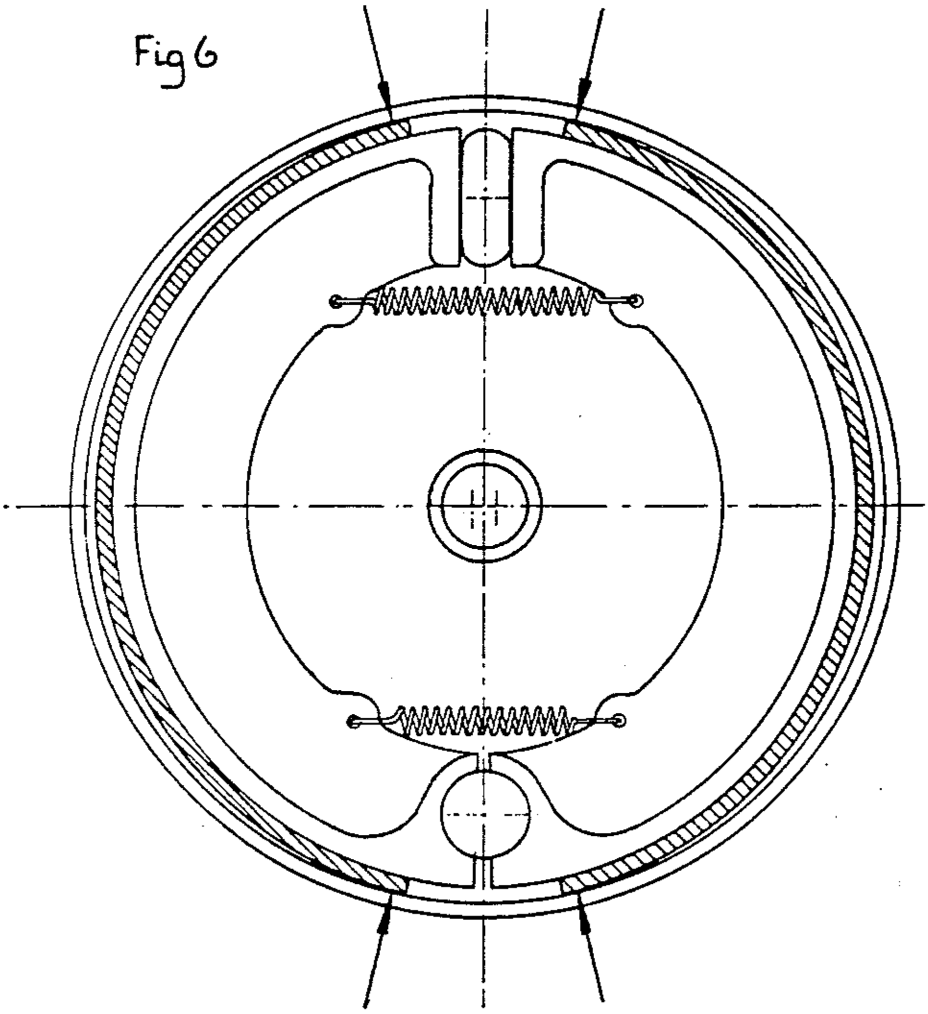


**Fig. 6. The effect of relining with lining too thick.**

rivets cropped off short, the remaining portion of the rivet can be punched through the flange of the shoe by means of a suitable rivet or nail punch.

**The new lining**

Procure a sufficient quantity of lining of the correct width and thickness to reline the shoes, taking particular care that the thickness is correct Too thick a lining may cause you to have difficulty in replacing the brake drum in position at the end of the relining operation; too thin a lining will prevent you from obtaining the maximum results from your brakes, since only the toes of the shoes will be coming into action. Replacement linings of the correct width and thickness and frequently cut to length and moulded to the contour of the shoe are obtainable from manufacturers, and their use is advised whenever possible.

**Rivets also**

Procure a sufficient quantity of copper or aluminium rivets with well countersunk heads and with shanks of the right diameter. Proper brake lining rivets are obtainable from most motor-cycle stores of repute. Never attempt to use mild steel rivets for this work.

**Getting off the lining**

The new linings should accurately be cut to length and bent to shape to fit snugly on to the shoe when it can be correctly positioned and held in place at the one end by means of toolmakers' clamps or similar devices. To facilitate bending the linings, it is advisable to warm it slightly. A drill is now brought into use of the same diameter as the rivet shank and using the rivet holes in the shoe flange as a guide, holes to accommodate the two end rivets are drilled in the lining, taking care to see that the lining is lying parallel to the edge of the shoe.

**Countersink the holes in the lining**

Since it is imperative that the heads of the rivets should remain clear of the brake drum to avoid scoring the surface of the drums and reducing the braking efficiency, it is necessary to countersink the holes just made in the linings to receive the countersunk heads of the rivets. Two methods may be employed to effect this. A large drill or rose type countersink may be employed to countersink the mouths of the holes, but by far the best way is to use a large centre punch and to produce a countersink by hammering it into the hold just made. This method of countersinking does not damage the ends of fibres forming the brake lining to the same extant as the other method; in fact, it tucks the loose ends inwards,

Fig 7.

