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CONTROL OF THE DISTRIBUTION OF A SPRAY PROJECTED TO AN AREA

BY

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Summary

A simple method is described for controlling spray distribution from impinging jet nozzles by insertion of an orifice plate in the path of the liquid to the impinging jets.

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In the course of experiments on the extinction of fires with water sprays, a simple method was found for controlling the distribution of a spray delivered to an area. This method, which is based on the use of pressure nozzles in radially arranged pairs of impinging jets, is illustrated by considering two nozzles A and B (Figure 1). Both nozzles contained six pairs of 9/64 in. impinging jets. Nozzle B gave a wider cone of spray than nozzle A, primarily because of the larger angle α between the axis of the nozzle, and the surface bisecting the angles between the pairs of jets. The nozzles were fitted to a $1\frac{1}{2}$ in. supply line by an adaptor C fitted with a filter D retained by a circlip E. Provision was also made for the insertion into the adaptor of an orifice plate G which could be secured by the locking-ring F.

The distribution of spray from these nozzles in a horizontal plane 8 ft. below the nozzles was determined by measuring the rate of flow at the centre of the spray and at radial distances increasing in units of 1 ft. on eight equally spaced radii. Table 1 shows the mean value and the coefficient of variation* of the rate of flow at different radii for the two nozzles, with and without orifice plates at nozzle pressures of 25, 50 and 90 p.s.i. The total delivery from the nozzles is also shown. Table 1 shows, as expected, that a larger area of spray-coverage was obtained with the wider angle nozzle. However, for both nozzles at all pressures there was a very dense core at the centre of the sprays when no orifice plate was used with the nozzles; this core disappeared almost completely when an orifice plate was used. Under the latter conditions, there was a fairly uniform distribution of spray at an appreciable distance from the centre. The coefficient of variation at a given radial distance was also considerably smaller when the orifice plate was used.

The effect of the orifice plate may be accounted for as follows. The spray consisted predominently of six dense plates of spray formed in the vertical planes bisecting the angle between the planes containing adjacent pairs of jets. When no orifice plate was used the plates of spray met at the axis and gave there a very high concentration of spray. When an orifice plate was used, however, the jet of water from the orifice struck first the inner holes of each impinging jet pair before being diverted to the outer holes. Thus the jets of water coming from the outer holes had a lower velocity than those from the inner holes. This caused a sufficient divergence of the plates of spray away from the axis of the nozzle to prevent these plates meeting on the axis.

By using various orifice plates it should be possible to control the distribution of spray between limits of a highly peaked type of distribution and a uniform or even slightly hollow distribution. Variation in the total flow rate of the nozzles may also be achieved by varying the number or the diameter of the jets used. The area of coverage from a single nozzle may also be varied by changing the angle α and also the angle of impingement between the jets.

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* Coefficient of variation = $\frac{\text{Standard deviation}}{\text{mean}}$

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TABLE 1

SPRAY DISTRIBUTION FROM MULTI-IMPINGING JET NOZZLES RATES OF FLOW AND COEFFICIENTS OF VARIATION

TYPE OF NOZZLE	CONTROL DEVICE	WATER PRESSURE LB/IN^2	DELIVERY GAL/MIN	DISTANCE FROM CENTRE OF SPRAYED AREA, FEET														
				0	1		2		3		4		5		6		7	
				gal. ft^2 min^{-1}	Mean* gal. ft^2 min^{-1}	Coeff. variation	Mean	Coeff. variation	Mean	Coeff. variation	Mean	Coeff. variation	Mean	Coeff. variation	Mean	Coeff. variation	Mean	Coeff. variation
NARROW ANGLE	NONE	25	19.4	6.54	1.13	0.43	0.398	0.68	0.145	1.10	0.031	1.64						
		50	28.2	14.70	2.10	0.64	0.716	0.83	0.276	1.17	0.027	2.24	-	-	-	-	-	-
		90	37.2	15.40	1.63	0.22	0.818	0.95	0.265	1.25	0.016	0.53						
	9/16 in. ORIFICE PLATES	25	18.6	0.400	0.419	0.10	0.616	0.096	0.269	0.43	0.0263	0.28	0.0026	0.29				
		50	25.7	0.500	0.914	0.15	0.980	0.173	0.203	0.36	0.0244	0.35			-	-	-	-
		90	33.4	2.280	2.281	0.17	1.158	0.634	0.085	0.56	0.0044	0.20						
WIDE ANGLE	NONE	25	19.1	3.02	0.583	0.38	0.215	0.47	0.125	0.24	0.080	0.92	0.046	0.79	0.012	0.88		
		50	26.3	5.09	1.049	0.36	0.376	0.53	0.165	0.91	0.108	0.85	0.046	0.96	0.014	0.93	-	-
		90	35.4	10.40	1.208	0.48	0.457	0.82	0.258	0.98	0.145	1.28	0.060	1.60	0.008	1.88		
	9/16 in. ORIFICE PLATES	25	17.7	0.270	0.162	0.066	0.153	0.12	0.165	0.19	0.163	0.22	0.124	0.36	0.053	0.48	0.010	0.33
		50	24.1	0.277	0.285	0.079	0.284	0.20	0.279	0.32	0.211	0.37	0.119	0.50	0.040	0.59	0.008	0.67
		90	31.1	0.625	0.612	0.061	0.564	0.21	0.425	0.50	0.200	0.78	0.072	0.88	0.016	1.05	0.002	1.58

