Wadkin

LEC

RADIAL ARM DRILL AND ROUTING MACHINE

MODEL "LE-LG"

INSTRUCTION BOOK NO: 742

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FOREWORD

This Booklet is intended to give a general idea of the methods of producing components from dural sheets on Wadkin Radial Arm Drill and Routing Machine,

The methods described are now standard practice throughout the British Aircraft Industry where high standard of accuracy is essential with a minimum out lay for jigs.

The major advantage of nesting or grouping a number of small jigs as shown, is that a saving of material can be effected, which in many British Aircraft shops amounts to 30 per cent, compared with the previous methods.

The illustrations were taken when using a small nest of jigs, so that close up views showing all details could be obtained, but the same procedure holds good for sheets of any size. The same methods are also suitable for producing large members such as wing and body main webs up to 20 feet or more long and the external shaping, the lightening panel holes, all drilling can be done at the same setting as the jigs.

These machines have proved equally effective for use on wood or stacks of plywood up to 1.in thick. The method of operation is similar to that for dural and same high standard of finish is obtained as from the fixed head type of router with which most firms are familiar.

RADIAL ARM ROUTER TYPE L.E.

This machine has been designed for cutting large components from the dural, or a number of smaller patterns from one sheet. The principle for operation is based on a movable router head being worked round jigs secured on the top of the duralumin sheets, as clearly seen in the following photographs.

A feature of the machine is the use of a stationary guide bush, which reduces wear on the jigs profile to a minimum. Best results are obtained by using a steel profile plate approx. 1/8in thick and plywood packing and a 3/8in diameter cutter in a 5/8in diameter guide bush, but the choice of cutters and jigs is dealt with on pages 28 and 29.

The machine consists essentially of a main body and swivelling frame carrying a movable radial arm. The arm can be swung through a full circle.

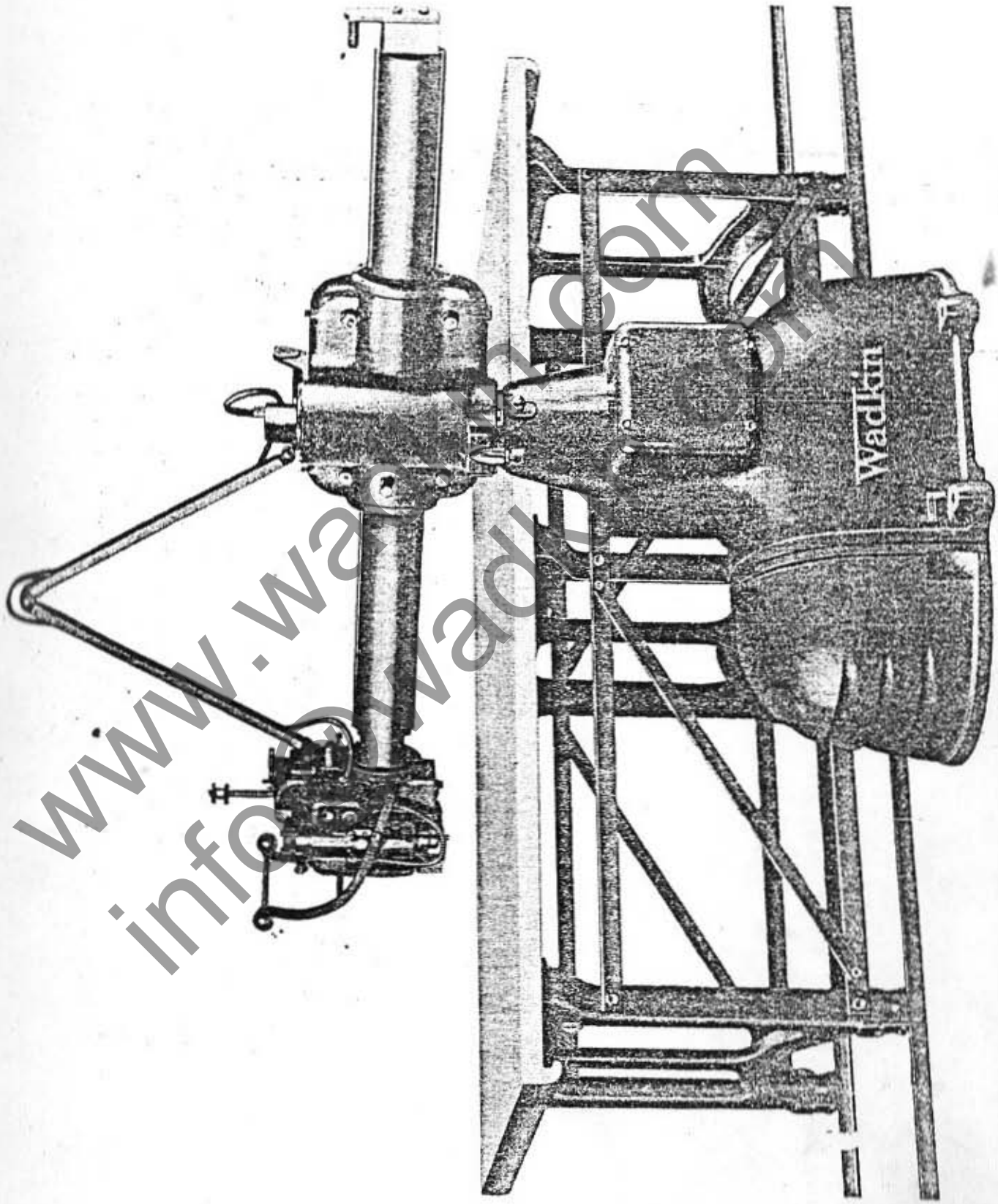
The radial arm is a aluminium casting carrying two hardened steel rods along its entire length, which forms the runway for movement. The arm moves on four ball bearing rollers in a swivel frame, three of which are adjustable.

The router head embodies built in motor of 2/8.5 h.p. rating and has a vertical rise and fall movement of 4in. The head is fitted with stops to control the depth of cutting. A spring plunger holds the head in the required position A spindle lock and also brake are provided. Motor is of the Squirrel Cage type and speed of 24000 r.p.m. is obtained by means of a frequency changer housed in the base of the main frame.

Control is by push buttons mounted on the router head, and the cable is carried in a hinged conduit.

The work table is a separate unit consisting of a wooden top secured to substantial cast iron legs rigidly cross braced. It is movable along steel rails, Full details of the tables available are given in the following pages

The maximum size of sheets that can be covered without moving the table are as follows.
7in.0in X 2in.6in: 6in.3in X 2in.9in: 5in.8in X 3in.0in:
When using a movable table,sheet up to 4in.0in wide and of any length can be routed.



RADIAL ARM DRILLING MACHINE L.G.

This machine has been designed for drilling holes up to 3/8in diameter in light alloy components including the nesting or tooling holes in the dural sheets, preparatory to routing.

As in the case of the router, it consists of a main body and swivelling frame carrying a radial arm on the end of which is mounted the drill unit.

The radial arm is an aluminium casting which moves through the swivelling frame on two circular steel tracks and four ball bearing rollers. Swivelling frame can be turned through a full circle.

The drill head embodies a squirrel cage electric motor rated at 1/2 h.p. and running at 2,800 r.p.m. It is fitted with brook self-centring chuck of 0 to 3/8in capacity

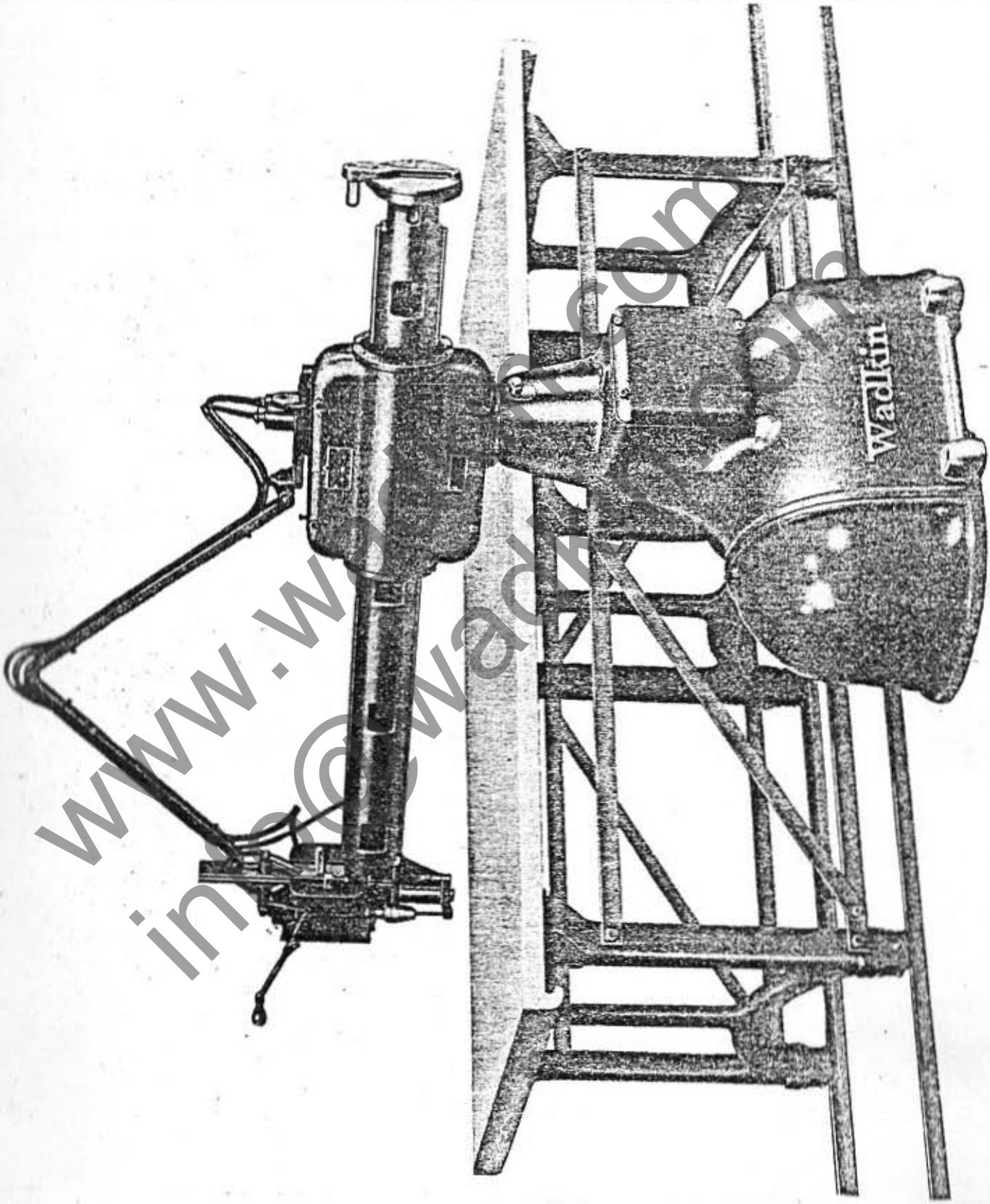
A vertical stroke of 2in is obtained by means of vertical steel rods working in 4 ball bearing rollers, ensuring a rigid yet effortless movement. A vertical adjustment of 3in is also provided, to set the drill relative to the face of the jig.

A pneumatic clamp is fitted to the drill head to press the jig and set the sheet firmly together, and prevent swarf entering between the sheets. The clamp is arranged to carry two clamp shoes and both these are supplied with the machine and are interchangeable. The most useful type is that designed to carry guide bushes up to 3/8in bore for use on bushed jigs. The second type is a claw shoe for the use on bushed jigs. Both these shoes are illustrated later in this book. The clamp is operated by a piston valve on the top of the operating handle and is designed for use with compressed air up to 100 lbs per sq. in.

