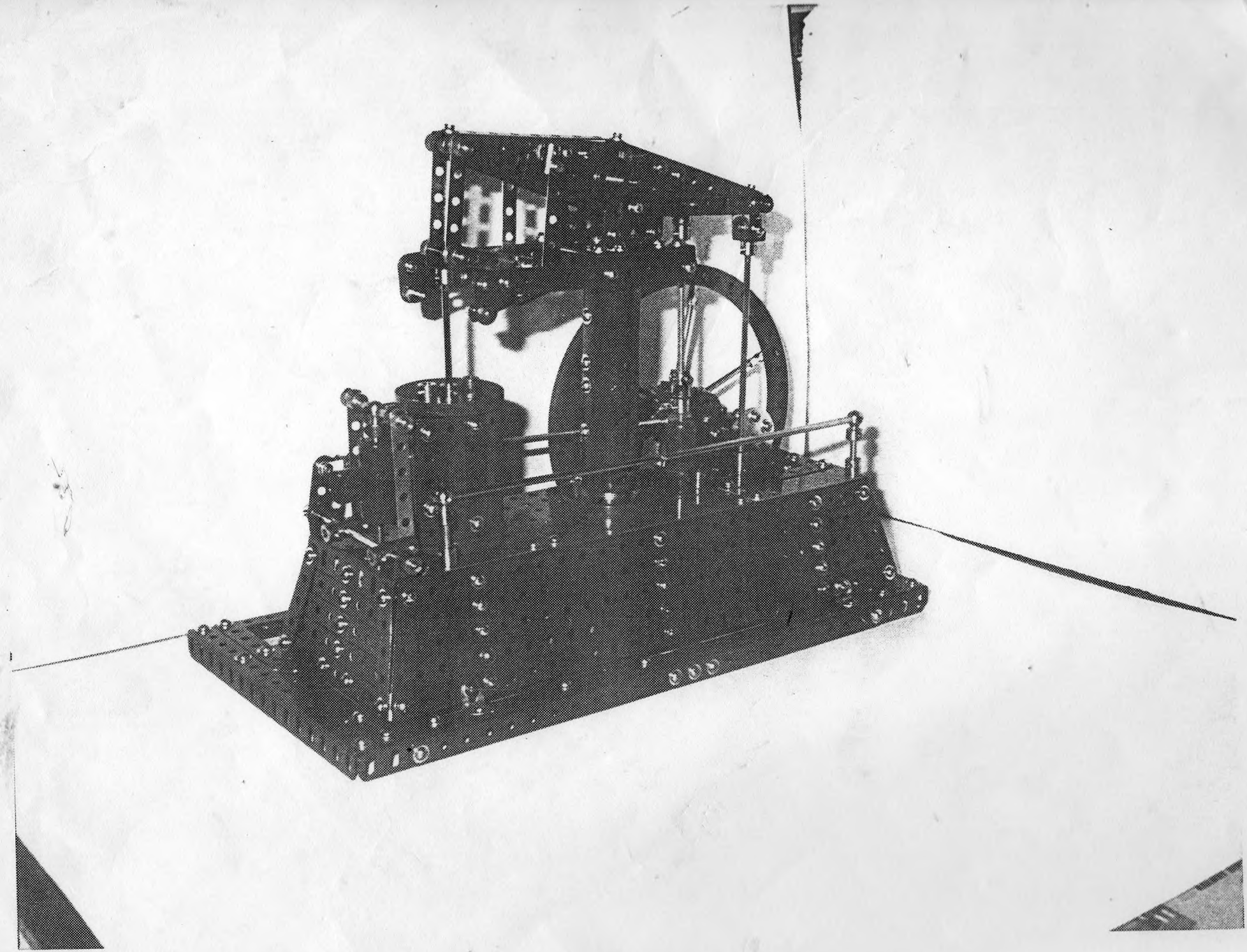


# MAINS OPERATED BEAM ENGINE.

Basic design taken from Bert Love's book "Model building in Meccano" and page 102 refers. The model has been built from Red/Green components and the power unit is situated in the base of the plinth and gives a steady slow drive to the crankshaft by means of chain. It is preferable to use a rubber belt but it was found this tended to give an erratic drive and was discarded in the event that chain and sprocket was found to be more positive-but with chain stretching being a hazard when model is operated for long periods. The Mains motor is a small unit of the induction type(no brush gear)and the gear reduction employed,was found to give adequate power and,at the same time,allowing the motor to run at max revs and not cause any over-heating. This will be described later.

## THE BASE OF THE MODEL.

The length of each long side is determined by the use of two 7½"A/girders butted end to end and joined inside their flanges by 1½"A/Girders. The round holes of the A/Girders are on the top. Each end consists of a 7½"A/Girder and these are bolted on top of the front girders by their round holes and each corner is further strenghened by 1½"corner brkts. A further compound angle-girder using two 7½"butted A/G's and joined by an 1½"A/gdr,is bolted down the base unit at a position 11 holes in from the front of the model with the round holes at the top and facing inwards towards the plinth. This girder is again strengthened by two 1½"corner brkts. There is a correction here:-The cross girder at the cylinder end does NOT have the two 1½"corner brkts,as a 7½"strip is bolted across at the 2nd hole in from the end and the two corner brkts are attached to the ends of this strip. The four corner brkts help support the plinth when it is attached to the base and you will note that the plinth is not central-there being a two hole space on the base at the cyl end-and only one hole at the Flywheel end. This is determined by the two 7½"A/gdrs forming the front of the base and is better than overlapping the a/girders one hole which would result in an uneven base line.