* Each mean is based on 8 readings.

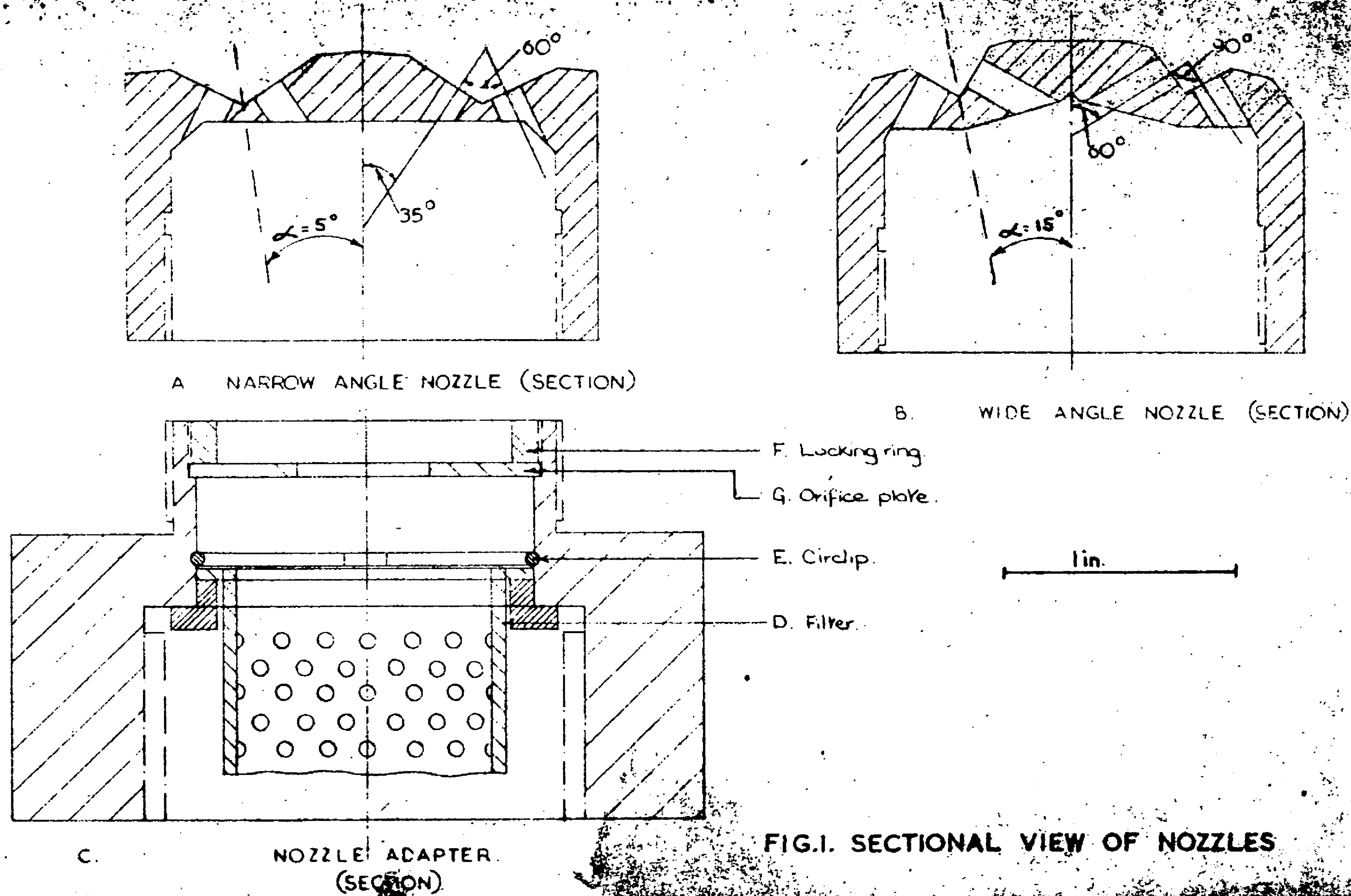

FIG.1. SECTIONAL VIEW OF NOZZLES