A DEVICE FOR APPLYING SR-4 STRAIN GAGES TO INTERIOR SURFACES OF HOLLOW, PAVEMENT LOAD-TRANSFER DOWEL BARS

Paul Milliman

Research Laboratory Division
Office of Testing and Research
Report No. 307
Research Project 54 F-38

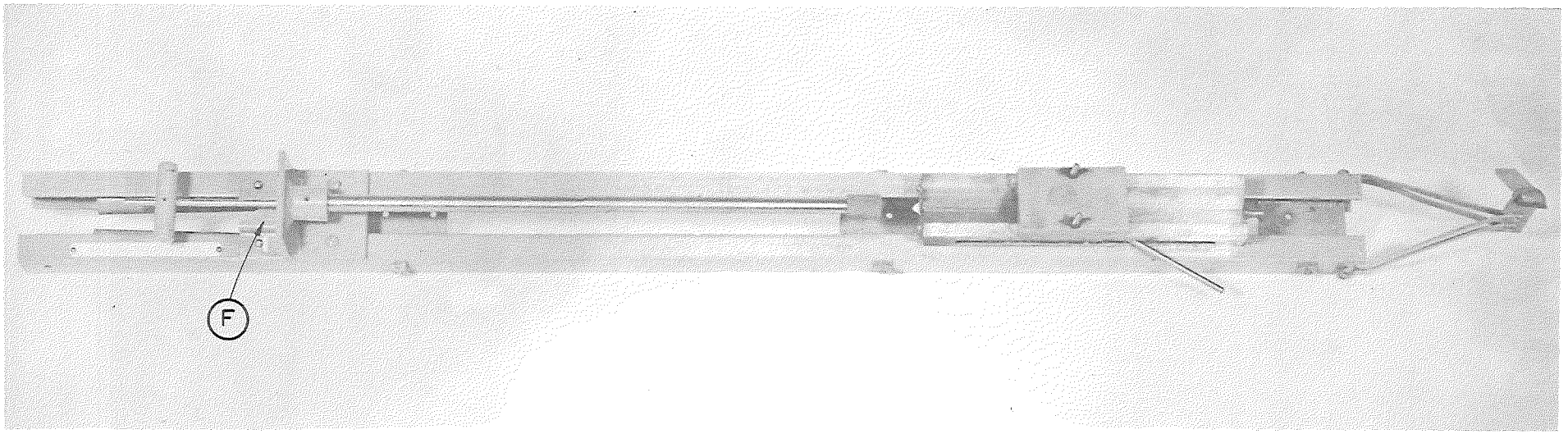
Michigan State Highway Department
John C. Mackie, Commissioner
Lansing, December 1959