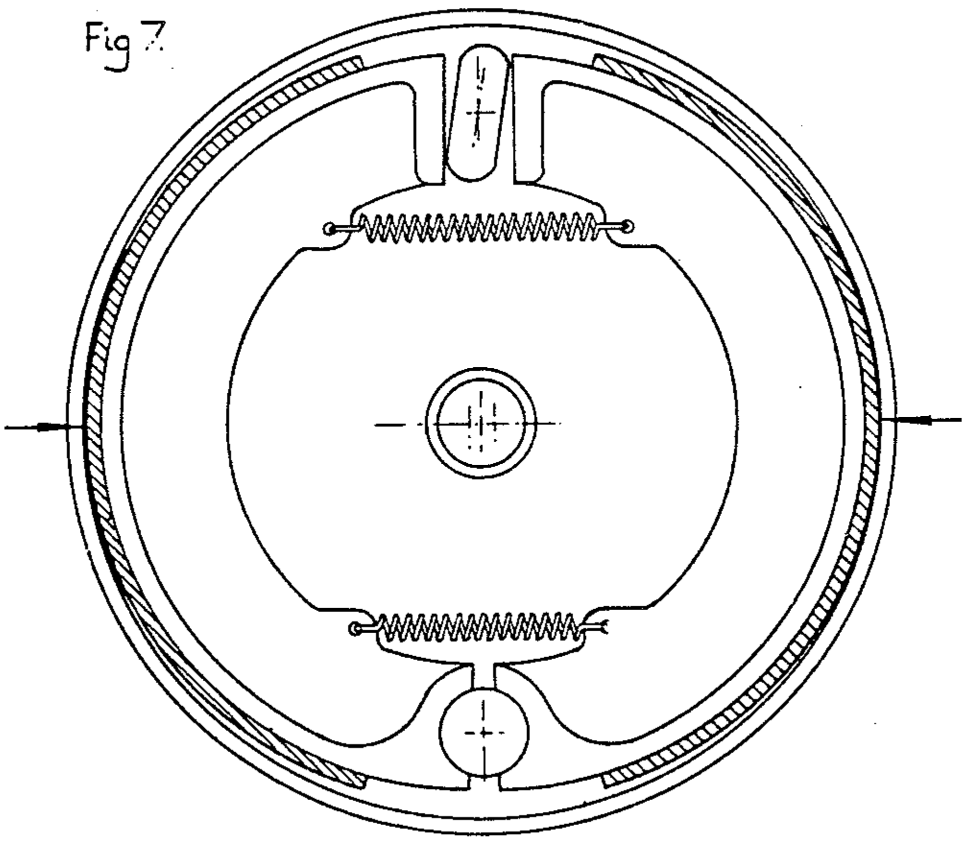

**Fig. 7. Effect of using lining which is too thin. Here, only the centres of the shoes make contact with the drum. Ineffective brakes are the result.**

Fig. 8

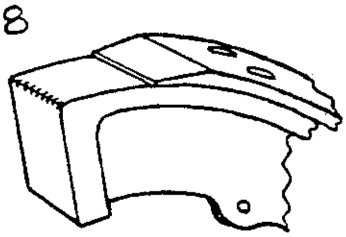

**Fig. 8. How to treat the ends of the linings, to obviate pick-up or chatter. The linings should be bevelled off in the manner here shown.**

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where they become firmly gripped by the conical head of the rivet.

**Riveting**

Inserting the rivets into the holes just countersunk, they may be riveted over on the inside of the brake flange. This is best accomplished by holding in the jaws of a vice short length of rod of a diameter equal to the diameter of the head of the rivet, and using this as an anvil upon which to rest the rivet head while the shank is being hammered over. This will ensure that the head of the rivet will bed firmly on its countersunk seating in the lining, and, furthermore, that its head is well below the working surface to the lining. Having riveted up the first two rivets to your satisfaction, you may remove the clamps, and place them further round the shoe, taking care that the lining is kept firm in contact with shoe flange the whole time. You may then drill and countersink the next hole, insert the rivet, and continue in this way until you have completed the hole of the riveting.

**Three points to watch**

Three points must be closely watched during the riveting process. The first is that the lining beds firmly on the shoe flange for the whole of its length and is devoid of buckles; the second is that no rivet should remain proud of the lining, and the third is that no local swelling of the lining has taken place round the rivet holes during the riveting process. Any high spots of the nature produced by the latter process would prevent the brake from being wholly effective and, to guard against this it is necessary to smooth off all such local swellings with the help of a file before replacing the brake shoes.

To avoid harshness of brake action, it is also advisable to bevel off the ends of the linings slightly before replacing the shoes.

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## POTTY COMMENTS

Firstly I must apologise for the length of time it's taken for this article to appear. The words were penned some six months ago, and I have been awaiting illustrations. These were going to be supplied by Dave Minton, but unfortunately the G.P.O. lost all the negatives. My thanks to Dave for his help and our regret on the loss of his roll of negatives. As a motor-cycle journalist who does his own photography this is more than a few snaps adrift, and to the G.P.O. . . . !

You will now have to make do with my own photographs or refer to Dave's article in *Motor Cyclist Illustrated* of May 1972, which give good illustrations of what I shall be talking about.

## BETTER BRAKING AND FORK BRACING

It is fairly easy to make the brakes on most Scotts more powerful, what is not so easy is to make the fork strong enough to deal with the existing brake stresses, let alone from improved brakes. It's the torque reaction that the brake plate imparts onto the forks that causes the trouble. I have bent several Scott forks due just to this and the very day after first drafting this article I bent the girders on my old M20 following an emergency stop. So how do we overcome this and still keep our bike looking "period"?

Most Scott hub brakes are efficient enough for the purposes they were designed for; and in some cases too efficient, e.g. 1929 Super, much too powerful, and hence the reduction in diameter in 1930. This is of course provided that a suitable lining is fitted and everything else is in good order. Many things can be done to improve the standard set up which brings us to the next series.

### POTTY MOD No. 3

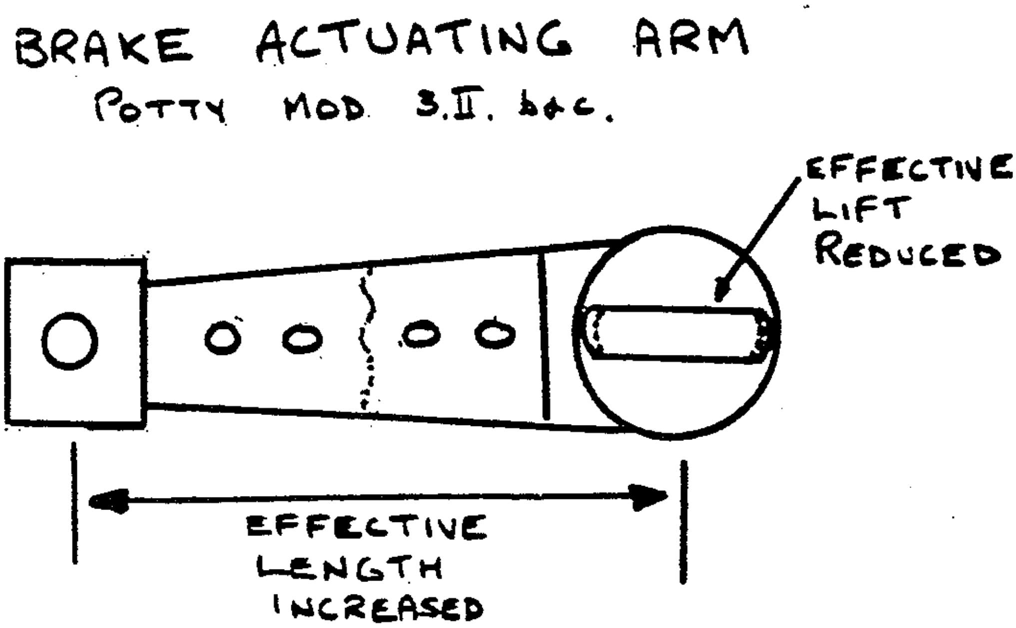
To improve the braking one or more of the following can be carried out:—