Push button control is built into the drill head and a hinged conduit provided for cabling.

Work table is movable along floor rails and consists of a stout wood top carried on cast iron legs rigidly cross braced. Full details of the tables are given in the following pages.

The minimum size of sheets that can be covered without moving the table are as follows:-
7in.0in X 2in.6in: 6in.3in X 2in.9in: 5in.8in X 3in.0in:
When using a movable table sheet up to 4in.0in wide and of any length can be handled.



INSTRUCTIONS SHEET No.575

This type of table is a new development in Radial Routing and has been introduced to eliminate the hardwood table top and the jig base board when preferred. The latter has not proved entirely satisfactory in service due to unseasoned jig boards being used, and subsequently twisting. Another disadvantage is the bulk of the jig boards for storage and damage done to them when stored in racks, and their general deterioration of over long periods of service.

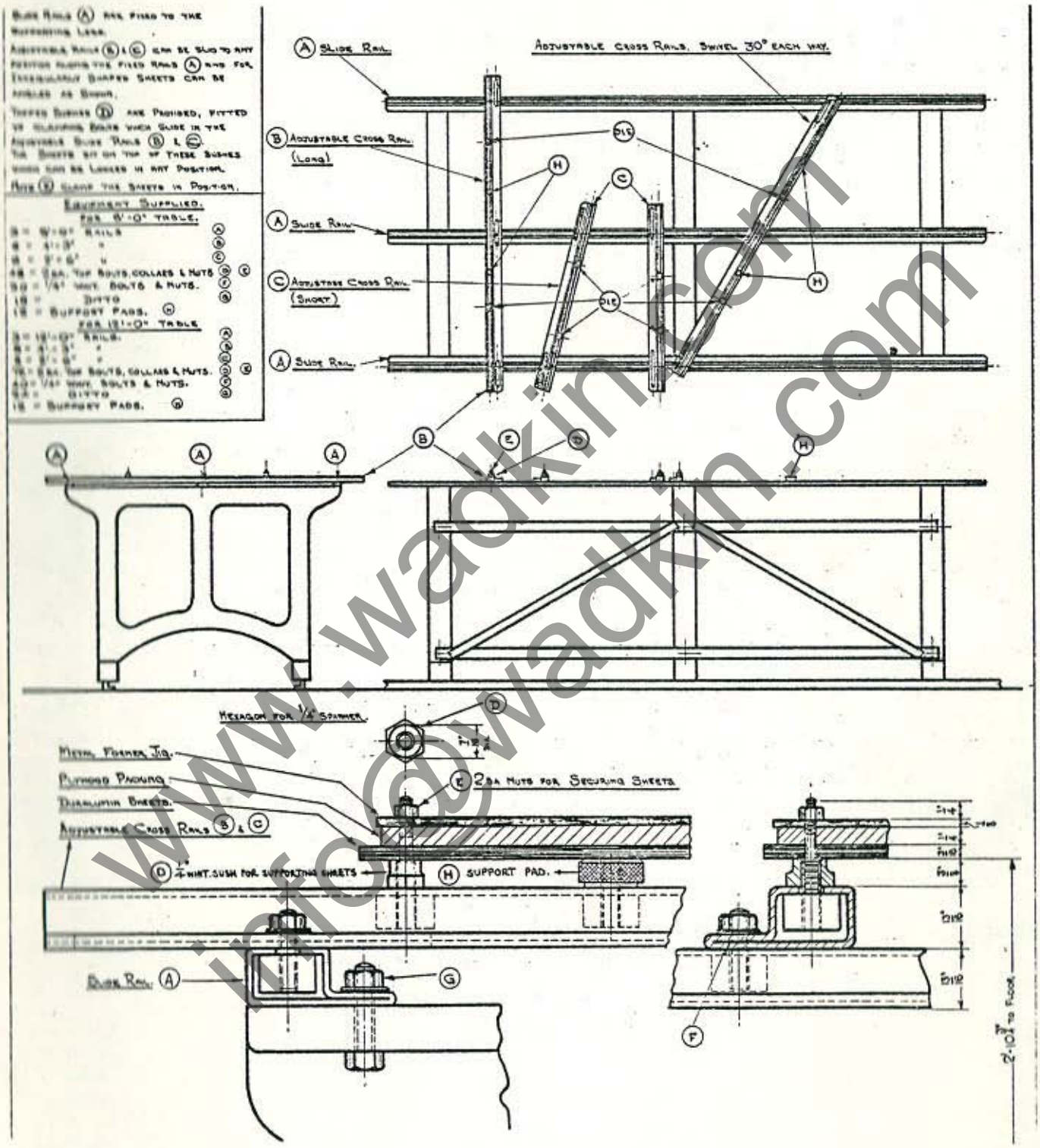
In the table arrangement outlined on the blueprint, no wood parts are used except the packing between the profile plates and the sheets and this can be screwed to the steel profile plate as before. The longitudinal rails A and the cross rails B and C take the place of the hard wood table. These rails are of bright steel fitted with a dovetail slot. The rails A are permanently attached to the table frame, and rails B and C are attached to A by dovetail bolts, so that they can be set in any position, square or swivel up to any angle of 30^{o}

The bushes D locked in position anywhere along rails B and C on dovetail bolts, take the place of the wood base board of the jig, and support the sheets. The profile plate and the packing are placed on top and clamped down in the usual manner. These bushes can be positioned anywhere over the surface area of the table by adjusting on the rails and moving the cross rails B and C to suit the drilled holes in the profile plate and when set up they remain locked changing the sheets.

The bolts sizes are rather large but these can be made to any required size to suit requirements.

In considering changing over from one method to the other, the table frame is identical and all that is required is to remove the wood top and fit the longitudinal rails A to the top of the table frame.

UNIVERSAL TABLE FOR RADIAL ARM ROUTER TYPE L.E.



LAYOUT ARRANGEMENTS FOR THE TABLES FOR RADIAL ROUTING AND DRILLING MACHINES

The work tables for the radial machines are mounted on small grooved rollers and run on guide rails fastened to the floor. A major advantage of this arrangement is that work of any length and up to 4ft wide can be conveniently drilled and routed on a work table of suitable length. Tables to 28.0in long have been supplied for main spar webs, and a power traverse for tables more than 12.0in long can be supplied. Standard tables are supplied in two sizes.

8.0in X 4.0in and 12,0in X 4.0in

LAYOUT OF MACHINES:

There are 3 general methods of using the drills and routers.

1. One drilling machine and one routing machine and two tables set out as shown on the layout over. The drilling can be done on one table, whilst the router is done by a second operator on the other table. When these operations are finished, the two tables are pushed along the rails, to the position shown in the lower view, the first table to be reloaded and the second table to be routed. An extension of this system is to install 4 tables and longer rails, so that a third operator may be employed in loading and reloading the two spare tables.

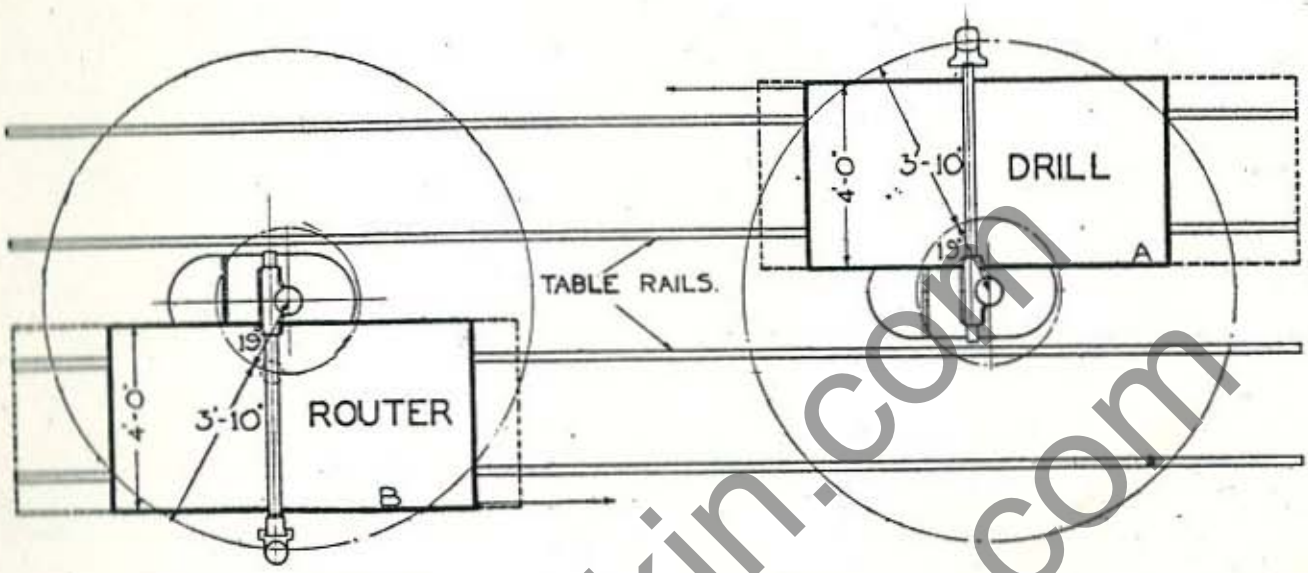
2. To keep the drilling and routing operations entirely separate, and all drilling on the sheets on drilling machines, and then pass all the work to a separate routing sections.

3. To install our L.E.G. machines having both drill and router on the one machine and have one operator completely finish the components from the blank sheets. This has the advantage that the difficulty of balancing the drilling and routing times does not arise.

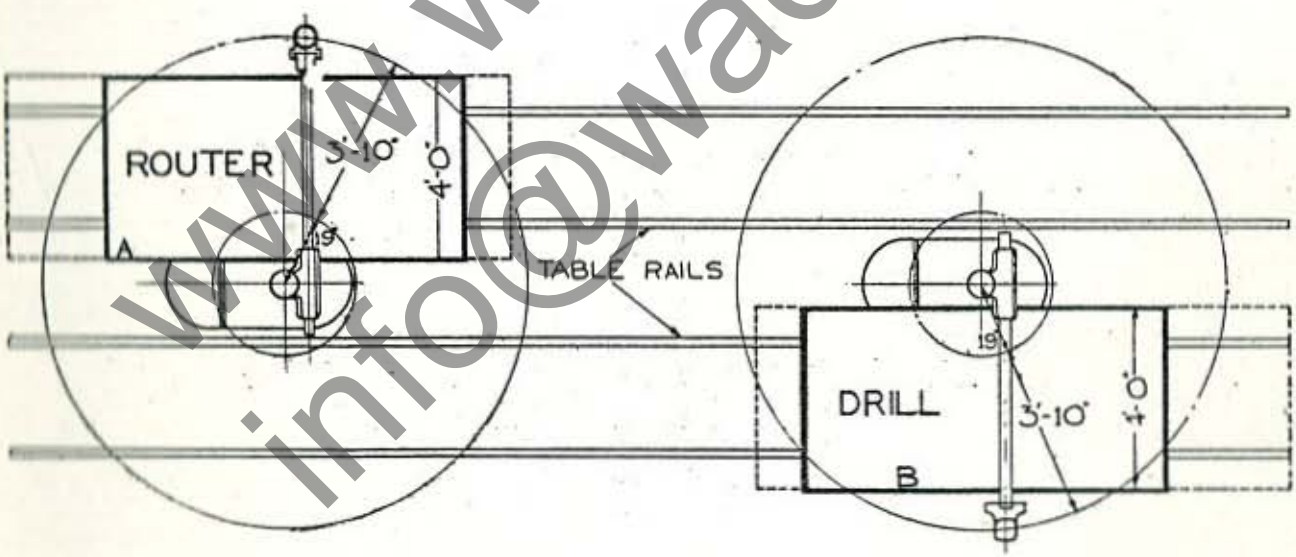
An extension of this system is to have a second table mounted on rails on the opposite side of the machine, so that a second operator can be unloading and reloading whilst the first operator is drilling and routing.

