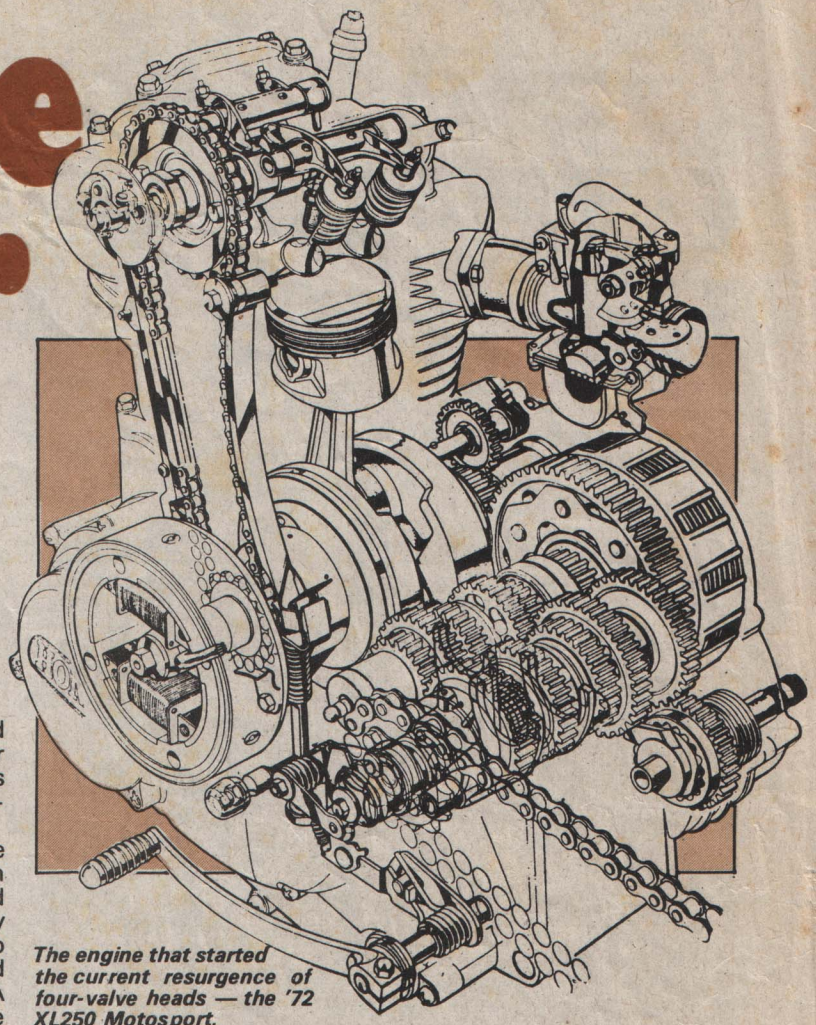
the single swinger

Performance Profile No. 3: XL Honda

Strengths, weaknesses and tuning potential of the four-valve Honda singles under the microscope.
Story compiled by Brian Crichton.



The engine that started the current resurgence of four-valve heads — the '72 XL250 Motosport.

ORIGINALLY conceived as a Japanese army bike the XL250 Honda of 1972 revived the flourishing trend for four-valve cylinder heads.

Though the XL in its 250 form gave no more power than an equivalent two-valve engine, and still doesn't, it does have the potential to respond to a tuner's hand.

Honda publicity blazed about the four-valve head allowing high rpm power because of the smaller valves and reduction in inertia compared to a two-valve head.

At the time of its launch the XL with its 74 × 57.8mm short-stroke single overhead cam motor looked very sophisticated and helped to fill a wide open spot vacated by the overhead valve BSA 250 singles of 1958-71 and the 250 Royal Enfield Continental also discontinued in 1971.

Latest newcomer to Honda four-valve single cylinder family the electric start FT500.

Though the XL was styled as a trial bike it was well suited to the road part of its dual role.

The silver tank Motosport didn't sell as well as expected in Britain when imported in 1973. Of those that did find their way upon dealers' counters many began to pop their four-valve heads up in road and off-road competition.

On the race track the Honda distinguished itself by averaging 66.12mph in a 24-hour race at Mosport, Canada in 1973.

This was a new class record for the track. Previous holder was a Yamaha TD2 road racer which had averaged 64.65mph in 1971.