THE PLINTH. Requires careful construction due to the angular effect.The top of the plinth consists of two 12½"a/girders and two 3½"ditto. The two 3½"a/g's are bolted to the ends of the long girders by their ROUND holes to the tops of the slotted holes of the long girders at each end. Looking from the front next bolt three 2½"strips to the top 12½"A/G under the flange,one in the middle of the girder and two more four holes in from each end.Repeat for the other side. Three 12½"strips are bolted to these strips from the top down but the bottom strip is a compound one made from two 7½"strips overlapped one hole at the middle and giving an extra hole at each end of the base of the plinth.Two 2½"strips are next bolted to the top a/gdr at each end,and also bolted to the ends of the compound strip at an angle. Angle brkts(½")are bolted at each corner by their SLOTTED holes. Repeat each side but leave out the 12½"strip on the far side two holes up on the plinth. This is for the motor spindle to protrude and will be described fully later. Each side of the plinth must then be slightly bent outwards to give a slope. The ends of the plinth are identical and here again a 2½" strip is bolted to the 3½"a/gdr UNDER the slotted flange. Three 3½"strips are attached and also a 4½"strip at the bottom. It is easier here to attach the two sloping 2½"strips due to the SLOTTED holes in the a/gds but the bottom 4½"strip has to be attached to the lugs of the angle brkts and the ends must also form a slope and careful construction is necessary to give a rigid plinth.Four angle brkts with their SLOTTED holes slightly bent,are attached to the plinth four holes in from each end but spaced from the plinth by washers to allow fixing to the base girders. The slotted holes of the angle brkts allow for adjustment so that the plinth sits on the four 1½"corner brkts correctly.

The top of the plinth has a 5½x3½"flat plate bolted in a central position and a flat 3½x2½"plate has been made to fix next to the large plate to take the cyl unit. This is best cut from a 4½x2½"flat plate but you can use a flanged 3½x2½" plate if you wish but this would have to go under the top girders whereas my

TOP OF PLINTH. A 3½" strip is bolted across the cyl end two holes in and a 3½x½" D/A strip is also bolted across the end holes of the top cyl end. Another 3½" strip is bolted across next to the large plate at the crank end and a Temsi 3½x1½" flex plate is bolted with a 3½" strip on top leaving a "well" for the crank 2½"x1½". The well is made from a 2½x1½" flanged plate with two 1½" flat girders bolted to the plate flanges to form the well. Two threaded bosses are bolted to the top row of holes in each flat gdr so that the tapped holes in the bosses can be fixed to the top by screws -one in each tapped hole. This holds the well in place under the crank. The main bearing consists of a Channel bearing and TWO D/arm cranks are bolted to one side only of the channel bearing so that the bosses of the cranks lie back to back each side of the bearing at the crank side only. Pass a rod through the two bosses of the cranks and make sure the rod will rotate easily. Attach the channel bearing to the top of the 12½"a/girder in a central position. The Flywheel support bearing consist of a 2½"a/girder bolted to the base girder by it's round holes-slotted flagge on the inside. Two 3½"A/gdrs are bolted by their round holes to the ends of the 2½" girder and a double arm crank is then bolted to the tops of the 3½"gdrs with boss outermost. Pass a long rod through this D/A crank and into the Channel brgs and adjust for running true by means of the slotted holes in the 2½" A/G on the base girder. Make sure also that the rod is level but the Flywheel when fitted-will alow this adjustment to be trued up.

THE FLYWHEEL. This is one of my classic constructions and careful use of the proper parts will ensure a heavy and realistic wheel. First, make a template by bolting a 7½" strip across the ROUND holes of a spare Circ strip and attach a Bush wheel at the centre by two nuts and bolts. Make sure a rod will pass through the boss of the wheel and through the centre hole of the 7½" strip. This is the template for the wheel construction which must be followed. Next, take two 6-hole Bush wheels. Bolts six large forks to each hole in one of the wheels but use threaded bosses in preference to nuts inside the fork lugs to give extra weight. Use six ¾" bolts to do this so that the other Bush wheel can be attached to the other side of the hub. Bosses on both wheels are outwards. You will need six 2½" rods and six Rod and strip connectors. Each boss of the six fork pieces is fitted with a grubscrew. Fit each rod with a R & S connector. You are ready to assemble the wheel but you need four or five circ strips. If using four, take two of them and line up the slotted holes so that both rings are identical. Fit two only of the rods and strip connectors to two opposite fork piece bosses in the hub and place over the template so that a short rod passes through the template boss and the wheel boss. It is a simple matter to line up the holes in the rod and strip connectors with the holding LONG bolts in the template. If the holes of the connectors pass over the template bolts OK-tighten the rod in the fork pieces. Repeat for the six rods. The two outside circ strips are next fitted with ¾" bolts in their OPPOSITE ROUND HOLES. Pass the bolt through one of the rod and strip connector holes, and then place two more circ strips over the shank of the bolt. It is best to do two only spokes this way as you can true up the completeed wheel without the other four spokes which may be fitted afterwards. Note that only FOUR of the spokes are directly opposite each other when bolted to the Circ strips-the other two must be bolted to the NEAREST opposite holes. You will have a good Flywheel if adjusted as I have described but trial and error is the order of the day here.