1. Improve the specification of the brake linings. (I don't know much about this so expert advice may be needed). I have found from experience that soft linings give greater friction but are prone to fading. Harder linings stand repeated applications and do not fade so badly, but at the expense of slightly less initial grip and greater application pressure. I do not know if this is true of all linings, but from my limited knowledge it seems to be so. I use a soft black rubbery lining on my Two-Speeders, of an industrial type marketed under the "Top Dog" brand name. For my Sprint Special and the Flyers that came before it, I have used standard "Nu Texa" linings and have found it ideal for this type of machine for all normal and race use and they only start to fade after about six laps at Cadwell. Obviously a specialised lining obtained from Ferodo's etc., could be obtained to suit each brake for purpose of the machine individually, and they do run this sort of specialised service.

2. To increase the pressure exerted by the brake lining on the drum.

(a) Fit a longer handlebar lever, or a lever with a shorter actuating radius or a combination of both.

(b) Increase lever length at brake drum. When I had one of these fracture rather than renew it as per original, I made up a lever three-quarters longer this was enough to make an appreciable difference to the braking (see diagram).




(c) Decrease the cam lift that bears on the shoes. Do this by carefully grinding away (see diagram).

Obviously, if any or all of these modifications are done, the movement of the handlebar lever is greater whenever the brake is applied, so it is very important that nearly all free play is taken up, and that there is no lost motion due to wear in the brake or handlebar lever. Adjustments will have to be made rather more often and the linings renewed before they would otherwise considered to be worn out. Also the 'mods' tend to increase the forces on brake cables, nipples, rods, etc., so make sure that they are up to it.

I would say that there is no need to modify a Scott rear brake if a standard rod operated one, apart from finding a suitable lining. If it doesn't work then something basic is wrong. In fact the only poor rear brake was on the non-cush hub Flyers fitted to the early tourer type. These are rather "tinny" and the brake drums tend to bell out. I don't know what you can do with these except perhaps shrink on a ring on the outside.

**POTTY MOD No. 4**

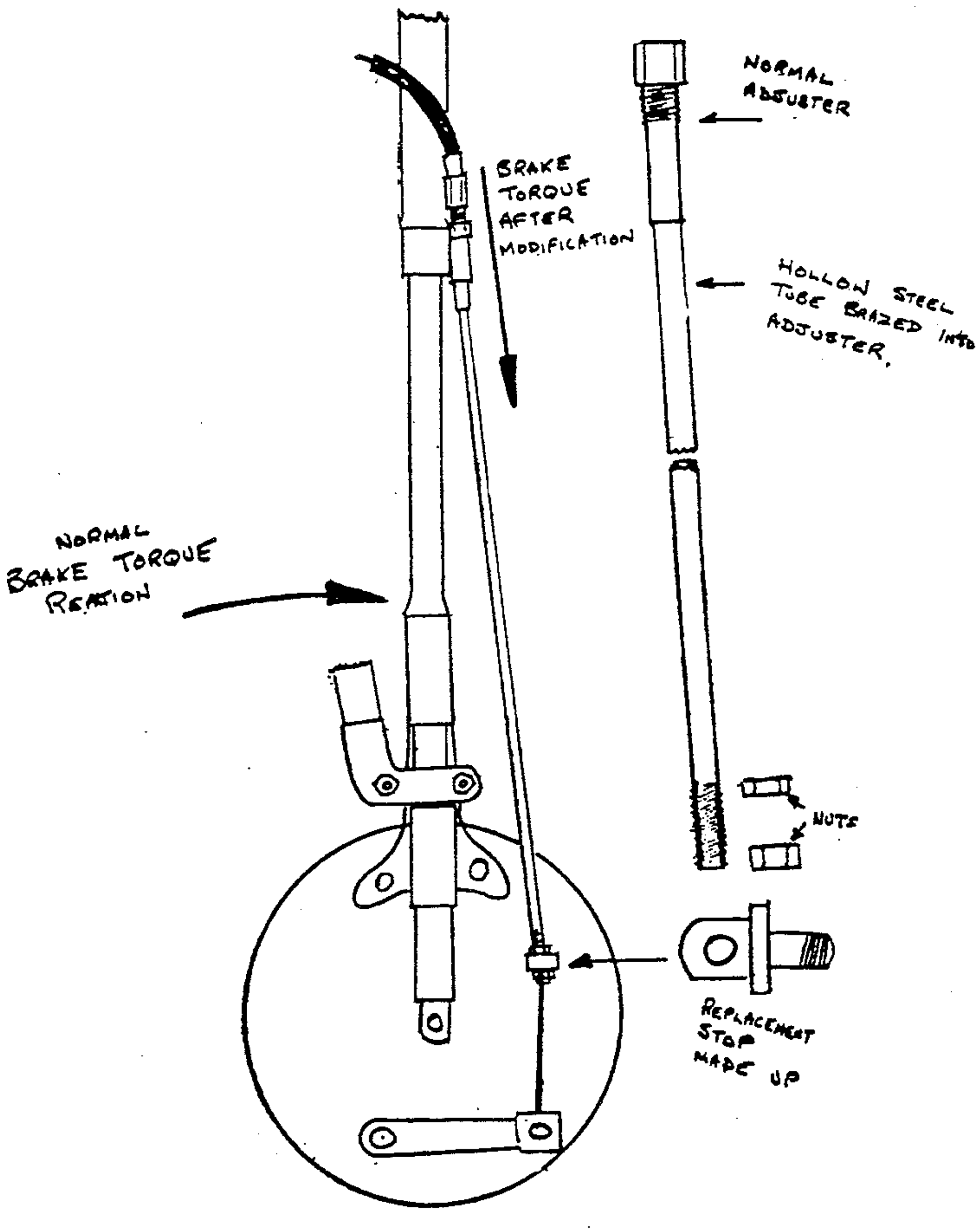
BRAKE TORQUE ARMS. This also beefs up the fork (triangulates it?). The biggest trouble is that most of the brake torque is taken by one of the fork legs at an angle at which the fork leg is at its weakest, i.e. at right angles to the leg. What is required is for the reaction to be taken along the length of the fork — look at a picture of a racing bike, even modern tele-forked ones usually have a torque arm to do this.