All routing and drilling machines types L.E. and L.G. are sent out with the radial arm prepared to receive a second head, thus converting either type combined machine having routing and drilling heads.

RECOMMENDED LAYOUT OF ARM ROUTING & DRILLING UNIT



After Drilling sheets on table 'A' and routing on table 'B' they can be moved along the rails to the position shown below
The sheets on the table 'A' to be routed, and table 'B' to be reloaded and drilled.



THE WADKIN METHODS OF PRODUCING DURAL COMPONENTS

The next 5 pages illustrate each operation in the production of 4 dural components from the blank sheet to the finished part. This small set up was so that close up photographs could be obtained, but the same methods can be used for large work.

The dural sheets are placed flat on the table top. The number of sheets which can be routed at one cut depends upon the gauge, but a total thickness of 1/4in should not be exceeded, and a thickness of 3/16in or less is recommended for economic working.
The following table is general guide :-

No. of sheets.	Gauge
4 or 5	22s
3	16s
1	10s

Fig 1 & fig 2.

The nesting jig (Fig 2) is normally made of plywood approximately 3/4in thick and is the same size as the sheets. The function of this jig is to position and drill the tooling holes required for locating and clamping jigs.

This nesting jig is made by setting out the individual router jigs on plywood board and arranging them to show a minimum waste of space, which is equivalent to the scrap on the dural sheets. Care must be taken to see that just over 1/2in gap is left between any two jigs, so that when routing the cutter can pass between the jigs.

The tooling holes in the individual jigs are now copied back in the nesting jig and afterwards opened out to suit the bush diameter on the pneumatic clamp shown on the page 22. No. jig bushes are required in the nesting jig.

This jig is now ready for repeating this combination of parts with the same elimination of scrap on every sheet.

Fig. 1

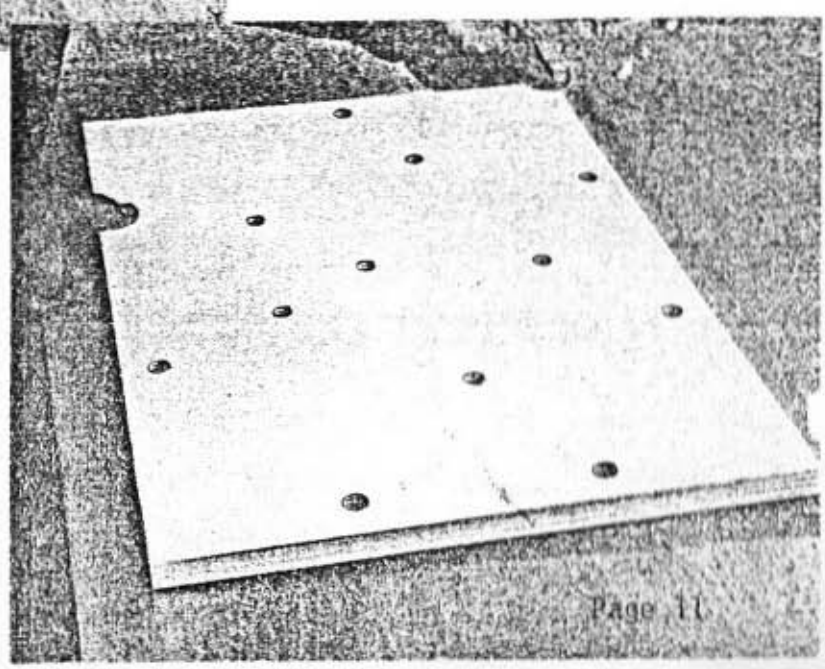


Fig. 2

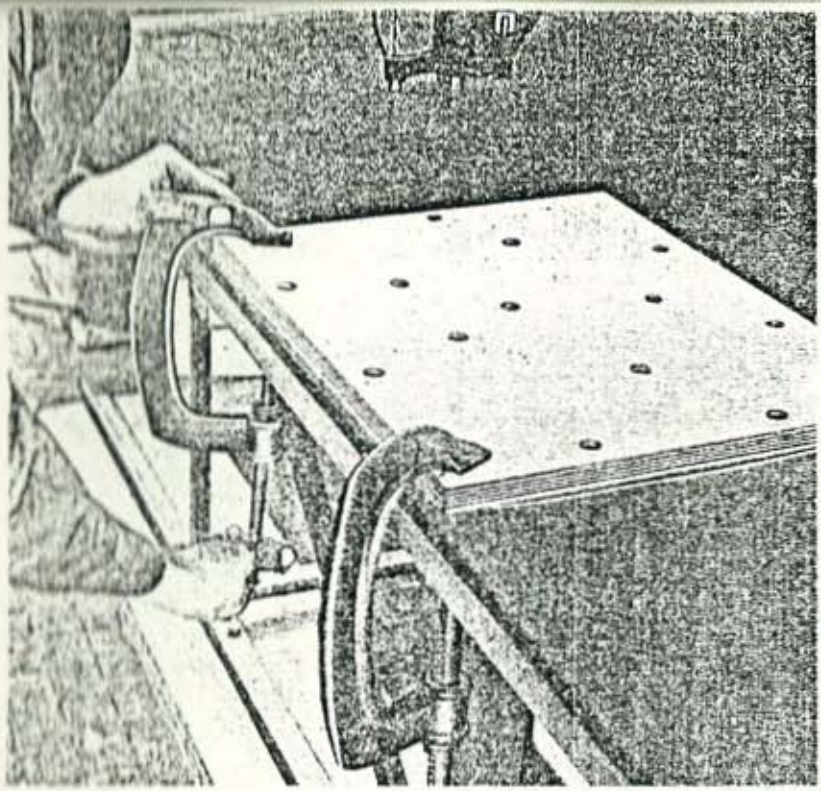


Fig 3

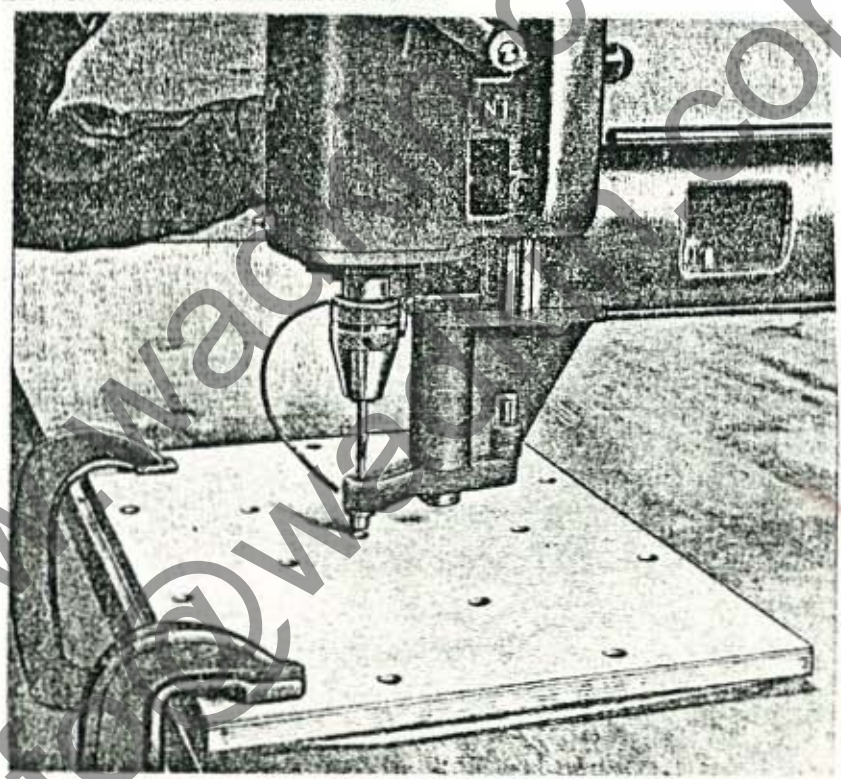


Fig 4

The nesting jig is now placed over the sheets and fastened by a few C clamps the number depending on the size of the sheets.

The locating holes are now drilled through the sheets, the nesting jig locating the position of each hole. To obtain accurate drilling the pneumatic clamp and self-centring bush used. The clamp holds down the sheets around the drill point and the drill bushes which is hardened and is carried on the clamp locates in each hole in the nesting jig and thus prevents the drill or any rotating part touching the jig, thus ensuring its long life and maintaining its accuracy.

This photograph demonstrates the pnuematic clamp action. The hardened bush is carried on the clamp which is operated by a small thumb button on the control stem convenient to the operators left hand. This bush has three functions:-
(1) To clamp the jig and sheets firmily to the table and prevent swarf packing between the sheets.
(2) To guide the drill.
(3) To locate easily and quickly in the jig (which does not require to be bushes). Bushes and drills of any size and up to 3/8in are interchangeable. The nesting jigs and sheets are now removed from the table.'