The crank is a flat trunnion bolted to a Crank and a Pivot bolt holding a coupling is fixed at the apex. Crank webs can use 1½" strips or part of a Wheel disc cut across with a saw to expose four holes. This is then bolted to the wide end of the trunnion to form a web. The feed pump is a Sleeve piece fitted with two Chimney adaptors. The bottom chimney adaptor has a bolt from the inside passed through the adaptor and sleeve piece into the

tapped hole of a threaded boss. This boss is fixed to the platform only.

# BEAM ENGINE-SHEET three.

## THE CENTRAL COLUMN AND PLATFORM.

Two cylinders are joined end to end bytwo narrow 3" strips inside the cylinders with the cylinder joins at the rear. You need two long 6½" screw rods and these are passed up in the middle of the 5½x3½" flat plate, through a Wheel flange and three Brass wheel discs, and through the two cylinders and then through two or three more wheel discs and finally into TWO 2½x2½" flat plates forming the top platform. The screw rods are three holes apart and must pass through the two cyls not fouling the narrow strips or bolts. The two flat plates are screwed down on the top tightly and lined up with the c/shaft. Two 2½"A/Gdrs are then bolted by their round holes under each side and double up 5½" strips are bolted on each side to these 2½" angle girders. The slotted holes allow for final adjustment. Two more 2½"A/Gdrs are also bolted on top of the square plates fore and aft. Two flat trunnions placed together are then bolted to the slotted holes of an 1½"A/G which is bolted to the top platform-repeat for the other side giving an 1½"width between each bearing truss. Corner brkts(1") are bolted to the extremities of the 5½" strips and short threaded pins are fixed to the corner brkts facing inwards at each side.

THE BEAM. Made from two 8 hole Bush wheels and 10 strips 4½" size. The two Bush wheels at the centre are spaced a strip width apart by collars and washers and 4½" strips are also attached to these bolts to form the length of the beam. Two further 4½" strips are attached to collars at the centre of the beam and at each end and must be bent slightly to conform with the beam shape. One inch corner brkts (4) are bolted each side of the beam to cover gaps.

THE PARALLEL MOTION. Built up from 2½" narrow strips. Two hang at the front nose and two more hang five holes back but attached to short couplings on a short rod that is passed through the beam. Two cranks are bolted to two cranks giving a 2½" length and the cranks are fixed to a rod holding the rear hangers and also two more 2½" strips pivotted to the front two hangers. A large fork with a short rod will be attached to the piston rod and the short rod holds the narrow strips and held by two collars but are free to pivot on the rod.

MAIN CYLINDER. Consists of a cyl unit placed on top of a wheel flange. ONE 3½x2½" flex plate is wrapped around the cyl but spaced from it by a collar on each holding bolt and attached to the cyl top and bottom. The curvature is at the pillar end and two 2½x1½" flex plates are also attached by the long holding bolts and go to the rear being overlapped by 2½" strips at the join with the curved 3½" flex plate. Another wheel flange is placed on top of the cyl with a Bush wheel boss upwards and held to the plinth top by two screw rods passed down through the cyl body and also two collars under the bottom wheel flange and bolted down on the 3½x2½ flat plate and held tight by nuts underneath. Two short angle girders are bolted to the sides of the 2½x1½" flex plates with slotted holes inwards. An 1½" A/G is bolted across the tops of the side A/G's and a 1½x1½" flat plate holding a sleeve piece, is also fixed to the side A/G's forming the valve chest. The sleeve piece has two chimney adaptors for the valve rod. The lifting valve arms are 3" narrow strips pivoted at their tops on a short rod passed through a Handrail coupling held in the valve rod in the sleeve piece. The bottoms of the narrow strips are pivotted in slotted couplings held on a rod passed through the lugs of the 3½" D/A strip across the top of the plinth at the very end of the plinth platform. A single arm crank is held on the rod and this is connected to a small eccentric on the c/shaft. The rod is a clock kit part and is made of Alv and very light in weight. The feed pump is a rod held in a small forkpiece at the top and held in place by a collar on a short rod, and a swivel bearing holds the pump rod which passes down through the sleeve piece into the flat plate of the plinth.

The C/shaft holds a small eccentric fitted with a coupling by short bolts-this holds the valve rod. A 1½" sprocket also on the rod and connected to an 1" chain wheel on the motor drive. Details of the motor drive are on an extra sheet but this completes the model instructions.

