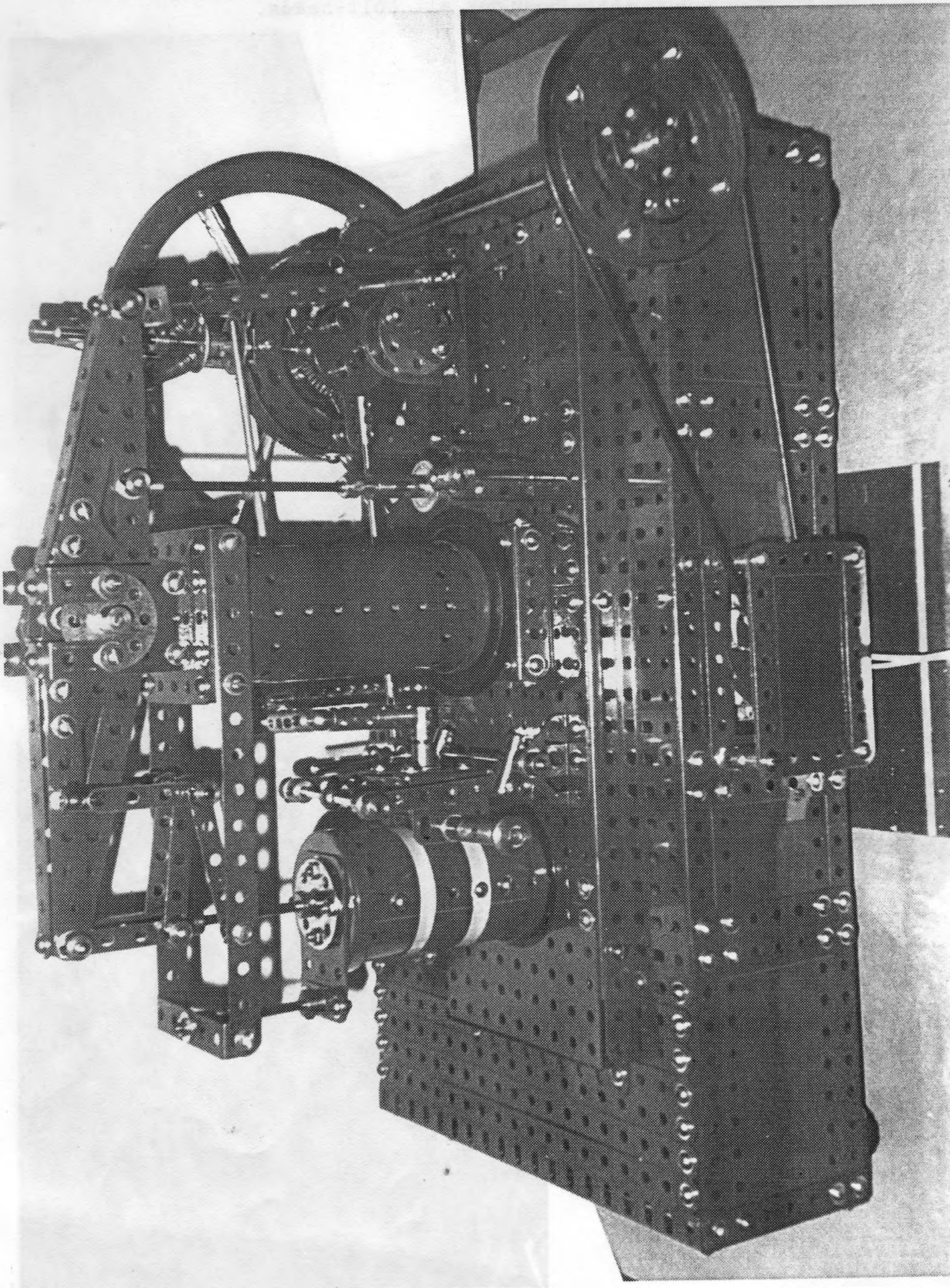
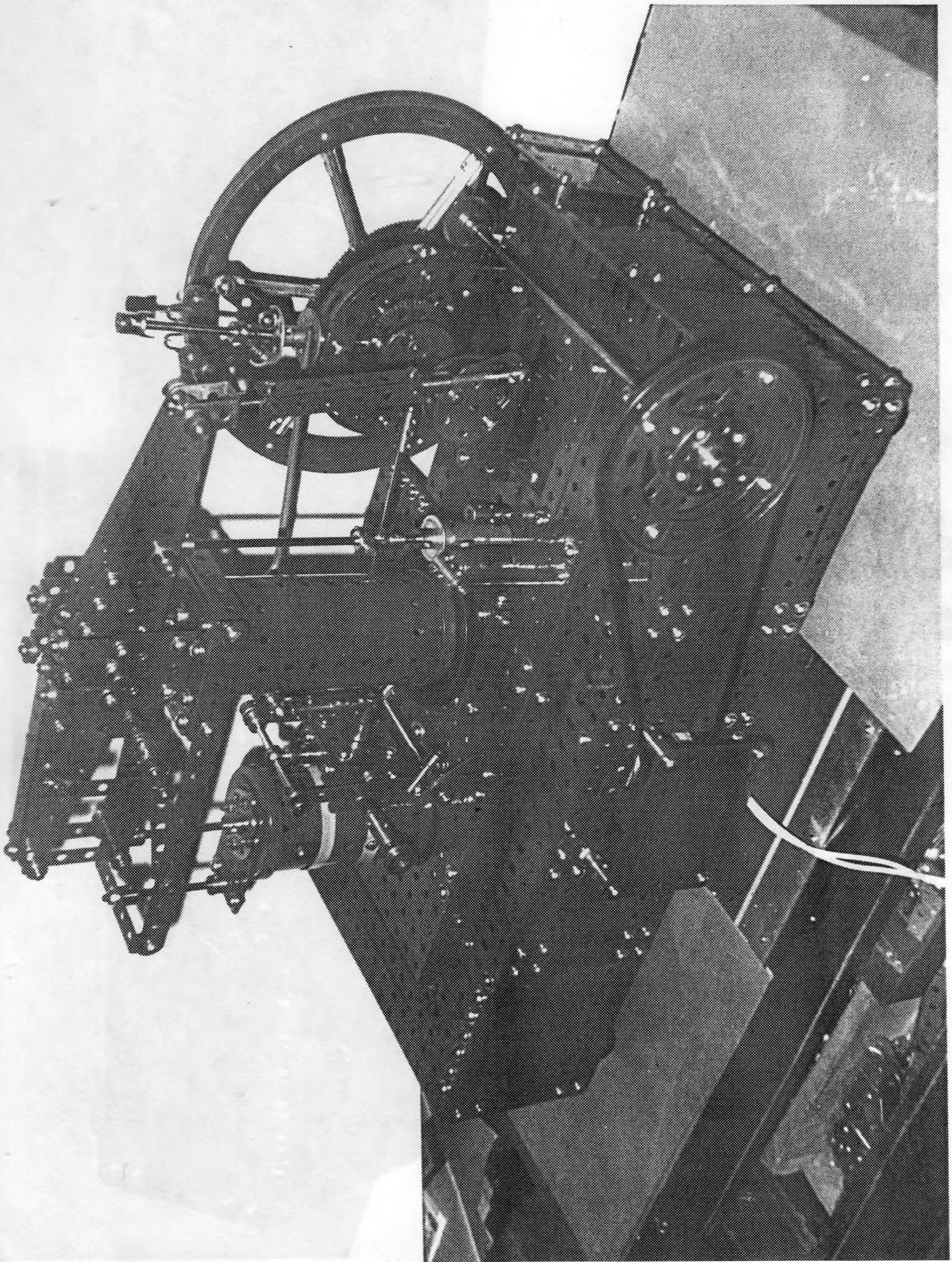