Three riders took the XL to success using a completely stock engine after a bored and stroked 360cc engine they had built blew up in practice.

The standard frame was retained. A CB750 tank held

the fuel and a front drum brake from a Suzuki 500 twin was laced to the front wheel to stop it.

In America the vast market for leisure bikes took to the XL for off-road use and the four-valve head Honda family began to grow.

Tuners were already boring out the mild-mannered 250, so Honda offered a factory 350 version in late '73.

BREATHING

Honda claimed that breathing was improved with the centrally mounted carburetter engine which replaced the original offset design.

The 500cc version you can now buy from Honda dealers could be regarded as an inevitable progression from the no longer produced 350. And the public's liking for a 250 single cylinder road bike was proved in this country when the RS250 shot into the top ten best sellers on its release in 1979.

The latest addition is the flat track styled FT500 which joins the enduro XR version of the trail models.

To date this brings the total number of members in the Honda four stroke family available in the UK to seven 250cc RS/XR/XL/CL and 500cc XL/XR/FT.

These engines and their forefathers have found their way on to all types of competition including beach racing and trials where a special works four-valver fought the two-strokes in the hands of Sammy Miller and Rob Shepherd.

Dixon Racing big bore 305cc kit for the XL250S. Price £40.

The trials bike has since been dropped. But in grass track Bill Pye using Yoshimura tuning parts has kept the four-valve flag flying.

Alf Hagon among others has made his mark on road racing with frames for single cylinder scratching, and off-road Bill Bell in America with his Baja desert winning specials probably hit the pinnacle of Honda XL success in that sphere.

HOP-UP

During the XL's ten year life span many performance parts have been developed. Cams, pipes and big bore kits constitute easily obtainable starting points in the quest for more power. A list of dealers who stock hop-up parts is included in this feature.

Moriwaki can supply 26, 29 or 33mm smoothbore CR carb kits with instructions for the XL250S plus longer duration cams from the XR. They also have race cams and can polish cylinder heads and increase inlet port area.

Dixon Racing's oft advertised big bore kit for the XL250 of all years will increase lung size to 305cc for a £40 outlay.

Porting to Yoshimura spec, stronger valve-springs and blueprinting the engine are among Dixon Racing's other services.

The importers of Yoshimura parts Dixon Racing are preparing an RS250 for grass tracker Bill Pye. They promise that development mods which will benefit owners will be marketed at a later date. Expected in late autumn are high compression piston kits and Yoshimura cams from America.

John Banks Racing can supply Mugen performance parts from Japan, Sondel import American J&R pipes for 250s from 1975 and 500s from '79.

Maitland Racing offer the following for XL/XR500: Mikuni carb kits, £100.23, 10.5:1 CR piston kits £28.88, heavy duty valve springs, £32.72, HP cams £103.78, exhaust pipes £51.75 and Super Trapp silencers £28.75.

Talon Products market two styles of power exhaust pipes for the RS250 costing from £41.40-48.30. Piper also have a power pipe at £59.80 for the same model.

Best known for their cams Piper market street and race cams for the XL250 with the following timing/lift/clearance spec. Street: inlet 35-65/0.310in/0.006in, exhaust 65-35/0.310in/0.008in, Race: inlet 43-77/0.360in/0.006in, exhaust 77-43/0.360in/0.008in. Exchange prices: street £34.50, race £36.80.

Brockliss stock a comprehensive range including 11:1 compression piston kits at £21.82 for the XR500, gaskets, 36 and 38mm carb kits for £68.94, valve spring kits £24.76, race cams £78.43 and 1¾in exhaust pipes £52.11.

Stockists of S&W products imported by M. R. Holland can supply Blue Magnum EI carbs from 30mm upwards for £79.58 plus a fitting kit for the XL/XR500. They have racing valves for the XL350 and valve spring kits for the 250 and 500 models.

FAULTS

To find out what are the most common faults with the XL range we visited Jock Kerr Developments in Hertford where they specialise in reclaiming worn parts, as well as exchange parts, big bore kits and performance parts.