# BEAM ENGINE-SHEET FOUR.

## THE DRIVE UNIT.

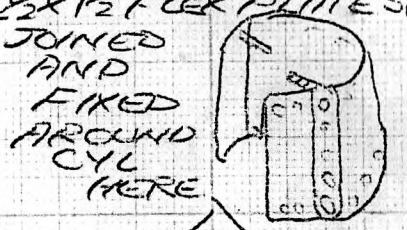
As stated, this is a Mains Induction drive and uses a small type of motor without reduction gear similar to those used in Hairdryers. The motor I have used will only take up a little room and will fit on a 5½x2½" Flanged plate which is fixed across the base 10 holes in from the cylinder end. The motor is fixed sideways on this plate so that I does not foul the sloping side of the model and allows a 2nd size up Meccano rubber belt from the ½"pulley on the motor shaft to a Mamod Flywheel taken from a Meccano steam engine or lineshaft and the bearings for this flywheel are just two 1½x½" D/A strips bolted near the motor and spaced four holes apart on the plate so that the Flywheel lines up with the Motor pulley. A 2" strip is bolted across the lugs of the D/A strips but spaced from the lugs to allow a worm to be fixed between the D/A strips in the centre and in the top holes of the D/A strips. A channel bearing is next bolted to the flanged plate in a position to allow a ½"pinion to engage with the worm and the short rod with the pinion protrudes outside the sloping plinth on the engine Flywheel side. A double arm crank is also fixed to one side of the channel bearing for support. The leads of the motor are taken to a plastic connector fixed on the outside of the plinth side at the rear for mains connection. An 1" sprocket on the short shaft takes the drive to the 1½"sprocket on the engine c/shaft.
This arrangement gives a slow but powerfull drive to the engine and is quiet and un-obtrusive. The motor on it's base can easily be removed from the engine by just taking out the four holding bolts from the flanged plate.
The bolts holding the two 1½x½"D/A strips may have to be spaced from the flanged plate by washers on the fixing lugs to enable a clean engagement with the worm and ½" pinion.

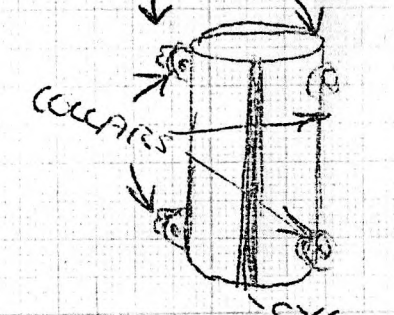
NOTES. The Beam must line up with the crank and the top of the cylinder and all bearings and pivots must be lubricated. The flywheel must run true and needs careful adjustment to achieve this. Note that the LARGE slotted holes in the circ strips are used for spoke anchoring to give proportion to the wheel.

# CYLINDER UNIT

A - WHEEL FLANGE
B - BUSH WHEEL
C - THREADED BOSS (2)
D - SCREW RODS 3½" (2)
E - SPACING COLLARS
F - TOP OF PLINTH
G - 3½ x 2½ FLEX PLATE (CURVED)
H - SPACING COLLARS
J - CYLINDER UNIT.
K - 2½" STRIP
L - 2½ x 1½" FLEX PLATE.
M - 2½" A/GIRDER
N - SLEEVE PIECE
P - CHIM ADAPTORS (2)
Q - 1½ x 1½ FLAT PLATE

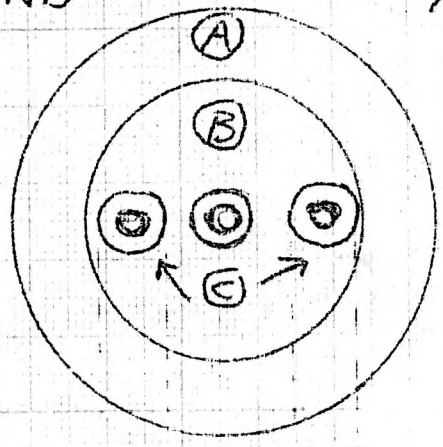
3½ x 2½ AND. 2½ x 1½ FLEX PLATES (2) JOINED AND FIXED AROUND CYL HERE