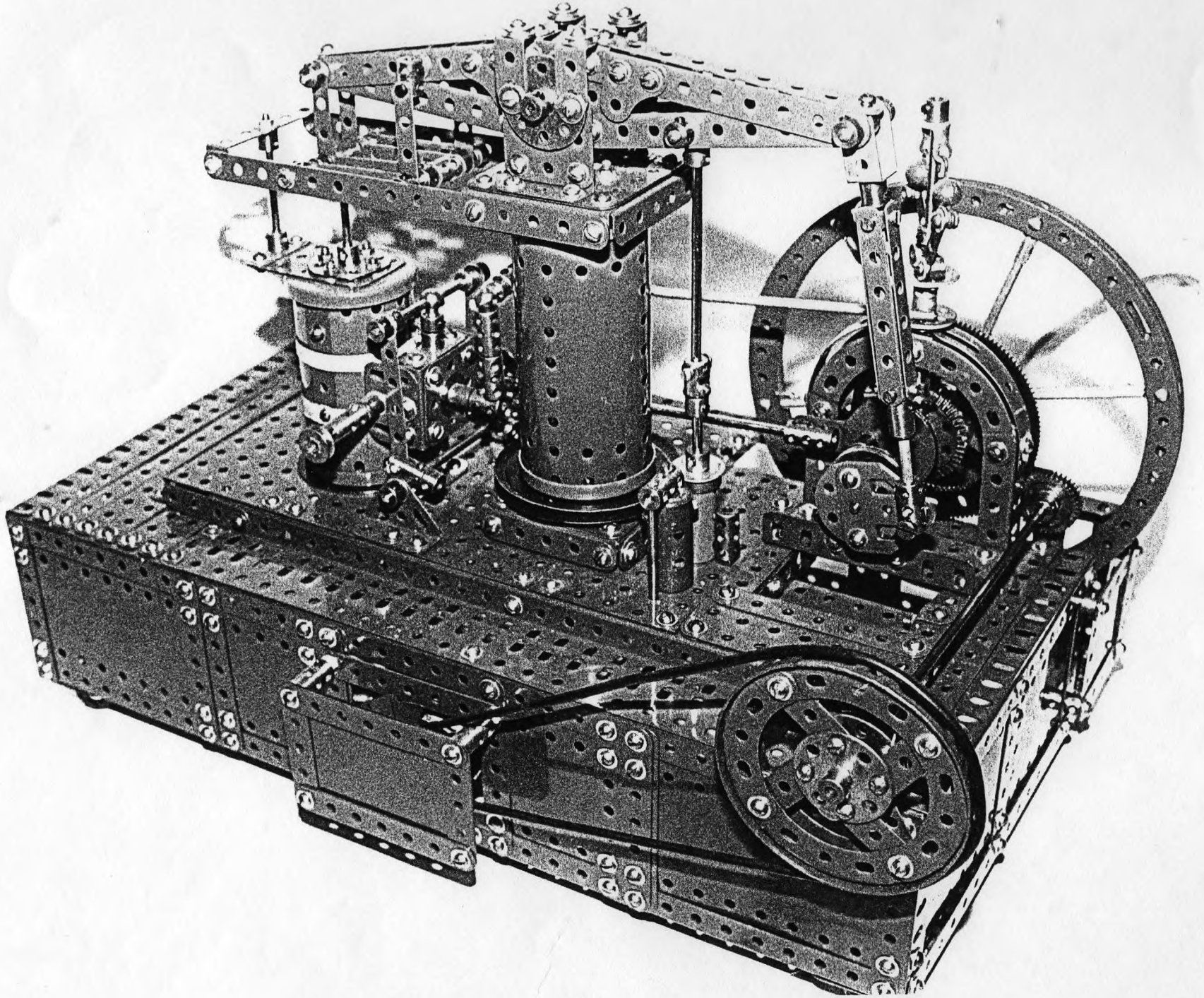
LATEST MODEL BEAM ENGINE.