1. FOR SUPER TYPE FORKS

Here we make use of the brake adjuster lug on the fork and by brazing a strong thin steel tube into the actual adjuster and by either making or adapting a stop for this as shown on the drawing. The whole thing is practically indistinguishable from a piece of outer cable and does not deter from the "vintage" original looks. I have had no trouble with my Super since fitting this mod.

2. FOR WEBB TYPE FORKS

Again the adjuster lug is used, but this time instead of a tube a length of dural plate is used, fitted at the top end with a forked control rod end bolted through the lug. The bottom end was mounted on a plate and a spacer fitted to the brake plate. The brake cable now runs alongside the torque arm on a simple bracket fitted under the forked control rod end of the lug.


NORMAL
ADJUSTER
BRAKE
TORQUE
AFTER
MODIFICATION
HOLLOW STEEL
TUBE BRAZED INTO
ADJUSTER.
NORMAL
BRAKE TORQUE
REACTION
NUTS
REPLACEMENT
STOP
MADE UP

## TED'S TOPICS

I have been asked to comment on 'Potty's' front brake mods (July issue), so here goes.

My own particular problem has always been to obtain sufficient braking power from the 5 inch webb front brake as fitted to early Supers, in fact to most Scotts between 1924 and 1926. As I see it, there are three basic problems.

1. Lack of brake drum and lining area.
2. Fading due to poor heat dissipation, and most commonly.
3. A steady weep of oil into the linings from the fork leg.

To take the last first—it is not often realised that on Super forks, the bottom dust covers act as an oil reservoir into which the bottom ends of the sliding bushes dip on full fork deflection. This allows oil which has run down from the fork leg reservoir to be used over and over again.

For this reason the dust covers MUST BE OIL TIGHT, in other words, the soldered joint must be intact and the cover should be sealed to the threaded part of the fork leg by a good jointing compound. Quite often, one sees deflector plates fitted around the lower edge of the brake plate to deflect oil from the linings, but if the dust covers are really oil tight these plates should not be necessary. They were of course fitted as standard to the later brakes used with the wider forks, but to the purist they look unsightly on the early type.

Turning now to the brake itself, it is possible to make a brake of this size quite powerful and fade-free in normal use. Virtually all brake drums today have cast iron drums or drum liners, because cast iron does not polish like steel and so retains a much higher coefficient of friction even when used with the hard metal-reinforced linings needed for good heat dissipation.

### CAST IRON DRUMS

Fortunately, the 5 inch webb brake drum is a separate unit in the built-up narrow hub—it is attached to a "flanged shell" carrying the spokes by three countersunk rivets—and it should therefore be possible to replace it by a cast-iron drum, if only there were room to increase the thickness to reduce any tendency to crack. There is no problem at the outer edge, which protudes well clear of the spoke flange, but at the inner end, there is only room for the normal ⅛ inch thickness of the drum if linings of standard thickness are used. If one is prepared to dismantle the wheel and hub, it is possible (as Derek Cox has shewn) to machine out the flanged shell to take a drum of $^{3}/_{16}$ inch thickness (which in itself is beneficial, even if it is still made of steel). I am planning to have some iron drums cast to try out a conversion like this, and as a further step, to mount two such drums back-to-back on a specially designed hub, mainly for sidecar use, where these days, a good front brake is a "must"!

A dual brake, I need hardly add, will allow the braking loads to be shared equally between the two fork legs, and with the Torque Arm modification similar to Potty's, it should be good enough to retard a fairly heavily laden sidecar outfit.

I still go slightly pale at the memories of having to stop quickly with a sidecar on a wet day with the back wheel locked and in no way impeding progress!

## SIDECARS

Talking of sidecars reminds me of my old friend Ernest Lister's throw-away line about carrying a spare pair of forks in his sidecar!

Superforks are not really very strong, particularly when subjected to the side loads imposed when sidecarring. One of their endearing features was an occasional tendency to break off at the bottom of the steering head. For this reason, many people thought it a wise precaution to FIT A SOLID STEEL PLUG INTO THE UNDERSIDE OF THE STEERING HEAD, retained by the mudguard bolt. This added strength, but more particularly enabled the rider to pull up safely if the forks did break. I believe the wide type introduced in 1927 were more prone to this problem than the narrow type.

## AN ANSWER TO THE "RIDDLE"

By the way, referring back to the July "Yowl". I think I can provide at least part of the answer to Val Ward's puzzle about the Ki-Gass Pump. These pumps (as no doubt Potty will verify) were originally designed for priming aircraft engines with fuel before a cold start. They were standard fitment on, for example early post war Austers, which I used to fly some years ago, and I believe they were fitted to Spitfires and a number of other military types. The procedure was to give the engine one or two full shots of fuel, (through a jet straight into the inlet manifold) from the panel-mounted pump, and after starting, to screw the plunger down firmly to shut off the flow to avoid upsetting the running mixture. The device was also sold as an accessory to cars, though the accelerator pump was nearly as effective.

I should imagine that the one in question had probably been arranged to spray into the transfer ports, to avoid the need to charge the crankcase with a rich, wet mixture on a cold morning.

Apart from the initial prime, the Ki-Gass system had the added advantage that after the engine had started, you could by gentle operation, keep it going long enough to warm up even if the carburation were set on the weak side. On aircraft engines it was more convenient and safer from the fire point of view than the earlier alternative of flooding the carburettor.

Incidentally, I think Val Ward is to be congratulated on the excellent conversion job he did on his 1929 Flyer. I saw it in the Island and thought at the time that, however non-standard it might seem to some eyes, the whole concept was so well in keeping with the early Scott tradition of light weight, low c.g. and freedom from frills that even Alfred himself would have thoroughly approved.

**Ted Fargus.**
**High Wycombe.**

# IMPROVING FULL WIDTH HUB BRAKES

*Jim Ogden, Gordon, Australia.*

There must be a lot of Scott owners with full width hub brakes who are mystified as to why such a beautifully designed brake unit should not work as well as it looks. The answer is that the brake unit itself is very good but handicapped by a brake compensation mechanism on top of the mudguard which effectively halves the force that is applied at the handbrake lever, (see sketch No. 2) with the compensator working like a block and tackle in reverse, a 2lb pull on the lever ends up as a 1lb pull on each brake lever arm.