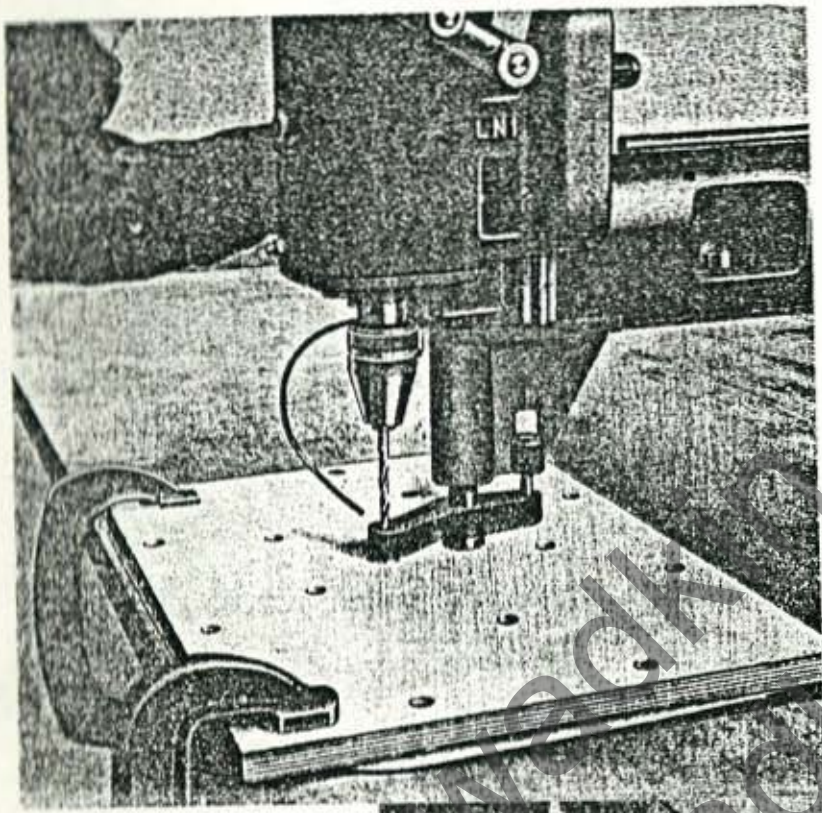


Fig 5

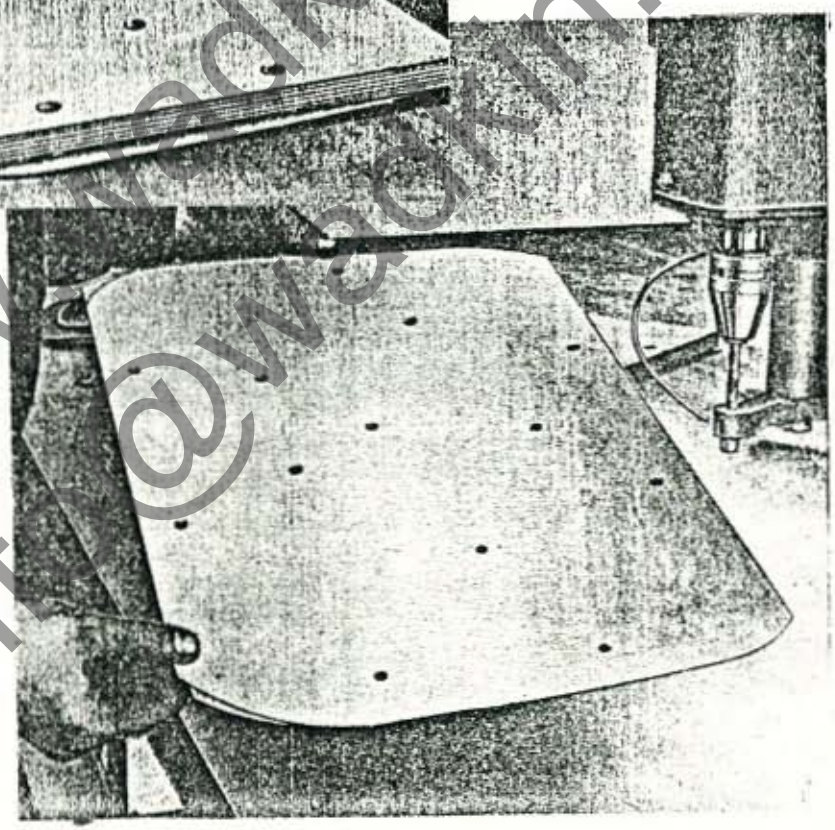


Fig 6

This photograph shows the necessary nesting or tooling holes in the sheets. These holes should be all the same diameter for purposes of standardisation of the bolts, drill and bushes where the tooling allow 3/16in dia bolts 7/32in drilled holes are suitable sizes. Now that routing practice is so well established, components for most new designs are now planned with tooling holes to faciliate routing. All the sheets to be cut should be drilled in this manner before proceeding to the next operation.

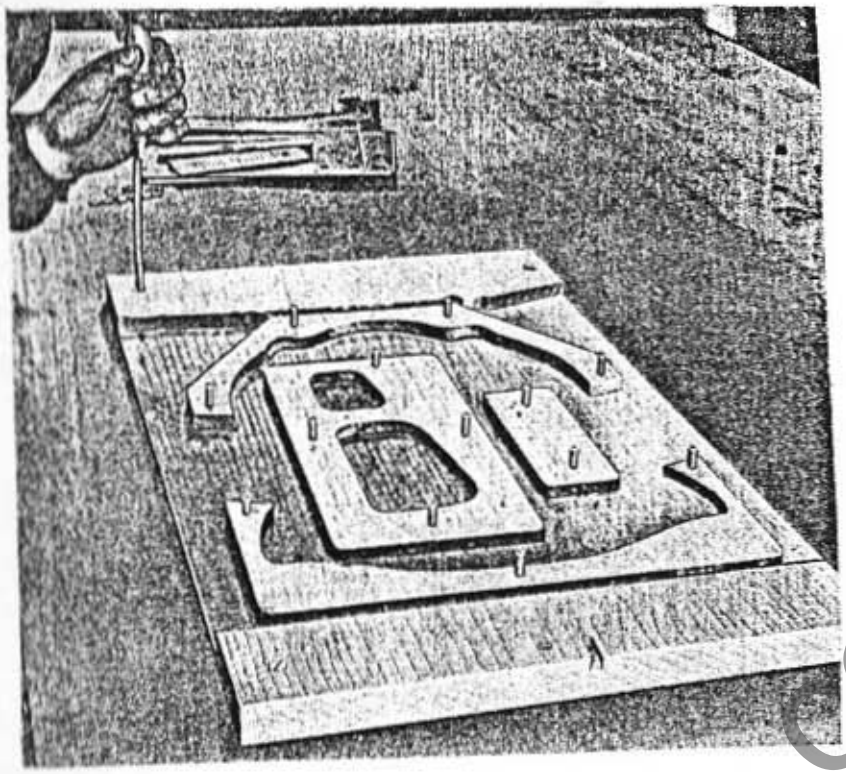


Fig 7.

fig 8.

Place the base on the table top and screw to the table top using four screws.

This is a hardwood on board approximately 1in thick which carries the bolts 3/16in or 1/4in diameter, necessary for clamping the sheets and jigs and can be prepared by copying through the holes in the nesting jig, recessing the underside for the bolts.

Locate the sheets, which now have all tooling holes in, over the bolts and press flat on the base board

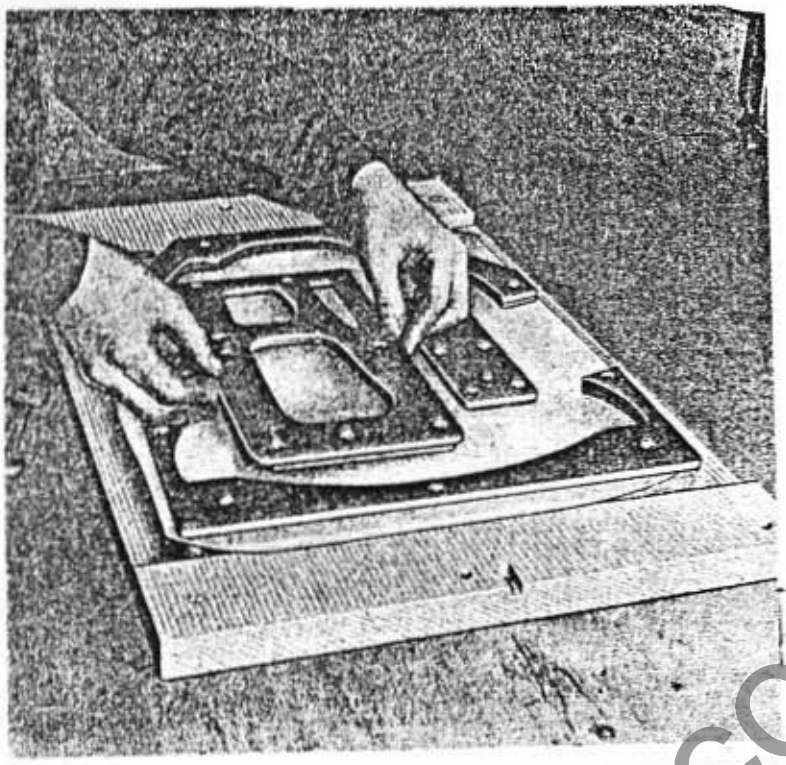


Fig 9

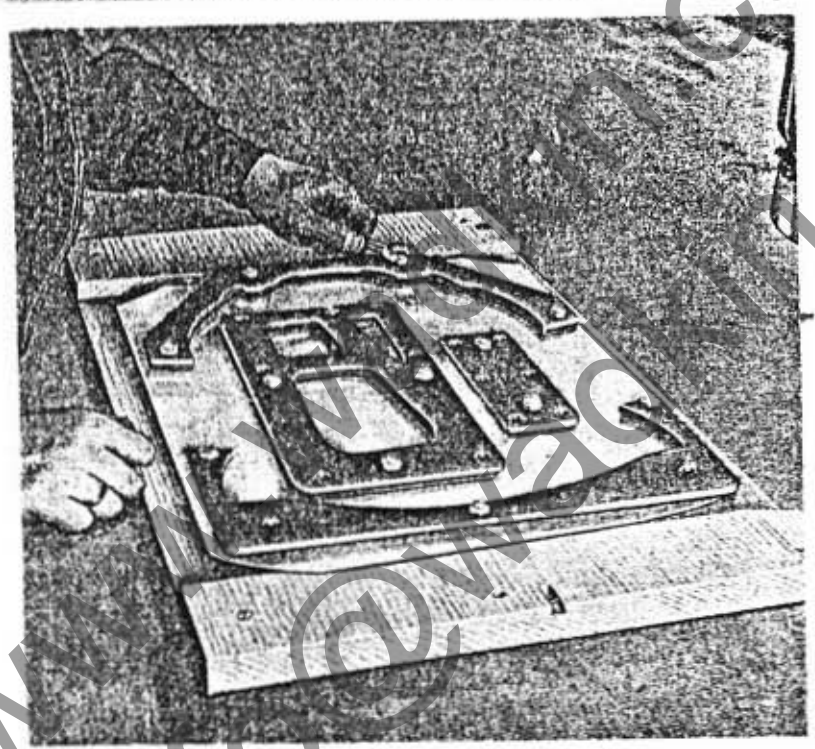


Fig 10

The individual routing and drilling jigs are now positioned on the bolts and clamped in position on the sheets. These bolts have two functions.
(A) To locate accurately the tooling holes in the sheets and those in routing jigs
(B) To clamp the sheets and jigs firmly to the base board.
These routing and drilling jigs are made from 1/8in sheet steel and do not require hardening because they do not contact any rotating part. The profile is made exactly to the components to be cut, and is prepared for drilling holes like an ordinary simple profile drill jig, except that bushes are not required, as these are carried on the clamp. A packing of 3/16in plywood is required between the sheets and the steel jig for cutter clearance.

Tighten all nuts. A nut runner is recommended for speeding up this operation.

Drill all holes, except of course tool holes which have already been drilled and used.

All bushes are tapered at their bottom end so that when the drill and bush are roughly positioned over the hole in the jig, the latter quickly enters the jig when the clamp is operated by depressing the pneumatic control knob in the operating handle. The portion of the guide bush which enters the jig also has a parallel portion, to give positive location to the drill position, and long life to the jig.

After drilling all holes, push the table along the slide rails to the routing machine.

When a combined machine, type L.E.G. is being used, the radial arm can be swung round, so that the Router Head is over the jig.