Based on an original engine shown in the current Stuart-Turner catalogue. Operated by a mains motor under the base with rubber belt drive to a pulley made from a 3½"circular girder and stepped curved strips. Instructions-with photocopies and diagrams are in the process of being typed and available for enthusiasts.



104b Note the use of a six-spoke flywheel made from layers of circular strips for added weight. The working Governor and valve gear are true copies of the original and the model is very realistic when in motion. Ideal for display purposes and as an educational exercise to show Watt's parallel motion. Completed in post-War Red/Green components with liberal use of brassware and washers under all bolt-heads.





Project No 22. NEW BEAM ENGINE. February 1988

This working model has been copied from several photographs taken by me at the Model Engineering Exhibition at Wembley early this year. A similar engine is shown in the current Stuart-Turner model catalogue obtainable direct from me. My engine has a 7½"diameter built up six spoke flywheel made from circular strips and the motor is an induction mains type situated under the plinth and driving onto a built-up 3½"pulley by means of a non-Meccano rubber belt.

Of course-you can use your own available type of motor-but remember to have some reduction gear as a beam engine has a slow measured motion and enables one to examine the parallel gear employed and other working parts. You should commence with the base plinth-this is 17" in length made from 12½" angle girders butted to 4½"angle girders. The round holes of these girders face you and the height of the plinth is 3½"determined by a number of 3½" angle gdrs at the corners-and in front of the flywheel. The FRONT of the model has the flywheel on the offside with the pulley drive and crank to the RIGHT-cylinder and valve gear to the LEFT. The joins of the A/G's are overlapped with 3½"flat girders and also have short angle girders INSIDE the flanges at the joins to give additional strength.

The WIDTH of the plinth is 9½" with girders at top and bottom of this length for the LEFT end only. The other end with the flywheel has a 9½" A/G at the bottom-but a 7½" one at the top to allow room for the flywheel rim in the gap so formed. The engine base-plate is 13½" in length by 4½" width and consists of four 12½" A/G's at the sides and two 4½" ones at each end. The 12½"A/girders are joined down their lengths by their round holes-the two lots of slotted holes for the top plates-and the bottom slotted holes allow the baseplate to be bolted to the top of the base plinth-two holes in from the RIGHT end and three holes in from the FRONT.Various flat girders and strips are used for filling in the surrounds of the top engine plate-but a gap is left to accommodate the flywheel. The top plate has four 4½x2½"flat plates bolted along the width from the LEFT end-butted together to give a FLAT surface and these plates are also supported underneath by additional 4½"A/Gdrs. The right end has a gap in the platform for the crank and is 1½"wide from the front-use a 3"xl½"plate and a 1½" strip to give a 3½" length for the gap.

Seven holes in from the front-bolt a 3½"A/G by it's round holes with the slotted flange to the front.This girder holds the crank bearing which is a 1½xl½"flat plate fitted with three or four wheel discs on each side of the plate-the centre holes of the discs co-inciding with the top centre hole of the flat plate. The offside bearing is a 2½"triangular plate bolted to a 3½"A/G in the slotted holes to allow for adjustment for the crankshaft. The girder is bolted to the offside compound girder(13½")with the slotted holes inwards and in line with the crank bearing.

THE CENTRE COLUMN. Consists of a boiler section joined along it's long edges to allow a pair of wheel flanges to be a push fit on the ends of the section. A square bottom plinth for the column is made from four 2½"A/g's with a 2½x2½"flat plate bolted at the corners to the top of the plinth. Use the round holes of the 2½"A/G's for the plate attachment. The top of the column has two further 2½x2½"plates bolted-one on top of the other-to the slotted holes of three 2½"A/G's flanged down. Two of these gdrs support the parallel motion arms at the sides-and the other gdr is at the rear of the top plinth(right) You now fix a 3"pulley,a wheel flange to the bottom plinth-by means of four long screwed rods(8") passed down from the top of the column into the engine plate via the plinth-the wheel flange is on top of the square plinth-then the 3" pulley-and then the bottom wheel flange on the end of the boiler section.The top square of plates is next spaced from the boiler section by seven or eight 8-hole wheel discs on the four screw rods.The whole clamped together and secured by four nuts on the top ends of the screw rods-and tightly. contd/--

Sheet Two.

The four 4½x2½"flat plates on the centre column base plate allow the left-hand plate to extend two holes from the ends of the angle girders-thus giving the 13"length previously mentioned. The four long screw rods should be first fixed by nuts to the base and locked with nuts. Then place the square plinth-the wheel flange,pulley,and boiler section over the four rods and the top plates and wheel discs-but adjust for the correct lateral position before tightening the four holding nuts at the top. Two 7½"strips are next bolted to each side of the column(one on each side-see the diagrams/photo-copies).

THE BEAM BEARING.Two 1½"A/G's are bolted to each side of the top 2½"sq plates by their round holes and flanges inner and centrally. Flat plates of 1½"size are next bolted to the vertical flanges-and also two bush wheels-one on each side-but spaced by washers from the plates to accommodate the wheel pummels. The bosses of the bush wheels coincide with the sideplate top centre holes. This is the pivot for the built up beam unit.

THE BUILT UP BEAM.Two 1½x1½"flat plates form each side of the beam centre-and are fitted with double arm cranks on each side at the plate centres. Eight 4½"strips are bolted to each corner of the plates-four on each side and the plates are also bolted to ½"double brkts at each corner giving a ½" width to the beam. Two more 4½"strips are next bolted along the top of the beam-their outer ends to tapped collar holes at the beam extremities. One inch corner brkts are also fixed each side of the beam as shown to cover the gaps.Place a short rod through the beam pivot bush wheel on the front side-pass into the beam D/A cranks-and then into the other bush wheel boss. The beam can then be adjusted to be EXACTLY in line with the centre holes of the base plinth-to be in line with the cylinder at one end-and the crank at the other-MOST IMPORTANT. Note that the centre-line of the vertical column is 13 holes in from the RIGHT hand end of the base 12½"A/gdrs. The crank end of the beam is then in line with the crankshaft and the other end of the beam is directly over the centre line of the cylinder-next to be described.