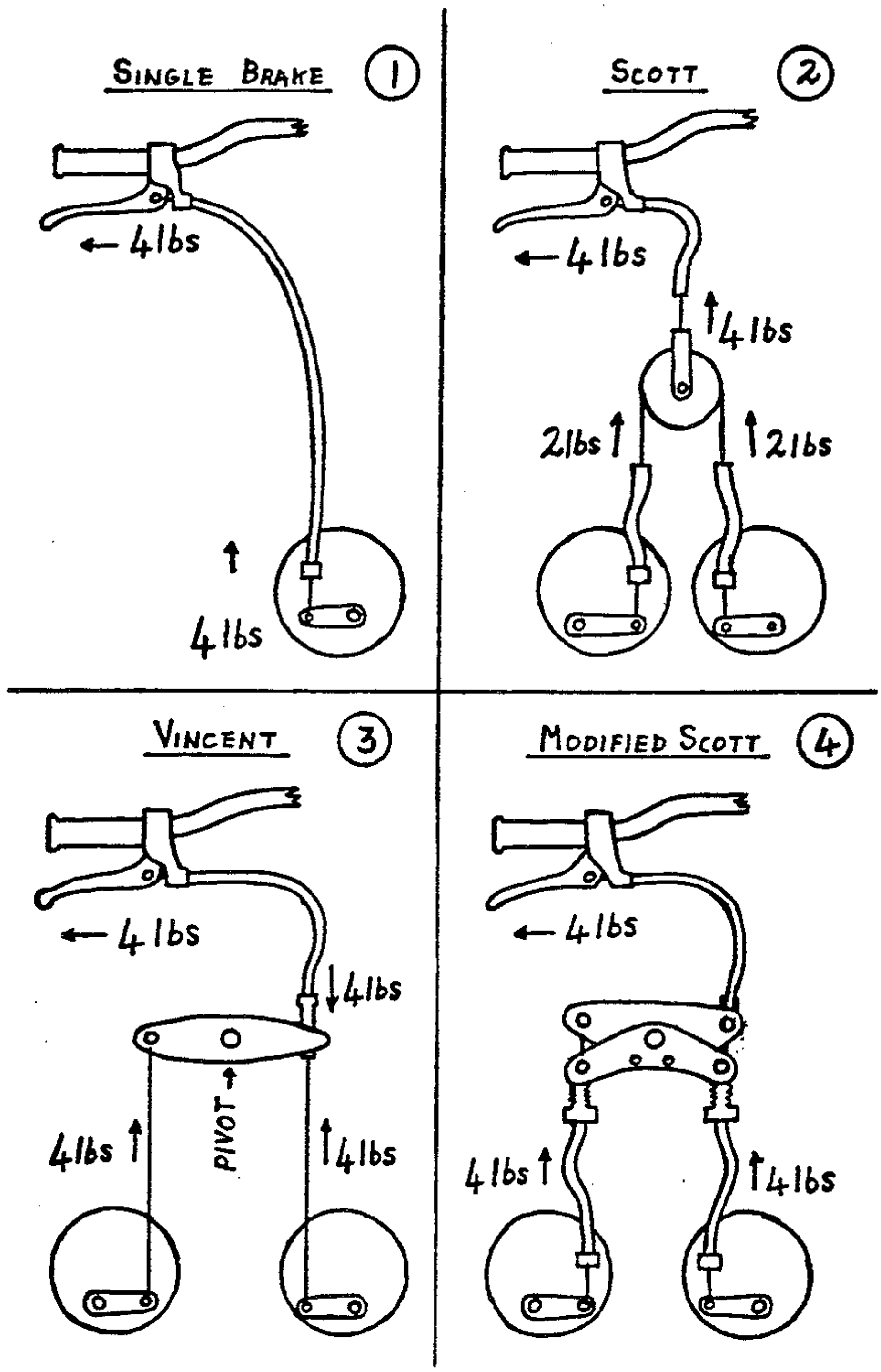
The thing to do would be to have a 2lb pull on the handlebar lever ending up as a 2lb pull on each brake arm. Fortunately for us, some clever person designing the Vincent many years ago, found a very simple way of doing this. His idea being to connect the brake up on one side, just as if it was a single brake, but instead of anchoring the outer cable on the side of the brake as is normal practice, he anchored it on one side of a rocking beam above the mudguard and the other end of the rocking beam was connected to the second brake, so that the second brake is operated by the outer cable, (see sketch No. 3). With this system, 2lbs of pull on the handlebar lever, gives the same amount of pull, 2lbs on each brake lever arm.

Having found this out a couple of months ago, I decided to have a go at making a similar device to fit on my Scott. The mechanism becomes a bit more involved when translated to fit on to the pride and joy, as the outer cables running down to the brake drums have to be retained, but is not too difficult. (See sketch No. 4).

The difference that this modification makes to the Scott brake is amazing—two fingers give about four times the amount of breaking that a fist-full achieved previously. The handlebar lever now moves twice as much as it did, but still comes nowhere near the twist grip on full application.

Could it be that twice the force applied gives four times the friction? I don't know—but it sure transforms the front brake.

On the subject of Vincent front brakes—this is what 'Argus' had to say in *Motor Cycle Sport* for April 1969, in an article entitled "A Masterpiece of its time", which was of course almost all glowing praise for the Monster from Stevenage. "In the same way the Vincent designer's ingenuity was inclined to be self-defeating. For example, the twin front brakes were applied by a single cable. The inner cable operated one while the outer cable reacted against a balance beam above the wheel to operate the other. This equalized the loads on the two brakes and incidentally gave a two-to-one leverage effect. But deflections at the balance beam pivot added to the flexibility of the mechanism, and friction at the pivot prevented the two brakes from pulling off equally. An additional return spring and an adjustable stop for the beam were fitted to later models, and this complicated the adjustment of the brakes. All considered, TWIN CABLES FROM A COMPENSATOR LEVER AT THE HANDLEBARS WOULD HAVE BEEN BETTER. (Which of course is just what Matt Holder fitted to the Birmingham Scott models way back in the mid-fifties!)


SINGLE BRAKE
1
← 4lbs
4lbs
SCOTT
2
← 4lbs
4lbs
2lbs
2lbs
VINCENT
3
← 4lbs
4lbs
PIVOT
4lbs
4lbs
MODIFIED SCOTT
4
← 4lbs
4lbs
4lbs

## BRAKE ANCHOR BOLT DANGER

I recently had a disturbing encounter with a defective rear brake anchor bolt that I feel obliged to bring to everyone's attention. The bolt was new, and freshly nickel plated, and being used on my Sprint Special! I placed it in position, and started to tighten the sleeve nut when there was quite a loud bang, and the bolt was found to be broken.

I shudder to think what would have happened if the fracture had occurred at speed. (See Peter Groucott's letter!)