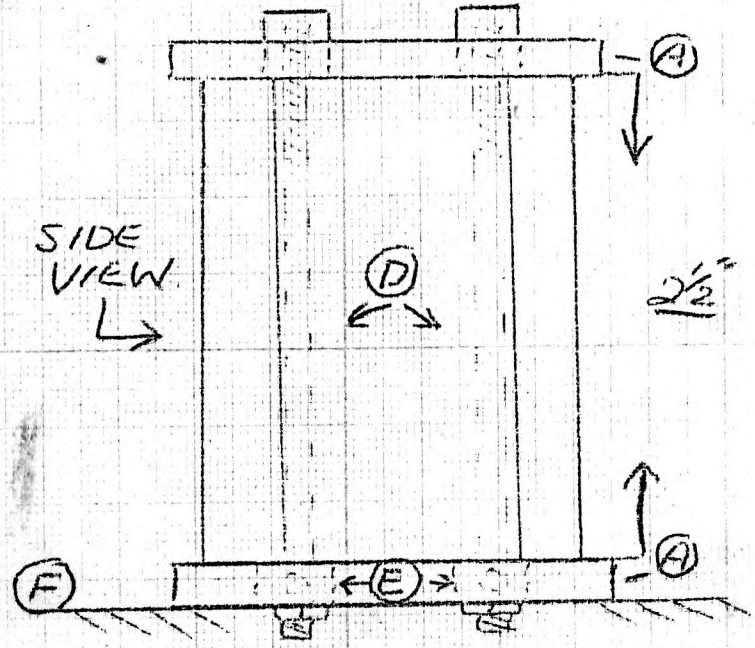


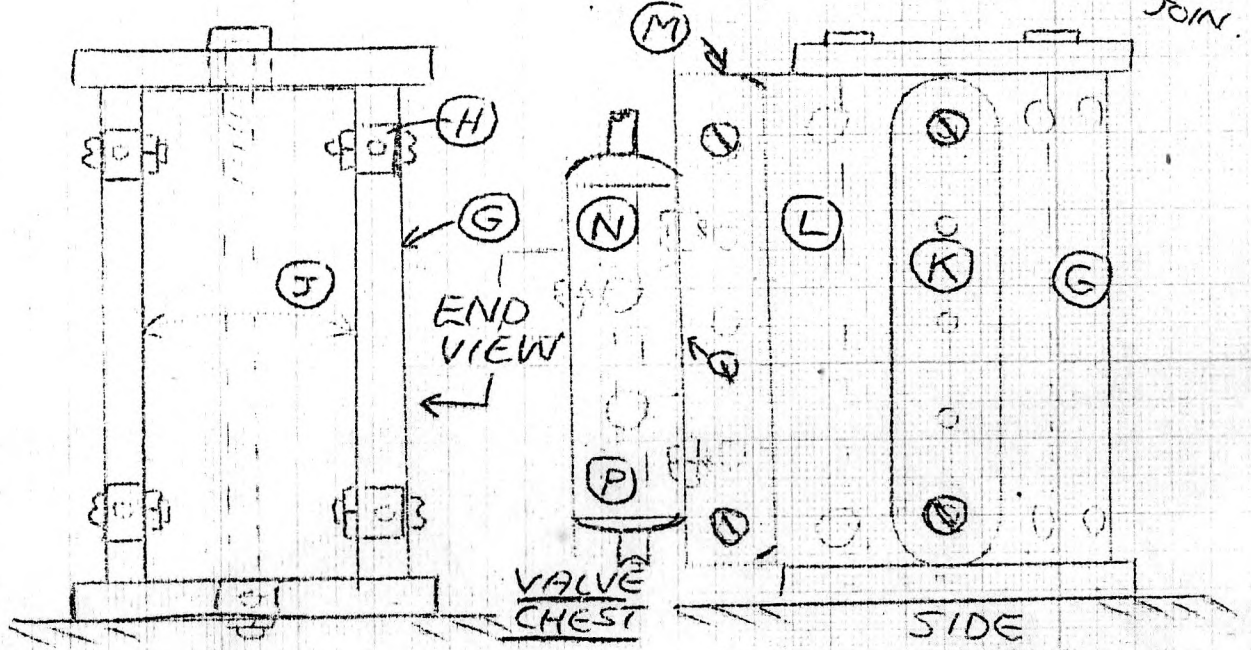



REAR END

HOLDS THE TWO WHEEL FLANGES TOGETHER

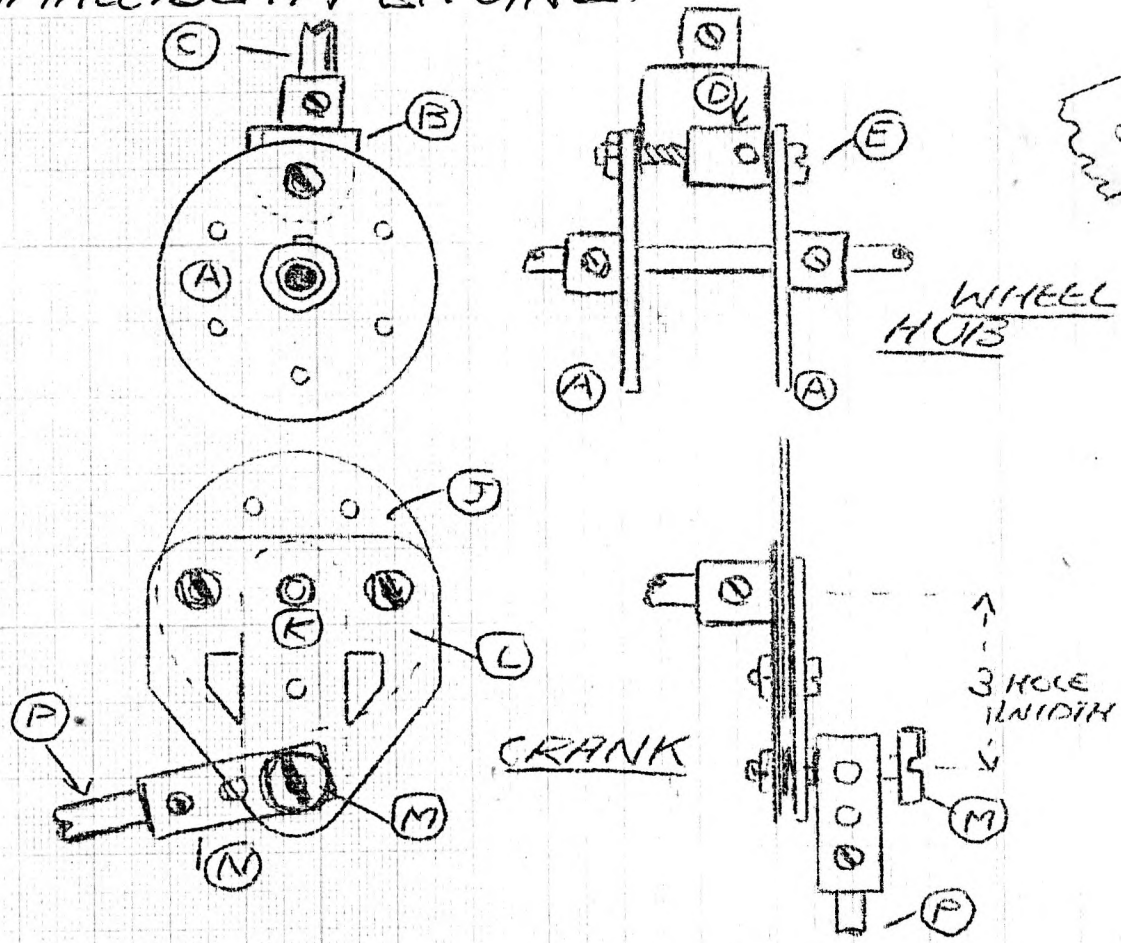