THE MAIN CYLINDER.This unit is made from two wheel flanges and with three 3½x2½"plastic plates joined along their edges and overlapped at the joins with 3½"strips-the whole to fit inside the wheel flanges at top and bottom. The cylinder is held on the base plinth by four screwed rods of 4"/4½"length and locked with nuts at the base in four opposite positions. A face plate-boss uppermost -is directly under the cylinder and is fixed by the nuts of the screw rods. The top wheel flange has a 2½x1½"plate passed over the rods-and also an 8 hole bush wheel-boss uppermost. The bush wheel is spaced by thin washers from the plate. The whole being held firm by nuts tightened on the bush wheel rim. The flat plate is also extended two holes to the LEFT for a double arm crank to be bolted across-boss upper-the boss holds a rod as an additional support for the motion side strips from the column. Make sure a rod passes FREELY through the cylinder bore. The end of the beam on the left should now be directly over the cylinder centre -if not-loosen the nuts on the column screw rods and adjust.

THE PARALLEL MOTION. The motion can be considered as a pivoted rectangle of narrow strips 2½"x2"-with two more 2½" strips being pivoted to the side strips four holes in from the left. The pivots are two ½"bolts with loose collars for spacing-both bolts being lock-nutted to the 7½"strips on each side. The front hangers are 2" narrow strips-and the rear two are again 2" strips but also attached by KEY bolts to short couplings tightly. contd/

 NEW BEAM ENGINE.

The parallel motion-continued. The key bolts are secured to tapped holes in the short couplings which allow each coupling to be fixed to a short rod passed through the beam sides five holes in from the cylinder end. A longer rod passed through the two rear hanger narrow strips-has collars as spacers on each side of a short coupling in the middle of the rod. The narrow strips are allowed to pivot freely on the hanger rods and are spaced from the beam to allow free movement. The front hanger strips are also pivotally attached to the lugs of a large fork piece on the top end of the piston rod. The piston is a STRAIGHT rod that is free to slide in the boss of the bush wheel at the top of the cylinder. A 2½x½"double angle strip is bolted between the ends of the side 7½" strips and fitted with a rod-socket-a short rod held in the rod socket is also fixed in the bore of a double arm crank at the top front extremity of the cyl.

You can now test the operation of the parallel motion and adjust for free running and good operation.

CONNECTING ROD.an 1"x½" double brkt is fitted with a rod socket and a 5" rod is fixed in it's bore. Two four-hole collars are on this rod and allow four 3"narrow strips to form a square attached to these collars by shoulder bolts.The bottom end of the rod has a coupling fixed with a pivot bolt passed through it's drilled bore. This pivot bolt is then fixed to the apex holes of two flat trunnions placed together and bolted across the face of a bush wheel. The boss of the wheel has two grub screws fitted and the crank is then attached to a 6½"rod crankshaft. Level up the c/shaft bearings by means of the slotted holes in the angle girders holding the bearings and attach the connecting rod to the right end of the beam by a short rod and retaining collars. You can now test the motion by hand.

VALVE CHEST AND MOTION. The chest is made up from a 1½x1½"flat plate bolted to 1½"angle girders forming a square which is then bolted to the top inside of a 2½x1½"flanged plate. This plate is next bolted just in front of the cyl in a central position.

A D/A crank is fixed to the top flange so that a short rod is free to slide inside the chest. An adaptor for screwed rod is first bolted to the centre hole of the 1½"plate-this part holds the steam feed pipe made from couplings and handrail support couplings. Two trunnions are bolted-one each side of the plinth-on the edges of the baseplate-with their vertical portions on the inside giving a 3½"width between their apex lugs. The apex holes are six holes from the centre line of the column to the left. A rod is passed through the trunnions and two brass strip couplings are fixed in parallel inside the trunnions. Two 3" narrow strips are pivoted to these couplings and their tops are also pivoted on a rod fixed to the handrail coupling holding the valve rod. Another handrail coupling is fixed to the ~~thread~~ rod holding the two strip couplings-just inside the inner trunnion-and by it's bulbous drilled portion. A 2" rod is fixed in the other end of this h/rail coupling in a near vertical plane-and a collar on this rod holds the end of the long rod from the eccentric and is adjustable on it's short vertical rod to alter the throw of the valve rod.

An 1½"flat girder is bolted to the nearside of the valve box and holds another threaded adaptor which forms the exhaust connection.

CONDENSER PUMP.Made from a sleeve piece capped with a small flanged wheel and attached to a coupling. This coupling is fixed to a threaded pin bolted to the baseplate and allows a rod to pass down the sleeve piece into the baseplate. The pump rod is fixed to a larg fork and this fork is jounalled in the beam sides six holes in from the crank end. A swivel bearing on the bottom of the rod is pivoted to a short rod in the sleeve piece. Again-test for free running and oil all bearings.

contd/---

NEW BEAM ENGINE.

CRANKSHAFT AND FITTINGS. The valve operating rod is a 6½"one held in the bore of a coupling attached to the strap of a large eccentric. Use shoulder bolts to attach the coupling-to allow the rod to pass into the bore. The eccentric is fixed to the c/shaft rod by it's middle throw boss and the boss faces towards the front of the model. Behind the eccentric is a fixed collar-the end bore of a coupling,spacing washers-and then a large bevel gear. The coupling bore holds a vertical rod(5") which also has the built up governor. The cage for the governor consists of two 2½" A/g's attached to the side of the plinth by their round holes and with the slotted flanges towards the flywheel.These girders are seven holes apart.Four stepped curved strips are attached to the tops of these girders-two each side of ½"double brackets to form an arc.Two formed slotted strips are also attached to these girder tops and carefully formed to the same radius as the curved strips. Another double brkt is bolted to the apex of the curved strips to allow the governor rod to pass through into the end bore of the coupling on the c/shaft. Use SMALL bolts to give the vertical rod free access. The actual governor is shown in a small diagram with this text. The valve rod is connected to the collar on the valve lift shaft by a rod and strip connector and is free to pivot. The collar can be raised or lowered on the vertical rod and fixed in any position by a grub screw in the collar at the rear. Behind the large bevel-I have a built up 3½"gear wheel-but you can use an ordinary one. A long rod is next journalled across the main base plinth so that an 1" gear engages with the 3½"one-I have used two 2" SLOTTED strips to allow for adjustment and to give a good mesh to the gears. The pulley consists of a 3½"circ girder fixed to a bush wheel by radiating 1½"strips. If you do NOT have this made up pulley part(3½"circ gdr replica)-you can use a 3" pulley-or-a 3"sprocket. The rubber belt drive is NOT Meccano and you may wish to take the drive from the motor by sprocket chain.