My sketch shows what had happened;the "ears" had snapped clean off. I am no metallurgist, and immediately suspected that the electroplating had caused the problem, but my plater said that "Hydrogen Embrittlement" is only a problem with chromium plating, and never with the cooler and milder nickel process. It therefore appears to be a material problem, or a machining problem. When I compared the broken bolt to those "in stock" at the rally, the stock items had noticeably thicker"ears".

Gerry Howard tells me that he hasn't made any new ones while he has been Spares Secretary, so the origin of the stock is uncertain.

I wouldn't have minded if it had just bent the ears, but to snap like a carrot is very dangerous indeed.

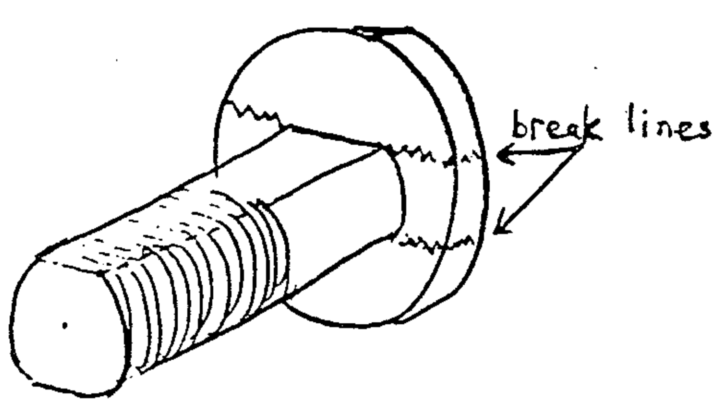
With "Product Liability" law, and other legislation, I wonder what the consequences for the Club, its officials and/or Spares supplier would be if someone was maimed or killed by the failure of a part supplied by the Club??

If any metallurgist in our ranks would like to do a post-mortem, the offending item is with Gerry Howard.

B.M.

P.S. Never make wheel spindles, fork spindles, brake parts, ets. Out of silver steel. It can be very tempting as it produces a nice looking article, but it will SNAP, without warning, sooner or later.

FAILURE OF REAR BRAKE ANCHOR BOLT



**Chislehurst**
**Kent**

Dear Brian,

**Brake Anchor Bolt**

Responding to the thinly veiled hint contained in the penultimate paragraph of your note on page 7 of the December issue, I got Gerry Howard to mail to me the fractured brake plate anchor bolt.

The fracture, with its appearance similar to that of a fine down-grain break in a piece of wood, indicated that the material from which the item had been machined, was probably cold rolled steel bar of the high-suphur free-cutting variety.

This was confirmed by a "sulphur print", which is made by pressing a ground cross-section or longitudinal section, against a piece of photographic printing paper previously soaked in dilute sulphuric acid, which is then washed and "fixed". The sulphide inclusions in the specimen react with the silver compounds in the printing paper surface.

The long sulphide inclusions in this bolt are very numerous, and could be seen to be orientated along the length of the bar.

As I am sure many Club members will be aware, this type of free-cutting steel contains manganese sulphide and also some ferrous sulphide, in the form of small inclusions which are elongated during the rolling or drawing process. These inclusions provide the free-cutting characteristics of the steel, by acting partly as chip-breakers and partly as tool lubricators, during machining. Unfortunately, the inclusions form planes of weakness and render the material quite unsuitable for many highly stressed applications, particularly when the stress is alternating (for example, roller bearing tracks), and fatigue cracks with ultimate complete failure often result.

However, in the case of this anchor bolt, the failure was a result of stress concentration to a level at which the material failed by fracture along the "grain" provided by the inclusions.

Not only is the material unsuitable for the purpose, but also the design of the bolt with the very sharp change of the section where the "ears" join the shank, is such that the resultant high localised stress at the root of the ear was greater than the material could withstand.

I would mention that there are other types of free-cutting steels — for example the "leaded" steels which do not have such poor physical properties; the lead is in spheroidal form and does not cause planes of weakness, but it provides the free-cutting characteristics.

Figs.1 and 2 illustrate the way in which the machining should have been carried out. The "notch" effect must be avoided in all components which are subject to alternating stresses, otherwise fatigue failure is likely to result in service, but it is still very important even in items such as bolts, which, if properly tightened, experience only small or nil changes in stress during service.

In regard to your plater's remark that hydrogen embrittlement is not a problem with nickel plated components, this is not strictly correct. All pickling and plating operations in which hydrogen is released by electrolysis, will result in hydrogen embrittlement to some degree; inhibitors contained in the solution are not 100% effective.

The hydrogen, when first released, is in mon-atomic form and penetrates the surface layers of the steel, along the grain boundaries. Whilst it may escape during a subsequent period at room temperature, the condition may be corrected much more satisfactorily and quickly by heating the component to about 150°C for 15 minutes or so.

I well remember a spate of fractured wheel spokes during wheel building at the A.M.C. Plumstead factory many years ago — I traced the problem to hydrogen embrittlement caused during cadmium

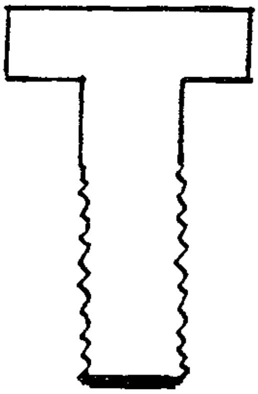


FIG. 1

Incorrectly Machined.

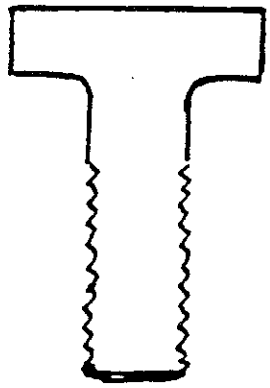


FIG. 2

Correctly Machined.

plating of the spokes at the supplier's factory. We eliminated the problem by employing the heating technique.

The conclusions, therefore, are that:-

(i) the material used for the bolt was unsuitable, and

(ii) the design, at the root of the ears, was poor, and

(iii) the fracture may have more easily occurred due to hydrogen embrittlement.

I am of the strongest possible opinion that stressed and other vital components should be fitted only if manufactured by a reputable, knowledgeable and experienced supplier. As you will know, the motor trade has for some years tried to impress upon users the dangers of using "pattern" spares of doubtful origin, and they have not done this solely to boost their own sales of spares!

It may be thought that my comments are unnecessarily lengthy, but the possible dangers make the matter so important that it cannot be overstated.