A DEVICE FOR APPLYING SR-4 STAIN GAGES TO INTERIOR SURFACES OF HOLLOW, PAVEMENT LOAD-TRANSFER DOWEL BARS

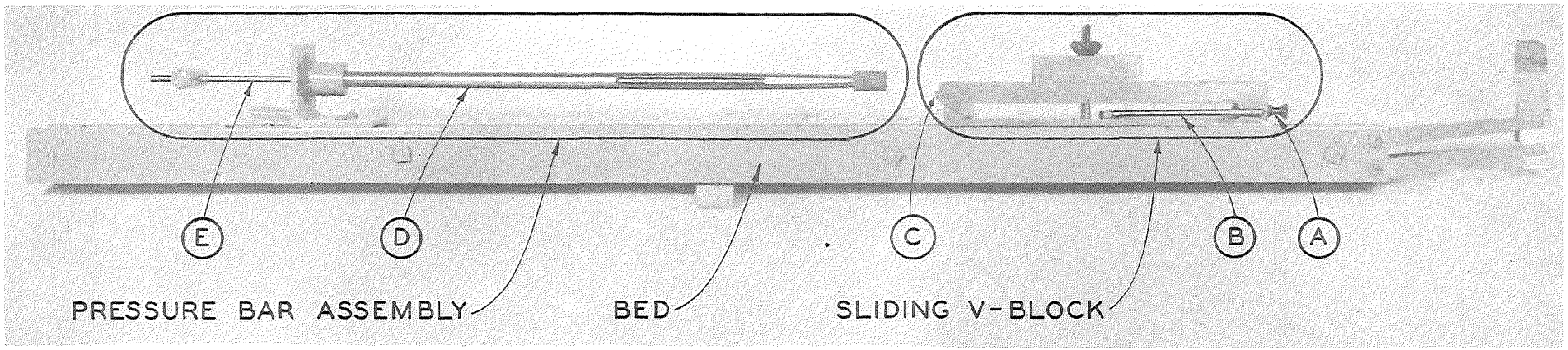
The design of dowel bars for load transfer across transverse joints in concrete pavements is currently based on analytically determined stresses. For some time, the Michigan State Highway Department has desired to check the accuracy of these theoretical stresses. Toward this end, a number of SR-4 strain gage instrumented dowels have been fabricated and tested by the Research Laboratory Division, with consistently unsatisfactory results.

The basic problem in these studies has been the fact that the gages must be placed inside the dowel, to eliminate interference with concrete-to-dowel bearing pressures. In the past, placing gages inside a dowel has always required that the dowel be cut or separated in some manner. This separation has then presented the problem of reassembling the dowel halves without damaging the gages, and so that the assembled dowel is structurally identical, or at least similar, to an uncut solid dowel.

To solve this problem, it was decided to attempt the construction of a device which would make it possible to mount SR-4 gages on the interior surface of a hollow, unseparated dowel. The resultant gage mounting device is shown in Figure 1.



Top



Side

Figure 1. Top and side views of the special tool for mounting strain gages in dowels.

Mounting Device

The three principal components of the gage mounting device, as shown in Figure 1, are:

1. The sliding "V-block,"

2. The unit which holds the gage and presses it into place, which may be termed the "Pressure Bar," and

3. The bed upon which these two components are mounted.

The sliding V-block holds the dowel in position while the gages are being applied and cured. This block is constructed so that it may be adjusted vertically (A-Figure 1) to accommodate different dowel sizes. A locking lever (B-Figure 1) holds the block-and-dowel combination in position while the gage is being applied and cured. In addition, there is a pointer (C-Figure 1) which fits into either of the two longitudinal grooves located at diametrically opposite points on the dowel exterior.

The pressure bar is a long, hollow steel tube, one end of which is split (D-Figure 1), containing a long rod (E-Figure 1) with an eccentric at one end. When this rod is rotated, the eccentric causes the split ends of the pressure bar to separate. An adjustable handle is fitted to the protruding end of this rod; the position in which this handle is secured along the rod determines the amount of spread for the split tube, and therefore the SR-4 gage application pressure*.

*Proper pressure may be found easily by fabricating a transparent hollow dowel of the same dimensions as the test dowel, and using gage-size pieces of paper with the appropriate bond material, for visual determination of a setting which gives a thin, uniform bond.

The tip of the pressure bar is fitted with a neoprene sleeve so that the pressure applied to any gage is through a non-damaging elastic material. This sleeve also helps pull the split tube ends back together after a gage has been cured, the pressure released, and the pressure bar is to be removed.

The complete pressure bar assembly is fixed to the instrument bed and there is a slot (F-Figure 1) for the handle of the eccentric rod to slide into as it spreads the pressure bar. This prevents any disturbance of pressure while the gage bond is curing.

The third component, the bed, is simply two lengths of channel iron fastened together with flanges facing, and with a space between to accommodate the guide on the sliding V-block. A clamp for the gage lead wires is mounted at one end of the bed, to hold them while gages are mounted and cured.

A complete detailed parts and assembly drawing is shown in Figure 2.