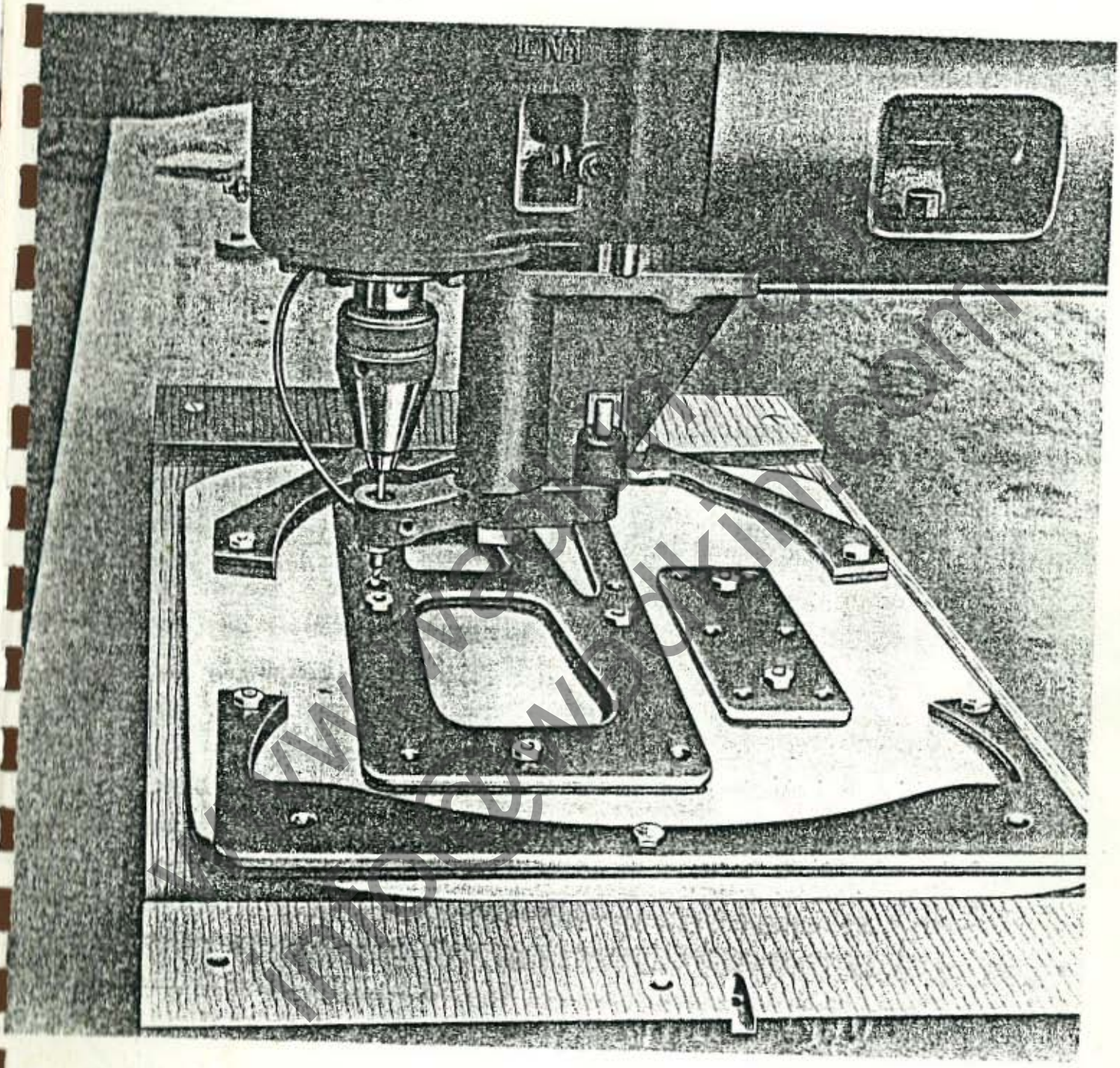


Fig 11.

The cutter head can be lowered to the position required to correspond with the sheets and positively locked by a plunger. Always move the head in an anti-clockwise direction around the outside of the jig profile, and when cutting internal panels holes move clockwise, so that the movement is against the direction of the rotation of the cutter.

In speaking of the operation of this machine, it must be emphasised that there is no pull or snatch when cutting and rigid grip is not only unnecessary but detrimental to efficient working. If the cutter is doing its work properly a pull of a few ounces is sufficient to move the head along, as it has been found that the action of the cutter helps to feed the head in the right direction. This lightness of control is very helpful to the operator in guiding the head around the jigs without slipping at the corners. The speed of feeding the head through the work is difficult to estimate, and in general is determined by the ability of the operator to move the head around the jigs, for example, a long rectangular plate say 10ft. long can be cut at 20ft or 25ft per minute while the speed on small parts as shown in the photograph opposite came out at 7ft. per minute. The time taken on this set up of 4 parts, including the three panel holes on the centre piece was about 1.1/2 minutes, the amount of cutting being 11 feet. From the above figures it may be said that 12ft per minute is a fair average for cutting speed.

The life of cutter between grinders is difficult to estimate, but many users of our radial routers are getting 5 or 6 hours continuous working between re-grinds. The cutter can be re-ground several times without practical loss of the diameter providing it is done properly on the fixture which we can supply, and not free-hand

It is usual to hone up the cutters in position on the spindles about every hour with a Carborundum stone. The operator becomes quite proficient at this after a little practice.

We wish to stress that the success of routing dural is dependent upon correct cutter grinding, as experience has proved that free hand grinding leads to failure. The components are now finished and the jigs can be removed and the pieces taken off.

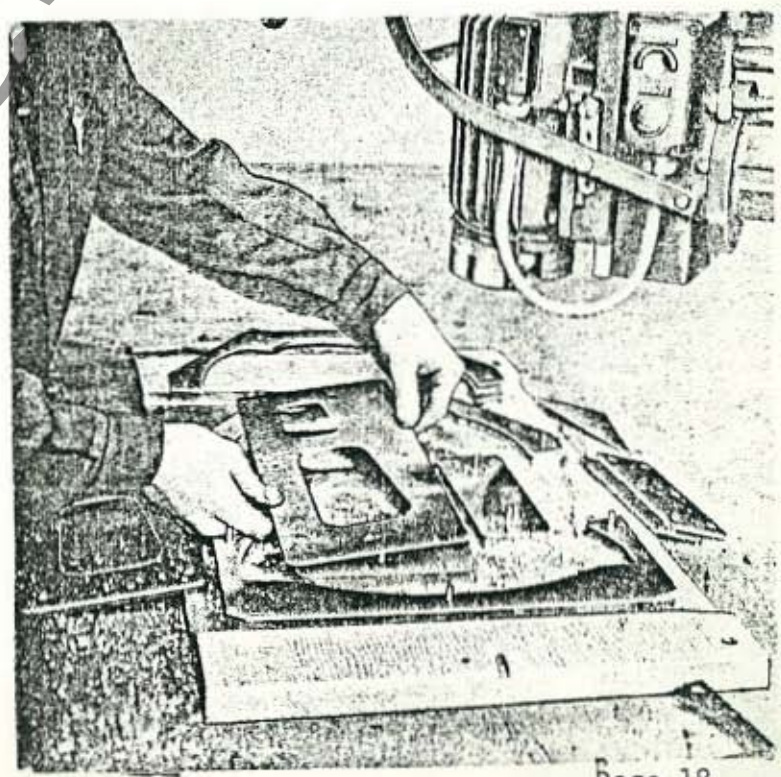
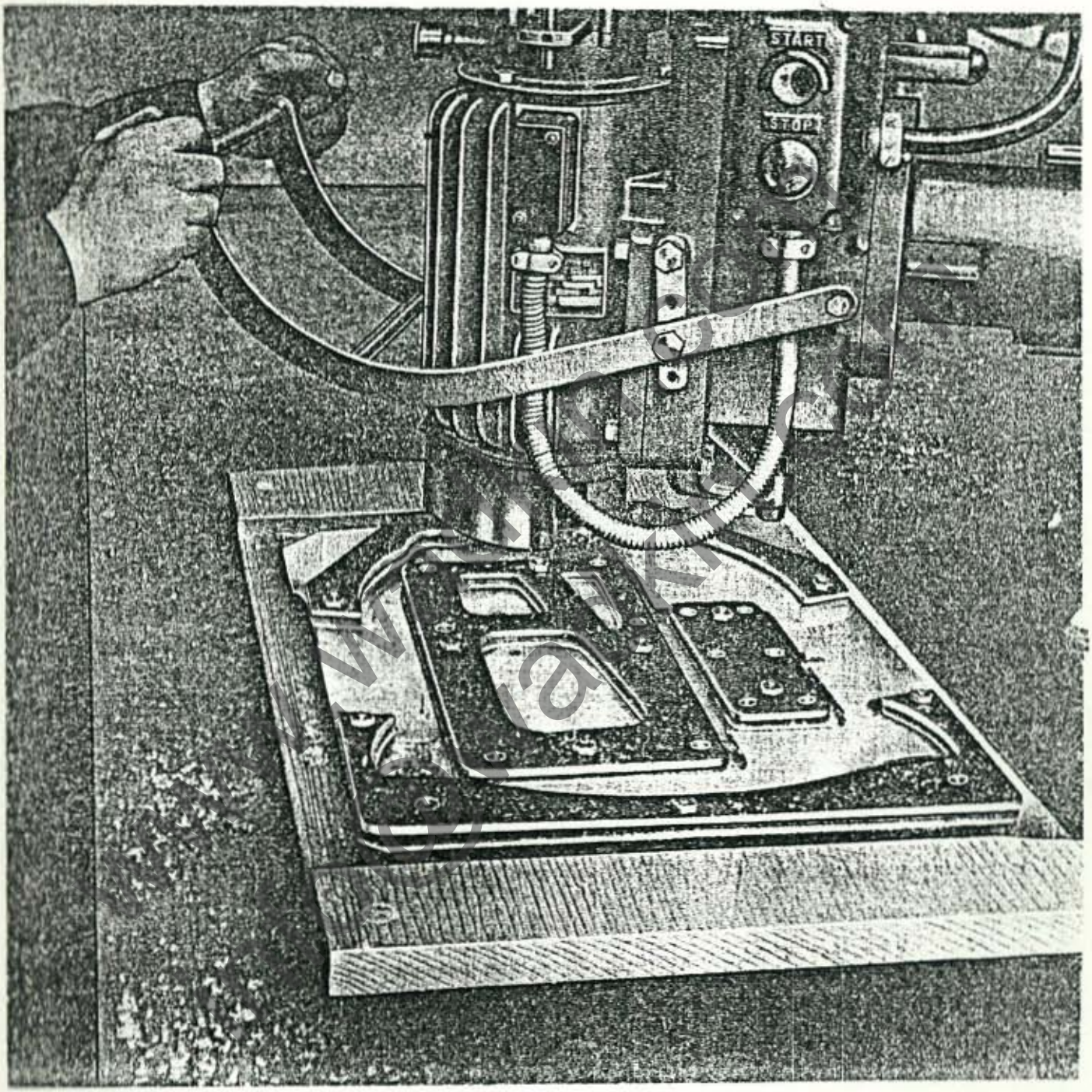


Fig 12


START
STOP

CHOICE OF CUTTER AND GUIDE BUSH SIZES.

The diagram over shows two alternative arrangements of the jig plates, cutters and guide bushes.

The upper arrangements is recommended in all cases where the jigs are not already in existence. A 3/8in diameter cutter having a 1/2in shank is used in a 5/8in diameter guide bush, so that the jig must be less than the profile to be cut be 1/8in all round, to compensate for the difference in diameter between the guide bush and cutter. This type of cutter is robust and gives the best results under all conditions.

The lower arrangement is used where existing profile jigs, that are the size of the components, have to be used. In this, the cutter is the same size as the guide bush, i.e. a 1/2in diameter cutter having a 3/8in shank is used in a 1/2 diameter guide bush. This type of cutter is not robust because the cutting diameter is larger than the shank and should only be used where size jigs are in existance and have to be used.

In components where it is essential to cut internal radii as small as 1/8in it is necessary to use a 1/4in diameter cutter in a 1/2in diameter guide bush and this arrangement should only be used where essential.