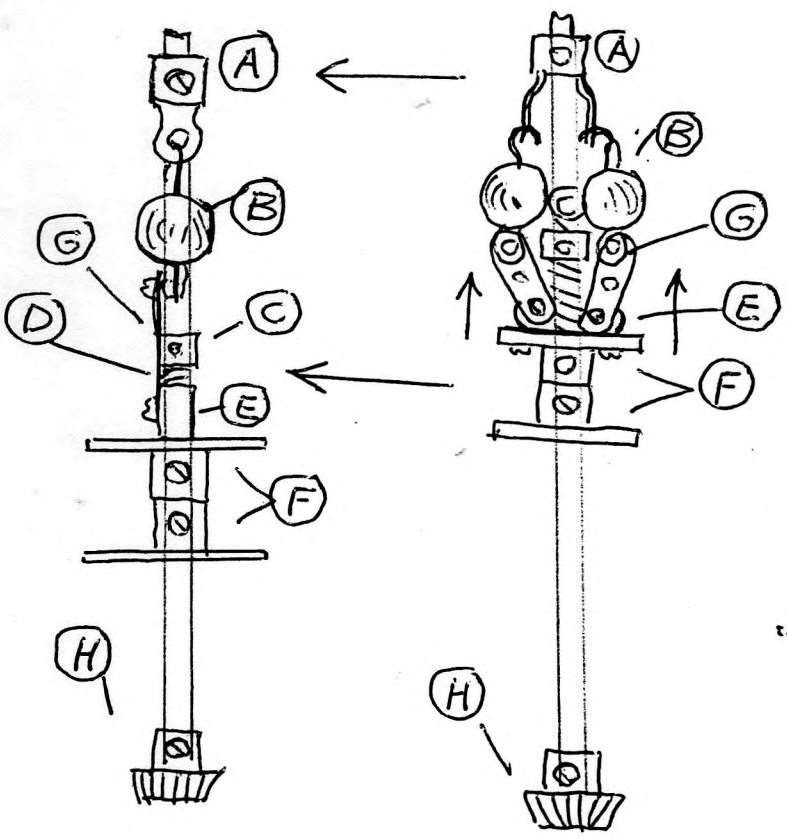
My mains motor is situated in the middle of the base plinth and is bolted to angle gdrs across the width of the model. You must devise your own drive method depending on the type of motor used.

THE FLYWHEEL.A heavy unit made from SIX 7½"dia circular strips. The six spokes consist of 12 rods fitted with rod and strip connectors at each end. The rods are 2½"long and allow double spokes to be connected between two six-hole bush wheels and their outer ends attached in six positions between the circ strips. See diagram of the wheel. If you do NOT have these circ strips in any profusion-use a 6" pulley instead. Counterweights are attached to the offside rim of the flywheel OPPOSITE the throw of the crank (1½"strips or layers of flat brkts will suffice). This gives a nice even motion to the completed model. The front and sides of the base are filled with strip or flexible plates and note that 3½"flat girders are evenly spaced OVER the flex plates.Another sleeve piece is attached to the engine plate with a coupling at the top holding a rod that passes into the plinth.Use a chimney adaptor bolted inside the sleeve at the top and another one that is bolted to the top plate and holds the sleeve piece. Once the flywheel and governor have been completed-the engine is ready for a trial run and for any adjustments. My model operates very free and requires minimum motor power. Oil all bearings and inside the eccentric sheave in particular. A dummy steam control pipe is attached to the inlet brass piping-this being a 5½"handle held in a coupling at right angles to the pipe. The outer end of the handle)straight portion) rests on the rim of the governor bush-wheel bearings as shown in diagram. Note various embellishments to the top of the column bearing and the bands around the cylinder.

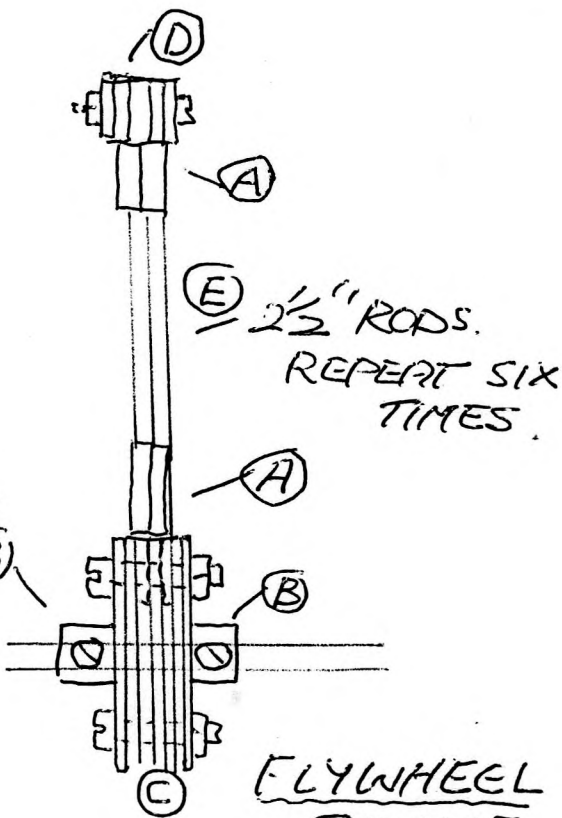
contd/--

NEW BEAM ENGINE.