Gage Mounting Procedure

1. Clean and de-grease dowel in the usual manner.

2. Place dowel in sliding V-block and rotate until longitudinal groove snaps over pointer; then clamp dowel in place.

3. Slide V-block up to point where gage pressure bar just enters dowel. Then, adjust vertical position of block until dowel is coaxial with pressure bar.

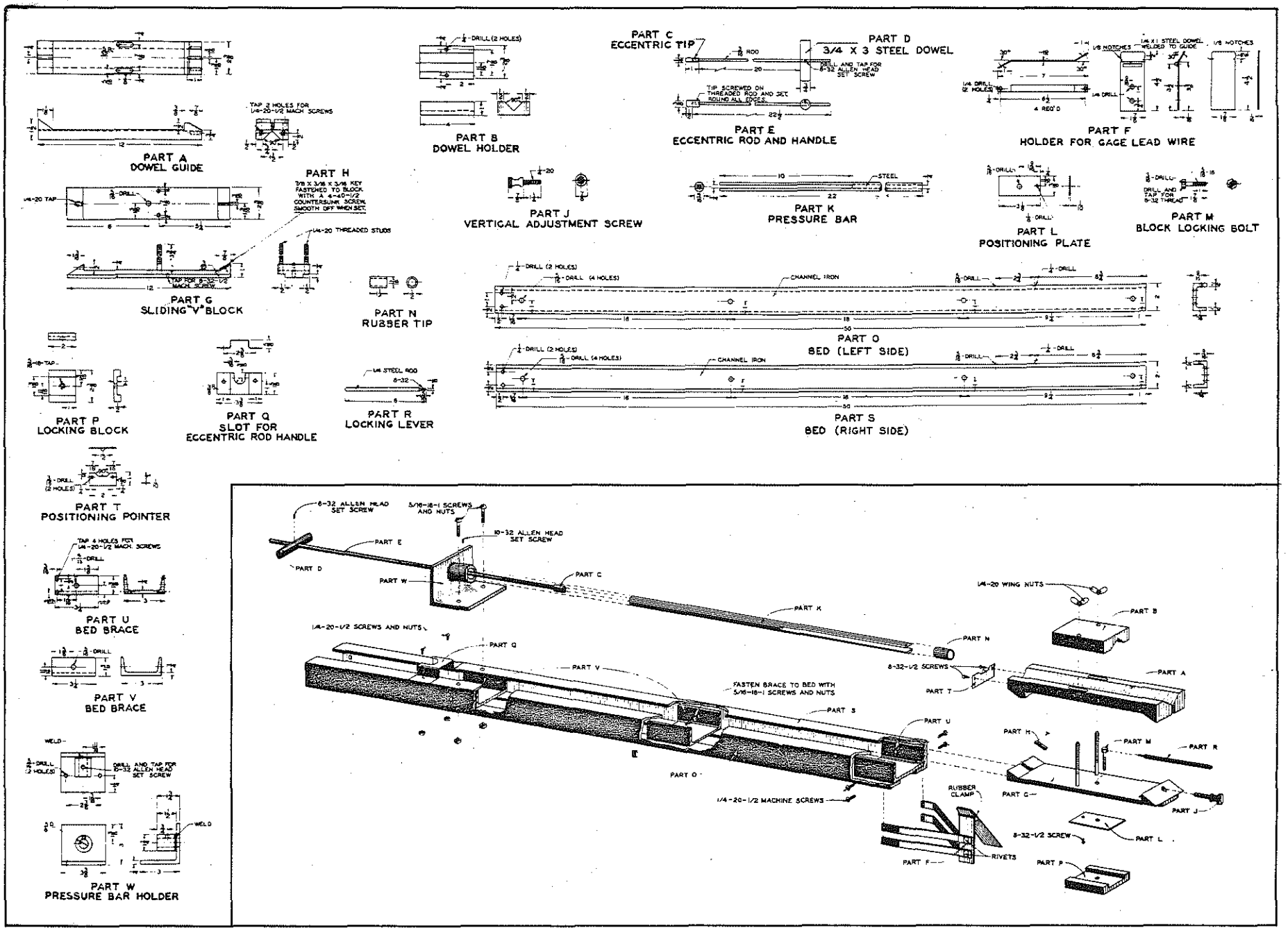


Figure 2. Detailed parts and assembly drawing of SR-4 strain gage mounting device.