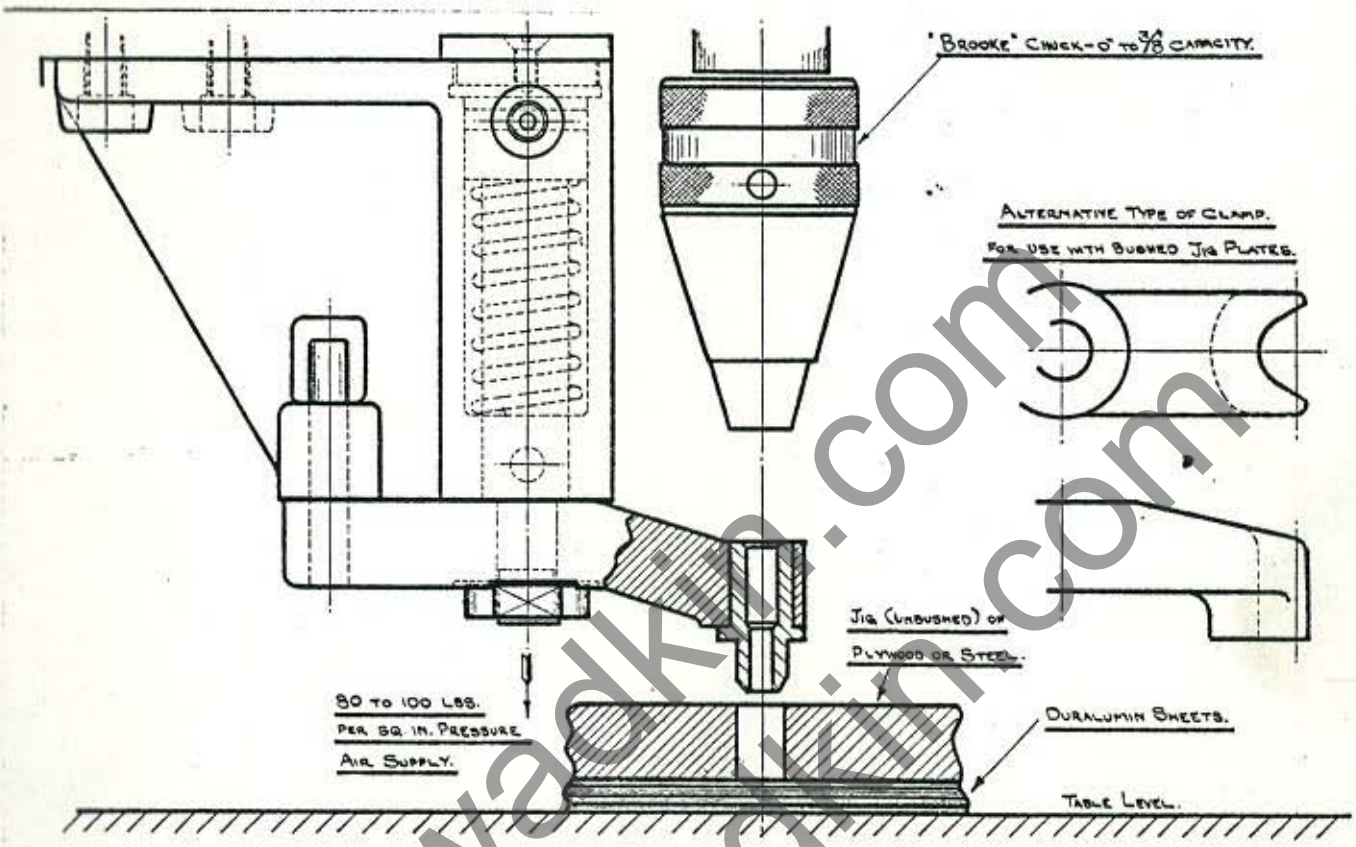
PROFILE PLATES

The next satisfactory type of profile plate is that made from 1/8in sheet steel with a shaped piece of plywood 5/16in thick underneath to allow for clearance on the top edge of the cutter. Reference to the blueprint will make the point quite clear. Plywood jig 1/2in thick can be used for routing, but these are not to be recommended except for small quantites of non repeating parts.

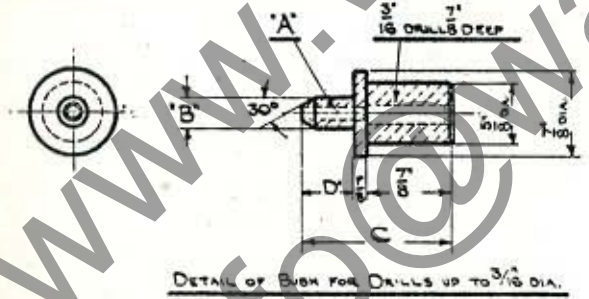
GUIDE BUSHES.

The guide bushes are supplied hardened and ground and are available in various diameters and bores. Undersized bushes .005in, .010in, .015in, and .020in below normal size can be supplied to compensate for cutter wear.
The bush is screwed into the guide plate and can be quickly changed when necessary.

HIGH SPEED RADIAL ARM DRILL TYPE L.G.



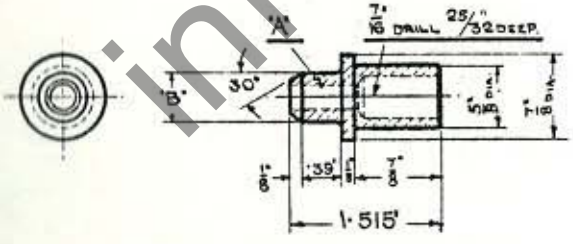
ARRANGEMENT OF PNEUMATIC CLAMP TO USE DRILLS 4" LONG OR MORE.



DETAIL OF BUSH FOR DRILLS UP TO 3/16 DIA.

"A" IS ALSO DRILL SIZE.

SIZE	"A"	"B"	"C"	"D"	PART No.
3/32"	3/32"	1/4"	1.483"	.39"+3/32"	LN. 160
1/8"	1/8"	5/16"	1.515"	.39"+1/8"	LN. 161
5/32"	5/32"	3/8"	1.515"	.39"+1/8"	LN. 162



DETAIL OF BUSH FOR DRILLS 3/16 DIA AND OVER.

SIZE	"A"	"B"	PART No.
3/16"	3/16"	7/16"	LN. 163
1/4"	1/4"	1/2"	LN. 164
5/16"	5/16"	9/16"	LN. 165
3/8"	3/8"	5/8"	LN. 166

BUSHES STOCKED BY WADKIN LTD.

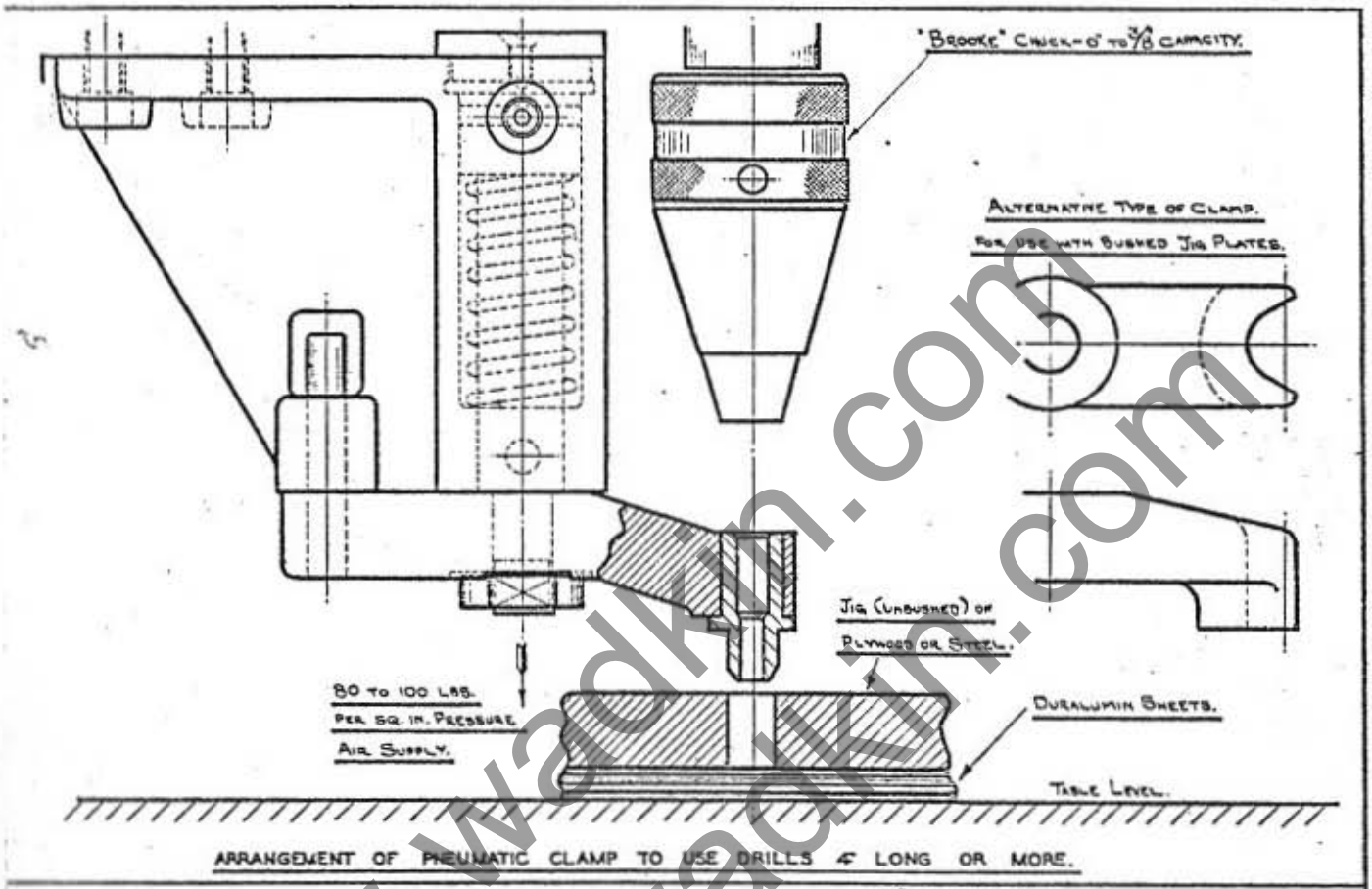
WADKIN LTD. GREEN LANE WORKS. LEICESTER. ENGLAND.

Feb, 77

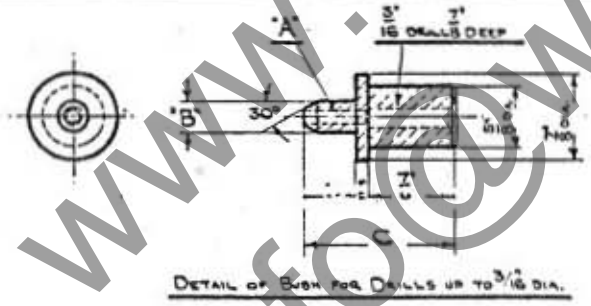
NESTING JIGS.

The arrangement shown on instruction sheet No 501 is particularly suitable for preliminary nesting jigs. This is used for drilling the preliminary tooling holes necessary in the sheets, to locate and hold down the individual drilling and routing jigs. The table at the bottom of this sheet gives typical bush sizes and these actual sizes are stocked by Wadkin Ltd. Other sizes can be supplied to suit special conditions such as small pitch drilling etc

The large outside diameter of the bushes are suitable for plywood jigs. When using steel face jigs, use the bushes recommended on pages 24 & 27



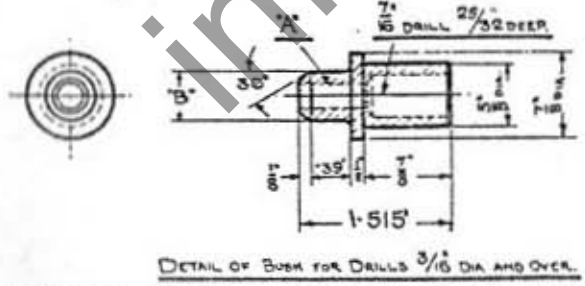
ARRANGEMENT OF PNEUMATIC CLAMP TO USE DRILLS 4" LONG OR MORE.



DETAIL OF BUSH FOR DRILLS UP TO 3/16 DIA.

"A" IS ALSO DRILL SIZE.

SIZE	"A"	"B"	"C"	"D"	PART No.
3/32"	3/32"	1/4"	1.493"	.39"+3/32"	LN.160
1/8"	1/8"	5/16"	1.515"	.39"+1/8"	LN.161
5/32"	5/32"	3/8"	1.515"	.39"+5/32"	LN.162



DETAIL OF BUSH FOR DRILLS 3/16 DIA AND OVER.

SIZE	"A"	"B"	PART No.
3/16"	3/16"	7/16"	LN.163
1/4"	1/4"	1/2"	LN.164
5/16"	5/16"	9/16"	LN.165
3/8"	3/8"	5/8"	LN.166

BUSHES STOCKED BY WADKIN LTD.

WADKIN LTD. GREEN LANE WORKS. LEICESTER. ENGLAND.