Many years of investigating component failures taught me to be very careful and NEVER to use any but authentic or approved parts. Of course, in our case we have to rely on suppliers other than the factory, and therefore it is obviously important to use only reputable ones. Who knows what might have happened had this anchor bolt failed completely whilst in service?

Yours sincerely — **Don Hewitt**

V9/6 July 1975

## ANOTHER REEVES (W)RINKLE

### (Overhauling 2-speeder rear brakes)

When I came to reline my rear brake I found that some previous owner had drilled holes in the shoes outsize, bringing the edge of the hole very close to the edge of the shoe. I decided to try and bond the linings myself.

First, I washed them in petrol (it wasn't 75p a gallon then!) then scored them with a hacksaw blade to make a key, then boiled in household detergent to remove all grease, taking care not to touch the face where the linings fit, with my fingers. The next item was a coat of Araldite on lining and shoe, putting together and pulling tightly down with copper wire round shoe and lining, putting the lot into a moderate oven, (after taking the lunch out) and leaving for 30 minutes or so.

They were then left to cool overnight. Next day I chamfered the linings and completed the assembly.

This was done two years ago. and has given no trouble.

**G. R. Reeves.**

V11/12 Dec. 1978

## SCOTT BRAKE LININGS. FERODO 1960 CATALOGUE

| *Year* | *F/R* | *Material* | *Ref. No.* | *L* | *W* | *Thk* | *Int Φ* |
|---|---|---|---|---|---|---|---|
| 1935-39 | F | MR 41 | BEN/15/1 | $6\frac{23}{32}$" | 1" | $\frac{1}{4}$" | $3\frac{1}{4}$" |
| | R | MZ 41 | BEN/8/1 | $6\frac{5}{8}$" | 1" | $\frac{3}{16}$" | $3\frac{13}{16}$" |
| 1946-50 | F | MZ 41 | BEN/21/1* | $5\frac{7}{8}$" | $\frac{7}{8}$" | $\frac{3}{16}$" | $2\frac{13}{16}$" |
| | R | MZ 41 | BEN/22/1 | $8\frac{7}{64}$" | 1" | $\frac{3}{16}$" | $3\frac{13}{16}$" |
| 1951-54 | F | MZ 41 | BEN/5/3 } | $8\frac{1}{2}$" | 1" | $\frac{3}{16}$" | $3\frac{13}{16}$" |
| | R | MZ 41 | BEN/5/3 } | | | | |

*Undrilled, 4 per box.

## CLUTCH LININGS

| *Year* | *Type of facing or insert* | *No. per set* | *Ref. No.* |
|---|---|---|---|
| 1932-54 | BA | 40 | G45B |
| | BA | 126 | F20B |
| 1957-58 | AN 11 | 40 | BMC46 |
| | AN 11 | 126 | BMC44 |

*(Information supplied by member J. W. Greenwood.)*

## "FERODO" BRAKE LININGS FOR SCOTT MOTOR-CYCLES

| Model | H.P. | Year | Front, Rear or Trans. | Hand or Foot | Make of Brake and Drum Diam. | Length | Width | Thickness | Inside Radius | Type of Ferodo Lining | No. per Set | Liner Ref. | Rivets per Set | Box Ref. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All models | 500 & 600c.c. | 1935/39 | F | H | E | 6 5/8 | 1 | 1/4 | 3 1/4 | MR | 2 | EN/15/1 | 12/C3 | J31 |
| | | | R | F | E8 | 6 23/32 | 1 | 3/16 | 3 13/16 | BZ | 2 | EN/8/1 | 12/C3 | J29 |
| All models | | 1934 | F | H | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |
| | | | R | F | E8 | 8 1/2 | 1 | 3/16 | 3 13/16 | L | 2 | EN/5/1 | 20/C3 | Z20 |
| Flying Squirrel de luxe | 500 & 600c.c. | 1930/31 | | | | | | | | | | | | |
| All models | | 1932/33 | F | H | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |
| | | | R | F | E8 | 6 5/8 | 1 | 3/16 | 3 13/16 | BZ | 2 | EN/8/1 | 12/C3 | J29 |
| Flying Squirrel TT Models | 500 & 600c.c. | 1929 | | | | | | | | | | | | |
| Squirrel | 300c.c. | 1931 | | | | | | | | | | | | |
| | | | F | H | W5 | 5 3/8 | 3/4 | 1/8 | 2 5/16 | BA | 2 | WB/2/1 | 14/C1 | P35 |
| | | | R | F | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |
| Super Squirrel | 500 & 600c.c. | 1929 | | | | | | | | | | | | |
| Squirrel and Super Squirrel | 500 & 600c.c. | 1930/31 | | | | | | | | | | | | |
| | | | F | H | W6 | 6 1/4 | 3/4 | 5/32 | 2 53/64 | BA | 2 | WB/6/1 | 14/C1 | U28 |
| | | | R | F | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |
| Squirrel | 300c.c. | 1930 | | | | | | | | | | | | |
| Flying Squirrel | 500 & 600c.c. | 1929/31 | F | H | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |
| | | | R | F | W7 | 6 7/16 | 1 | 5/32 | 3 21/64 | BA | 2 | WB/3/1 | 14/C1 | J47 |

**The above was reproduced from an early "Ferodo" catalogue. Research by K. W. Lack and B. Scholes. All dimensions are shown in inches.**

## THE GOOD SCOTTING GUIDE (Part six)

**Brian Marshall**

Quite recently in the various vintage/classic publications there has been some considerable correspondence about brake problems; with tales of woe concerning failure of alloy brake shoes, disintegration of brake linings, severe corrosion at the interface between shoe and lining, premature failure of linings, and so on.

Now the causes of all these problems are not all that difficult to pinpoint, but any individual's problem can easily be a combination of various factors that can take more than a little puzzling out!

The failure of alloy brake shoes is, I think, due mainly to old age and consequent metal fatigue. As I mentioned in a previous article in this series, some pre-war alloy castings have reached the end of their safe life, and this applies equally to brake shoes. Any showing signs of cracking or significant corrosion should be rejected. By significant corrosion I mean anything other than a light white powdery layer of oxidation. Any surface pitting that cannot be easily sanded away should be viewed with suspicion.

It is not a difficult procedure to make a pattern out of the old shoes, and then get some new shoes cast at a local foundry. There was an excellent 'how-to-do-it' article on this very subject in the *V.M.C.C. Journal* earlier this year (1994).