The gap for the flywheel is three holes wide and you need to fill in the left hand back of the model with 21 hole strips cross-ways and lengthways-to give the gap. The left hand side of the plinth has six 9½"strips across the top of the model next to the top angle girder(slotted holes on top). Four 7½" strips and a 12½"flat girder are lengthways from the cross strips leaving a 3 hole gap for the wheel. The end of the plinth on the right has a 9½"A/G across the bottom-but a 7½" one on the top with a 7½"strip plate in between the two. A 2½x2½"flex plate is bolted under the flywheel rim-but stood off by spacing collars so as not to foul the wheel rim. You can see what is required when the wheel is in position. Here is a sketch of the built up Governor-and the flywheel is below:-



A= SMALL FORK
B= 2 SMALL HOOKS
C= FIXED COLLAR
D= COMP SPRING
E= TWO COLLARS ATTACHED TO BUSH WHEEL.
F= 1" BUSH WHEELS
G= 1½" NARROW STRIPS.
H= SMALL BEVEL



E 2½" RODS. REPEAT SIX TIMES.

A= ROD & STRIP CONNECTORS
B= 2 BUSH WHEELS 6H.
C= WHEEL DISCS 6H.
D= CIRC STRIPS 7½" DIA
E= 2½" RODS (2) FOR EACH SPOKE.

FLYWHEEL SPOKE

NOTE-IMPORTANT. The c/shaft bearings MUST be bolted at their highest position in the angle girder slotted flange holes to enable the 3½"gear to clear the base plinth top.

NEW BEAM ENGINE.

THE GOVERNOR. Refer to sketch. The small fork at the top of the rod holds two small loaded hooks by their curved hook portions-in the holes of the fork. Two 1½" strips are then pivotally attached to the hooks by their round lugs and again pivoted at the sides of two collars fixed to opposite holes in the top 1"bush wheel. Use a ½" bolt with a grub screw in the collars. You may have to file the end of the strips so that the collars will take the ends of the strips-or raise the collars from the bush wheel by small washers to give clearance. As the governor gains speed-the two hooks fly outwards and consequently lift the bush wheel against the compression spring. No grub screw in this wheel-the lower bush wheel is fixed to the shaft.Use shoulder bolts for attaching the collars to the bush wheel.

THE FLYWHEEL.Note that two 6 hole bush wheels are used back to back with layers of wheel discs between-and the lugs of the rod and strip connectors. Do NOT tighten holding bolts until the whole wheel is completed and then test on a jig before tightening bolts. If you have built the wheel as described-it will run true and be quite heavy. Use two set or grub screws in the bush wheel bosses for better grip.

FEET FOR THE MODEL. I have used some "Action Pack" plastic chubby wheels attached to each corner of the model. The four holding screws are recessed in the hub of these wheels and do not cause scratching a table-top. The photo-copy sent with these instructions(two) shows the stood-off 2½x2½"flex plate under the flywheel rim(P.104b).

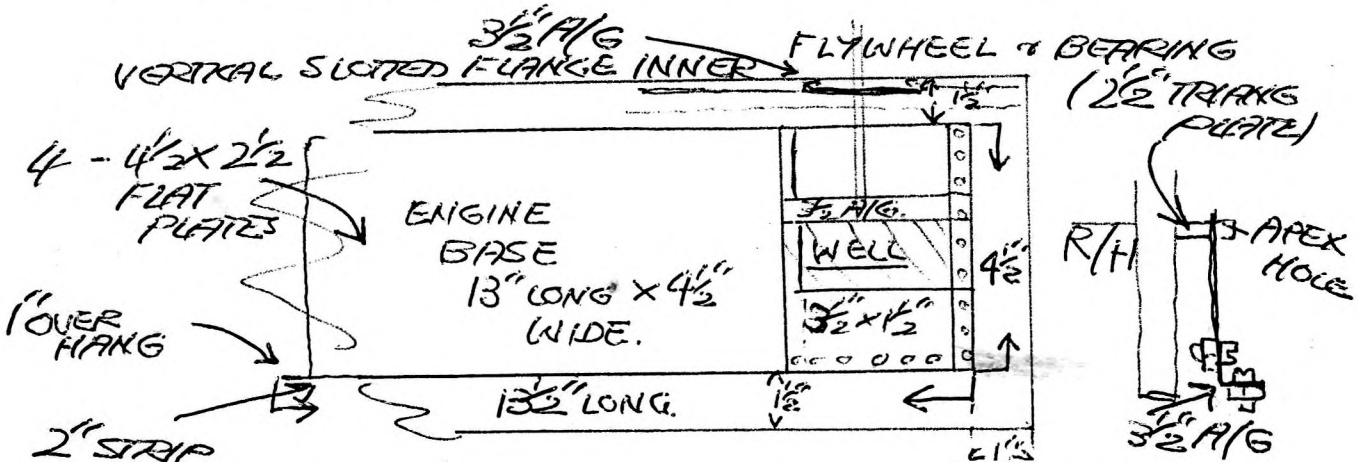
The top of the base plinth is reasonably clear from the copy and note the 2" strips at the extreme left end of the engine plinth-to cover the two holes overlap of the top 4½x2½ flat plate. This completes the model-but you are free to contact me if you have any difficulties.