COMBINED ROUTING AND DRILLING JIGS

Instruction sheet No.504 shows the clamp arrangement for drilling in the combined routing and drilling jigs. The steel jig and packing piece are the same thickness as those shown in sheet No.574 although, of course, this is not essential.

The table at the bottom of the sheet gives typical sizes and these actual sizes are stocked by Wadkin Ltd.

Three types of clamp shoe are supplied with the machine.

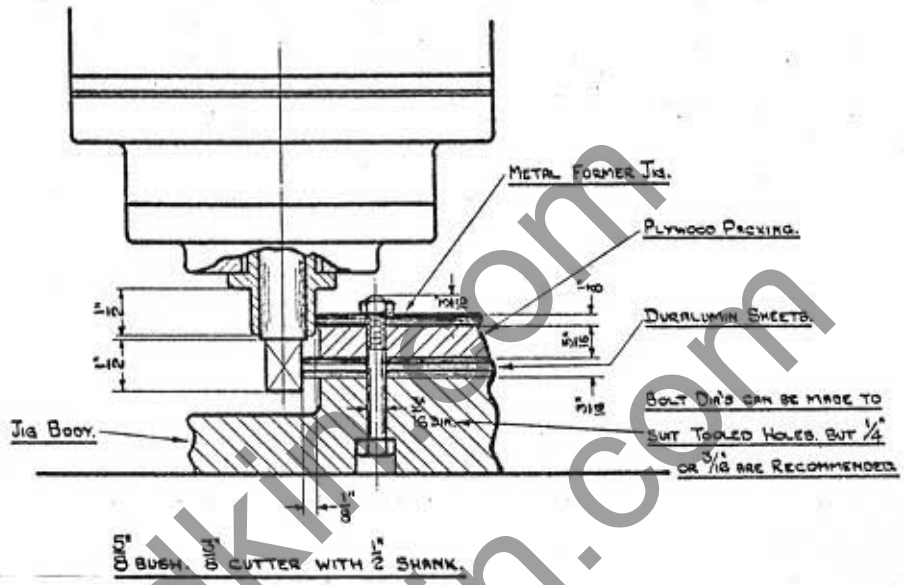
(1) General purposes combined clamp & drill bush holder illustrated on the opposite page and on the previous page.

(2) A pressure shoe for use with bushed jigs illustrated on the extreme right. This is used to clamp the jig and sheets firmly together and prevent the swarf getting between the sheets.

(3) A smaller general purpose clamp & drill bush holder illustrated on page 25

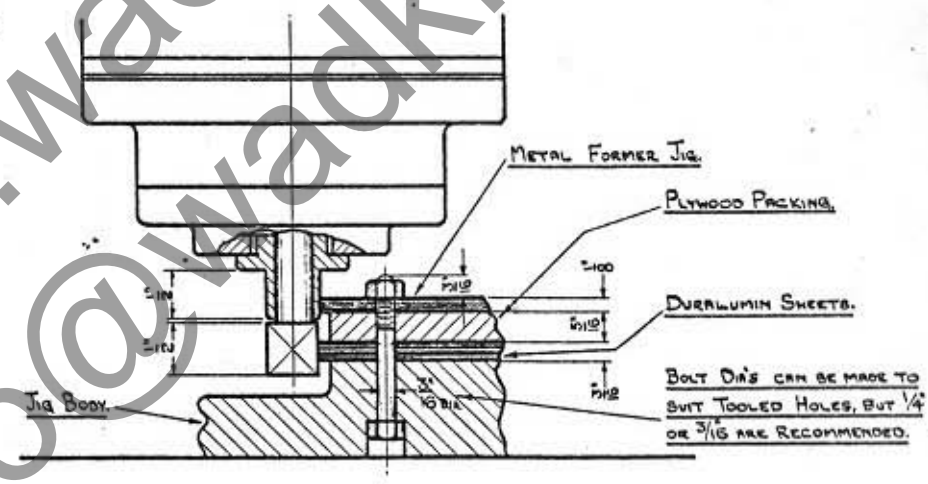
Recommended System.

Important.
Former Jig must be 1/8" less on outside profiles and 1/8" more on inside profiles than finished sheets.



1/2" Bush, 1/2" Cutter with 1/2" Shank.

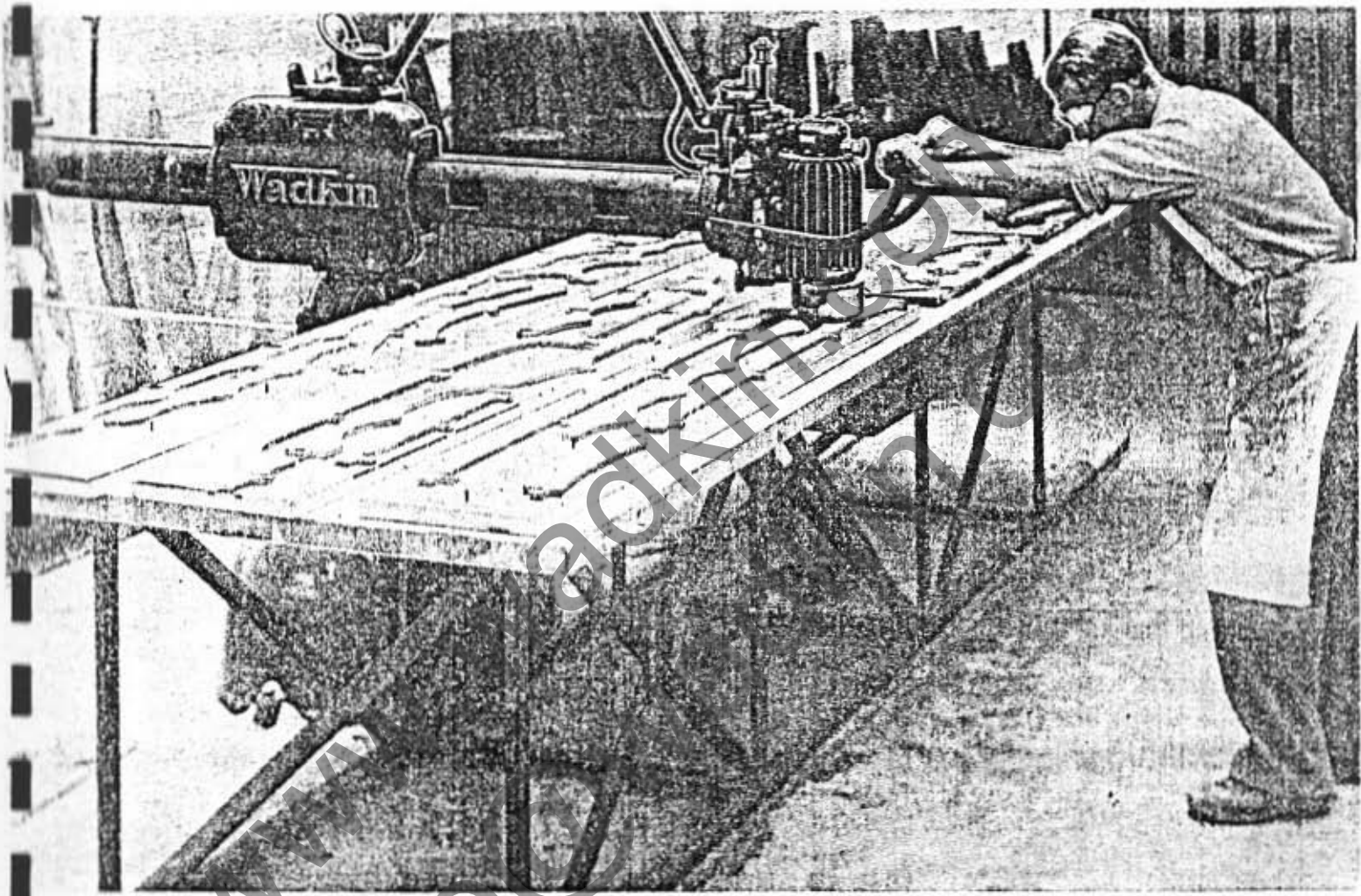
System To Be Used Where Size Former Plates are in Existance.



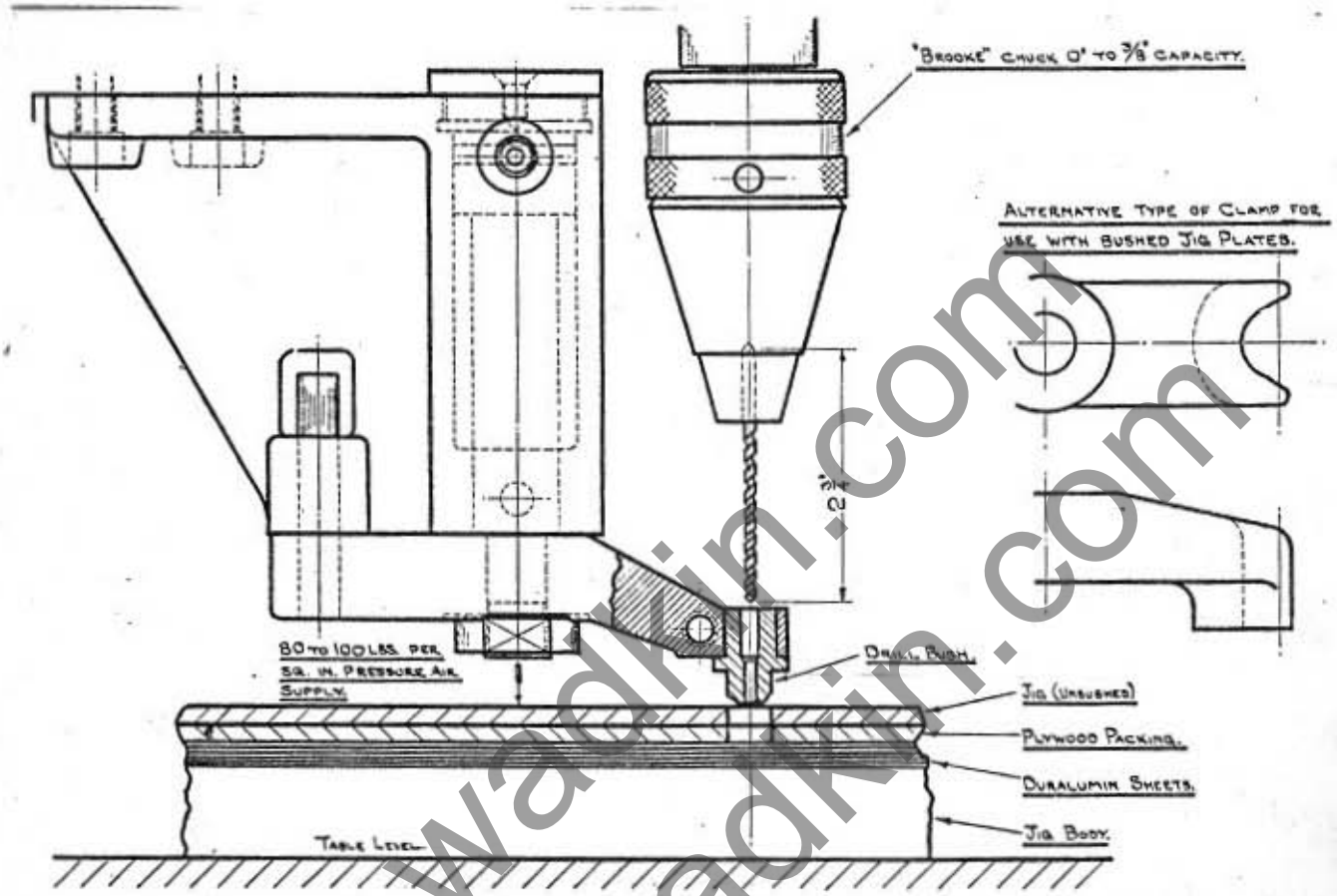
1/2" Bush, 1/2" Cutter with 1/2" Shank.