4. With pressure bar still in dowel end, adjust eccentric rod handle until desired gage pressure is obtained.

5. Solder lead wires to SR-4 gage and place spaghetti over connections.

6. Slide gage lead wires through dowel and fix ends in clamp provided.

7. Place a piece of parting material (vinyl) on rubber tip of pressure bar and then position SR-4 gage, upside down, over it. Fix gage in place by applying 1/32-in.-wide strip of transparent cellophane tape to each end of gage (A-Figure 3).

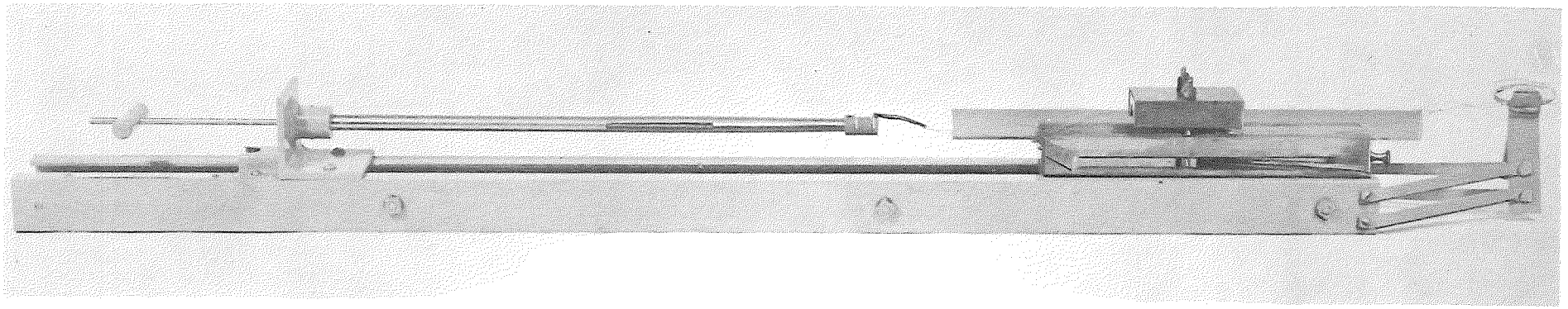
8. Apply bond cement to gage.

9. Slide V-block toward pressure bar until bar end enters dowel and reaches desired depth, as indicated by scale on pressure bar (B-Figure 3).

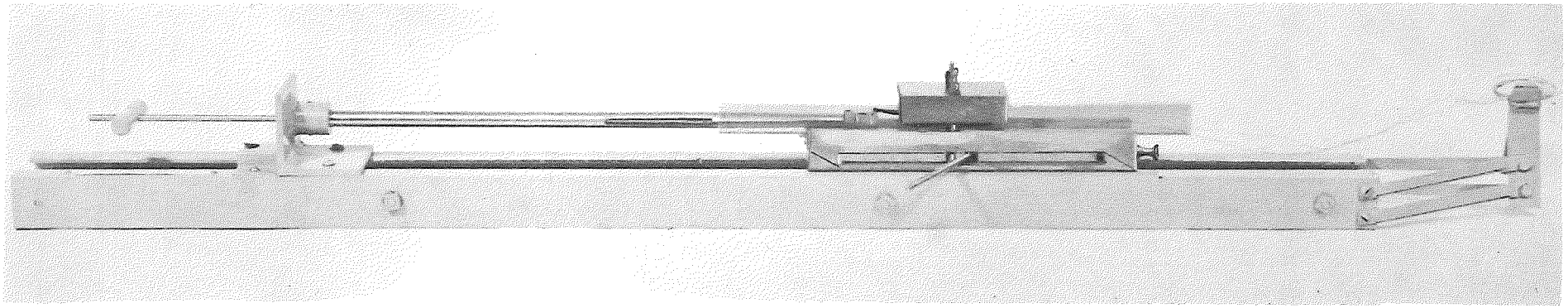
10. Bring handle of locking lever forward to lock V-block in position.