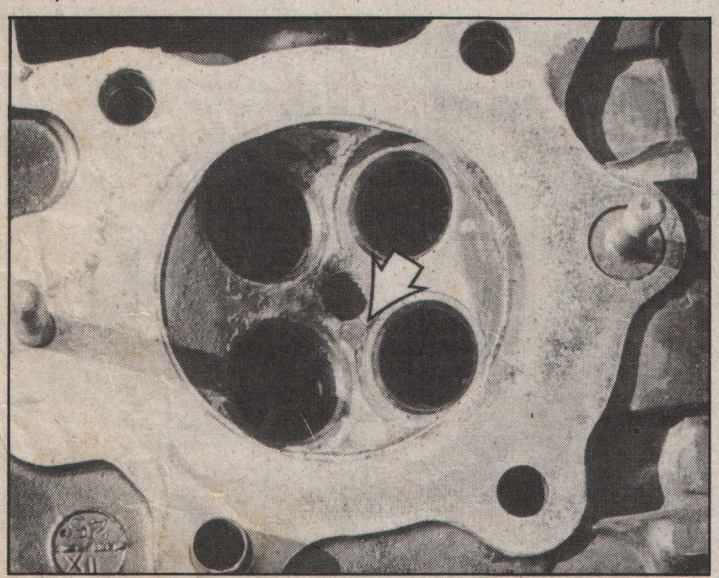
Mike Sturgeon who runs the company informed us that the most common problem is cam bearing wear due to lack of maintenance.

If the oil is not changed regularly the oilways clog starving the cam. The resulting metal to metal contact quickly ruins both head and cam because the cam runs directly in the head casting.

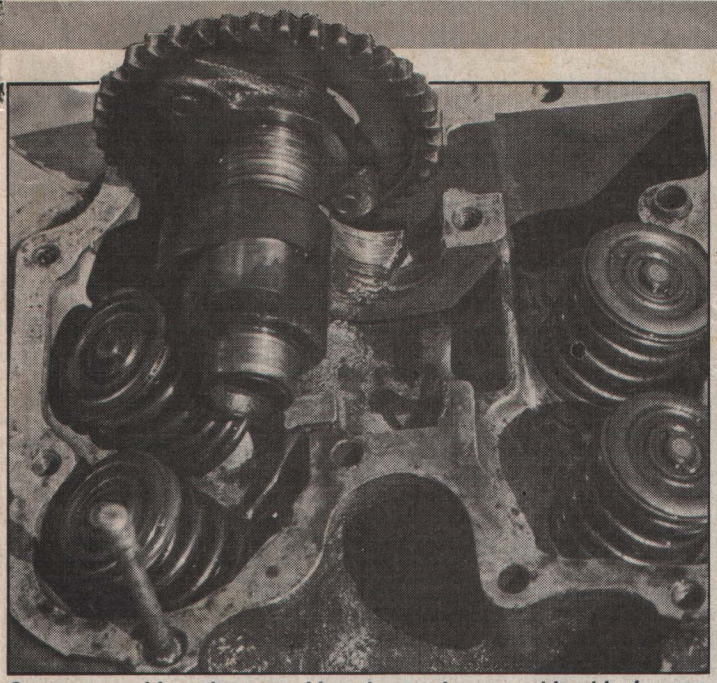
Since a new XL250S head alone costs about £140 the problem sounds drastic. Jock Kerr staff can solve it for a fraction of that price by inserting bearings in the head for the cam to spin in.

Another major problem is cylinder head cracking from one of the valve seats to the spark plug hole. The valve seat can also fall out. JKD will repair such a crack for £25 by welding the head and cutting in a new valve seat.

If you decide to search for a second-hand head and cam inspect it carefully for these problems. More likely than not it will be the reason the bike has wound up in the breaker's yard.



Look carefully to detect cracked head between exhaust (smaller) port and spark plug hole.



Cam removed from its normal housing to show considerable damage to both head and cam.

Another JKD service is metal spraying and reprofiling rocker faces as well as worn cams.

Any oil related problems will almost certainly mean that the oil pump should be replaced or reconditioned, says Mike, and the filters cleaned.

For example the cam chain tensioner can wear, rubber particles find their way into the oil strainer and then to the pump which feeds them to the head clogging the oilways. This then causes the widespread cam wear.

Why does the steel cam wear so badly and the softer aluminium head less so? Mike explains that the oil film breaks down resulting in friction welds. This causes a chemical change in the high silicon content aluminium, yielding glass which scores the cam journals.

This company also warns owners about replacing valve springs. Mike reckons that the closely wound part should be at the bottom, otherwise the valves can drop.