------- FINIS ------

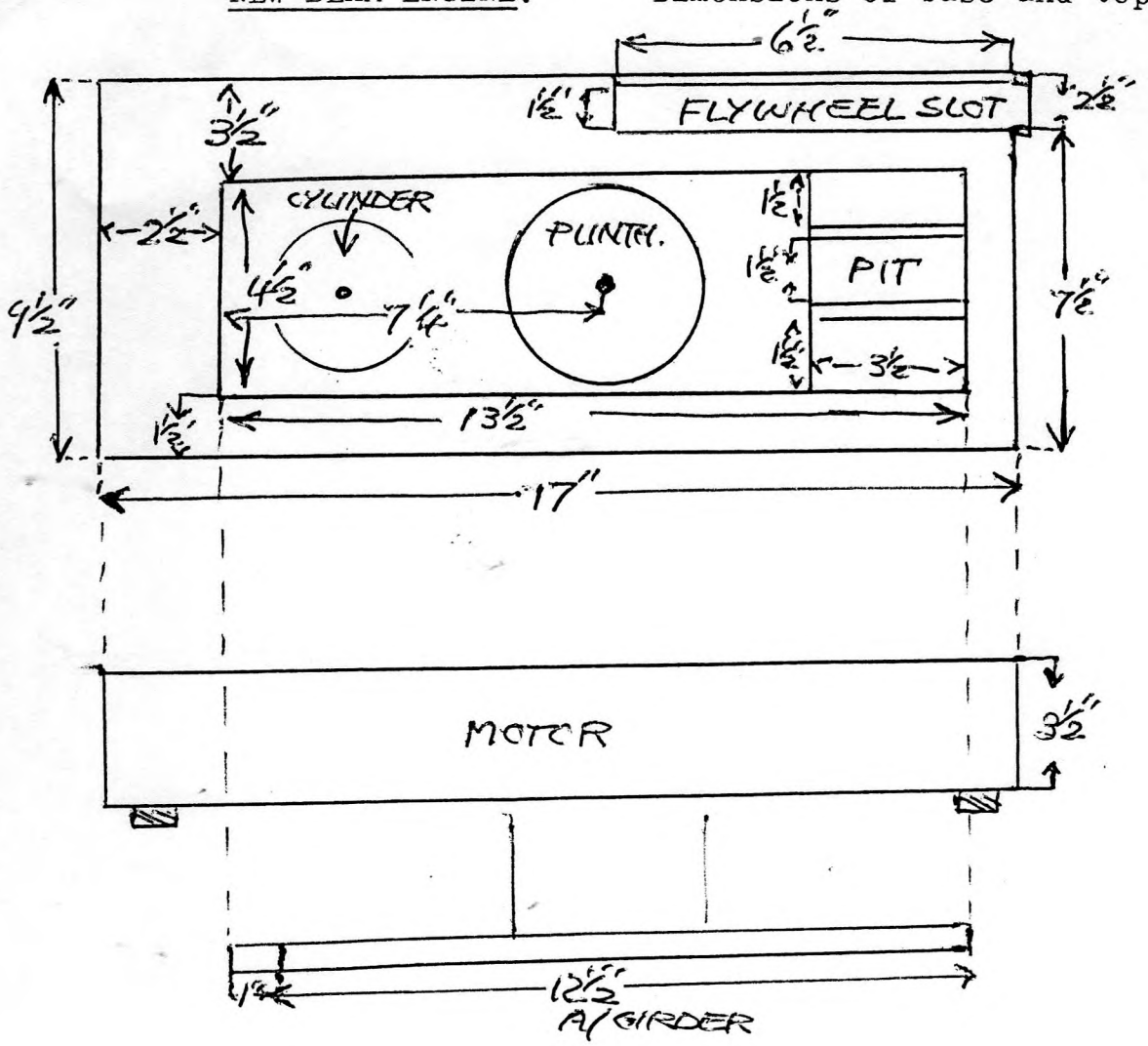
ADDITIONAL NOTE. The "well" for the crank is 2½x1½"deep and a 2½x1½"flanged plate is bolted inside the well at the crank bottom. One bolt holds the plate at the left against a 4½" A/G crossing the engine base-the other end has a reversed ½" angle brkt to fix it to the inside of the far right 4½" A/G. See sketch below :-

ALSO NOTE:The valve operating eccentric is fixed at it's SMALLEST throw-not the middle one as given in text.

The formed slotted strips around the top curvature of the governor housing do not meet in the middle,but allow the vertical governor rod to clear them through the ½"double brkt fixed between the apex of the 2½"curved strips.



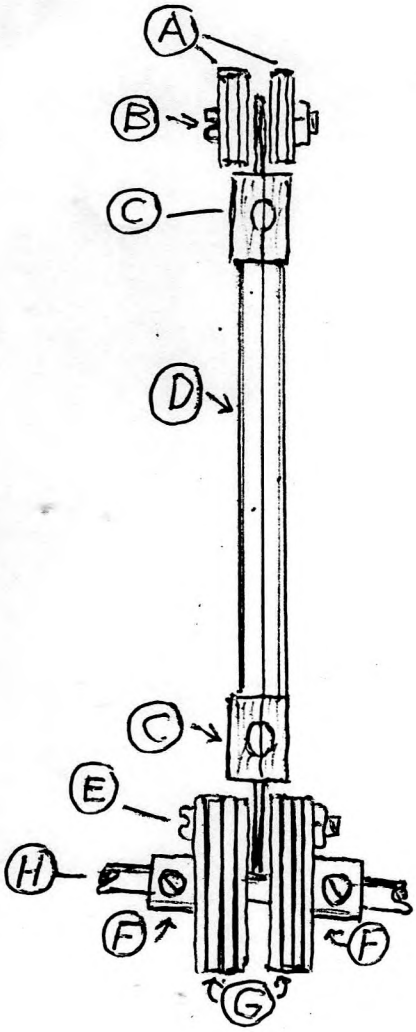
NEW BEAM ENGINE. Dimensions of base and top base.