11. Turn eccentric rod handle to vertical position, spreading pressure bar ends, and push handle into handle slot (C-Figure 3).

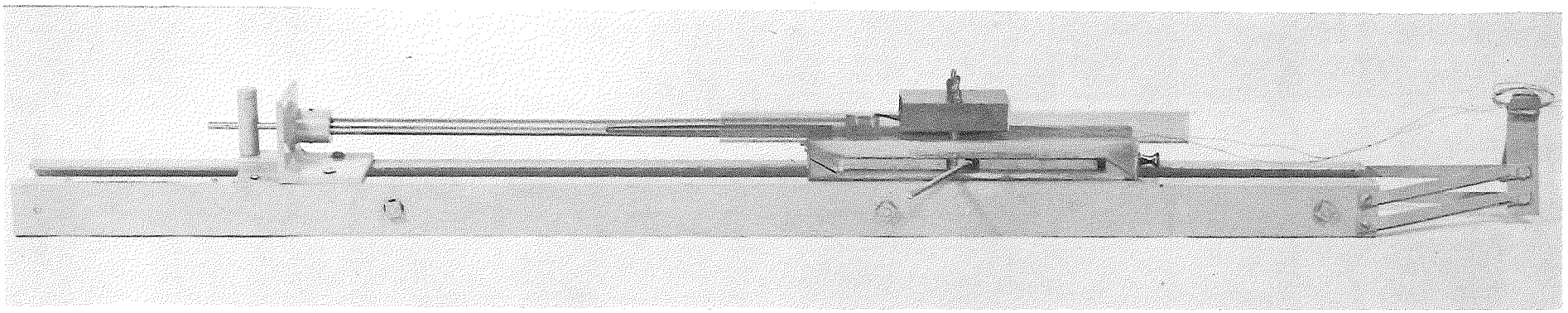
12. After allowing proper time interval for curing of bond material--depending on material and temperature--pull eccentric rod handle out of slot and turn to horizontal position. Then push handle of V-block locking lever to unlocked position and slide block back to its original position.



A. Gage positioned on rubber tip ready for insertion into dowel.



B. Gage inserted into dowel - sliding "v" block locked preparatory to application of gage pressure.



C. Gage pressure applied and maintained until gage cement is cured.

Figure 3. Application of strain gages to interior of hollow dowel (plexiglas dowel used only for photographic demonstration purposes).

To mount additional gages, simply repeat the above procedure, omitting Steps 1 through 4.

Obviously, the gages must be mounted in order from the dowel end nearest the lead clamp, toward the other end. Also obvious is the fact that gage spacing is limited only by the size of the gages used. No trouble was encountered in mounting gages on opposite interior sides at the same depth.

After all gages have been mounted, the leads should be brought out through a flexible waterproof tube, the end of which is clamped over the dowel end. To waterproof, simply fill the dowel with petrosene wax or other suitable waterproofing material, and plug the open end.

Discussion

The Research Laboratory Division conducted a dowel stress study (Research Report No. 258) in which three hollow dowel bars were instrumented with SR-4 strain gages by means of the device described above. These three dowels, 20 in. long, 1-1/4 in. OD and 7/8 in. ID, were internally instrumented with a total of 28 gages, and then embedded in an experimental concrete slab. After six months, the experiment was concluded and the installation abandoned. At that time, none of the 28 gages had failed and none had a resistance to ground of less than 150 megohms.

The principles of this device could be adapted to SR-4 strain gage mounting in openings of practically any size or shape, in any type of structure or component where it is desirable or necessary to measure strains on an internal surface which ordinarily would be inaccessible.