On the later XLS models with CDI ignition and balancer weights for smoothness JKD have been discovering through their customers that some 250 models hole pistons and also breaks the balancer chain.

As a first tuning step JKD recommend going for a bigger bore and increased compression, followed by gas flowing and then a different cam plus taller overall gearing to make better use of the increase in power.

For the early 250 XL models 305 and 350cc JKD kits are available. Only 350cc kits are available for the RS and XLS models. To reduce possible increased gudgeon pin wear with bigger pistons JKD say they insist on machining out the small end to accept larger pins with their big bore kits.

For most tuning applications JKD see no need to go to more expensive forged pistons. Their kits retain the original compression ratios. An increase to 10:1 would be a useful step up in the search for more bhp throughout the rev range.

If your crank needs to be reconditioned before going for extra power this will cost £46 at JKD.

RESTRICTED

Dynamometer experiments by Ledar have shown that the early 250XL was restricted on the induction side. Simply removing the air cleaner increased maximum power by 12 per cent on one engine tested.

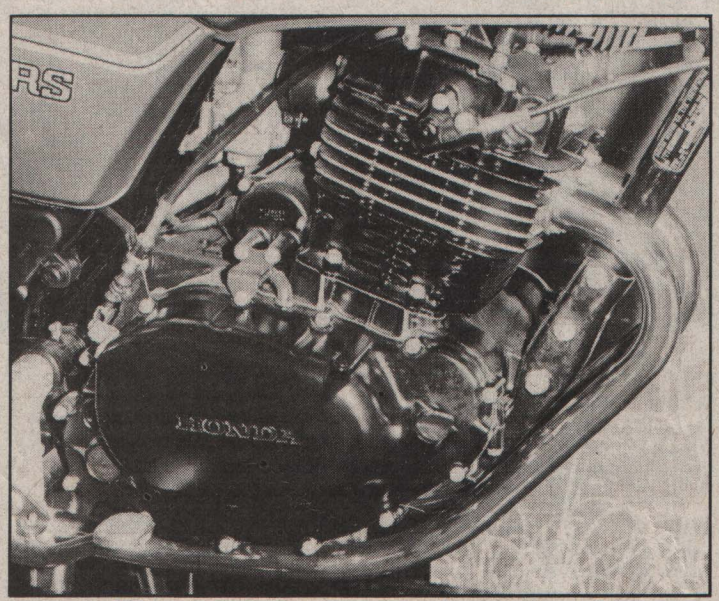
Another interesting feature emerged from testing on the same dyno. The original XL250 engine produces more power than the twin-pipe XL250S, but only to the tune of 1bhp.

Further evidence that the early engine was intake restricted was found by replacing the original 28mm Keihin with bigger carbs. They gave more power up to and including a 34mm EI, the largest one tried.

A best figure of 21.4bhp was obtained by LEDAR using the EI compared to a starting figure of 17.5bhp with the 10,000-mile engine in completely stock trim.

As you would expect the bigger carbs gave more power at higher revs but lost flexibility at low revs. In road riding terms this meant gently throttle openings until the engine had reached 4000rpm with the EI in place. Over 4000rpm the engine would respond to sudden full throttle openings.

From these and other tests carried out on the LEDAR dyno it's reasonable to suspect that all the four-valve Honda singles are intake restricted.



Latest RS250 features electric starter. It's the only Honda four-valver to have two completely separate exhaust pipes and silencers. Carb has accelerator pump.

YOSHIMURA

Tuner Pops Yoshimura worked on an early XL250 developed for moto cross use. An America report on his work claimed an increase in power from 16.8 to 24.7bhp — a 40 per cent improvement.

Cam duration was changed from 215 deg inlet and exhaust to 240 deg inlet and exhaust. New timings were: inlet opens 15 deg btdc and closes 45 deg abdc, exhaust opens 45 deg bbdc and closes 15 deg atdc. The race cam also gave 0.8mm extra lift.

Yoshimura reshaped and polished the head, enlarged the ports, polished the valves, machined down the parts of the valve guides which protrude into the ports, skimmed the head by 0.7mm, fitted a high compression piston, machined 2½lb of metal from the flywheels, knife-edged the webs which separate the ports, fitted a 31 mm magnesium Keihin carb and hand filed the cam bolt holes into slots so that he could adjust the cam for precise timing. Ignition timing was set at 45 deg full advance.