The top motion baseplate is 14½" in length which is determined by the four 4½x2½" flat plates bolted side by side-plus the pit-end plate of 3½"x1½"(or a 3" plate with a 1½"strip bolted across. So the 12½" angle girder used in the base gives the top plates an 1" overlap and a 2" strip is used for extending the angle girder the 1" to make the 13½"length. Cross girders support the motion plate and these are 9½" in length. Allow access for the flywheel-the actual slot is 1½"wide. The position of the motor drive depends on the choice of motor. You can bolt a gearbox type to cross girders in the base to allow the spindle of the motor to protrude from the side. Fill in the exposed sides with flex plates and strips. The rear side of the base can be left "open" for access and not filled with plates. The large photo-copy is sufficiently clear to show main details. You can discern the position of the top motion plate in relation to the base,also the fixing positions for the central column,the cylinder,and the c/shaft bearings and governor support frame.
The bands around the cylinder are cut from old plastic flexible plates in a contrasting colour(Yellow).
See snaps enclosed for colour scheme.

NEW STUART-TURNER BEAM ENGINE.

DETAILS FOR SIX-SPOKE FLYWHEEL.



A =Six circular strips 7½"dia.
B =Long bolts
C= Rod and strip connectors.
D =Twin 2" or 2½"rods.
E =Long bolts with nuts.
F =Wheel discs(6) with 6 holes.
G =Two six-hole bush wheels.
H =Crankshaft.

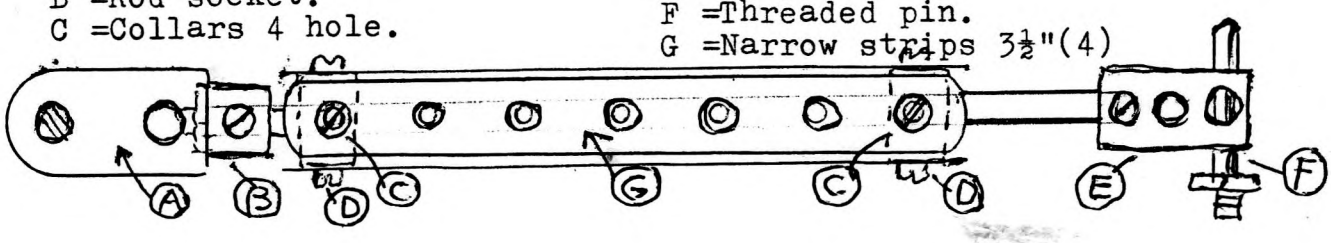
CONSTRUCTION OF FLYWHEEL.

Bolt a 7½"strip across the diameter of one circular strip. To the centre of the strip-bolt a six-hole bush wheel or disc at their centres. You will need a total of 24 rod and strip connectors-four for each spoke. To each end of a 2"/2½"rod-insert a connector so that the two lugs lie flat. Bolt one lug to a radial hole in the disc or bush wheel at the centre of the 7½"strip-and adjust the other connector so that it lines up with the radial holes in the circular strip. Construct further five spokes in the same way but double up for the two spoke rods required. Remove the 7½"strip and bolt the six spokes between bush wheels and discs at the centre hub. Radiate the spokes around the circular strip to give equal six spoke formation. Test that the wheel runs true-or adjust.Bolt a further five circ strips-three each side of the rod and strip connector lugs with long bolts. Fit grub or setscrews to the hub bushwheels.Tighten all bolts once wheel is running correctly on shaft.

The more discs and circular strips you can use-the heavier the flywheel,but allow space for the other components near the wheel and the width of the slot. Bolt heads are to the front in all cases. Note that spokes have to be attached to some slotted holes in the circular strips to give better spacing. If the spoke-rods are discoloured-you can polish them or use some fine emery cloth to brighten them-all the better for display purposes.

MAIN SWEEP OR CONNECTING ROD.

A =1"x½"double brkt.
B =Rod socket.
C =Collars 4 hole.
D =Shoulder bolts
E =Coupling.
F =Threaded pin.
G =Narrow strips 3½"(4)



NEW BEAM ENGINE.

Some additional notes.

The top engine base(13½"x4½") has a 12½" flat girder bolted in front of it on the top of the base plinth. Slotted holes in the 12½"A/G along the edge of the engine base are bolted to the main base three holes in from the front-and the 12½"flat girder is bolted along in front of it.Another 12½" flat girder is fixed behind the engine plinth in the same position as the front one,and also the slotted holes in the offside 12½" A/G-are bolted to the top of the plinth.

A 4½" A/G is bolted across at the edge of the 4½x2½"flat plate on the left end of the engine plinth-and by it's slotted holes-to cover the gap at the end while the 2" strips on each side-cover the 1" gap at the end of the side 12½" A/G's. The heavier the flywheel-the better for the model -so-if you use a 6" pulley instead of layers of circ strips-add weight to the pulley with strips bolted to the eight spokes.

The four feet are bolted to 1½"corner brkts at each bottom corner-in the slotted cut out of the brackets.

Remember that the beam MUST be directly in line with the connecting rod and cylinder top.

LUBRICATE all moving joints and pivots while the triple eccentric MUST be free running and not out of line.

The central column MUST be absolutely rigid so the four screwed rods have to be tightened down to ensure this.

I have used small non-Meccano washers under all bolt heads and have also used dome-headed bolts which look more like rivets in my opinion. Make sure that the pivot bolt fixed to the crank is SQUARE-if not-this will cause undue friction.

FIXING THE TOP ENGINE BASEPLATE.

The slotted flanges of the baseplate(12½") are attached to cross girders-on the left end by 9½"A/G's and another one just in front of the flywheel rim. Another 7½"A/Girder is bolted across the base plinth three holes in from the R/H end to a 12½"A/G running laterally along the base plinth in front of the flywheel. This allows the three-hole gap for the flywheel. The 12½"A/G is extended by a 4½"one and this compound girder runs the length of the base plinth. The top engine plate is then bolted to the cross angle gdrs three holes in from the front of the model. The top engine base has two 12½" angle girders down each side-one with it's round holes on the top for fixing the 4½x2½"flat plates and the other girder is bolted to it with it's slotted holes outwards(see sketch):-