DRILLING JIGS

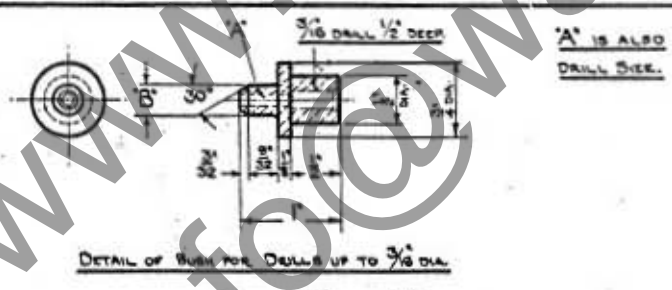
The combined clamp and guide bush holder shown across has been introduced so that jobbers length drills can be used. The clamp illustrated on pages 31 & 33 requires drill 4in long and these are not readily obtainable in small diameters. The portion of the clamp which carries the guide bush is small and very suitable for working inside shaped pressing and also for fine pitch drilling.
All holes up to the 3/8in diameter can be done on this bush holder, is desired, although it is not quite so robust as that illustrated on pages 23 & 25



This photograph demonstrates how the head of the machine can be moved to cover any part of the table. In addition the table is movable on rails to enable work outside the radius of the arm to be brought into position for routing.

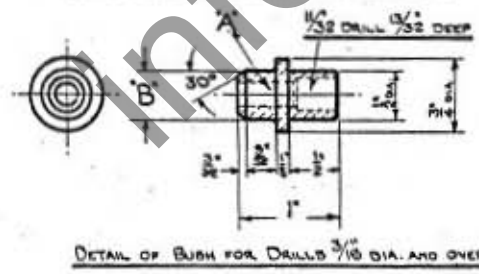


ARRANGEMENT OF SPECIAL PNEUMATIC CLAMP TO USE SMALL DRILLS OF STANDARD LENGTH.



DETAIL OF BUSH FOR DRILLS UP TO 3/16 DIA.

SIZE	"A"	"B"	PART No.
3/32"	3/32"	1/4"	LN.293
1/8"	1/8"	1/8"	LN.197
1/32"	1/32"	1/8"	LN.196
MORSE No. 50	.070"	1/4"	LN 460

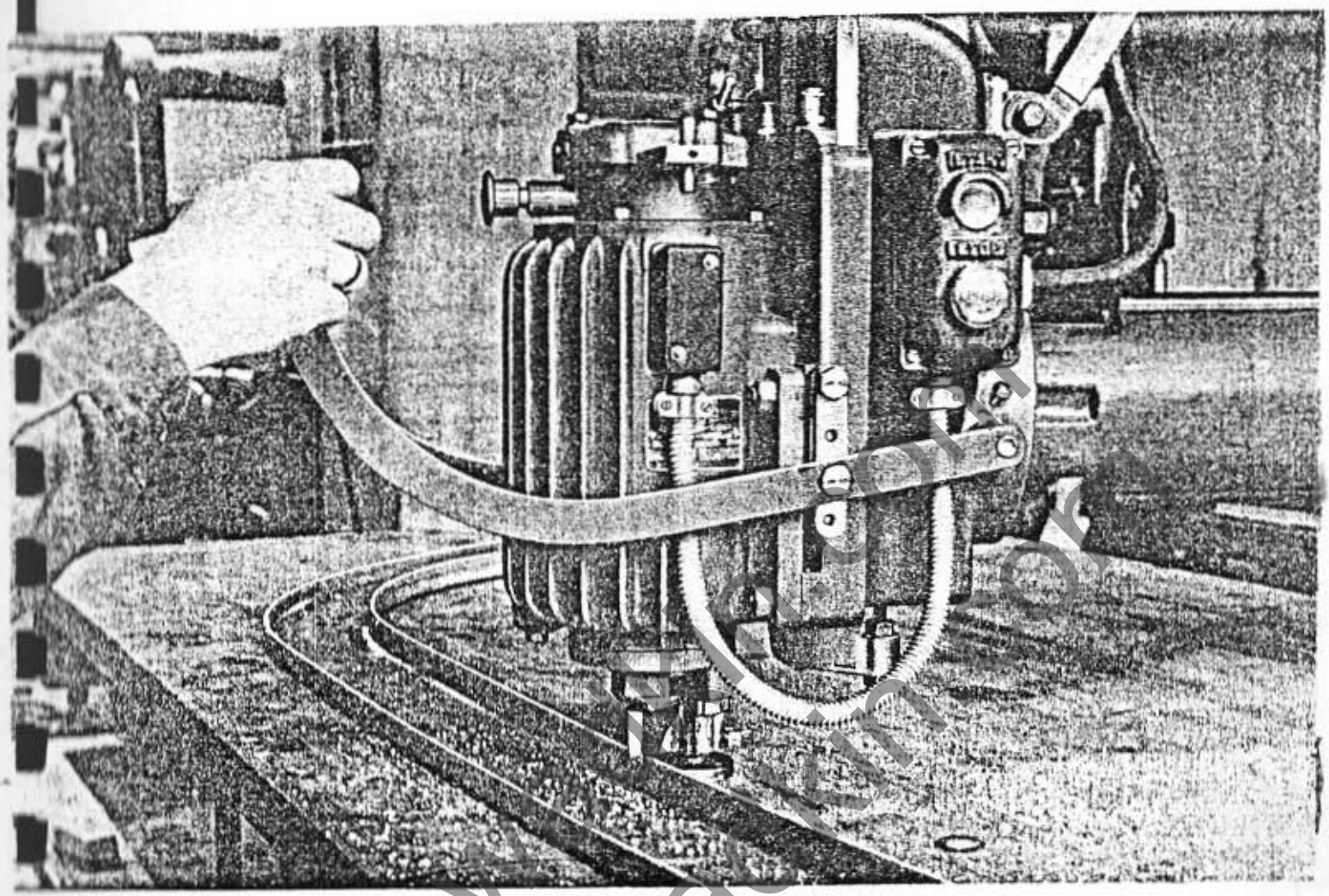


DETAIL OF BUSH FOR DRILLS 3/16 DIA. AND OVER.

SIZE	"A"	"B"	PART No.
13/64"	13/64"	1/8"	LN.198
1/4"	1/4"	1/2"	LN.199
9/32"	9/32"	3/16"	LN.294
5/16"	5/16"	3/16"	LN.295

BUSHES STOCKED BY WADKIN LTD.

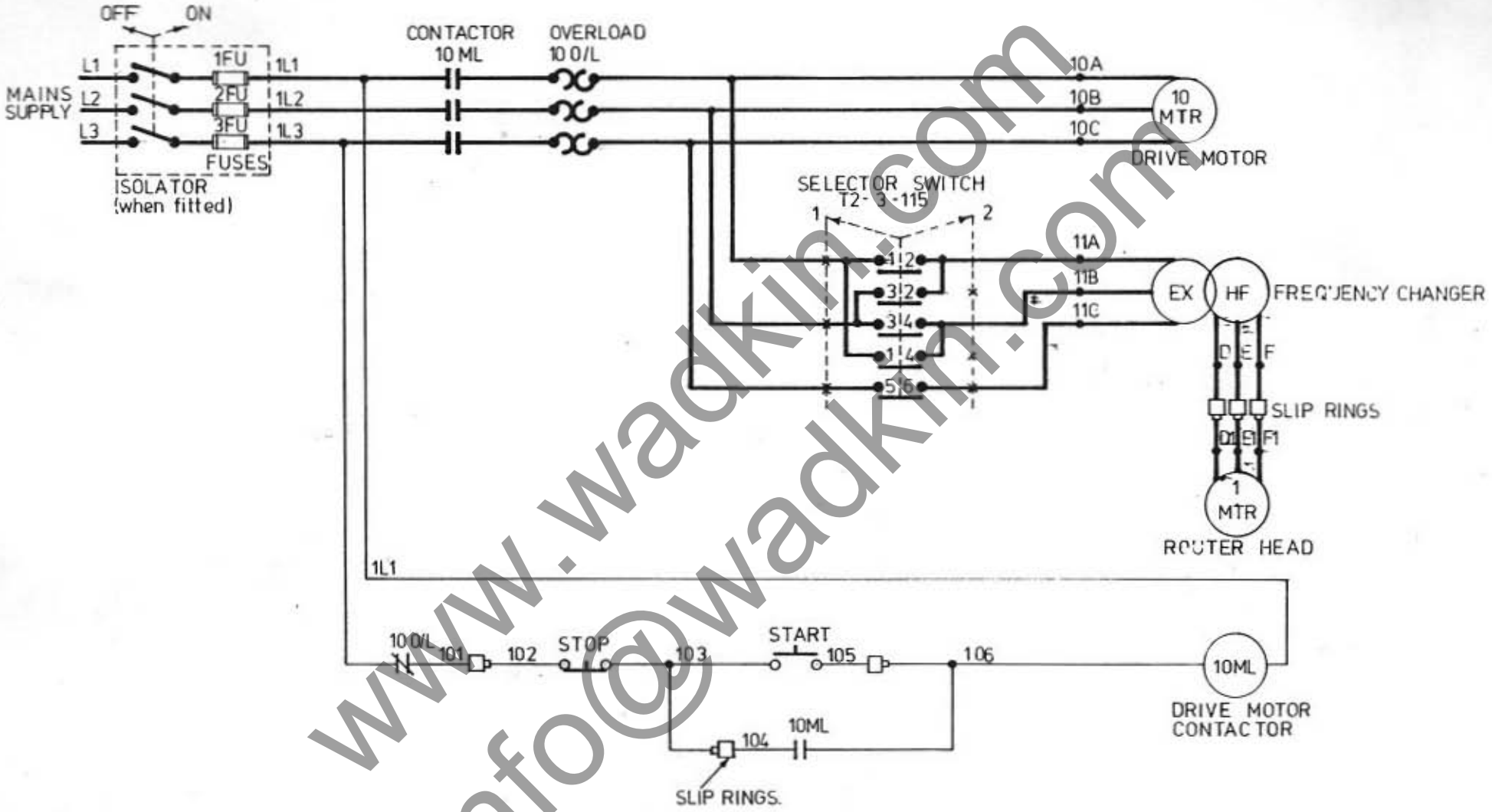
WADKIN LTD. GREEN LANE WORKS. LEICESTER. ENGLAND.



Although the Radial Arm Router is essentially a cutting out machine for flat sheets, several other applications have been developed.

The photograph opposite shows a dural channel being milled to depth after pressing. The attachment can be fitted to any standard router in three or four minutes. This channel was milled on both edges in 40 seconds, cutting time averaging a floor to floor time of 90 seconds.

This application is typical of several similar classes of work that can be handled efficiently on the Wadkin Radial Arm Router. We should be pleased to advise as to its application to your special problems.



PART No.

SIMILAR TO

THIRD ANGLE PROJECTION

WADKIN LTD. LEICESTER

SURFACE FINISH	IMPERIAL LIMITS	DATE	SIG.	D		C		B	DATE 13·9·'78	A	DESCRIPTION	QTY.	MATERIAL
▽ – ROUGH M/C	FRACTIONS ± 1/32"	ALT. No.							DRN. BY		LS		
▽▽ – FINISH M/C	DECIMALS ± .005"										LE ROUTER WITH SLIP RINGS.	PART No.	
▽▽▽ – ROUGHGRIND	METRIC LIMITS								CHKD. BY			D.2676	
▽▽▽▽ – FINISH GRIND	WHOLE NUMBERS = ± 1 M/M DECIMALS = ± 0·1 M/M BALL BEARING LIMITS SEE LIST												