These and a performance pipe were the main alterations which gave the 24.7bhp figure. Replacing the megaphone with the very quiet standard pipe surprisingly only reduced power by 1.9bhp.

POTENTIAL

As in last month's performance profile of the Kawasaki Z1 we consulted Leon Moss of Lincs Engine Development and Racing. This company is impressed with the tuning potential of the four-valve singles and gave the following opinions.

The Honda single cylinder four-valve design is in the same league as the car world's DFV Cosworth which has won more Formula One GPs than any other engine.

With the Honda pent-roof combustion chamber and the relatively flat top piston you can get a very high compression ratio which is important for increasing power.

The smaller four-valve engines profit most here because as the bore size increases combustion effici-

ency decreases.

Most of the Honda four-valve engines have a compression ratio of about 9:1. It is preferable if possible to keep the flat-top piston and bring compression up by skimming the head.

Start by making the squish height equal to the thickness of the head gasket. Then work down depending on how far you wish to go. Repeating last month's advice of the Kawasaki-4s: for a full race engine you want to reduce the squish until the piston just touches the head at 500rpm over peak power.

You will have to allow a more generous squish clearance on the bigger singles to take into account more piston/rod stretch.

In terms of airflow the four-valvers give really good figures. For example the standard Honda 500 single without modification is better in proportion to a fully developed works Kawasaki-4 head.

Also the valve area of these four-valve engines is roughly equal to that of highly developed two-valve engines of similar capacity having two cylinders.

For example inlet valve area on an XL500 which has 35mm diameter valves is 19.2sq cm. This compares to 21.6sq cm for equivalent displacement on a Z1000J Kawasaki with standard 37mm diameter valves.

CRACKING

One problem with aircooled four-valve heads is that of cracking near the plug boss because of lack of cooling. It's an inherent drawback of the design, which you have to live with.

Problems aside there is potential to get 30bhp from the 250 engine and up to 60bhp from the 500.

The best 500 short-stroke Manx Nortons pulled around 53bhp, maybe some of the works bikes even gave 55bhp. They had immaculate breathing for a two-valve engine. The Honda breathes as well and it will run to 8500rpm. Though its MEP (mean effective pressure) levels aren't so good it gives better high rpm power which can push its output beyond 55bhp.

One of the drawbacks of the Honda is the single cam valve train design. You have the disadvantage of extra reciprocating weight of the rocker arm and you need an asymmetric cam to get valve lift right.

The design limits the scope of the cam profile. For example on a cam and bucket design there's nothing to stop you accelerating the bucket almost instantaneously. With rocker arms and an asymmetric cam you just cannot do that.

Being able to open the inlet valve suddenly pulses the induction and is good for power. The twin cam Manx pulsed the inlet and exhaust out of sight with consequent MEP improvement. With the Honda arrangement you cannot generate such massive induction pulses.

From the bifurcated inlet port the 500 engine looks as though it is deliberately carburettor restricted. It is suggested that for performance work a 42 or 44mm carb would be suitable. In standard form the '82 XR500 sports only a 34mm Keihin.

For milder competition, such as off-road, a smaller carb will give better mid-range and be easier to tune. A street 500 would benefit both the middle and at the top with a 40mm Amal . . . and the cost wouldn't break the bank.

CAMS

To improve cylinder filling a long duration cam will be required. Valve lift in the order of five-sixteenths of the valve diameter should be aimed for. A duration of 260-270 deg measured at 1mm lift will yield the required results.

Until you buy a long duration cam you won't see the benefit of induction time. You need the valve out of the way i.e. well off its seat, in order for the pulse to appear.

Also with a hot (long duration) cam you will have to match the induction length for maximum benefit. About 11-12in will be required from valve head to trumpet end.