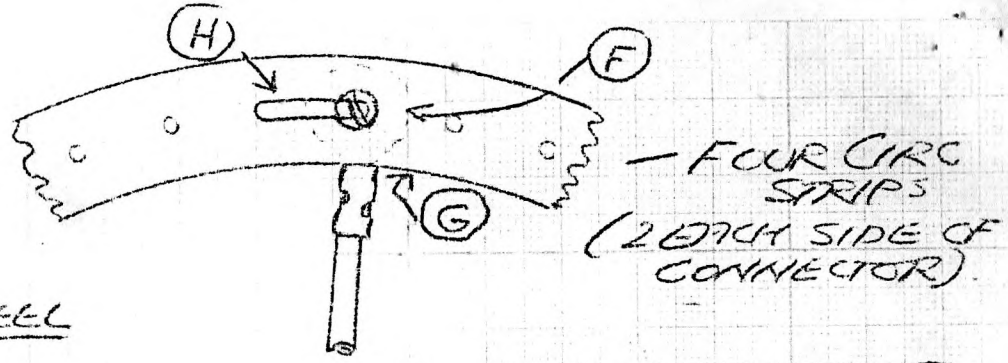




CENTRE OF CYL 5 HOLES IN FROM END OF PLINTH

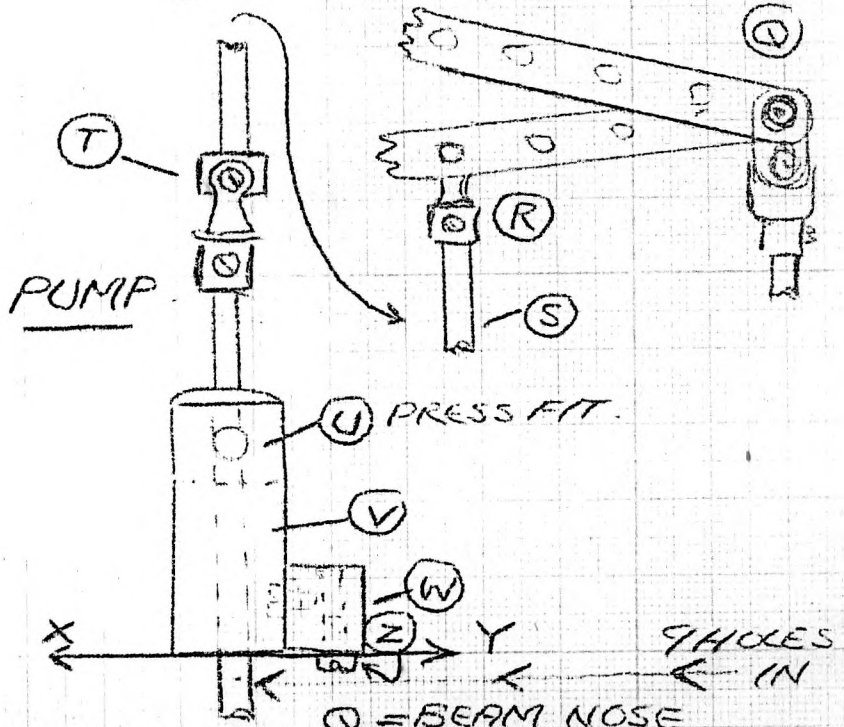
# SMALL BEAM ENGINE.