There are, I think, a couple of causes for brake linings breaking up. I suspect that brake lining material is hygroscopic, that is to say it has an affinity for moisture in the atmosphere. With new linings, in regular use, this is not a problem, because they heat up rapidly under braking, and the heat disperses the moisture. However, if 'new' linings are old stock, stored in a damp cellar for many years, or the machine is only used occasionally, sufficient moisture will have accumulated in the lining material for it to begin decomposing and weakening.

Breakage can also occur if rivet holes are incorrectly positioned too close to one another, or too near the edge of the lining, but do make sure that your brake drums are not oval. This can happen to a quite remarkable degree, particularly with the rather thin pressed steel drums on Webb front brakes, and an over-enthusiastic spoke-tightening session by your wheelbuilder. The resultant grabbing and snatching of the brake imposes horrendous loads on the linings, spokes, brake torque arm, and front forks. Various wheel specialists can skim the drums back to circular provided that they aren't too far gone, and this can be done without cutting the drum out of the wheel. (Owen Greenwood is one such specialist that springs to mind.)

In the various instances of bonded linings separating from the shoes reported recently, I have yet to see anyone offer an explanation. I have seen it myself, and on every occasion the shoe was an alloy one, and there was an eruption of aluminium oxide corrosion at the interface, the resulting expansion having forced off the lining and broken the bond. My personal pet theory for this (and I would welcome any contradiction), is that it is caused by a combination of the dampness problem previously described, AND a chemical reaction:

The catalyst used to make epoxy resin adhesives 'set' is usually a powerful oxidising agent such as an organic peroxide (with Benzoyl peroxide being a common one). I suspect that some of this peroxide gets well into the surface of the aluminium, and causes the violent corrosion, particularly if there is also some moisture about.

With some modern high friction coefficient linings there is a strong possibility of making your brakes too good for the health of your Scott (and you too!).

Two-speeders are particularly at risk if fitted with the seven inch Webb front brake. This was true even in the vintage years — year by year the factory gradually upped the size of the front brake, from the 'shoe polish tin' brake of the early 1920s, up to 1929 and the seven inch Webb. The fitting of the big brake immediately caused a spate of broken and bent forks, and instead of beefing up the forks the factory rather cynically went back to the six inch brake for 1930 and 1931. Even Webb girders can be badly bent by a seven inch Webb brake applied by a strong right hand. (Ask Glyn Cambers!)

The answer is to transfer the brake's torque reaction higher up the forks to the bottom crown by adding a long torque arm from the brake plate up to the bottom yoke of the forks. If you don't know what I mean, look at the photos on pages 46 and 51 of *The First Scott Scene.*

There is little likelihood of brake torque bending the very strong Scott 'kite'-shaped forks fitted to Flyer De Luxe models and TT Replicas, but there is still a problem, as you will see from my photograph! That happened to me in November 1993, and I can tell you that it was not a nice experience.

I braked very heavily (the 'full white knuckle') when the usual myopic idiot pulled out of a side turning in front of me. As the torque arm bent through 90° and pulled off its locating peg, the resulting pull on the brake rod locked the front wheel solid, and for a split second I started to go off the saddle, head first over the bars. Fortunately the enormous load simultaneously pulled the nipple off the brake cable. This released the brake BUT allowed the brake plate to try and revolve together with the wheel. After about half a revolution the lever 'turret' on the brake plate hit the bottom slider and came to a stop again!

Fortunately by this time I was back in the saddle, had missed the car, and had my feet on the tarmac. Equally fortunately the torque arm had not played a tune on the spokes, and there was no damage except to the brake rod, cable, torque arm, and my underpants.

The new torque arm is nearly twice as thick, and slightly wider too.

So, Rule No. 6 is: BRAKE BUT DON'T BREAK.

## Adhesives, Oils, and Explosive Fuels

Dear Tom,

A belated comment on articles in *Yowl*.

In Brian Marshall's 'Good Scotting Guide' (October) he is confusing his resins. Organic peroxides are used for the polymerisation initiation of polyester resins. Epoxy resins use a hardener, usually a diamine. The recommended adhesive for bonding brake linings used to be a phenolic/nitride type, but this may have been superseded.

I suspect the cause of bond failure is inadequate preparation which is as important, if not more important, than adhesive selection.

The following is a typical pre-treatment used on aluminium in the aircraft industry:

1. Vapour degrease in trichloroethylene
2. Immerse in alkaline cleaner
3. Rinse in demineralised water and dry
4. Etch by immersion in an acid solution (usually a sulphuric/chromic acid solution)
5. Rinse with demineralised water, dry, and bond immediately

The corrosion will be due to inadequate preparation and subsequent poor bond — the adhesive should protect the aluminium! The corrosion also occurs with riveted linings. Theoretically it should be worse with riveted linings as electrochemical attack can take place because aluminium is more electropositive than either copper or iron. Moisture and chlorides from road salt make things worse!

Brake lining material can pick up water, but it usually does this by wicking down the fibres. New linings are not fully cured but rely on the heat from use to finish the curing — if supplied fully cured they would probably be too hard to bed in properly.

I hedge my bets by riveting and also using a rubber toughened epoxy resin adhesive to prevent corrosion and eliminate any air gaps.

Brian's letter in the December issue on oils was interesting. The viscosity is measured by the time taken for the oil to flow through an orifice in a standard instrument such as a Redwood or Saybolt viscometer at a given temperature, the values being expressed in Redwood or Saybolt seconds.

The SAE specifications for crankcase oils and gear oils are as follows at $100^{\circ}$F.

| | | S.U.S. | | | |
|---|---|---|---|---|---|
| | 30 | 400-700 | 400-800 | 80 | |
| motor | 40 | 700-900 | | | gear |
| | 50 | 900-2600 | 800-1500 | 90 | |
| oils | 60 | 1600-2100 | | | oils |
| | 70 | 2100-4000 | 1500-4000 | 140 | |

Anyone having difficulty in obtaining SAE 140 gear oil could get it from Stewarts, the Sunbeam specialists, as it is used in the rear drive units of S7 and S8 Sunbeams.

Brian's recollections of model aircraft engines mirror my own — about 20 years ago I worked at the British Rail Transport Centre in Derby. We used to have inter-laboratory drag racing competitions during the lunch hour in one laboratory with a long corridor. Power for ours was a 5cc model aircraft engine in a carbon fibre chassis (I worked in the plastics development unit) and many man hours were spent searching the B.D.H. chemicals catalogue and developing better fuels. I seem to remember the best was a mixture of iso-octane, toluene or benzene, isopropanol, petroleum ether, ether and nitromethane! If only we had spent more time on authorised projects the A.P.T. might have worked.

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