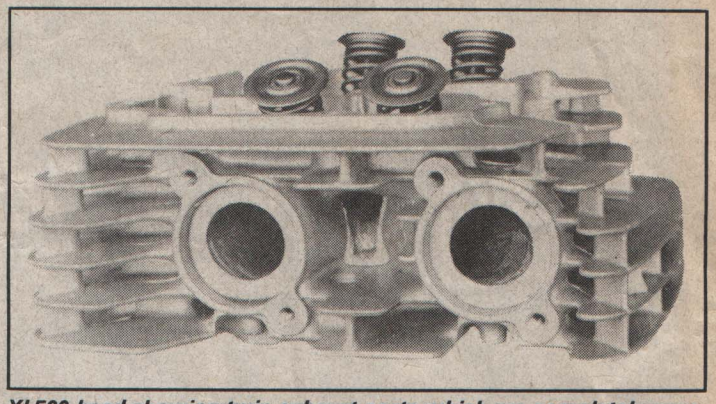
LEDAR do a race cam for the XL250 for £22 inc postage. This is useable on the street and works well with a bigger than standard carb for more high rpm power.

Primary length on the exhaust needs to be the established figure of 30in or very close, measured from the valve.

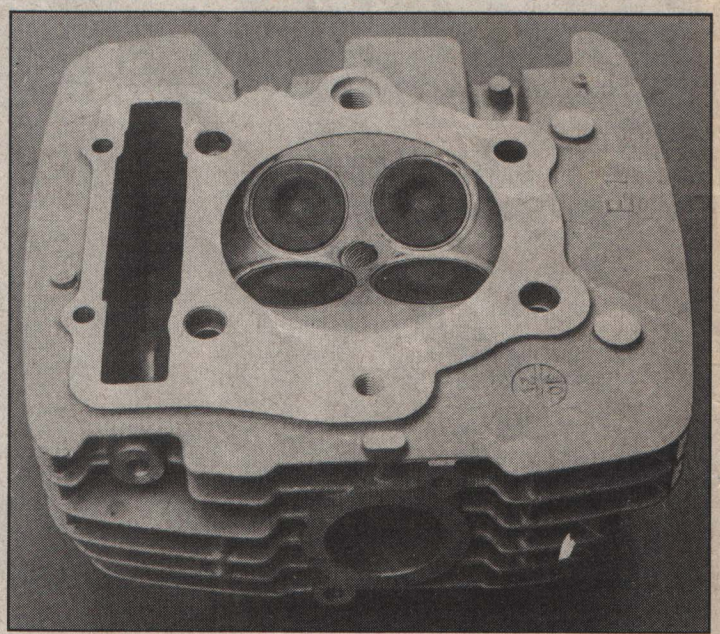
On the later engines with two separate pipes it's probably best to keep them separate for the length of the primary system and then possibly join them into a megaphone or a straight length of pipe.

There are various overbore kits available for all the XL/XR engines. The biggest LEDAR have encountered is the 590cc using an American piston for road racing. Such an engine should give 60bhp with comparative ease.

This kind of power in a light chassis explains why the single cylinder Honda four-stroke racers can whip through the bends and put up such fast lap times! □



XL500 head showing twin exhaust ports which are completely separate unlike the inlet, a single port until separated by a web.



Pent-roof head so called because combustion chamber is shaped like roof of a house. Inlet valves are bigger than exhaust.

ADDRESSES OF PERFORMANCE PARTS STOCKISTS

John Banks Racing, *Tayfen Road, Bury St Edmunds, Suffolk. Tel 0284 2382.*

Dixon Racing Ltd, *1 High Street, Godalming, Surrey GU7 1AZ. Tel 04868 28928.*

LEDAR, *10 School Lane, Baston, Lincs.*

Moriwaki, RAT Motorcycles, *19-21 Goswell Road, London EC1. Tel 01-251 2437.*

Brockliss Motorcycles Ltd, *332 Brockley Road, London SE4 2BT. Tel 01-691 5717.*

Jock Kerr Motorcycle Developments, *31 Chambers Street, Hertford, Herts. Tel Hertford 51718.*

Piper FM Ltd, *Bromley Green Road, Ashford, Kent. Tel 0233 733131.*

Roy Baldwin (International) Ltd, *97-99 Maidstone Road, Rochester, Kent ME1 1RN. Tel 0634 42902.*

M R Holland (Distributors) Ltd, *ton Road, London NW5. Tel 01-485 0473.*

Sondel Sport, *28-32 Highbury Corner, London N5 1RD.*

Talon Products, *Swains Factory, Crane Mead, Ware, Hertfordshire. Tel Ware 4105.*

M R Holland (Distributors) Ltd, *Unit 2, Wardentree Lane Industrial Estate, Spalding, Lincs. Tel 0775 4831.*

ALF MAGOW