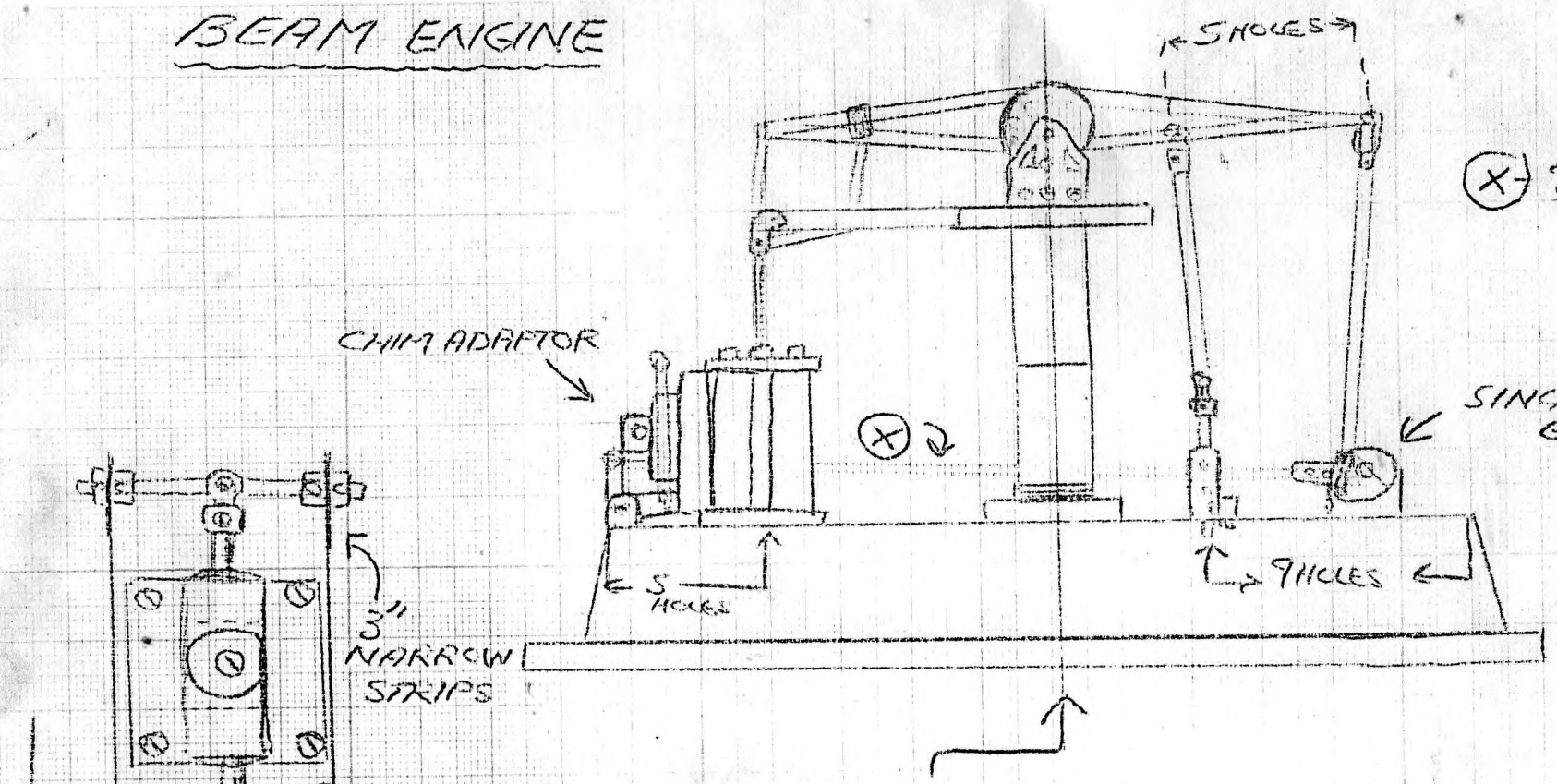


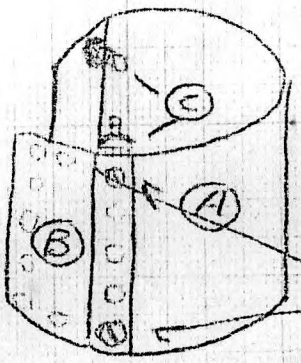

A = 2 BUSH WHEELS (6 HOLE)
B = LARGE FORKS (6)
C = SPOKES (2½" RODS)
D = THREADED BOSS (6) FOR WEIGHT.
E - LONG 3/4 BOLTS
F. ROD & STRIP CONNECTORS (6)
G - CIRC STRIP. (AT LOT OF 4)
H - LONG SLOT.
(OTHER SPOKES IN ROUND HOLES OF CIRC STRIPS.

J = 6 HOLE DISC.
K = SINGLE CRANK
L = FLAT TRUNNION.
M - PIVOT BOLT
N - COUPLING.
P = ROD 5½"

Q = BEAM NOSE
R = SMALL FORK
S = 3½" ROD
T = SWIVEL BRG
U = CHIM ADAPTOR
V - SLEEVE PIECE
W = THREADED BOSS
X-Y- TOP OF PLINTH
Z - HOLDING SCREW.

# BEAM ENGINE




CYL COVER

A - 3½ × 2½ FLEX PLATE
B - 2½ × ½ " " (2)
C - FORK SPACING COLLARS ON 4 HOLDING BOLTS

## Museum replicas

Although the open method of construction employing perforated strips has certain drawbacks this type of assembly can be put to good use in modelling early or museum models which in their own day had a certain amount of open ironwork in their mechanisms. The beam engine illustrated below is an excellent example of the way in which elementary parts can be assembled with great realism and effectiveness in recreating the prototype. The principle of the beam engine was one of the earliest attempts to convert the reciprocating motion of the steam piston into rotary motion. The crankshaft and flywheel were well established by this time and the rocking beam at the top of the engine was the forerunner of the cross-slide used in the horizontal steam engines. A rocking beam however, has a drawback when mounted above a fixed cylinder. The pivoting connecting rod at the crankshaft ends presents no problem as it may follow its own locus in space without detriment to the motion. However, at the piston end, the rise and fall of the beam, being in a curved path cannot stay in alignment directly over the piston through which the piston rod must rise and fall in a straight vertical path. This problem was overcome in early beam engines by using chain links to accommodate the differences in alignment but the introduction of Stephenson's parallel link motion solved the problem. This linkage, sometimes known as the parallelogram linkage is neatly modelled in narrow strips and brassware as shown. The model is electrically driven from an internal motor and has an eccentric linkage running from the crankshaft back to a valve motion behind the steam cylinder.

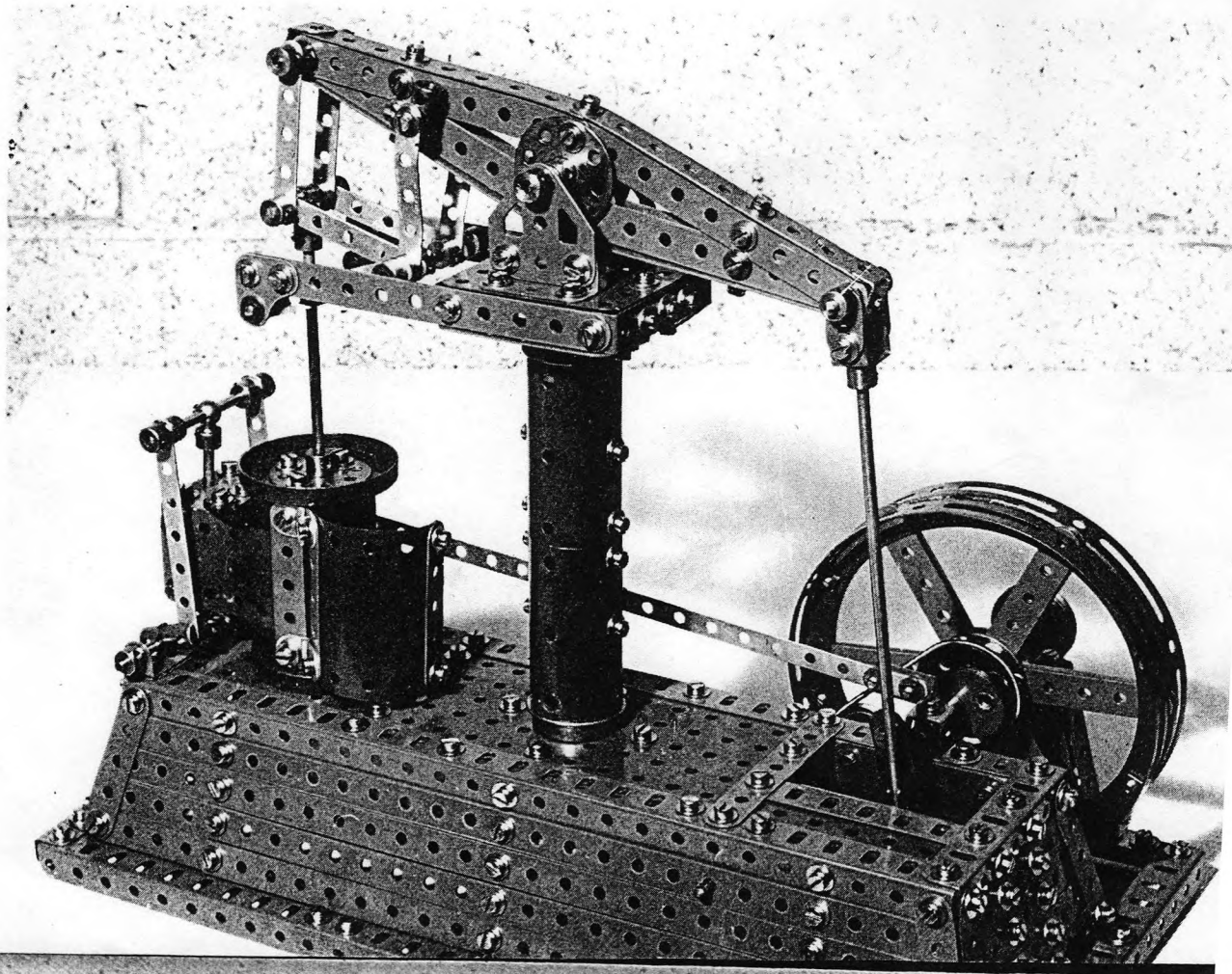


Fig. 93 Highly detailed working model of early beam engine with parallel link motion to ensure vertical movement of piston rod.